TM 10-1679

MAINTENANCE MANUAL

U. S. ARMY

MACK MODELS NO-2, 3 & 6

7½ TON 6x6 PRIME MOVER TRUCKS

CHASSIS SERIAL NO'S.
NO 8D 1002 thru 1501
NO 8D 1504 thru 2503

U. S. A. REGISTRATION NO'S.
522146 thru 522548
536984 thru 537080
544440 thru 545439

CONTRACT W-670-ORD-3303
CONTRACT W-670-ORD-4290

Mack

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APRIL 1943

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WAR DEPARTMENT

Washington, April 10, 1943.

TM 10-1679, Maintenance Manual, Trucks, 7½-ton, 6 x 6, Prime Mover, MACK, (Models NO-2, 3 & 6) published by the Mack Manufacturing Corporation, is furnished for the information and guidance of all concerned.

(AG 062.11 (4/26/41) PC (C), June 10, 1941.)

By order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

Official:
J. A. ULIO,
Major General,
The Adjutant General.

SGV TD

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MACK MANUFACTURING CORPORATION
Technical Service Department
L. I. City, N. Y., U. S. A.

INDEX

Division of Manual into Groups

This manual is divided into Groups, which correspond with the United States Army Ordnance Department Functional Group Code. Given under each group below in small type, is a list of the main units described in each group.

General Data: Index, Division of Manual into Groups, Division of each Group into Sections, Oil & Water Capacities, and General Dimensions.

Operation: Instruments & Controls; and Operating Instructions.

Preventive Maintenance: Maintenance suggestions, and Preventive Maintenance Schedules.

Lubrication: Lubrication Chart, and Lubricating instructions.

01 **Engine:** Cylinder block & heads, Crankshaft & bearings, Crankshaft oil seal, Pistons & rings, Piston pins, Connecting rods & bearings, Valves & springs, Valve lifters & guides, Valve tappets, Push rods, Rocker arms, Camshaft & Bushings, Valve timing, Timing gears, Oil pump & gage, Oil filters, Manifolds, Engine mountings, Accessory drive, and Vibration damper.

02 **Clutch:** Clutch disk, Pressure plate & springs, Release bearing, Pedal, and Pilot bearing.

03 **Fuel:** Carburetor, Air cleaner, Fuel pump, and Governor.

04 **Exhaust:** Muffler & pipes.

05 **Cooling:** Thermostats, Water pump, and Fan & belts.

06 **Electrical:** Generator & regulator, Starter & drive, Distributor & condenser, Ignition coil, Lighting switches, Ignition timing, Ignition tune-up, Headlamps, Spark plugs, and Battery.

07 **Transmission:** Main drive pinion, Main shaft, Countershaft, Reverse shaft, Gears, and Bearings.
Transfer Case: Main shaft, Driven shaft, Idler shaft, Declutch shaft, Power-take-off shaft, Gears, and Bearings.

09 **Propeller Shaft:** Universal joints.

10 **Front Axle:** Differential, Spur pinion, Bevel pinion, Front wheel drive, Gears, Bearings and Steering Geometry.

11 **Rear Axle:** Axle shafts, differential, Spur pinion, Bevel pinion, Gears, Bearings, Torque rods, and Trunnion brackets.

12 **Brakes:** Hand brake, Foot brakes, and Air compressor.

13 **Wheels:** Bearings, and Tires.

14 **Steering:** Steering gear, Drag link, and Tie rod.

15 **Frame:** Pintle hook, Drawbar and Frame.

16 **Springs:** Shackles, Rubber shock insulators, and Shock absorbers.

18 **Body and Cab:** Windshield, Cab top, Cab mounting, Seat, Handles, Locks, Doors, Windows, Glass and Paint.

19 **Winch:** Safety brake.

20 **Hoist:** Hoist.

23 **Tools:** Standard tools furnished with vehicle.

Division of each Group into Sections

This manual is further subdivided as follows. Each group covering a major unit as Engine, Clutch, etc., is divided and described in Sections as given below. Some groups do not require this exact description but, in general, they are treated in the same manner.

1. **Description and Principle of Operation:**
   Includes statement of type or design of unit used, and how it works. Uncommon features are mentioned especially.

2. **Trouble Shooting and General Solutions:**
   Includes most common failures arising after reasonable service, or due to neglect in servicing or other conditions, and the possible solutions or remedies.

3. **Adjustments:**
   Includes all possible adjustments that can be made without disassembling the unit. Methods of making adjustments are given. Adjustment figures include necessary fits as: measurements, clearances, etc., with tolerances to be maintained. Special tools needed are indicated.

4. **Dis-assembly:**
   Includes step-by-step procedure to completely dis-assemble unit. Special tools needed are indicated.

5. **Repairs:**
   Includes methods of effecting all possible repairs, fitting of parts and sizing: as broaching, lapping, grinding in place, etc. Special tools needed are indicated.

6. **Lubrication:**
   Includes instructions for lubrication that can be accomplished only while the unit is dis-assembled. For other lubricating instructions, see "Lubrication" group.

7. **Re-assembly:**
   Includes step-by-step procedure to re-assemble unit, but only where different from reverse of dis-assembly. Additional adjustments, not given under section 3 above, are included. Special tools needed are indicated.

8. **Specifications:**
   Includes all specifications and other service data essential to proper maintenance. A summary of all adjustments listed in above sections is given.

9. **Tools:**
   Includes special tools, other than standard tools furnished with vehicle or common mechanic's tools, essential for the dis-assembly, repair, adjustment and re-assembly of the unit. See "Group 23: Tools" for standard tools furnished with vehicle.

Capacities and Dimensions

NOTE: Summary of Adjustments is given on inside back cover.
Summary of Gear Ratios and Road Speeds is given in Section 8 of Group 11.

Engine

Model	MACK	EY Military
Type	Gasoline	Overhead
Horsepower	A.M.A.	60.0
Displacement	Cu. in.	707
Bore	Inches	5
Stroke	Inches	6
Number of Cylinders		6
Engine Governed Speed	R.P.M.	2100

Capacities

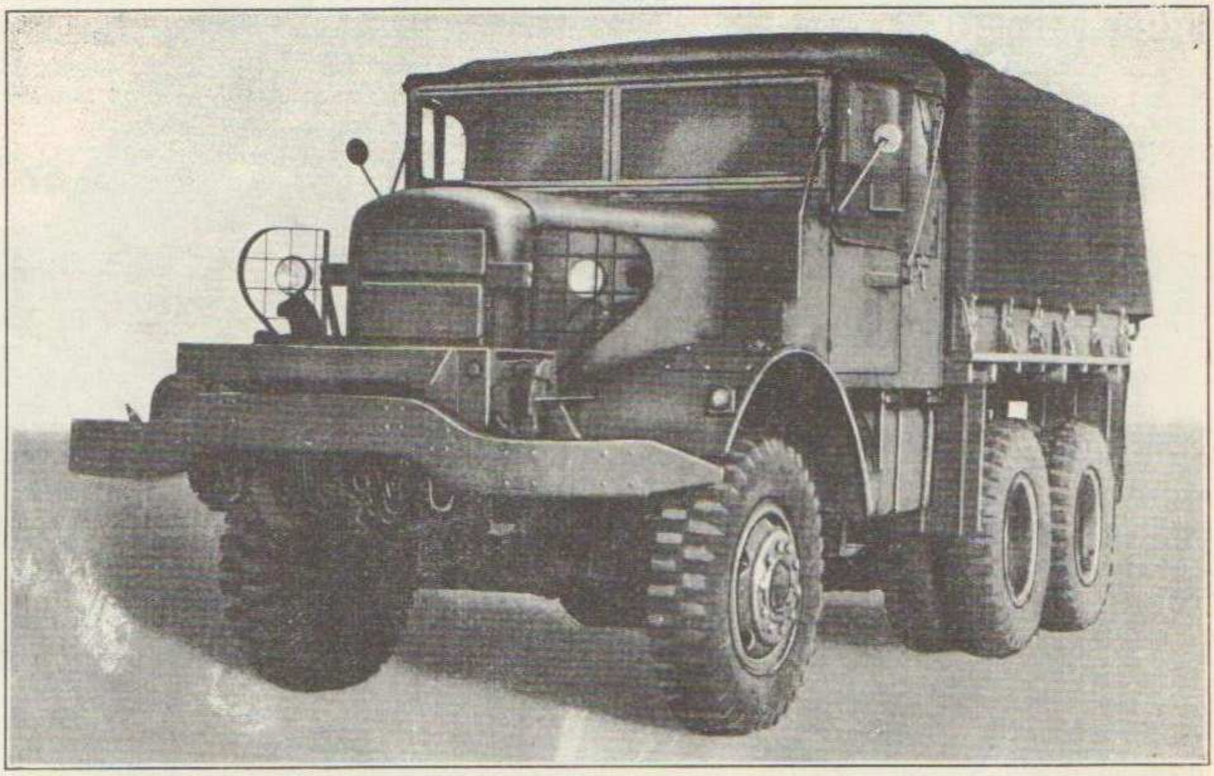
Fuel Tank	Gallons	each 80
Engine Crankcase, Refill	Quarts	19
Oil Filters, extra	Quarts	9
Cooling System	Quarts	54
Transmission	Pints	28
Oil Bath Air Cleaner	Quarts	3½
Winch	Pints	8½
Transfer Case	Pints	30
Front Wheel Drive, Upper Case	Pints	2
Lower Case	Pints	3
Front Axle Differential	Pints	15
Rear Axle Differential	Pints	each 22½
Steering Gear	Pints	8

Dimensions

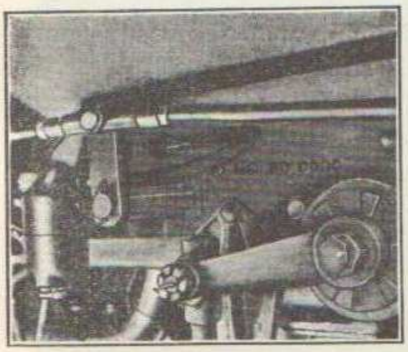
Turning Radius, Right	Ft.-In.	36'-0"
Turning Radius, Left	Ft.-In.	36'-0"
Height Overall	Inches	121⅞"
Width Overall	Inches	96"
Length Overall	Ft.-In.	24'-8⅝"
Weight of fully equipped truck without load	Pounds	28,675
Road Clearance	Inches	14"
Wheelbase	Inches	127"-58"
Tire Size	Inches	12.00-24
Tire Inflation Pressure	Pounds	Front 80 Rear 65

OPERATION

It is important to specify chassis number of vehicle when servicing same. Engine serial number should also be given. This is especially important when ordering parts. The illustrations below will assist in locating the serial numbers.



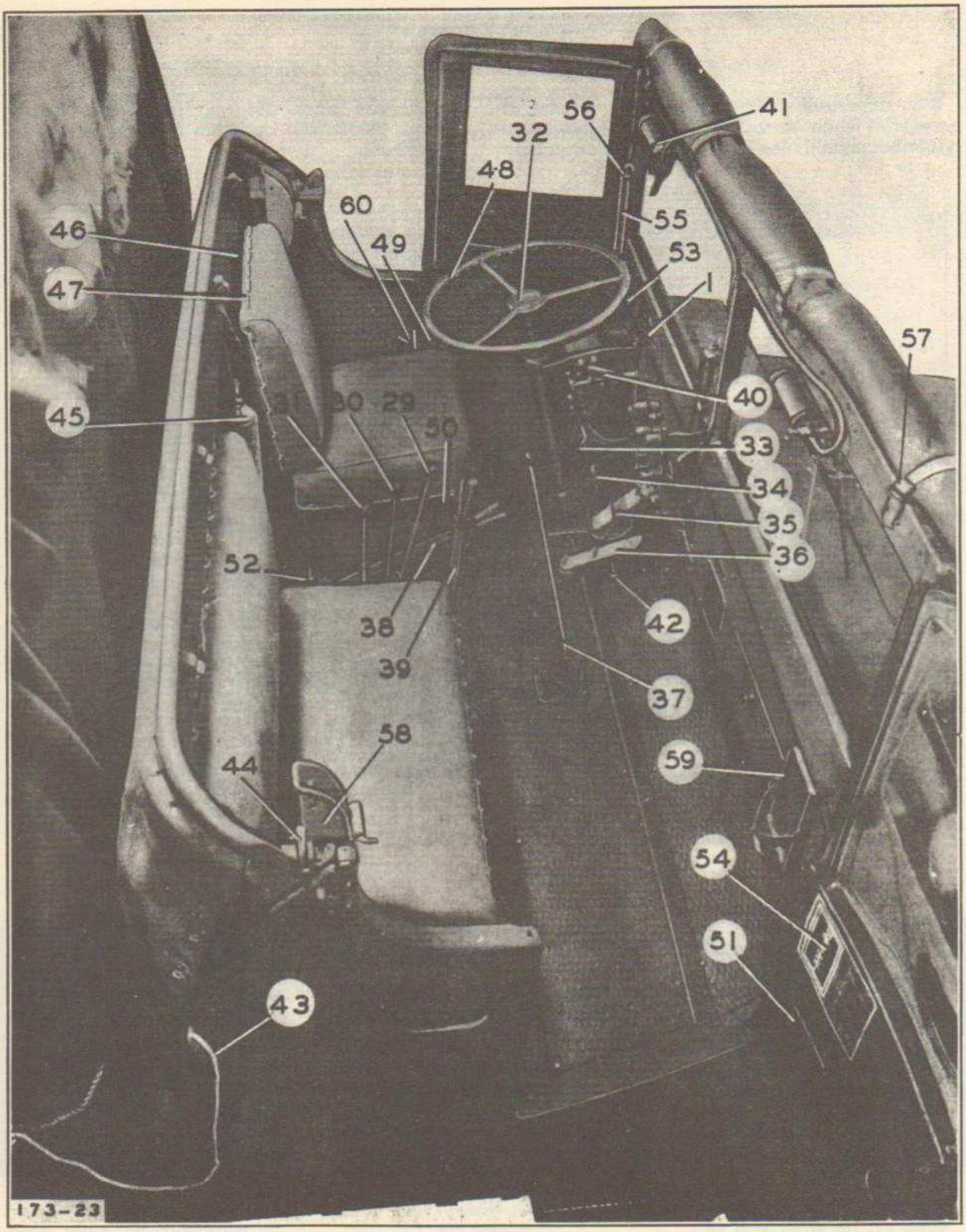
Mack Models No. 2, 3 & 6 7½-ton 6x6 *Prime Mover Trucks*



Chassis Serial Number
stamped on front end of left frame side member

Chassis Name Plate
located on instrument panel

Engine Serial Number
stamped on right side of timing gear housing



View of Cab Controls

Instruments and Controls

1. OVERSPEED WARNING PLATE: A constant reminder of the engine speed allowable.

2. INSTRUMENT PANEL LAMPS: Five lamps are provided to light the several gages and instruments.

These lamps can be lighted only by means of the panel light switch (21) and when the blackout lighting switch is in position "3".

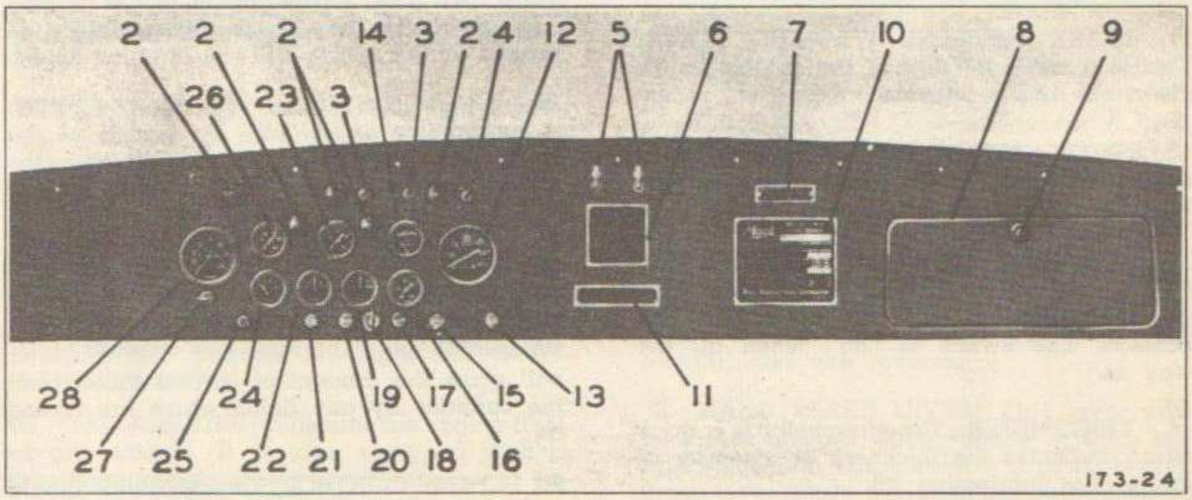
3. LEFT AND RIGHT HAND WINDSHIELD WIPER CONTROL VALVES.

4. HEADLAMP BEAM INDICATOR: Located directly above the speedometer.

When the red light is "on", the high beam of the headlamp is lighted. When the light is out, the low beam is lighted or the headlights are "off".

5. CONNECTIONS FOR WINDSHIELD WIPER TUBING.

6. CAUTION PLATE: This caution plate carries instructions for locating five plugs to be opened for draining the cooling system.



View of Instrument Panel

1. Overspeed Warning Plate
2. Instrument Panel Lamps
3. L.H. and R.H. Windshield Wiper Control Valves
4. Headlamp Beam Indicator
5. Connections for Windshield Wiper Tubing
6. Caution Plate
7. Publication Data Plate
8. Glove Compartment
9. Glove Compartment Push Button
10. Chassis Name Plate
11. Brake Pressure Warning Plate
12. Speedometer
13. Blackout Driving Light Switch
14. Viscometer
15. Blackout Switch
16. Temperature Gage
17. Throttle Control
18. Ignition Switch
19. Main Ammeter
20. Choke Control
21. Instrument Panel Light Switch
22. Auxiliary Ammeter
23. Oil Pressure Gage
24. Fuel Gage
25. Fuel Gage Switch
26. Air Pressure Gage
27. Tachometer Maximum Speed Reset Lock
28. Tachometer
29. Front Axle Drive Shifter Lever
30. Range Gear Shifter Lever
31. P.T.O. Shifter Lever
32. Horn Button
33. Clutch Pedal
34. Headlamp Foot Switch
35. Brake Application Valve
36. Accelerator Pedal
37. Transmission Shifter Lever
38. Hand Brake Lever
39. Winch Clutch Lever
40. Hand Brake Valve
41. Windshield Wipers
42. Accelerator Stop
43. Cab Rear Curtain Rope
44. Cab Roof Latch
45. Fire Extinguisher
46. Curtain Pocket
47. Seat Cushion Cover Lacing
48. Steering Wheel
49. Door Handle
50. Seat Adjustment Lever
51. Tire Pressure Plate
52. Fuel Line "Three-Way" Valve
53. Gear Shift Instruction Plate
54. Lubrication Plate
55. Windshield Elevating Arms
56. Windshield Elevating Arm Thumb-Screws
57. Cab Top Straps
58. Rifle Holder
59. First-Aid Kit Bracket
60. Starting Switch

7. PUBLICATION DATA PLATE: This gives the TM-number of the Parts List and Maintenance Manual pertaining to this vehicle.

8. GLOVE COMPARTMENT: A handy roomy compartment located on the right side of the instrument panel.

9. GLOVE COMPARTMENT PUSH BUTTON: Pressure on the center of this button unlatches the glove compartment door giving access to the glove compartment interior.

10. CHASSIS NAME PLATE: Located to the right of the center of the instrument panel, and shows the model, chassis serial number, nomenclature, weight and oil recommendations.

11. BRAKE PRESSURE WARNING PLATE: This is a reminder to stop the vehicle immediately if buzzer sounds.

12. SPEEDOMETER: The speedometer indicates road speed of the vehicle in miles per hour and total mileage traveled.

13. BLACKOUT DRIVING LIGHT SWITCH: This switch controls the single blackout driving light when switch (15) is in first "on" position. The switch is "off" when all the way in.

14. VISCOMETER: The viscometer is a gage which indicates the thickness or viscosity of the engine lubricating oil.

When the pointer is in "low" range on the dial, the oil is too thin, resulting in poor lubrication, and should be changed.

When the pointer is in the "normal" range, proper lubrication is assured.

When the pointer is in "high" range, the oil is too heavy for proper lubrication.

15. BLACKOUT SWITCH: The switch which controls the headlamps is designated a blackout switch.

It has one "off" and three "on" positions.

When the control knob is all the way in, all lights are "off".

Pulling the knob out to the first "on" position, lights the blackout tail, blackout driving, and blackout parking lights; also the blackout stop light, when stop light switch operates.

Pulling the switch knob out to the second "on" position, which can be done only after the switch lock button is pressed, lights the head lamps, service tail and instrument lamps if switch (21) is pulled out; service stop lamp will also light when stop light switch operates.

Pulling the knob out to the third "on" position lights the service stop light only. This is for daylight operation.

16. TEMPERATURE GAGE: This gage indicates the temperature of the water in the cooling system. Temperature should range between 155° F. and 175° F. If temperature reaches 212° F., the vehicle should be stopped and the cause of this excessive rise corrected.

17. THROTTLE CONTROL: The throttle control is used when starting the engine or making adjustments to the engine. When button is pushed in, the engine will run at idling speed.

18. IGNITION SWITCH: The ignition switch is turned "on" and "off" by means of the switch key which can be removed from the lock only when in the "off" position.

19. MAIN AMMETER: The main ammeter indicates how much current the two batteries are receiving when the engine is running above idling speed.

When the engine is stopped, this ammeter will show the amount of current taken from the batteries by any lights which are turned on.

20. CHOKE CONTROL: Choke control should be used only when necessary.

Choke should be pulled out far enough to allow the engine to run smoothly during the warm-up period.

Choke should be pushed in as soon as possible after the engine is running smoothly. If choke is allowed to stay out, the fuel mixture will become too rich and may cause injury to the engine by allowing the unburned fuel to seep into the crankcase and dilute the lubricating oil.

21. INSTRUMENT PANEL LIGHT SWITCH: This switch is used to put the instrument lights on, if light switch (15) is in the second "on" position.

22. AUXILIARY AMMETER: This auxiliary ammeter is provided to show that the second battery, which is connected in parallel with the first, is receiving a charge.

23. OIL PRESSURE GAGE: The oil pressure gage indicates the pressure of the engine lubricating oil. This gage should indicate approximately 45 to 60 lbs. at 2100 R.P.M. maximum speed and 10 to 20 pounds at 300 R.P.M. idling speed.

24. FUEL GAGE: This is an electrically operated gage and indicates the approximate level of the fuel in the tank whenever the ignition switch is turned "on". The current taken by the gage is negligible.

25. FUEL GAGE SWITCH: This switch selects either the right or left fuel tank gage and connects it to (24). When the ignition switch is "on" and the fuel gage switch is "in", fuel gage indicates level of fuel in left hand tank. Pulling the fuel gage switch knob out allows fuel gage to indicate fuel level in right hand tank.

26. AIR PRESSURE GAGE: The air pressure gage indicates the air pressure in the reservoir and pipe lines.

27. TACHOMETER MAXIMUM SPEED RESET LOCK: Tachometer is equipped with an auxiliary pointer which indicates the maximum speed reached by the engine. This lock permits resetting the pointer to zero if the engine is not running, or if running, to the corresponding engine speed.

28. TACHOMETER: Indicates the engine RPM at any instant. It is also equipped with a maximum speed pointer which remains at the point of highest speed until reset by the key in the reset lock.

29. FRONT AXLE DRIVE SHIFTER LEVER: This lever is to the right of the hand brake lever. It is used to connect or disconnect the drive leading to the front drive axle. See gear shift instruction plate (53).

30. RANGE GEAR SHIFTER LEVER: The range gear shifter lever is the center one in a group of three mounted on the transfer case. It is used to select high or low range gears in the transfer case. It can also be shifted to neutral to run the P.T.O. without moving the truck. See gear shift instruction plate (53).

31. P.T.O. SHIFTER LEVER: The P.T.O. shifter lever is to the right of the range gear shifter lever. It is used to connect or disconnect the drive leading to the winch. See gear shift instruction plate (53).

32. HORN BUTTON: A slight pressure on this button closes a circuit which opens a magnetic air valve and allows air to go to the vibrators of the air horn.

33. CLUTCH PEDAL: This is a grooved steel pad type. Pressure on the pedal disengages the clutch and allows the gears to be shifted.

34. HEADLAMP FOOT SWITCH: This switch is located on the extreme left of the toe board and controls the service headlamp beams. It enables the operator to change to "Driving" or "Traffic" beam, as traffic conditions warrant.

35. BRAKE APPLICATION VALVE: By depressing the pedal on the application valve, the valve is opened and allows air to flow to the air brake chambers on the axles, thus applying the brakes.

36. ACCELERATOR PEDAL: This pedal regulates the amount of fuel fed thru the carburetor to the engine. The engine speed is increased and decreased by pushing down and releasing the pedal.

37. TRANSMISSION SHIFTER LEVER: This lever is used to select any of the speeds provided in the transmission. For various shifting positions, refer to the gear shift instruction plate (53). The transmission has five speeds forward and one reverse.

38. HAND BRAKE LEVER: This lever must be pulled upward when vehicle is to be held at a stand-still. When vehicle is to be moved, grasp lever firmly while pulling upward slightly. This will release the ratchet latch and allow the lever to be lowered, thus releasing the brake.

39. WINCH CLUTCH LEVER: This lever is to the right of the P.T.O. shifter lever. It is similar to the hand brake lever in appearance. It is used to disconnect and connect the drive between the winch drum and the winch shaft.

40. HAND BRAKE VALVE: The brake valve is mounted on the steering column and is used to apply the brakes of a trailer or towed vehicle independently of the truck brakes. It can be used only if the towed vehicle or trailer is equipped with air brakes and is properly connected to the towing vehicle with jumper hoses.

41. WINDSHIELD WIPERS: These wipers are the air operated type and are controlled by valves (3) on the instrument board.

42. ACCELERATOR STOP: This stop provides a limit beyond which the accelerator pedal may not be depressed. Lowering or removing the stop would have harmful effects on the accelerator linkage and the performance of the vehicle.

43. CAB REAR CURTAIN ROPE: This rope is laced thru the lower edge of the rear curtain and is used to connect the curtain to the top rear edge of cab. Cab contains hooks to connect the rope.

44. CAB ROOF LATCH: This latch provides a positive lock for keeping the cab top in the "up" position. After the cab top has been raised, swing the latch to the outside so that it lies behind the roof bow framing.

45. FIRE EXTINGUISHER: This is mounted to the rear center of cab with a positive lock. The spring type clamp on this lock must be opened before the fire extinguisher can be removed. Operation of the extinguisher consists of turning the handle to the left and then operating up and down like a pump.

46. CURTAIN POCKET: This is mounted on the rear left of the cab (behind the driver's seat). It is a canvas bag container used to store the door curtains and rear quarter curtains.

47. SEAT CUSHION COVER LACING: When the seat and back cushion covers become soiled or contaminated, this lacing must be removed from the eyelets surrounding the board before the cover can be removed.

48. STEERING WHEEL: This wheel is the three spoke type steel core covered with olive drab tenite. It is used to control the direction of the front wheels.

49. DOOR HANDLE: The door handle is used to unlatch the cab door. By pressing down on the forward end of this handle the door may be opened.

50. SEAT ADJUSTMENT LEVER: Adjustments on the forward or rear positions of the driver's seat are made by pulling upward on the lever on the front center of the seat frame. Hold the lever upward until seat is in position desired. When the handle is released it will lock the seat in this position.

51. TIRE PRESSURE PLATE: This plate is mounted near the lower edge of the R.H. cab door. On it are stamped the recommended tire pressures for front and rear tires.

52. FUEL LINE "THREE-WAY" VALVE: This valve is located on the cab floor near the rear R.H. corner of the driver's seat base. By turning the handle on the valve, the fuel can be drawn from either the right or left tank, or shut off completely with the handle in the center position.

53. GEAR SHIFT INSTRUCTION PLATE: This plate is mounted on the extreme left of the windshield base rail. The plate contains the various lever positions for the transmission, hand brake, front axle drive, range gear, P.T.O., and winch clutch levers.

54. LUBRICATION PLATE: This plate is mounted on the inside of the R.H. cab door. On it is a lubrication diagram for the chassis containing points of lubrication, recommended lubricants, and mileage intervals.

55. WINDSHIELD ELEVATING ARMS: L.H. windshield can be opened outward (hinged at top) by moving the windshield elevating arms up and out. Both arms for the same glass should be operated simultaneously in order to prevent glass breakage.

56. WINDSHIELD ELEVATING ARM THUMBSCREWS: These screws are provided to hold the windshield elevating arms in either a fixed open or closed position. Before the arms can be used these screws must be opened.

57. CAB TOP STRAPS: These straps are rolled and fastened to the upper windshield rail when the cab top is in the "up" position. When the cab top is lowered, the canvas roof must be rolled and strapped to the upper windshield rail with these straps.

58. RIFLE HOLDER: Two rifle holders are provided in the cab and are located directly beside the R.H. & L.H. seats.

59. FIRST-AID KIT BRACKET: This bracket is bolted to the extreme right hand side of the instrument board. It is used to mount a regulation kit.

60. STARTING SWITCH: The starting switch is located at the front L.H. corner of the driver's seat. The switch is operated by pressure exerted upon it by the driver's hand. This pressure is to be continued until the engine fires, at which time it must be released instantly.

Operating Vehicle

Daily Before Operation

Check items listed in Schedule PMS #3 of "PREVENTIVE MAINTENANCE" group.

Before Starting Engine

Apply hand brake.

Disengage clutch.

Move transmission shifter lever to neutral position.

Keep clutch pedal depressed until engine is started.

Starting Engine

Pull out throttle one-third way.

Turn ignition key on.

Pull out choke button.

Depress starter switch.

Push choke button in when engine fires evenly.

Gradually push in throttle allowing engine to run at fast idle for several minutes—do not race engine to warm it.

Allow engine to warm before moving vehicle.

Starting Engine in Cold Weather

Starting will be facilitated by use of winter engine oil of low cold test.

Do not overtax starting motor and batteries by cranking longer than 30 seconds without interruption—hesitate about 10 seconds before making another attempt. This permits starter to cool and batteries to "pick-up".

Starting Engine in Warm Weather

It should not be necessary to choke the engine in warm, and especially hot, weather. Should engine be flooded, push Choke button (in) and pull Throttle button (out), close starter switch (in) and turn engine over a few times to clear cylinders. Then push throttle button (in), and depress starter switch.

Idling Engine

Do not idle engine unnecessarily for long periods of time. It is harmful to engine, forming carbon and diluting oil. It is also a serious drain on the battery.

Choking Engine

Do not keep choke button out any longer than necessary to permit even firing. Prolonged choking will cause serious injury to engine by allowing unburned gasoline to leak down past the pistons. This removes the lubricating oil from cylinder bores, permitting excessive wear. It also thins the crankcase oil, thereby impairing its lubricating value to all the parts served by the engine-oil circulation system.

Racing Engine

Never race engine during warm-up period, nor while tuning engine when under no load.

Never operate engine beyond the governed speed.

Select correct gear to hold vehicle back when descending grades and supplement with brakes if necessary, as it is possible for vehicle to drive engine beyond governed speed, even tho equipped with a governor, unless this is done.

Engine bearings, pistons and valves will be damaged if the above precautions are not taken.

Starting Vehicle

Release hand brake. Depress clutch pedal, shift lever to second speed, and while speeding up engine slightly, slowly engage clutch in a manner so as to neither stall the engine nor jerk the vehicle. Use first speed only when difficult conditions are encountered. As vehicle gains speed, shift to next speed, and continue shifting until vehicle is proceeding in highest gear suitable for grade

Engaging Clutch

Engine speed should be synchronized as closely as possible with vehicle speed before engaging clutch. When engaging clutch, release pedal slowly at first, synchronizing the movement with the depressing of accelerator, but toward end of clutch engagement allow clutch to take hold quickly—do not restrain pedal unnecessarily long when clutch is practically engaged. Never allow the weight of the foot to rest on the clutch pedal when clutch is not being disengaged, as this will result in short clutch-disk and release-bearing life.

Shifting Transmission

The clutch must always be disengaged when changing gears. In shifting, begin with second speed, then shift to third, fourth, and finally to fifth speed. See Gear Shift Diagram in "Group 07: Transmission". Vehicle must be brought to full stop before shifting from forward to reverse and vice versa.

"Double-clutch" when shifting from fast to slower ratio.

Double-clutching is a process of shifting from a fast to a slower ratio, which requires the following motions: release clutch, move lever to neutral position, engage clutch, accelerate engine to approximate the speed corresponding to the road speed in the lower gear to be selected, release clutch, move lever to slower gear position and then engage clutch.

Coasting

Never coast with clutch disengaged or transmission in neutral as this is extremely unsafe.

Should re-engaging of transmission gears and clutch be attempted while coasting down grades at high speeds, engine, propeller shafts, and other units will be damaged, and control of vehicle lost.

Stopping Vehicle

Release accelerator and apply foot brakes. To avoid skidding, and to utilize the compression of engine to save brakes, do not declutch until vehicle has slowed down to idle speed of engine, or just before engine begins to stall; after which continue to apply brakes until vehicle stops. Then move gear shift lever to neutral and re-engage clutch.

Stopping Engine

Push in throttle control completely and as soon as engine speed is reduced, turn ignition key off.

Braking

Whenever possible, brake applications should be started far enough in advance so that moderate pressure can be used.

On slippery pavements, apply and release brakes alternately instead of holding them on continuously. When descending a long grade, select the same gear which would be used to ascend the grade, and supplement this where necessary with the use of the air brakes.

The braking force is in proportion to the distance the brake pedal is depressed by driver.

Never completely depress pedal unless an emergency stop must be made. The pedal should be depressed fairly well at first and then graduated off as the speed is reduced, so as to accomplish a smooth stop. Do not fan the pedal unnecessarily as this gives poor brake performance and wastes air pressure.

This truck is provided with trailer connections so that when towing a vehicle, the trailer brakes will operate when the truck brakes are applied. A hand control valve is also provided which can be used to apply the brakes of a trailer, independently of the truck brakes. The above applies only to trailers equipped with air brakes, and properly connected to the towing vehicle with suitable jumping hoses. For connections of jumper hoses, see "Trailer Connections" in "Group 12: Brakes".

On down grades, on slippery pavement, or with a very heavy trailer, the hand control valve should be applied slightly ahead of the foot pedal to prevent "jack-knifing". Care must be exercised not to lock the trailer brakes, as this would result in excessive tire wear, and, on a crowned road, the trailer would slide sideways.

Always allow the engine to remain in gear with throttle closed, until vehicle slows to idling speed of engine, before disengaging clutch.

The hand brake operating on the propeller shaft, is intended for parking and emergency use only. Avoid harsh engagement except as required in an emergency.

Checking Instruments

The dash instruments should be observed occasionally while proceeding.

Oil gage should register pressure of from 10 to 20 at idle speed and from 45 to 60 maximum.

Ammeter should show charge but if battery is fully charged, ammeter will register little or no charge at any engine speed. If no charge, report battery for hydrometer test.

Heat indicator should show between 155° and 175° F. If engine overheats, stop and investigate before damage occurs. Do not pour cold water into a hot engine—after cooling, add water slowly with engine running idle, so that pump will prevent cold water from entering cylinder head directly.

A frozen cooling system must be allowed to thaw out slowly in a warm place if damage is to be averted. If vehicle freezes en route and cannot be taken to a garage, cover radiator and hood with a blanket, and let the engine run slowly until the blanket steams.

Shut off the engine and let it stand for a few minutes and repeat the operation three or four times, if necessary, until the heat gradually thaws it out. Do not use boiling water to thaw out a frozen radiator.

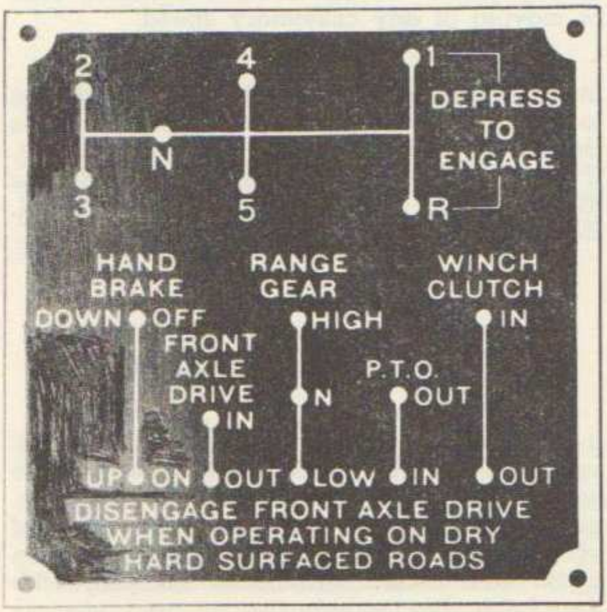
Air brake gage (on the dash) should register at least 80 lbs. and preferably 105 lbs. Should the gage indicate a rapid drop in pressure, the vehicle should be stopped immediately and the trouble corrected before proceeding further.

Tachometer (on the dash) should be watched closely so that proper engine speeds are maintained under all load and road conditions. Engine speed range is between a minimum of 1,000 R.P.M. and governed speed. Proper selection of gears will keep engine in this "power range" and will result in better performance.

Transmission & Transfer Case Operation Including Front Axle Declutching Instructions

Shift Positions

Transmission, Transfer Case Auxiliary Range Gear, Power-Take-Off and Front Axle Drive De-clutching Control Shift Handle positions, are indicated clearly in the Gear Shift Diagram. A Plate carrying this Diagram is fastened above the instrument panel to the left of the driver.



Shift Diagram

Starting Truck

When Truck operation is desired, make certain that the Transmission Shift Handle (handle nearest the Instrument Board) is in the neutral (center) position.

Disengage the Engine Clutch by depressing the Clutch Pedal, and start the Engine. It is good practice to keep the Clutch Pedal depressed while the engine is being started as this lightens the load on the starting motor.

Engage the Clutch and warm up the engine without racing it. Allow it to run at a fast idle for a few minutes.

Disengage the Clutch and shift the Transmission into second gear.

Then lightly engage and disengage the Clutch while shifting the Transfer Case Range Gear Shift Handle (the handle to the left of the P.T.O.) into the proper range gear.

Now fully engage the Clutch and operate the truck, shifting the Transmission thru second, third, fourth, to fifth speed in the manner customarily employed with any heavy-duty truck.

Shifting Transfer Case

The selection of the proper range gear of the Transfer Case is as follows:

In all general operations over hard surfaced roadway, the truck should be operated with the auxiliary Range Gearing in high range; that is, with the handle in the forward position.

In operations on extremely steep grades and over hazardous terrain, where unusual pulling power is necessary, auxiliary low Range Gearing should be employed. Further, low Range Gearing should be utilized when the truck is to be operated at extremely low speeds for considerable distances, this to minimize the use of Transmission reduction gearing.

It will be noted that a lip is installed between the Transfer Case auxiliary Range Gear and the Front Axle Drive declutching mechanism Shift Handles. This lip is provided to prevent Auxiliary Low Range Gearing being utilized with the Front Axle Drive disengaged. When operating conditions necessitate the use of the Transfer Case auxiliary Low Range Gearing, the Front Axle Drive must be engaged.

Low Range Gear Operation

Procedure for shifting the transfer case from high to LOW range gear must be as follows:

Engage front axle drive just prior to stopping vehicle.

Stop vehicle completely.

Shift main transmission into first or second speed as required.

Shift transfer case into LOW range as explained below.

To shift the auxiliary Range Gearing from high to low range, the Range Gear Shift Handle (immediately to the left of the P.T.O. lever) is shifted from the forward to the rearward position. When it is desired to shift back to high range, the shift can be made by any experienced driver with the truck moving, since the auxiliary range gearing is of a type adapted for high speed engagement.

The Transfer Case high range gearing provides a 1 to 1 or direct-drive ratio. The low range gearing is of 2.50 to 1 under-drive reduction.

Front Axle Drive

Front Axle Drive declutching mechanism is provided to permit the front-wheel drive being engaged and disengaged from the driver's seat. The control handle is located between the hand brake lever and the range gear lever. With the handle in the rearward position the Front-Axle Drive is disengaged (front Wheels not driving). The handle is shifted forward to engage the drive to the front axle.

Operating Front Drive

The Front-Axle Drive control should be operated as follows:

Declutching mechanism may be engaged or disengaged while the truck is standing still, or moving at any customary speed.

In no event should manual effort be applied to the Shift Handle, to the extent that the Handle or Control Rods are deliberately bent. If the shift cannot be made with reasonable manual effort, with the truck at a standstill, then the truck should be moved.

Disengaging Front Drive

It is generally found more difficult to disengage the drive to the front axle than to engage it. The disengagement can be accomplished readily by exerting a light manual effort on the Shift Handle while operating the truck, with closed throttle or coasting with the clutch disengaged.

Engaging Front Drive

The engagement of front-axle drive does not require excessive effort if it is accomplished properly. If the declutching mechanism parts are in line, the engagement can be made readily with the truck either at a standstill or moving.

But if it is found that the shift cannot be completed readily, it is probably due to mating parts not being in line. In this event a continuous light pressure on the shift lever, while the truck is moving, will result in engagement as the gears reach alignment.

When to Engage Front Drive

Front-Axle Drive should be engaged before the truck leaves hard surfaced roadways to negotiate hazardous terrain. Driving on all wheels, the truck will traverse a stretch of mud, snow or sand-covered terrain that it can not generally negotiate with the rear wheels only driving.

Engagement of the front drive after the truck has become mired, while driving on rear wheels only, may often result in the vehicle being unable to extricate itself, whereas, had the front wheel drive been engaged before leaving hard surfaced terrain, the truck would have negotiated the difficult going.

When to Disengage Front Drive

Front Axle Drive should be disengaged when the truck is being operated over improved highways that are not in a hazardous condition due to snow, ice or mud.

Procedure When Mired

If a driver fails to engage the Front Axle Drive before attempting off-road operation and the truck becomes mired, the rear wheels should be allowed to turn at a low speed while a reasonable (manual) effort is being exerted on the declutching mechanism Shift Handle, until engagement is accomplished.

Caution

As the Transmission first speed (low gear) is a high (under-drive) reduction (8 to 1), care should be exercised in the operation of the truck when this low gear is used in connection with the Transfer Case auxiliary low Range (2.50 to 1 under-drive) Gearing. Since a very high final reduction is provided, this results in unusual pulling power and accordingly, imposes a great strain on driving train parts. Under such conditions of operation, engine power should be applied carefully by extremely easy engagement of the Clutch and gradual application of the Accelerator pedal.

Every effort should be made to prevent sudden shock to the driving parts when in these low gears. Guard carefully against dropping the Clutch in suddenly at any time, and especially if the truck rolls backward, no matter how slowly.

If there is any tendency for the truck to roll backward, block the wheels before attempting a start, and then engage the Clutch and Accelerator carefully. If it is not convenient to block the wheels, and should conditions permit, by all means allow the truck to coast back, under control of the brakes, to a standstill, before attempting to start forward.

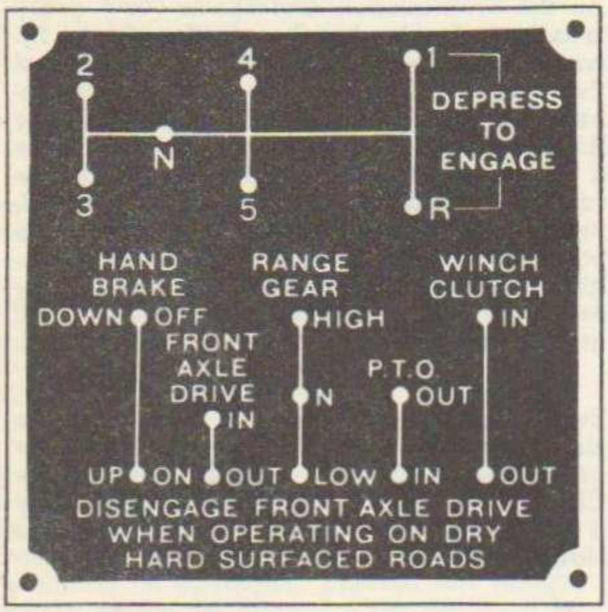
Failure to observe these simple precautions will inevitably result in snapping of drive gears and shafts.

Warning

The Engine is equipped with a Governor which is set for 2100 R.P.M. under full load. Under no circumstances should the Governor be set for a higher speed. Also, regardless of whether or not an engine is equipped with a governor, it very definitely can be run too fast down grades; for here a condition exists in which the truck is driving the engine, thus making the governor ineffective.

If the engine is operated for any length of time at a speed greater than 2100 R.P.M., as shown by the Tachometer on the Instrument Panel, the engine bearings, pistons, and valves will be seriously damaged.

Operating Winch



Shift Diagram

Consult the instruction plate shown for location of control levers mentioned in this instruction. This plate is mounted in the cab.

Unwinding Cable to Rewind Under Load

To remove the winch cable from the drum, place the winch clutch lever rearward into the OUT position. This will disengage the winch clutch and allow the drum to turn. A drag brake which prevents the drum from rotating faster than the line, is provided. This brake produces a light drag that can be felt while unreeling.

Rewinding Line Under Load

Connect the winch cable to the load or anchor making sure it is fastened properly. Never use the end of the winch cable as a lasso. If winch cable is used to surround the object, the cable will retain a permanent kink at each sharp corner of the object and at the point where the hook is connected after surrounding the object. These kinks in turn weaken the cable.

Put the Range Gear shifter lever into neutral (center) position to prevent driving the wheels.

Pull the Power Take-off (PTO) lever rearward into the "in" position.

Shift the Transmission into first gear.

Shift the winch clutch lever forward to the "in" position. If this cannot be accomplished readily, rotate the winch shaft by engaging the engine clutch while the engine is idling. Keep a steady pressure against the winch clutch lever until the shaft rotates enough to allow the jaws of the winch clutch to line up. At this point the lever will move forward and engage the winch clutch.

Engaging the engine clutch with the shifter levers in the above mentioned positions, will allow the winch drum to rotate so as to reel in the cable.

Note especially that during winch operation, it should never be necessary to operate the engine at a speed greater than 1000 R.P.M., as indicated by the Tachometer on the instrument panel.

When light loads are involved (such as reeling a lightly loaded line on the drum), and higher line speeds are warranted, the Transmission may be shifted into a gear higher than first gear. This will increase the winch line speed without the necessity for excessive engine speed.

The same procedure is used for lowering a load as for reeling, except in selecting the transmission gear. When lowering a load with the winch, the reverse gear in the transmission must be used in order to reverse the rotation of the winch drum.

Winding Line

Great care should be taken to see that the line always is wound properly on the drum. Too high a winch line speed, and reeling the line in with no load on the line, will result in improper winding or kinking of the line. A line never should be wound on the drum without tension on the line.

If no other load is available, at least two men should hold back on the end of the line, while the line is being reeled in on the drum. If an anchor is available, the end of the line should be attached to it, and the truck towed forward by the winch, while the line is being wound on the drum.

Detaching Line

When the loaded winch line has been reeled in, the line tension must be relieved before load can be detached.

Declutching Drum

Do not attempt to disengage the winch clutch with the line under tension. If the line is loaded and clutch is to be disengaged for some reason, block the load and reverse the rotation of the drum or move the vehicle forward until tension is relieved. Then move winch clutch lever into "out" position.

Safety Brake

An automatic Safety Brake for winch line control forms a part of the winch construction. This brake is provided to prevent a load at the end of the line from slipping backward, and operates only when the Winch Clutch is engaged.

When a load at the end of the winch line is being pulled up an incline, and winch operation is stopped by disengaging the Truck Clutch, the Safety Brake will hold the load, but the load should be chocked promptly.

Only operators experienced in the use of Winches should be permitted to operate the winch line to haul loads up inclines.

Testing Safety Brake

With the Winch Drum Clutch engaged (IN), when winch operation is stopped by disengaging the Truck Clutch, the automatic Safety Brake should hold relatively heavy loads at the end of the extended winch line. When it is found that loads at the end of the lines are not being held properly, the automatic Safety Brake should be adjusted.

Adjusting Safety Brake

To adjust the Safety Brake, remove the Brake Case Cover, tighten Brake Spring Nut one-half turn, set up Check Nut and test for effectiveness of brake. If necessary, continue to tighten Nut by half turns. Arrow on Rocker must point in same direction as rotation of Brake Disk, when winch line is being reeled in under power.

Line Holder

After the line has been unhooked from a load and is wound on the drum, the Winch Clutch Lever should be placed forward into the IN (engaged) position to prevent the drum from rotating, and the winch Line Holder (furnished with the winch) should be installed to prevent the line and hook hanging down and becoming tangled in the truck-drive mechanism.

Moving Truck While Operating Winch

If the winch is to be used while moving the truck under its own driving power, this may be done with the auxiliary range gear in low (rearward) position. Due to the "lock out" built into the transmission, it is necessary to engage the front axle drive in order to go into low range. This procedure will provide driving power on all wheels while the winch is being used.

Operating Chain Hoist and Trail Clamp

Note: For operation of the Chain Hoist and Trail Clamp, see "Group 15: Frame."

The following instructions are of vital importance:

At no time is the truck to be run with the chain hoist hooks attached to the gun trail clamp eyes.

When not in use, the trail clamp is never to be carried attached to the draw bar; but is to be left attached to the gun trails or carried in the truck body.

Before running truck, the chain hoist should be put into running position. This means that the chained hook on the left leg of the lifting arch is to be attached to the tie bolt housing, and the two hoisting chain hooks are to be hooked to the loop on the right leg of the lifting arch. Then the hoist is to be drawn up snugly with the hand chain to prevent it from swinging while the truck is in motion. Wrap the hand chain around a leg of the lifting arch or throw it in the body.

PREVENTIVE MAINTENANCE

LUBRICATING AND TIGHTENING: The excellent driver, having a pride in his vehicle, always keeps it well lubricated and tightened.

LUBRICANTS: Use only lubricants conforming to specifications and keep them clean. They should be stored to avoid contamination by dirt.

UNUSUAL NOISES: Investigate all unusual noises. If due to loose parts, tighten or otherwise correct. If the noise seems due to some internal mechanical failure or if the cause is unknown, report the facts for correction to a mechanic; do "not" attempt to operate the vehicle while in this condition except after advice by a qualified technician.

STARTING INSPECTION: Before starting a trip, check amount of fuel in tank, oil in engine, and water in cooling system. Also check tire pressure, brakes, lights, mirrors, horn, and windshield wipers. These items are important in the safe operation of the vehicle.

TESTING BRAKES: Test brakes daily soon after starting. If not adjusted properly, or if defective in any way, report the matter at once for adjustment or correction.

FRONT WHEEL ALIGNMENT CHECK: Note the front wheel alignment and steering of your vehicle. If steering is hard, if vehicle tends to travel (or wander) to the right or left, or if the steering wheel shakes (shimmies) while you are holding it, have a mechanic inspect and make necessary repairs.

BATTERY INSPECTION: Batteries should be inspected frequently and terminal corrosion removed by scraping or using a solution of baking (bicarbonate) soda and water. After terminals have been cleaned, they should be coated with vaseline or light grease.

ELECTRIC CIRCUIT TERMINALS: Keep all electrical connections clean and tight. Bear in mind that corroded terminals, also loose and dirty ground cönnections will cause ultimate failure of the electrical system.

SPARK PLUGS: Check spark plugs frequently for loose connections and broken porcelain. Defective spark plugs and wires should be replaced.

AIR CLEANER: It is good insurance to frequently inspect and clean the air cleaner (usually fastened to the carburetor). Replace or add oil when needed in those known as the "oil bath" type.

WORKING UNDER VEHICLE: When working under a vehicle, it is NOT advisable to depend only upon its jack to support the weight. Use wooden blocks or wooden jacks.

REPORTING DEFECTS: Report any mechanical trouble and have it corrected. Makeshift repairs should be used only as an expedient.

BACKING: Back as little as possible—never back without sounding your horn and making absolutely sure that the way is clear.

STOPPING DISTANCES: The approximate stopping distances, from the time the driver anticipates, or sees the need, to the time the vehicle is stopped are:

	With Good Brakes	With Passable Brakes
At 20 miles per hour	43 feet	52 feet
At 30 miles per hour	80 feet	100 feet
At 40 miles per hour	128 feet	164 feet
At 50 miles per hour	186 feet	243 feet

TIRE INFLATION: Proper tire inflation not only produces the greatest number of miles per tire, but helps in avoiding accidents. Unequally inflated tires result in poor steering, in poor braking, and in excess sideway on curves.

CHANGING TIRES: When changing tires, block your wheels with a rock or something similar. Never depend upon the brakes to hold the vehicle while tires are being changed.

SPINNING OF WHEELS: Spinning the rear wheels only digs them deeper into mud and snow. Cant the vehicle forward and backward a few inches repeatedly until you can pull or back out.

OVERLOADING VEHICLE: Load trucks to capacity only—never overload. Overloading may cause metal fractures and failures. An emergency stop cannot be made in time if the vehicle is overloaded.

RACING ENGINE: Racing the engine, especially when it is cold, causes excessive strain on the mechanism and undue wear because the oil is thickened by low temperatures and fails to circulate promptly.

ENGINE ACCELERATION: Accelerate gently. "Tramping" on the accelerator only forces more fuel into the cylinders than can be effectively used and may result in the engine stalling.

ENGINE IDLING: Permitting the engine to idle for long periods of time not only wastes fuel, but fouls spark plugs.

ENGINE OVERHEATING: When engine is overheated, cold water should NOT be poured into the radiator unless the engine is running so that the water will circulate and mix the cold water with the hot before it strikes the cylinder block and head. When engine overheats, always check the fan belt first for slippage; tighten if necessary to eliminate overheating.

USE OF BRAKES—LOOSE GRAVEL: On a loose gravel road, motor vehicles often sway and skid dangerously if going at high rates of speed. Loose gravel may be thrown, injuring pedestrians or breaking windows of passing vehicles. Use your brakes with caution to bring the vehicle under control. To apply the brakes abruptly while skidding only increases skidding. If a tire blow-out occurs concentrate on steering the vehicle. Then take your foot off the accelerator and use your brakes with caution.

APPLYING BRAKES: Applying brakes too rapidly results in excessive tire wear. It may also result in a dangerous skid when on wet or icy pavement.

STOPPING VEHICLE: Come to a gradual stop. Sudden stops, the same as sudden starts, waste fuel and are dangerous to the passengers.

USE OF CLUTCH: Sudden engagement of the clutch, causing jerky starting or "killing the engine," increases the strains on the clutch and other parts involved. Move the clutch plates slowly and evenly.

USE OF GEARS: Holding the vehicle in second gear until attaining a high rate of speed easily doubles fuel consumption. Shift to high gear before 25 miles an hour is reached.

LOW GEAR: Low speed gear ratios are provided for use when the "going" is heavy. The best driver shifts into these lower ratios when necessary for most efficient vehicle operation. Always descend a hill in the same gear you used in ascending it.

COASTING: When going down grade use engine compression to assist you in control. Never disengage the clutch and "coast" down. This is extremely dangerous when an unforeseen emergency demands prompt stopping of the vehicle. When "coasting," the use of brakes usually results in burned linings (and useless brakes).

FIRE: Given a few seconds to start, an oil or fuel fire in your vehicle becomes difficult to handle. Stop engine and turn off lights immediately. Have all passengers leave the vehicle as soon as you have stopped it. Use a fire extinguisher. Apply it thru louvers for engine fires and raise the hood only when such openings are not provided. If no extinguisher is available, smother the flames with a tarpaulin, blanket, coat, sand, dirt, or other material.

RECKLESS DRIVING: Reckless driving increases hazards to life and limb and strains on vehicle mechanism.

SUMMARY—ABUSE AND NEGLECT: Abuse and neglect of the vehicle entrusted to you will always result in premature repairs. Your efficiency as a driver can be effectively measured by the cost of repairs made and charged to the vehicle.

Note: In using the following schedules, omit instructions for units not furnished on this model vehicle.

SCHEDULE PMS #2

DAILY — AFTER OPERATION

First Echelon

PURPOSE: To be sure vehicle is ready to operate again at a moment's notice.

DRIVER'S TRIP TICKET AND PERFORMANCE RECORD (W.D., Q.M.C. Form No. 237—Revised 1942). Prepare this form for items needing Second Echelon attention as listed below or as noted during PMS #3, #4, and #5.

The "Daily—After Operation" preventive maintenance is particularly important because at this time the driver inspects or tests various units to detect any defects that may have developed during the march and corrects them or reports any he cannot handle himself.

If he does this thoroly, the vehicle should be ready to roll again on a minute's notice. The "Daily—Before Operation" preventive maintenance is then necessary only to ascertain that the vehicle is in the same condition in which it was left after the "Daily—After Operation" preventive maintenance.

The "Daily—After Operation" preventive maintenance should never be entirely omitted even in extreme tactical situations but may be reduced to the bare fundamental services outlined for the "At Halt" preventive maintenance.

When performing the "Daily—After Operation" preventive maintenance the driver must remember and consider any irregularities noticed during the day in the "Before Operation," "During Operation," and "At Halt" preventive maintenance services.

The "Daily—After Operation" preventive maintenance service consists of inspecting or testing the following units and correcting or reporting any defects:

In Cab—Before Stopping Engine

2-1. HAND BRAKE: Hand brake lever ratchet should keep lever in applied position and brakes should hold.

2-2. ENGINE NOISES — SMOOTHNESS OF IDLE: Note whether engine idles smoothly. Also investigate any unusual noises noticed during operation but not reported.

2-3. TEMPERATURE GAGE: When vehicle is stopped and engine is idling, the temperature gage reading will increase due to the reduced flow of cooling system fluid. This increased reading does not indicate true condition of cooling system or that any excessive temperature condition exists. Read gage as soon as vehicle is stopped and before above increase and be sure it does not register above the "Normal Temperature" sector.

2-4. OIL PRESSURE GAGE: Be sure gage shows correct pressure.

2-5 VISCOMETER: Indicator should remain in the normal range section of dial with engine at normal operating temperature.

2-6. AMMETER: If the electrical load does not exceed the generator output, the ammeter should show a positive charge at engine speeds faster than 12 to 15 miles per hour in direct drive. The ammeter needle should be steady while the generator is charging. A zero reading when all lights and electrical accessories are turned off does not indicate any trouble but is usual when battery is well charged. A high charge reading may indicate a dangerously low battery or a fault in the generator or generator regulation.

2-7. TACHOMETER: Be sure indicating needle registers.

2-8. AIR BRAKE PRESSURE GAGE: Gage should not indicate more than approximately 105 pounds or less than approximately 80 pounds. It should show a steady pressure build up with engine running at a fast idle. Pressure should not drop excessively when brakes are applied.

2-9. FUEL GAGE: Note approximate amount of fuel needed to fill tank.

2-10. WINDSHIELD WIPERS: Operate. Be sure arms or blades are not missing and that wipers do not move too slowly and move thru their complete stroke.

In Cab—After Stopping Engine

2-11 HEATER AND DEFROSTER: If heater fan or defroster fan do not operate, report immediately or note (according to the weather). Be sure heater core or connections do not leak.

2-12. HORN: Be sure horn will sound.

2-13. FIRE EXTINGUISHER: Remove from bracket, shake, and judge from sound and weight whether it is full. When extinguisher is replaced, bracket should hold it firmly with the handle in the locked position. Every vehicle should have a filled fire extinguisher in good working order at all times.

2-14. REAR VIEW MIRRORS: If broken, discolored or lost, report. If loose in bracket, tighten. Adjust for best vision.

Exterior, Front, Right Side, Rear, and Left Side

2-15. LIGHTS: Inspect light switches at all positions. Be sure lights do not flicker or fail to light. During blackouts, inspect the lights with switch only in blackout position. Be sure all switches are in "off" position after lights are inspected and that all lights are out. If lamps are loose, tighten. Report broken brackets and cracked lenses.

2-16. WINDSHIELD: Clean windshield. Be sure it is not broken.

2-17. WHEELS AND AXLE FLANGES: Tighten any loose nuts and bolts on wheels and axle flanges. Report damaged wheels, rims or rim gutters missing nuts and bolts, or grease leaks.

2-18. BRAKE DRUMS AND WHEEL HUBS: Place hand on each brake drum and wheel hub. All brake drums should be at approximately the same temperature. An excessively hot drum may indicate dragging shoes or improper adjustment. An abnormally cool drum may indicate brakes on that wheel are not functioning. Wheel hubs that are too hot to touch with the hand may indicate under-lubricated, damaged or improperly adjusted bearings.

2-19. SHEET METAL: See that hood, fenders, body panels, moldings and other parts are not damaged, loose or missing.

2-20. POWER TAKE-OFF AND WINCH: See that cable is tight and evenly wound. If not, rewind cable. Be sure cable is not kinked and strands are not broken, as a faulty cable may break and cause serious injury or death. Examine propeller shaft and universal joints to be sure nothing is wound around it.

2-21. BUMPERS, TOWING HOOKS, PINTLE AND SAFETY CHAINS: Bumpers and towing hooks should be tight. Pintle hooks should lock, latch should operate freely and it should be tightly bolted on frame. Be sure latch is equipped with a lock pin for towed loads. Inspect safety chains, also pintle and bumpers for any missing parts, damage or dangerous wear.

2-22. LOAD, TARPAULIN, FASTENINGS: Go over any cargo carefully to locate any damage to it. Make sure all ropes are lashed securely to hooks or rings. Make sure there has been no shifting during operation and that the load is still evenly distributed and complete. See that there are no loose pieces that may fall off during operation of vehicle. Place tarpaulin over load to protect against the elements. Be sure tarpaulin is tightly secured. Check for tears or holes in tarpaulin, missing or worn straps, rings, ropes or rain gutters.

2-23. TRACTOR FIFTH WHEEL AND PLATE: See that lower plate coupler pin, locking jaws, and guide are well lubricated. If covered with grit or sand, clean off and re-lubricate. See that hand lever for king pin lock operates easily and closes completely. Inspect for any worn, loose or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted.

2-24. TRAILER LIGHTING AND BRAKE CONNECTION: Be sure that cables are not frayed or broken and that attachment plugs are not damaged or missing. Listen for air leaks if brakes are air operated. Make sure that support springs hold lines securely.

Under Vehicle

2-25. STEERING MECHANISM: Look carefully beneath front end. Be sure steering knuckle arms, tie rod, and drag link are not bent. Have assistant driver turn steering wheel enough to right and left to take up all slack in steering mechanism. Observe any play in steering linkage or any looseness of steering gear on frame. Feel steering knuckle housings with bare hands. If too hot to hold hand on, they may be damaged. Look for leaks of lubricant from steering knuckle housings or from steering gear, which may indicate need to replenish lubricant or repair grease seals.

2-26. TIRES: Remove all foreign matter, such as nails, glass or stones, from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts or wrong tread direction. Kick all dual tires to detect flats. It is impossible to detect flats on dual wheels just by looking at them.

Replace any missing valve caps. Check for improperly located valve stems.

If a tire was changed during the run, be sure the following conditions are complied with:

Duals should be properly matched. Tires with greatest wear should be on the inside dual so load will be approximately the same on each dual tire when on normally crowned roads.

Directional tread tires should be mounted so they run in proper direction.

Directional tread and non-directional tread tires should not be used on wheels of same driving axle.

2-27. SPARE TIRE CARRIER: See that carrier holds tire securely, that lock operates and that there are no damaged parts.

2-28. SPRINGS AND SUSPENSIONS: Examine springs for broken leaves, shifted leaves, loose or missing rebound clips, angle of spring shackles and position of spring on saddle. Springs with shifted leaves do not have their normal strength. Missing rebound clips may permit spring leaves to break on rebound or will permit leaves to shift. Broken spring leaves may cause load to shift, make vehicle top heavy or hard to handle or may even permit axle to shift out of line. Weakened spring may break completely and lock the steering mechanism so driver will lose steering control of the vehicle.

2-29. BRAKE LINES: See that brackets and springs are tight and in place. Make sure no fluid is leaking from the lines or connections.

2-30. AIR BRAKE RESERVOIRS: Open drain cocks fully to draw condensation from reservoir. When no water shows in escaping air, close drain cocks tightly. Be sure they do not leak when closed. If water is not drained, it will pass thru entire air system. In cold weather, valves may freeze or entire system may freeze, resulting in brake failure.

2-31. DRIVING AXLES: Place hand on differential housings to determine if unusually hot. Examine for lubricant leaks.

2-32. TRANSMISSION: Place hand on transmission to determine if unusually hot. Examine for lubricant leaks.

2-33. TRANSFER CASE: Place hand on transfer case to determine if unusually hot. Examine for lubricant leaks.

2-34. PROPELLER SHAFTS: Remove any foreign material found around shafts. Tighten loose universal joint bolts, look for bent shafts or missing parts.

Under Hood

2-35. RADIATOR: Remove cap and replenish water if low. A heavy layer of oil on water in radiator may indicate leaking gaskets or other injury in cooling system or engine lubricating system.

2-36. WATER LEAKS: If water in radiator was excessively low, examine for leaks in radiator core, water pump, hose connections or cylinder block and check oil level in crankcase to be sure it has not risen due to water leaking into crankcase.

2-37. FAN BELT: Push belt halfway between pulleys. It should deflect about ¾ inch. If too tight, the extra load in generator or water pump bearings may cause bearing failure. If it is too loose, the condition should have been noticed during operation as a squealing noise. This can overheat engine or prevent generator from keeping battery charged. If belt is beginning to fray badly, it should be renewed.

2-38. ENGINE OIL: Remove bayonet oil level gage, dry with a clean cloth and then check level of oil. Also note condition of oil to be sure it is clear and free of any dirt or water. Add oil when necessary as recommended for the vehicle.

2-39. OIL LEAKS: If engine oil was excessively low, examine for leaks from all exposed oil lines, oil filter, engine oil pan, front or rear end of engine or other parts of engine. The cause of any sudden excessive loss or use of oil should be located to avoid danger of complete loss of oil and consequent damage to engine during operation.

2-40. OIL FILLER CAP (BREATHER): If operating in sandy or dusty territory, remove oil filler cap and wash it in kerosene. Shake off excess kerosene, then dip cap in engine oil. Let excess oil drain off before replacing.

2-41. CARBURETOR AIR CLEANER: Check oil level in cleaner bowl. Rub finger thru oil to detect dirt. If bowl is dirty, clean it and refill with engine oil. See instructions on cleaner.

2-42. SPARK PLUGS, DISTRIBUTOR AND COIL: Look for oil leaks around spark plugs and make certain spark plug wires are all attached to spark plugs. Note any cracked, chafed, disconnected or broken wires.

2-43. FUEL LEAKS: Examine carburetor, fuel filter, fuel pump and connections for fuel leaks, which may cause a fire hazard or cause engine to stop.

Exterior—Final

2-44. REFUEL TANK: When refueling tank, contact filler hose nozzle to tank first so any sparks from static electricity will occur before fuel is flowing from nozzle. Otherwise the spark may cause a fire or an explosion. Do not fill tank entirely to top of filler neck but leave space for expansion that takes place when the fuel warms up. Be sure filler cap vent is open and replace cap securely.

2-45. TOOLS, TIRE CHAINS AND OTHER EQUIPMENT: Make sure all tools assigned, including Pioneer Tool Equipment Set, tire chains and other equipment, are with vehicle and that all tools are in good condition.

If chains or traction devices have been used, clean them and inspect for badly worn, broken or missing links or damaged fastening hooks. Repair and oil them as necessary so they will be ready for use again.

SCHEDULE PMS #3

DAILY — BEFORE OPERATION

First Echelon

PURPOSE: To be sure conditions have not changed since last PMS #2.

Many things can happen to a vehicle between the "Daily—After Operation" inspection and the time the vehicle rolls again. Sabotage may be attempted; moisture may ground or short circuit electrical connections; another vehicle may back into it; tires may go down; engine oil, fuel or water may leak out. A check for such defects is necessary before operation.

The "Before Operation" preventive maintenance should never be entirely omitted, even in extreme tactical situations. By being thoroly trained on the recommended schedule, the driver will go thru the inspection almost automatically so that but a few moments' time will enable him to size up the condition of the vehicle.

Exterior—Before Starting Engine

3-1. VEHICLE IN GENERAL, LEAKS: Look on ground under vehicle for leaks of oil, water or fuel. Look for any injury to vehicle, signs of tampering with it or with load and load fastenings. Be sure tarpaulin is firmly fastened and has not been disturbed. Raise hood and look for signs of any tampering or sabotage. In handling the next three items investigate for cause if any item is not as it was left after completion of the "Daily-After Operation" preventive maintenance

3-2. RADIATOR (SAME AS 2-35 AND 2-36): Remove cap and replenish water if low. A heavy layer of oil on water in radiator may indicate leaking gaskets or other injury in cooling system or engine lubricating system.

If water in radiator was excessively low, examine for leaks in radiator core, water pump, hose connections or cylinder block and check oil level in crankcase to be sure it has not risen due to water leaking into crankcase.

3-3. ENGINE OIL (SAME AS 2-38 AND 2-39): Remove bayonet oil level gage, dry with a clean cloth and then check level of oil. Also note condition of oil to be sure it is clear and free of any dirt or water. Add oil when necessary as recommended for the vehicle.

If engine oil was excessively low, examine for leaks from all exposed oil lines, oil filter, engine oil pan, front or rear end of engine or other parts of engine. The cause of any sudden excessive loss or use of oil should be located to avoid danger of complete loss of oil and consequent damage to engine during operation.

3-4. FUEL (SAME AS 2-43 AND 2-44): Examine carburetor, fuel filter, fuel pump and connections for fuel leaks, which may cause a fire hazard or cause engine to stop.

When refueling tank, contact filler hose nozzle to tank first so any sparks from static electricity will occur before fuel is flowing from nozzle. Otherwise the spark may cause a fire or an explosion. Do not fill tank entirely to top of filler neck but leave space for expansion that takes place when the fuel warms up. Be sure filler cap vent is open and replace cap securely.

In Cab—Starting Engine

3-5. STARTER: When starting engine, note if starter knocks. The shaft may be bent or teeth may be damaged on the starter gears so a slight amount of additional use of the starter will cause it to fail entirely. If starter cranks engine only very slowly it may indicate a low battery that is likely to fail soon.

If no sound is heard after depressing starter switch, battery may be low or starter gears may be locked. Turn on lights and again depress starter switch. Lights will go out when starter switch is depressed if battery is very weak or if connections are loose. Tighten battery-to-starter connections and battery-to-ground connections if they are loose. If starter gears are locked, report. Do not attempt to push vehicle or serious damage may be caused. After engine has started, let it run at a fast enough speed so ammeter shows (by a slight movement forward "charge") that generator cutout has closed. This will warm up engine, and oil will be warmed enough to circulate to all parts of the engine. Meanwhile, proceed with the following steps.

3-6. INSTRUMENTS, HORN, WINDSHIELD WIPER: Re-inspect instruments for proper reading. See whether windshield wiper and horn still operate correctly.

3-7. FIRE EXTINGUISHER (SAME AS 2-13): Remove from bracket, shake, and judge from sound and weight whether it is full. When extinguisher is replaced, bracket should hold it firmly with the handle in the locked position. Every vehicle should have a filled extinguisher in good working order at all times.

Exterior—Front, Right Side, Rear and Left Side (With Engine Warming Up)

3-8 LIGHTS (SAME AS 2-15): Inspect light switches at all positions. Be sure lights do not flicker or fail to light. During blackouts, inspect the lights with switch only in blackout position. Be sure all switches are in "off" position after lights are inspected and that all lights are out. If lamps are loose, tighten. Report broken brackets and cracked lenses.

3-9. WINDSHIELD (SAME AS 2-16): Clean windshield. Be sure it is not broken.

3-10. LOAD, TARPAULIN, ETC. (SAME AS 2-22): Go over any cargo carefully to locate any damage to it. Make sure all ropes are lashed securely to hooks or rings. Make sure there has been no shifting during operation and that the load is still evenly distributed and complete. See that there are no loose pieces that may fall off during operation of vehicle. Place tarpaulin over load to protect against the elements. Be sure tarpaulin is tightly secured. Check for tears or holes in tarpaulin, missing or worn straps, rings, ropes or rain gutters.

3-11. TRACTOR FIFTH WHEEL AND PLATE (SAME AS 2-23): See that lower plate coupler pin, locking jaws, and guide are well lubricated. If covered with grit or sand, clean off and re-lubricate. See that hand lever for king pin lock operates easily and closes completely. Inspect for any worn, loose or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted.

3-12. TRAILER, LIGHTING AND BRAKE CONNECTIONS (SAME AS 2-24): Be sure that cables are not frayed or broken and that attachment plugs are not damaged or missing. Listen for air leaks if brakes are air operated. Make sure that support springs hold lines securely.

3-13. TOOLS, TIRE CHAINS AND OTHER EQUIPMENT (SAME AS 2-45): Make sure all tools assigned, including Pioneer Tool Equipment Set, tire chains and other equipment, are with vehicle and that all tools are in good condition.

If chains or traction devices have been used, clean them and inspect for badly worn, broken or missing links or damaged fastening hooks. Repair and oil them as necessary so they will be ready for use again.

Under Vehicle

3-14. TIRES (SAME AS 2-26): Remove all foreign matter, such as nails, glass or stones, from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts or wrong tread direction. Kick all dual tires to detect flats. It is impossible to detect flats on dual wheels just by looking at them.

Replace any missing valve caps. Check for improperly located valve stems.

If a tire was changed during the run, be sure the following conditions are complied with:

Duals should be properly matched. Tires with greatest wear should be on the inside dual so load will be approximately the same on each dual tire when on normally crowned roads.

Directional tread tires should be mounted so they run in proper direction.

Directional tread and non-directional tread tires should not be used on wheels of same driving axle.

3-15. GROUND BENEATH VEHICLE: Inspect ground beneath vehicle for any leaks of oil, fuel or water that have developed since starting the engine as these may indicate tampering or sabotage not previously noticed.

In Cab—Engine Warmed Up

3-16. ENGINE: Accelerate engine slightly several times after it has reached normal operating temperature, and be sure there are no unusual noises which would indicate trouble. If not indicated by the temperature gage, normal operating temperature may be assumed when the following conditions are true: engine idles with the choke fully released; oil pressure gage indicates reasonably close to normal operating pressure; and viscometer reads in the normal range. The normal warm-up period will vary; in cold weather it can be shortened by covering the radiator. When warming engine up do not run it faster than just enough to make generator cutout close as indicated by a movement of ammeter hand towards "charge."

SCHEDULE PMS #4

DAILY — DURING OPERATION

First Echelon

PURPOSE: To detect improper performance.

In preventive maintenance the noticing of little things counts, such as: unusual noises or odors, slight peculiarities in vehicle performance, and taking correct steps before the defects develop to the point of causing a complete breakdown.

While the vehicle is in motion, a good driver listens for any sound which may be a sign of trouble, such as rattles, knocks, squeals or hums. He looks for steam from the radiator or smoke from any part of the vehicle. He knows and watches for the odor of an overheated generator, overheated brakes, boiling anti-freeze, fuel vapor from a leaky fuel system or other such signs of trouble. Every time he uses the brakes, shifts gears, or turns, he considers it a test and notes any unsatisfactory or unusual performance.

A good driver constantly checks the instruments and notices promptly if any instrument indicates that some unit may be operating improperly.

General

4-1. UNUSUAL SOUNDS: Listen for such noises as the following, which usually indicate the trouble specified:

(a) SQUEALING IN ENGINE: Generator or water pump troubles.

(b) LOUD KNOCKING IN ENGINE: Loose or burned-out connecting rod.

(c) DULL HEAVY THUMPING IN ENGINE: Loose or burned-out main bearing.

(d) LIGHT RATTLING NOISE IN ENGINE: No oil in engine. This noise will usually last only a few moments, after which engine will slow down and seize. By detecting this, an especially alert driver can do much to avoid wrecking an engine.

(e) SPARK PING: If this noise develops rapidly, it may indicate that engine is overheating. A very slight spark ping during fast acceleration is not a sign of serious trouble but may indicate engine needs tune-up.

(f) HISSING SOUND: Escape of steam due to overheating.

(g) GRINDING NOISE UNDER FLOORBOARD: Transmission, power take-off, or transfer case trouble.

(h) HEAVY VIBRATIONS BENEATH VEHICLE: Loose or bent propeller shaft.

(i) CONTINUOUS HUM IN WHEELS: Improper wheel bearing adjustment.

(j) SQUEALING OF TIRES ON TURNS: Underinflation, overload, or excessive speed.

(k) AXLE HUM: Improperly adjusted or worn axle gears.

(l) KNOCKING IN AXLE: Damaged gear teeth or bearings.

4-2. INSTRUMENTS: Watch instruments for proper reading as checked before operation.

4-3. STEERING: Check for excessive pulling to either side and for wandering of vehicle if not due to crown of road. This may be caused by loss of pressure in tires. Also check for excessive play in steering mechanism, and for front wheel shimmy which may indicate excessive wear, loose parts or improper adjustments.

4-4. BRAKES: Be sure brakes continue to operate smoothly and effectively. Failure of brakes to hold vehicle may result from burned linings.

4-5. CLUTCH: Clutch should not chatter, squeal or slip when fully engaged. Clutch release bearing should not make excessive noise when clutch pedal is pressed, as this indicates a damaged bearing. Clutch pedal should have enough free travel before it begins to disengage clutch. Otherwise, clutch may slip when engine is pulling a heavy load at higher engine speed. Clutch pedal should not have too much free travel as it may not disengage fully, causing gears to clash and damaging gear teeth when shifting transmission or transfer case gears.

4-6. TRANSMISSION: Gears should shift smoothly and vehicle should not creep out of gear during operation. The gears should operate quietly. Unusual noise may indicate approaching failure which will completely wreck the transmission if operation of vehicle is continued.

4-7. PERFORMANCE: Be on the alert for lack of power, which may be caused by dragging brakes. Loss of engine oil or water will also cause a sudden falling off of engine power and if such a condition is noticed by the driver immediately, he may be able to avoid a complete breakdown of the vehicle by stopping it at once, permitting engine to cool off and then replenishing the water in cooling system or the engine oil.

A sudden increase in the engine power may indicate loss of part of the load.

An irregular missing and gradual slowing down and loss of engine power may be due to low fuel in tanks, leaks in fuel lines, improperly operating pump or excessive vaporizing of fuel in fuel lines, fuel pump or carburetor. Vehicles should be stopped if possible and trouble corrected before engine stops entirely. It is usually easier to locate such a trouble while engine is still running than after it has stopped completely.

SCHEDULE PMS #5

DAILY — AT HALT

First Echelon

PURPOSE: To detect deficiencies developed during operation.

Some troubles are difficult to discover while rolling, so that advantage should be taken of every halt to locate and correct anything that may cause a fall-out after the march is resumed.

During halts, the driver corrects or reports any condition noticed during operation but which was not serious enough to require action at the time.

In Cab

5-1. HAND BRAKES. (SAME AS 2-1): Hand brake lever ratchet should keep lever in applied position and brakes should hold.

Exterior, Front, Right Side, Rear, and Left Side

5-2. WINDSHIELD. (SAME AS 2-16): Clean windshield. Be sure it is not broken.

5-3. BRAKE DRUMS AND WHEEL HUBS. (SAME AS 2-18): Place hand on each brake drum and wheel hub. All brake drums should be at approximately the same temperature. An excessively hot drum may indicate dragging shoes or improper adjustment. An abnormally cool drum may indicate brakes on that wheel are not functioning. Wheel hubs that are too hot to touch with the hand may indicate underlubricated, damaged or improperly adjusted bearings.

5-4. LOAD, TARPAULIN, FASTENINGS. (SAME AS 2-22): Go over any cargo carefully to locate any damage to it. Make sure all ropes are lashed securely to hooks or rings.

Make sure there has been no shifting during operation and that the load is still evenly distributed and complete. See that there are no loose pieces that may fall off during operation of vehicle. Place tarpaulin over load to protect against the elements. Be sure tarpaulin is tightly secured. Check for tears or holes in tarpaulin, missing or worn straps, rings, ropes or rain gutters.

5-5. TRAILER LIGHTING AND BRAKE CONNECTIONS. (SAME AS 2-24): Be sure that cables are not frayed or broken and that attachment plugs are not damaged or missing. Listen for air leaks. Make sure that support springs hold lines securely.

Under Vehicle

5-6. STEERING MECHANISM. (SAME AS 2-25): Look carefully beneath front end. Be sure steering knuckle arms, tie rod, and drag link are not bent. Have assistant driver turn steering wheel enough to right and left to take up all slack in steering mechanism. Observe any play in steering linkage or any looseness of steering gear on frame. Feel steering knuckle housings with bare hands. If too hot to hold hand on, they may be damaged. Look for leaks of lubricant from steering knuckle housings or from steering gear, which may indicate need to replenish lubricant or repair grease seals.

5-7. TIRES: Be sure tires are not unusually hot, as this will raise pressure and weaken the tire casings so they may blow out unless permitted to cool before further driving.

(SAME AS 2-26): Remove all foreign matter, such as nails, glass or stones, from tires or from between duals. Inspect tires for signs of abnormal tread wear, cuts or wrong tread direction. Kick all dual tires to detect flats. It is impossible to detect flats on dual wheels just by looking at them.

Replace any missing valve caps. Check for improperly located valve stems.

If a tire was changed during the run, be sure the following conditions are complied with:

Duals should be properly matched. Tires with greatest wear should be on the inside dual so load will be approximately the same on each dual tire when on normally crowned roads.

Directional tread tires should be mounted so they run in proper direction.

Directional tread and non-directional tread tires should not be used on wheels of same driving axle.

5-8. SPRINGS AND SUSPENSIONS. (SAME AS 2-28): Examine springs for broken leaves, shifted leaves, loose or missing rebound clips, angle of spring shackles and position of spring on saddle. Springs with shifted leaves do not have their normal strength. Missing rebound clips may permit spring leaves to break on rebound or will permit leaves to shift. Broken spring leaves may cause load to shift, make vehicle top heavy or hard to handle or may even permit axle to shift out of line. Weakened spring may break completely and lock the steering mechanism so driver will lose steering control of the vehicle.

5-9. DRIVING AXLES. (SAME AS 2-31): Place hand on differential housings to determine if unusually hot. Examine for lubricant leaks.

5-10. TRANSMISSION. (SAME AS 2-32): Place hand on transmission to determine if unusually hot. Examine for lubricant leaks.

5-11. TRANSFER CASE. (SAME AS 2-23): Place hand on transfer case to determine if unusually hot. Examine for lubricant leaks.

Under Hood

5-12. RADIATOR. (SAME AS 2-35): Remove cap and replenish water if low. A heavy layer of oil on water in radiator may indicate leaking gaskets or other injury in cooling system or engine lubricating system.

5-13. WATER LEAKS. (SAME AS 2-36): If water in radiator was excessively low, examine for leaks in radiator core, water pump, hose connections or cylinder block and check oil level in crankcase to be sure it has not risen due to water leaking into crankcase.

5-14. FAN BELT. (SAME AS 2-37): Push belt halfway between pulleys. It should deflect about ¾ inch. If too tight the extra load in generator or water pump bearings may cause bearing failure. If it is too loose, the condition should have been noticed during operation as a squealing noise. This can overheat engine or prevent generator from keeping battery charged. If belt is beginning to fray badly, it should be renewed.

5-15. ENGINE OIL. (SAME AS 2-38 AND 2-39): Remove bayonet oil level gage, dry with a clean cloth and then check level of oil. Also note condition of oil to be sure it is clear and free of any dirt or water. Add oil when necessary as recommended for the vehicle.

If engine oil was excessively low, examine for leaks from all exposed oil lines, oil filter, engine oil pan, front or rear end of engine or other parts of engine. The cause of any sudden excessive loss or use of oil should be located to avoid danger of complete loss of oil and consequent damage to engine during operation.

SCHEDULE PMS #6

WEEKLY

First Echelon

PURPOSE: To perform servicing and tightening operations that are necessary at this time for the continued satisfactory performance of the vehicle.

The "Weekly" preventive maintenance is a general tightening and check of certain factors that may affect vehicle performance. It also covers items that affect appearance.

In Cab

6-1. CAB FLOOR MAT AND FLOOR: Be sure floor mat is not torn or worn thru, and that floor boards are tight and are not broken.

6-2. CAB LINING AND SLATS: Be sure cab lining is not torn or damaged, that door panels are tight, and that broken or loose slats are corrected.

6-3. UPHOLSTERY: Be sure upholstery is not torn or worn excessively and that springs do not project thru seat covers.

6-4. CLUTCH PEDAL FREE TRAVEL: Be sure clutch pedal has correct free travel as outlined in 4-5.

Clutch should not chatter, squeal or slip when fully engaged. Clutch release bearing should not make excessive noise when clutch pedal is pressed, as this indicates a damaged bearing. Clutch pedal should have enough free travel before it begins to disengage clutch. Otherwise, clutch may slip when engine is pulling a heavy load at higher engine speed. Clutch pedal should not have too much free travel as it may not disengage fully, causing gears to clash and damaging gear teeth when shifting transmission or transfer case gears.

Exterior—Front, Right Side, Rear and Left Side

6-5. BODY HOIST: Raise body if vehicle is equipped with a body hoist. Listen for unusual noises in cross heads, hoist cylinders, or power take-off. Be sure there are no leaks from the body hoisting mechanism which might permit the cylinder to run dry.

6-6. BODY: See that hood is not damaged and that holding devices and brackets are tight. A loose latch may permit hood to fly open during operation and block driver's vision. Be sure that paint on body, hood and fenders is in good condition and that there are no rusty places. Any lettering should be legible. Check for damaged or missing tail gate chains, locking devices, safety straps and molding.

6-7. FENDERS AND SUPPORT BRACKET BOLTS: See that fenders are not dented or broken and that they are tightly bolted to brackets. Jagged edges on fenders may cause injury to anyone accidentally coming in contact with vehicle while it is parked or moving.

6-8. BUMPERS, TOWING HOOKS, PINTLE AND SAFETY CHAINS. (SAME AS 2-21): Bumpers and towing hooks should be tight. Pintle hooks should lock, latch should operate freely and it should be tightly bolted on frame. Be sure latch is equipped with a lock pin for towed loads. Inspect safety chains, also pintle and bumpers for any missing parts, damage or dangerous wear.

6-9. BRUSH GUARDS: Tighten all loose mounting bolts and replace any missing bolts

6-10. TAGS AND BRACKETS: Clean all tags. Straighten bent tags or brackets; tighten any loose bolts and replace missing bolts.

6-11. TRACTOR FIFTH WHEEL AND PLATE (SAME AS 2-23): See that lower plate coupler pin, locking jaws, and guide are well lubricated. If covered with grit or sand, clean off and re-lubricate. See that hand lever for king pin lock operates easily and closes completely. Inspect for any worn, loose or damaged parts. Look for bent U-bolts or marks on frame that would indicate bed plate has shifted.

6-12. DOOR LOCKS AND HANDLES: Be sure no parts are damaged or missing and that the latches hold doors securely closed. Doors should be checked for proper fit and easy closing and opening. Tighten any loose screws or fastenings.

6-13. DOOR HINGES: Tighten any loose screws or bolts and replace any that are missing.

6-14. DOOR GLASS REGULATION: Be sure all door glass can be raised and lowered properly and that no parts are damaged or missing.

Under Vehicle

6-15. STEERING KNUCKLES (FRONT DRIVING AXLES): Look for leaks of lubricant from steering knuckle housings, which may indicate need to replenish lubricant or to repair grease seals.

6-16. SHOCK ABSORBERS: Examine arms, linkage and shock-absorber-to-frame bolts for looseness and tighten. Check for leakage of fluid from shock absorbers, which may indicate need to replenish fluid. If shock absorbers fail to function properly, springs may break because their rebound is not controlled.

6-17. TRANSFER CASE BOLTS TO FRAME: Be sure bolts holding transfer case to frame are tight. If not, they may become so loose that transfer case might be pulled from frame under severe operating conditions.

Under Hood

6-18. BATTERY: Clean top of battery and terminals with clear water or a solution of water and baking soda if available. Tighten terminals if loose. Remove plugs and if electrolyte is not well over top of plates, report condition so distilled water may be added as needed. If distilled water cannot be obtained from any available source, the cleanest and purest water obtainable may be substituted.

6-19. ENGINE, CLEAN: With a cloth, remove oil and dirt from engine and accessories.

Exterior—Final

6-20. CHECK OF LUBRICATION: Remove level plug from all driving axles, transmission, transfer case and steering knuckles and be sure lubricant is at correct level. Check condition of all lubricant seals.

6-21. GENERAL TIGHTENING: Tighten axle housing, transmission and transfer case, cap screws and replace any that are missing. Tighten axle flange and wheel nuts.

6-22. VEHICLE, CLEAN: Sweep out inside of cab. Clean all glass. When cleaning body, do not rub lusterless paint as it will become shiny and lose its camouflage value.

6-23. TIRES: Inflate tires to correct pressure using gage. Do not attempt to bring tires to proper inflation pressure while they are excessively hot.

1,000 MILE SERVICING OPERATION—6,000 MILE SERVICING OPERATION

TECHNICAL INSPECTION
(Line out words not applicable)

U.S.A. Reg. No. .... **Mileage** .... **Date** ....

Vehicle Nomenclature ....
(Make) **(Model)** **(Size)** **(Drive)**

Organization .... **Station** ....

Last Maintenance Operation: .... **at** ....
(Type) **(Mileage)** **(Date)**

By using appropriate markings as indicated below, this form may be used by 2nd echelon company, battery, or troop personnel for the 1,000 mile maintenance operation; 2nd echelon battalion or regimental personnel for the 6,000 mile maintenance operation; or by 3rd or 4th echelon personnel as a Technical Inspection Report. This form indicates the scope of a complete technical inspection of the above listed motor vehicle for all echelons. All items indicated in any one column will be completed to the extent of the ability of personnel and adequacy of equipment available. This form is not to be used as a job order for higher echelon repairs.

Procedure for accomplishing all items are explained in Technical Manual 9-2810.

1,000 OR 6,000 MILE MAINTENANCE OPERATION

Check "V" if satisfactory; "X" correction has been made; "O" repair or replacement needed. Explain items marked "O" under "Remarks" using item numbers.

External Around Vehicle

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
☐	☐	☐	1. Front bumpers
☐	☐	☐	2. Front tow hooks
☐	☐	☐	3. Brush guards
☐	☐	☐	4. Radiator shell
☐	☐	☐	5. Hood & fasteners
☐	☐	☐	6. Hood side panels
☐	☐	☐	7. Sheet metal cracks
☐	☐	☐	8. Front fenders
☐	☐	☐	9. Windshield & cowl
☐	☐	☐	10. Running boards
☐	☐	☐	11. Doors, handles & glass
☐	☐	☐	12. Tire carriers
☐	☐	☐	13. Pioneer tools & brackets
☐	☐	☐	14. Gasoline cans & brackets
☐	☐	☐	15. Side curtains
☐	☐	☐	16. Collapsible top & frame
☐	☐	☐	17. Tarpaulin, hooks & ropes
☐	☐	☐	18. Body panels
☐	☐	☐	19. Rear fenders or splash guards
☐	☐	☐	20. Tail gate & chains
☐	☐	☐	21. Rear bumpers
☐	☐	☐	22. Pintle hook
☐	☐	☐	23. Rear tool compartment
☐	☐	☐	24. Paint
		☐	25. Caster
		☐	26. Camber

Tools & Equipment

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
☐	☐	☐	27. Vehicle tools
☐	☐	☐	28. Fire extinguishers
☐	☐	☐	29. Decontaminating unit
☐	☐	☐	30. First aid kit
☐	☐	☐	31. Publications
☐	☐	☐	32. Standard form No. 26
☐	☐	☐	33. Traction devices
☐	☐	☐	34. Tow chain or rope
☐	☐	☐	35. Snatch block
☐	☐	☐	36. Winch shear pins (Spare)
☐	☐	☐	37. Fuel can & nozzle
☐	☐	☐	38. Bucket
☐	☐	☐	39. Tire gage

TECHNICAL INSPECTION REPORT

Check "V" if satisfactory; "O" repair or replacement needed. Explain items marked "O" under "Remarks" using item numbers. CAUTION: Lubricate and service vehicle sufficiently for safe operation if it is not to be deadlined.

Inside Cargo Body

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
☐	☐	☐	40. Body panels & floor
☐	☐	☐	41. Safety strap
☐	☐	☐	42. Troop seats
☐	☐	☐	43. Bows & stakes
☐	☐	☐	44. Roll-up straps
☐	☐	☐	45. Tarpaulins
☐	☐	☐	46. End curtains
☐	☐	☐	47. Gun mounts

Inside Cab or Passenger Body

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
	☐	☐	48. Seat cushions & backs
☐	☐	☐	49. Floor boards & mats
☐	☐	☐	50. Safety strap
☐	☐	☐	51. Seat supports & latches
☐	☐	☐	52. Inside door & cowl panels
☐	☐	☐	53. Headlining & paneling
☐	☐	☐	54. Cab rear glass & screen
☐	☐	☐	55. Door & window controls
☐	☐	☐	56. Windshield regulators
☐	☐	☐	57. Rear vision mirrors
☐	☐	☐	58. Map compartments & tables
☐	☐	☐	59. Cowl ventilator
☐	☐	☐	60. Brake pedal; feel, reserve, free travel
☐	☐	☐	61. Hand brake lever; travel, ratchet

Hood Up—Engine Stopped

Cooling System

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
☐	☐	☐	62. Radiator braces (fastenings)
☐	☐	☐	63. Fan blades
☐	☐	☐	64. Fan belts, water pump drive
☐	☐	☐	65. Water pump seals
☐	☐	☐	66. Hose & connections
☐	☐	☐	67. Core obstructions (external)
	☐	☐	68. Clean (flush) cooling system
☐	☐	☐	69. Anti-freeze protection
☐	☐	☐	70. Water jacket side plate
☐	☐	☐	71. Water drain cocks, expansion plugs
	☐	☐	72. Test thermostat
☐	☐	☐	73. Check for leaks
☐	☐	☐	74. Pressure cap
☐	☐	☐	75. Overflow pipe & tank
☐	☐	☐	76. Steam relief tube & valve

1000 MILE SERVICING
6000 MILE SERVICING
TECHNICAL INSPECTION

Brakes

☐ ☐ ☐ 77. Pedal pull back spring
☐ ☐ ☐ 78. Master cylinder; leaks, level, vent, stop light switch
☐ ☐ 79. Air compressor
☐ ☐ ☐ 80. Air compressor; drive; air strainer, unloader valve
☐ ☐ ☐ 81. Air governor
☐ ☐ ☐ 82. Air safety valve
☐ ☐ ☐ 83. Air supply valve
☐ ☐ ☐ 84. Air low pressure regulator
☐ ☐ ☐ 85. Lines & connections; (all types) leaks, damage, clips, brackets

Fuel System

☐ ☐ ☐ 86. Fuel tank; leaks, damage
☐ ☐ ☐ 87. Fuel tank cap & vent
☐ ☐ ☐ 88. Fuel tank straps or mountings
☐ ☐ ☐ 89. Fuel gage tank unit connections
☐ ☐ ☐ 90. Fuel line & shut off cock, tank to filter
☐ ☐ ☐ 91. Fuel filter
☐ ☐ ☐ 92. Fuel line, filter to pump
☐ ☐ ☐ 93. Fuel pump
☐ ☐ ☐ 94. Fuel line, pump to carburetor
☐ ☐ ☐ 95. Air cleaner
☐ ☐ ☐ 96. Caburetor & governor
☐ ☐ ☐ 97. Throttle, accelerator & choke control
☐ ☐ ☐ 98. Carburetor linkage
☐ ☐ ☐ 99. Intake manifold & heat control

Exhaust System

☐ ☐ ☐ 100. Tail pipe & mountings
☐ ☐ ☐ 101. Muffler & mountings
☐ ☐ ☐ 102. Exhaust pipe & connections
☐ ☐ ☐ 103. Exhaust manifold

Starting System

☐ ☐ ☐ 104. Battery
☐ ☐ ☐ 105. Hydrometer test
☐ ☐ ☐ 106. High rate discharge test
☐ ☐ ☐ 107. Battery cables & terminals
☐ ☐ ☐ 108. Battery mounting
☐ ☐ ☐ 109. Engine ground strap
☐ ☐ ☐ 110. Starting motor switch & button
☐ ☐ 111. Starting motor

1000 MILE SERVICING
6000 MILE SERVICING
TECHNICAL INSPECTION

Ignition System

☐ ☐ ☐ 112. Ignition switch & low voltage wiring
☐ ☐ ☐ 113. Ignition coil
☐ ☐ ☐ 114. Ignition distributor
☐ ☐ ☐ 115. Distributor automatic advance control
☐ ☐ ☐ 116. High voltage wiring and conduits

Lighting System

☐ ☐ ☐ 117. Light switches and connections
☐ ☐ ☐ 118. Fuses & circuit breakers
☐ ☐ ☐ 119. Head lamp, service & blackout
☐ ☐ ☐ 120. Tail lamps, service & blackout
☐ ☐ ☐ 121. Stop light switch & connections
☐ ☐ ☐ 122. Stop lamps, service and blackout
☐ ☐ ☐ 123. Body & instrument lights
☐ ☐ ☐ 124. Heaters, fans & defrosters
☐ ☐ ☐ 125. Trailer: electrical sockets

Engine Oiling System

☐ ☐ ☐ 126. Engine oil level & condition
☐ ☐ ☐ 127. Crank case breather & oil filler cap
☐ ☐ ☐ 128. Valve cover breather
☐ ☐ ☐ 129. Oil lines external
☐ ☐ ☐ 130. Oil filter

Engine Running—Temperature Normalized

Instruments

☐ ☐ ☐ 131. Oil pressure gage
☐ ☐ ☐ 132. Ammeter
☐ ☐ ☐ 133. Fuel gage
☐ ☐ ☐ 134. Tachometer
☐ ☐ ☐ 135. Low pressure indicator
☐ ☐ ☐ 136. Air pressure build up
☐ ☐ ☐ 137. Voltmeter
☐ ☐ ☐ 138. Viscometer
☐ ☐ ☐ 139. Windshield wipers
☐ ☐ ☐ 140. Horn
☐ ☐ ☐ 141. Engine temperature
☐ ☐ ☐ 142. Brake pedal; "feel" when starting engine (vacuum assisted brakes)
☐ ☐ ☐ 143. Vacuum lines, check valve & connections
☐ ☐ ☐ 144. Test all light bulbs & headlight aiming

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
			Under Hood
☐	☐	☐	145. Check cylinder head gasket
	☐	☐	146. Valve clearance
	☐	☐	147. Compression
☐	☐	☐	148. Spark plugs
	☐	☐	149. Trimming, ignition
☐	☐	☐	150. Carburetor
☐	☐	☐	151. Manifold vacuum
☐	☐	☐	152. Governor
			Engine Internal Inspection
		☐	153. Check for clearances, wear & damage. Establish the necessity for repairs or replacements
			Hoist Vehicle (place on suitable stands or blocks)
☐	☐	☐	154. Tires
☐	☐	☐	155. Wheel rim flange nuts (combat)
☐	☐	☐	156. Wheel stud nuts, inner & outer
☐	☐	☐	157. External oil leaks (wheels & hubs)
	☐	☐	158. Wheel bearings
	☐	☐	159. Wheel bearing lubrication
	☐	☐	160. Brake shoes & linings
	☐	☐	161. Brake shoe retracting spring
	☐	☐	162. Brake drums
	☐	☐	163. Brake supports (backing plates)
	☐	☐	164. Brake wheel cylinders
	☐	☐	165. Brake parts, lubrication
	☐	☐	166. Oil seals
	☐	☐	167. Front axle shafts & U joints
☐	☐	☐	168. Front axle shaft end screw
	☐	☐	169. Steering knuckle pivot bearings
☐	☐	☐	170. Turning radius stop screws
☐	☐	☐	171. Steering tie rod
☐	☐	☐	172. Steering connecting rod (drag link)
☐	☐	☐	173. Steering pitman arm, shaft nut
☐	☐	☐	174. Steering gear; adjustment, leaks, level and condition of lubricant
			Wheels On
☐	☐	☐	175. Toe in

1000 MILE SERVICING	6000 MILE SERVICING	TECHNICAL INSPECTION	
			Brakes
☐	☐	☐	176. Lines & connections (all types), leaks, damage, clips, springs & brackets
☐	☐	☐	177. Linkage
	☐	☐	178. Power cylinder & air cleaner L
☐	☐	☐	179. Slave cylinder & control valve
☐	☐	☐	180. Air reservoirs & drain cocks
☐	☐	☐	181. Air check valves; relay valve
☐	☐	☐	182. Air brake chambers
☐	☐	☐	183. Slack adjusters
			Clutch
☐	☐	☐	184. Free pedal travel
☐	☐	☐	185. Pedal to toe board clearance
☐	☐	☐	186. Pedal pull back spring
	☐	☐	187. Clutch release bearing
			Transmission
☐	☐	☐	188. Leaks, level & condition of lubricant
☐	☐	☐	189. Mounting screws: strut rod
☐	☐	☐	190. Power take-off
☐	☐	☐	191. Propeller shaft & U joints (transmission to transfer case)
			Transfer Case
☐	☐	☐	192. Leaks, level & condition of lubricant
☐	☐	☐	193. Mounting bolts
☐	☐	☐	194. Breather
☐	☐	☐	195. Power take-off
	☐	☐	196. Hand brake linkage
	☐	☐	197. Hand brake lining
☐	☐	☐	199. U joint, slip joint, propeller shaft (s), to front & rear axle (s) winches & hoists
☐	☐	☐	200. Pillow block (oil leaks, vent, mountings)
			Driving Axle (S)
☐	☐	☐	201. Leaks, level & condition of lubricant
☐	☐	☐	202. Axle housing alignment
			Winch & Body Hoists
☐	☐	☐	203. Clutches, brakes, drums, cables & guides
☐	☐	☐	204. Leaks, level & condition of lubricant
☐	☐	☐	205. Shear pin

1000 MILE SERVICING
6000 MILE SERVICING
TECHNICAL INSPECTION

General Tightening & Suspension

- ☐ ☐ ☐ 206. Radiator support bolts
- ☐ ☐ ☐ 207. Timing gear cover
- ☐ ☐ ☐ 208. Fender & front end sheet metai assembly bolts
- ☐ ☐ ☐ 209. Engine mountings
- ☐ ☐ ☐ 210. Engine oil pan & lower clutch housing
- ☐ ☐ ☐ 211. Engine side pans
- ☐ ☐ ☐ 212. Spring hangers
- ☐ ☐ ☐ 213. Spring shackles
- ☐ ☐ ☐ 214. Spring U bolts
- ☐ ☐ ☐ 215. Spring rebound clips
- ☐ ☐ ☐ 216. Spring center bolts
- ☐ ☐ ☐ 217. Shock absorbers
- ☐ ☐ ☐ 218. Shock absorber links
- ☐ ☐ ☐ 219. Control arm bushings (knee action)
- ☐ ☐ ☐ 220. Cab mounting bolts
- ☐ ☐ ☐ 221. Body mounting bolts
- ☐ ☐ ☐ 222. Body assembly bolts
- ☐ ☐ ☐ 223. Frame; cross members, brackets & rivets
- ☐ ☐ ☐ 224. Torque rods
- ☐ ☐ ☐ 225. Torque rod brackets
- ☐ ☐ ☐ 226. Rear spring seat, (bogie axle) bearings

Trailers
Electrical Brake System

- ☐ ☐ 227. Resister & load control
- ☐ ☐ ☐ 228. Brake hand control
- ☐ ☐ ☐ 229. Sockets & coupling cable
- ☐ ☐ ☐ 230. Safety switch
- ☐ ☐ 231. Solenoid & armature

1000 MILE SERVICING
6000 MILE SERVICING
TECHNICAL INSPECTION

General

- ☐ ☐ ☐ 232. Landing gear
- ☐ ☐ ☐ 233. Fifth wheel & bed plate
- ☐ ☐ ☐ 234. Coupling & latch
- ☐ ☐ ☐ 235. Safety chain

Note: Lubrication—all points in accordance with specific instructions

Radio Interference Suppression

- ☐ ☐ ☐ 236. Shakeproof washers, bonds & grounds
- ☐ ☐ ☐ 237. Suppressors, spark plug & distributor
- ☐ ☐ ☐ 238. Bond straps
- ☐ ☐ ☐ 239. Filters & condensers
- ☐ ☐ ☐ 240. Shielding & grounds

Road Test

- ☐ ☐ ☐ 241. Ease of starting; engine idle
- ☐ ☐ ☐ 242. Instruments
- ☐ ☐ ☐ 243. Clutch operation
- ☐ ☐ ☐ 244. Gear shift & declutching controls
- ☐ ☐ ☐ 245. Brakes
- ☐ ☐ ☐ 246. Brake equalization
- ☐ ☐ ☐ 247. Steering
- ☐ ☐ ☐ 248. Engine power and acceleration
- ☐ ☐ ☐ 250. Speedometer
- ☐ ☐ ☐ 251. Unusual engine noises
- ☐ ☐ ☐ 252. Unusual power train noises
- ☐ ☐ ☐ 253. Shock absorber action

Note: If performing 1,000 or 6,000 mile maintenance operation, recheck all deficiencies found during road test.

Remarks or Recommendation: ....

....

....

....

....

Mechanic or Inspector **Supervising Officer**

Rank or Title .... **Rank or Title** ....

Repairs by higher echelon entered on Job Order Request No.

	Date	Initials
Repairs requested	....	....
Truck forwarded	....	....
Truck returned	....	....

LUBRICATION

Lubrication, as it directly concerns operating personnel, is the maintaining of a lubricant between rubbing surfaces. All such surfaces are designed for operation on a lubricant of selected qualities and are enclosed, sealed or otherwise fitted to retain a supply of that lubricant for a reasonable length of time.

Lack of lubricant permits these surfaces to wear rapidly and consume useful power. The lubricant shortage may also insulate certain parts from the intended method of cooling, which is thru the lubricant itself. Excess lubricant may expand and force seals intended to retain it, whereupon all the lubricant can escape. In many cases, the excess must be churned around, thereby consuming energy and transforming it into enough heat to cause damage.

The wrong lubricant cannot be retained as intended and may cause damage because it does not have the qualities desired.

Even tho the various parts requiring lubrication are designed so that constant attention will not be necessary, such design is based on "normal" service. Army vehicles are not in "normal" service. It is therefore necessary that frequent attention be given to lubricated points.

The engine is subjected to more extensive damage than other parts, in the event of even a short interruption in the lubricant supply. The crankcase oil level must therefore be checked at halts and before and after every operation, and maintained at the proper level.

Present oils dissolve much of the dirt ordinarily deposited in engines, and hold it in suspension without impairing the lubricating value of the oil. This ability to hold impurities is limited, and as soon as the capacity is reached, the impurities will be collected from some surfaces and deposited in small passageways. It is therefore necessary to change oil at the time the capacity is reached.

Oil filters, on engines so equipped, will collect this dirt. At about the same time, other small oil passages in the engine are in danger of becoming clogged. Oil filters must be checked weekly and if there are heavy deposits the oil must be changed. If in any operation, deposits are found every week, the inspection must be made more frequently.

Enclosed gear housings are lubricated with a universal gear lubricant which is susceptible to deterioration. They must be drained and new oil added before the deterioration impairs the lubricating value of the old oil. Gear lubricant must be inspected whenever the chassis is lubricated and changed if there is any noticeable difference in consistency or feel from new lubricant. The change period should not exceed 6,000 miles in any service, and if the gear case operates at a temperature higher than comfortable for the hand, the period should be shortened. If the vehicle is used in low gear for an appreciable part of the time, or is operated at sustained high speeds, it is also necessary to shorten the period.

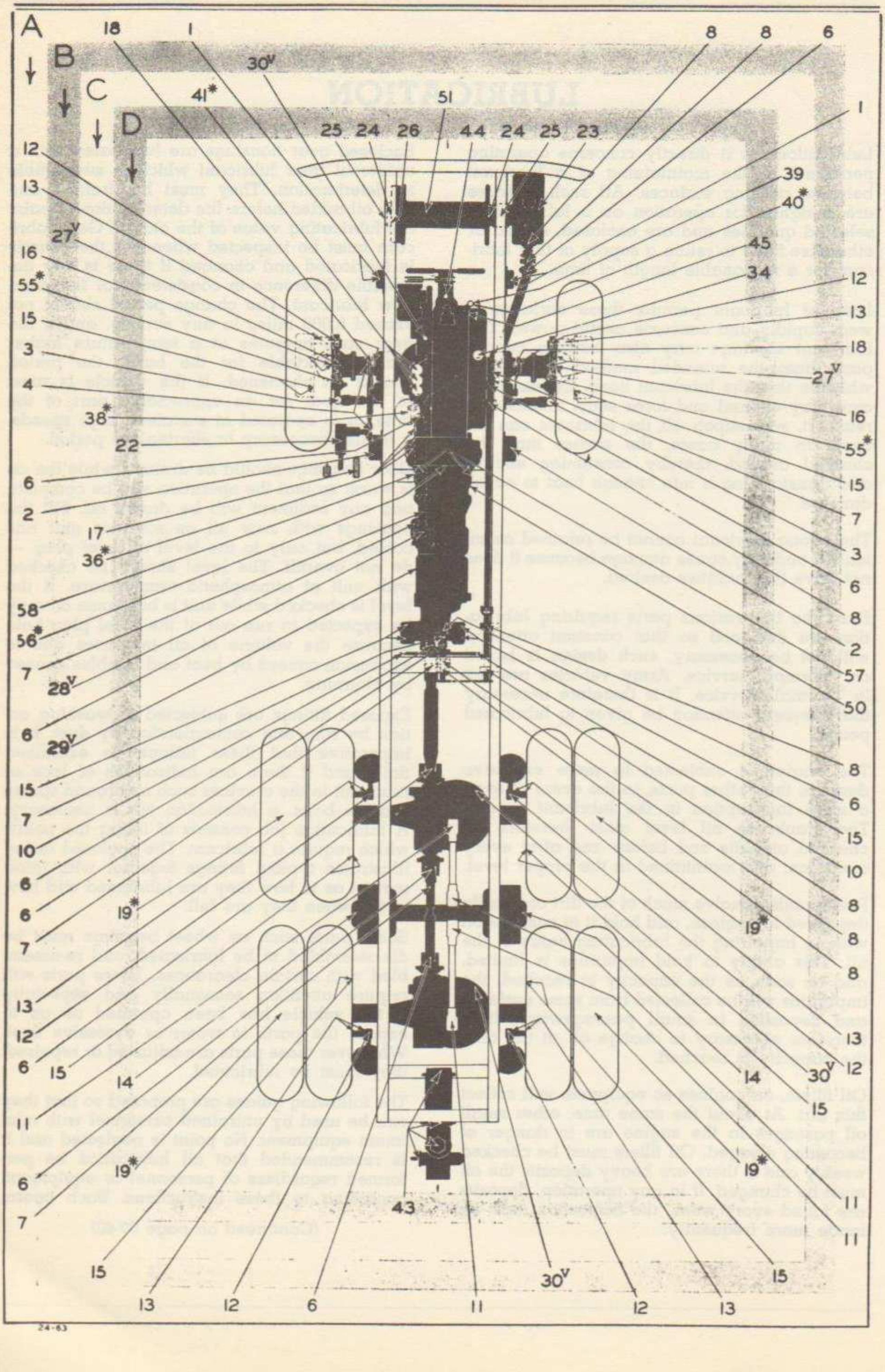
Gear housings should be drained while the oil is warm so that the operation will be complete and any sediment will be drawn off. Fill the housings with new oil as soon as unit has cooled, but only to the level of level plug — do not overfill. The level should be checked with unit at atmospheric temperature. If the level is checked while unit is hot, some oil may be expected to run out of the level plug hole because the volume of oil increases due to expansion caused by heat and bubbles caused by churning.

Exposed fittings are subjected to washing action by rain and contamination by dust. It is imperative that these fittings be examined daily and if there are indications of lack of lubricant in the crevices such as around spring shackle bolts, a lubrication job is necessary. A lubrication job consists of filling the points which require a lubricant. The enclosed listing illustrates typical fittings together with information as to how they are lubricated and how to tell when they are full.

Some parts such as wheel bearings must be dis-assembled to be lubricated, and re-assembled with certain clearances. These parts will require attention seasonally and especially if the vehicle has been operated so as to expose the parts to water or excessive dust. Whenever these parts are adjusted or repaired, they must be lubricated.

The following guides are prepared so that they can be used by untrained personnel with minimum equipment. No point is neglected and it is recommended that all lubrication be performed regardless of personnel or equipment, according to these instructions. Such opera-

(Continued on page 00-40)


A
B
C
D
18
1
30V
41*
51
25
24
26
44
24
25
23
8
8
6
1
39
40*
45
34
12
13
18
27V
16
55*
15
7
3
6
8
2
57
50
8
6
15
10
8
19*
8
8
13
30V
12
15
14
19*
11
11
12
13
27V
16
55*
15
3
4
38*
22
6
2
17
36*
58
56*
7
28V
6
29V
15
7
10
6
6
19*
7
13
12
6
15
14
11
19*
6
7
43
15
13
12
6
11
30V
12
13
15

24-63

LUBRICATION CHART

7½-ton 6x6 Chassis with Winch

Air Brakes

Daily	250 Miles or Weekly	1000 Miles or Monthly	6000 Miles or Semi-annually	
		1		Spring Shackle
		2		Spring Eye Bolt
		3		Tie Rod End
		4		Drag Link
		6		Universal Joint Needle Bearings
		7		Universal Slip Joint
		8		Propeller Shaft Center Bearing
		10		Lever Shaft
		11		Radius Rod
			12	Slack Adjuster
		13		Brake Camshaft
		14		Rear Spring Bearing
		15		Brake Anchor Pins
		16		King Pin Bearings
		17		Brake Application Valve
		18		Shock Absorber Link
			19	Wheel Bearings
		22		Steering Gear Housing
		23		Winch Worm Housing
		24		Winch Drum Bearings
		25		Winch Shaft
	26			Winch Clutch
		27		Bevel Gear Housing—Front Axle End
		28		Transmission
		29		Transfer Case
		30		Axle Housing
	34			Distributor
			36	Starting Motor
38				Air Cleaner
39				Crankcase
	40			Crankcase Breather
41				Oil Filter (Primary "A")
		41		Oil Filters (Secondary "B")
		43		Pintle Hook
		44		Fan Hub
		45		Engine Mounting Trunnion
		50		Clutch Release Bearing
	51			Winch Cable
			55	Upper Bevel Gear Bearing
			56	Clutch Pilot Bearing
		57		Clutch Release Shaft
		58		Clutch Pedal Cam Roller

Make: MACK

Models: NO.-2, 3 & 6

Tools

Cleaning Rag.
Screw Driver.
Open-end Wrenches.
Adjustable Wrench.
Wheel Bearing Adjusting Nut Wrench.
Hand Operated Grease Gun.

Instructions

Clean and lubricate all points in the order indicated, except those which require dis-assembly.

Clean all vents.

Check and adjust level in housings.

Dis-assemble as separately instructed.

Drain as separately instructed.

* Requires Dis-assembly, except item 41 (Primary "A" filter only)

V Indicates Vent

Frames

Frame	Lubricant to Use	Working from
A	Item 55: Wh. Brg.Grease Others: Chassis-Grease	Below Vehicle
B	Item 15: Engine Oil Others: Gear Oil	Below Vehicle
C	Engine Oil	Above Vehicle
D	Item 19: Wh. Brg. Grease Items 14, 22, 23: Gear Oil Item 43 draw bar pins: Engine Oil Others: Chassis-Grease	Above Vehicle

Lubricants

Predominating Temperature °F.	Above 90°	Between 90° & 32°	Between 32° & 0°	Below 0°
Chassis-grease	2 or 1	1	1 or 0	0
Gear Oil	90	90	80	80
Engine Oil	50	30	10	10*
Wheel Bearing Grease	3 or 2	2	2	2

* Refer to O.F.S.B. No. 6-11

tions as require tools or equipment not provided, are to be omitted by untrained personnel. These guides show the approximate location of the lubricant fitting which is identified by a number according to a uniform designation reproduced herewith. The instructions will apply to all vehicles unless specially noted in the guide.

It is recommended that lubricants be applied starting with the fitting indicated at the top left corner of the outer frame (A) on the chart, and continuing around the vehicle toward the rear. Then proceed with the remaining frames (B, C and D) in the same order.

The fittings noted in the outer frame are lubricated from BELOW with chassis-grease applied from a pressure gun, and require that the vehicle be on a lift or lubricated by a man lying or crouching on the ground. It is not necessary for the man to interrupt the order, to change lubricant or dispenser or crawl out from under the vehicle except as necessary to pass the axles. The necessary tools are a screw driver, open-end wrenches, adjustable wrench, wheel bearing adjusting nut wrench and a hand-operated grease gun. A rag is necessary for cleaning.

The fittings noted in the second frame (B) are lubricated from BELOW with other than chassis-grease. It will be convenient to change the lubricant as necessary without interrupting the order indicated. Tools will be necessary for removing the drain and filler plugs and vents. A pressure gun containing gear oil and an oil can are also necessary. Changing the lubricant in the gear housings is considered a separate operation and responsibility. A gear lubricant dispenser is essential.

The third frame (C) notes fittings lubricated from ABOVE with engine oil, when the vehicle is on the ground. Tools are required for the air cleaner and oil filter. Since the crankcase oil may be changed at times other than those at which other points are lubricated, the oil change is considered a separate operation and responsibility.

The fourth frame (D) indicates fittings lubricated from ABOVE with other than engine oil, when the vehicle is on the ground. A wrench is required for the steering gear housing plug. Wheel bearings and spring seat bearings requiring dis-assembly, will be lubricated separately.

Shock absorbers and batteries are omitted from these guides. In the event of any deficiency in shock absorber action or brake action a mechanical check should be made.

Battery water level should be checked at least weekly and necessary action taken. The lubricator will examine the battery and report if connections are corroded, or case cracked, chafed or loose in box. He will not make repairs.

The lubricator has the opportunity to examine parts of the vehicle which are relatively inaccessible. Any leaks of water, oil, grease or fuel, excessive rusting of chassis parts, broken, bent, or damaged bolts, rivets, brackets or other members will be apparent. Any such deficiencies will be reported. All caked mud, brush, etc. should be removed and all fittings wiped clean before and after applying the lubricant. The area around vents and seals should be wiped clean. Excess lubricant performs no beneficial function but collects dust and dirt.

Vents are provided on most closed gear housings to relieve the pressure due to expansion of the lubricant. Vents are indicated on the chart with a "v" next to the number. These are to be cleaned as part of the lubrication operation.

These instructions are particularly written so that no part will suffer from over-lubrication regardless of how frequently it is lubricated. It is therefore recommended that examination be made as frequently as practicable, particularly if the vehicle is exposed to dirt or water and the part lubricated if there is any indication of necessity.

Summary

CRANKCASE OIL: Check daily.

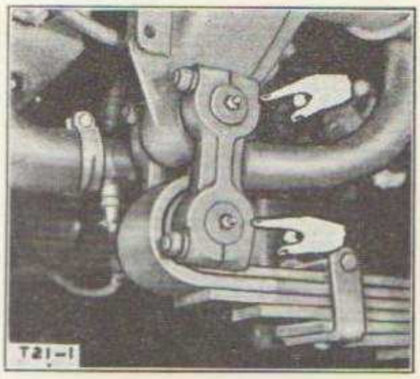
EXAMINE OIL FILTER WEEKLY: Change per indications not to exceed 1,000 miles or monthly.

GEAR HOUSING: Check daily. Change per indication not to exceed 6,000 miles or semi-annually.

WHEEL BEARINGS: Clean out and repack only ½ full seasonally, or whenever brakes are adjusted, or after operations in water or excess dust. Adjust bearings.

CHASSIS: Check daily. Lubricate per indications not to exceed 1,000 miles or monthly.

Lubricating Points



1. Spring Shackle.

2 Places.

Pressure Gun.

Chassis-grease.

Until grease shows on both sides.

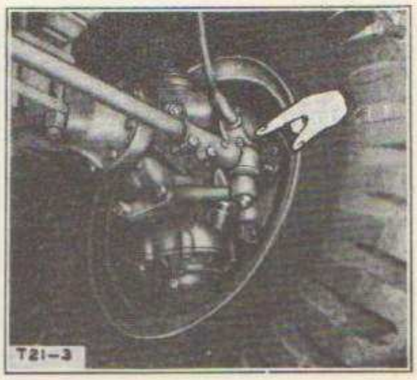
2. Spring Eye Bolt.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease shows on both sides of eye.



3. Tie Rod End.

1 Place

Pressure Gun.

Chassis-grease.

Until grease comes out of joint.

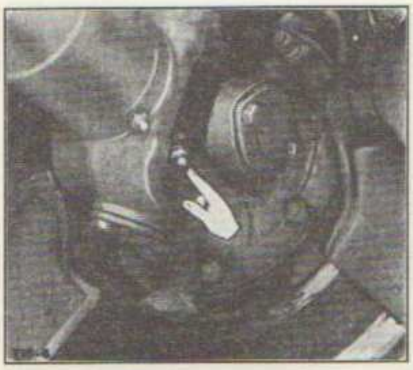
4. Drag Link.

2 Places

Pressure Gun.

Chassis-grease.

Until grease comes out of connections.



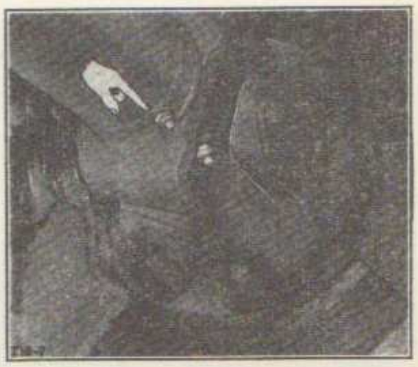
6. Universal Joint. Needle Bearings.

1 Place

Pressure Gun.

Chassis-grease.

Until grease shows at relief valve in center of cross.



7. Universal Slip Joint.

1 Place

Pressure Gun.

Chassis-grease.

Until grease shows at relief opening.

Lubricating Points

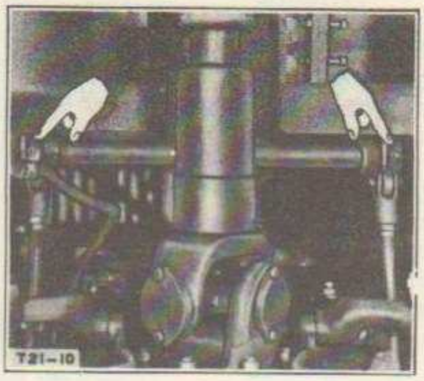
8. Propellor Shaft. Center Bearing.

1 Place

Pressure Gun.

Chassis-grease.

Add grease until pressure builds up.



10. Lever Shaft.

2 Places.

Pressure Gun.

Chassis-grease.

Until grease comes out between brackets and levers.

11. Radius Rod, Axle End.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease comes out of connection.

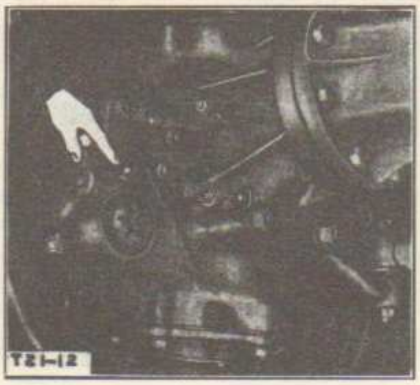
11. Radius Rod, Cross-member End.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease comes out of connection.



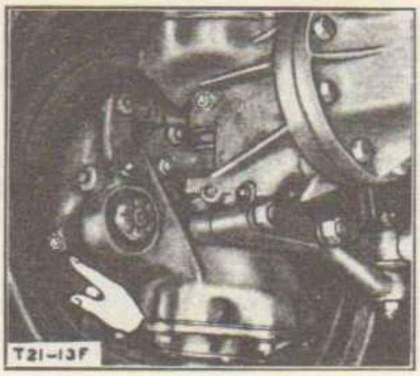
12. Slack Adjuster.

1 Place

Pressure Gun.

Chassis-grease.

Install fitting and add grease until pressure builds up. Replace plug.



13. Brake Camshaft, Front.

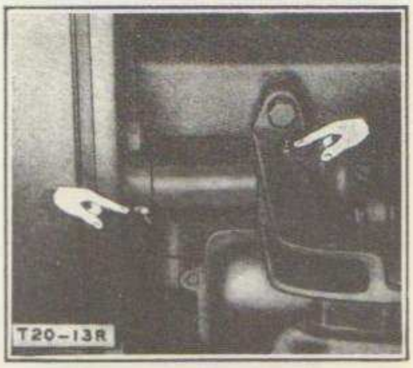
1 Place

Hand grease Gun.

Chassis-grease.

Until pressure increase is felt. Do not over-lubricate.

Lubricating Points



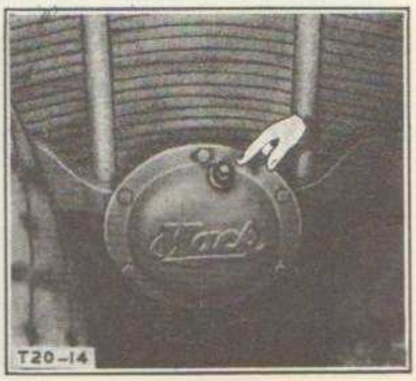
13. Brake Camshaft Rear.

2 Places

Hand grease Gun.

Chassis-grease.

Until pressure increase is felt.
Do not over-lubricate.

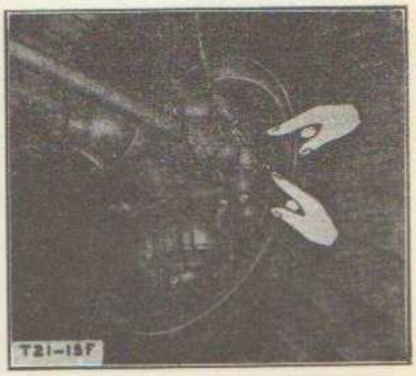


14. Rear Spring Bearing.

1 Place.

Gear Oil

Add oil to level of filler plug.



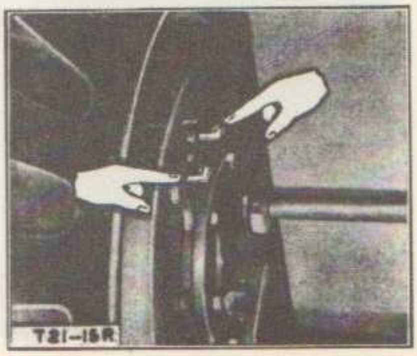
15. Brake Anchor Pins, Front.

2 Places.

Hand grease gun.

Chassis-grease.

Until pressure increase is felt.
Do not over-lubricate.

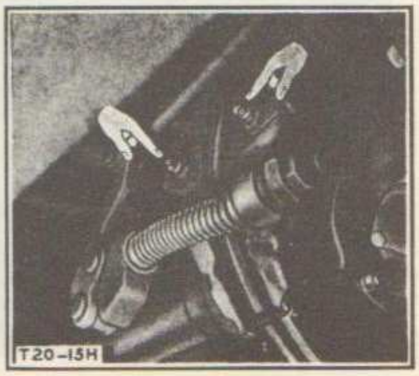


15. Brake Anchor Pins, Rear.

2 Places

Engine Oil.

Add 4 or 5 drops to each cup.



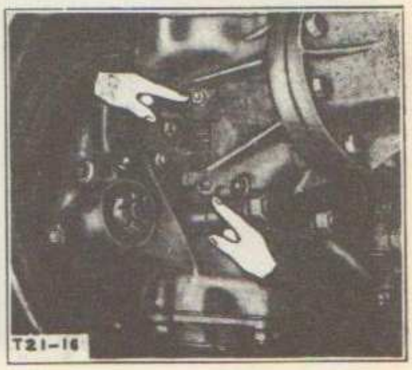
15. Brake Anchor Pins, Hand Brake.

2 Places.

Hand grease gun.

Chassis-grease.

Until pressure increase is felt.
Do not over-lubricate.



16. King Pin Bearings.

2 Places.

Hand grease gun.

Chassis-grease.

Until pressure increase is felt.
Do not over-lubricate.

Note: Grease fittings are on front at right hand side, and on rear at left hand side.

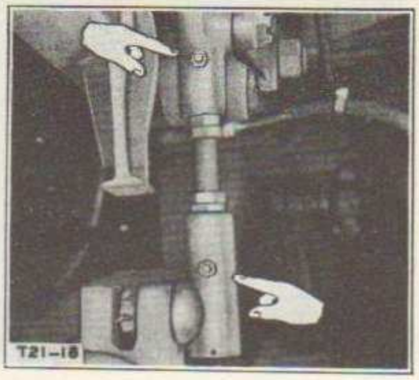
Lubricating Points

17. Brake Application Valve.

1 Place

Engine Oil.

Add 4 or 5 drops of #10 S.A.E. oil.



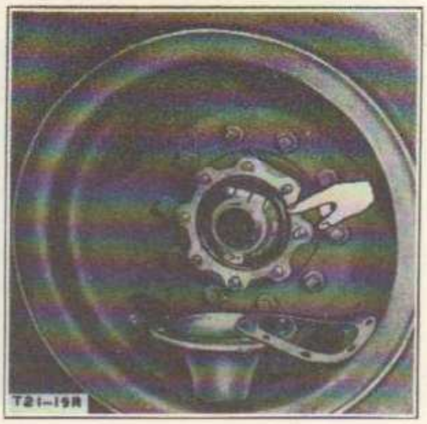
18. Shock Absorber Link.

2 Places

Pressure Gun.

Chassis-grease.

Until grease comes out of connections.

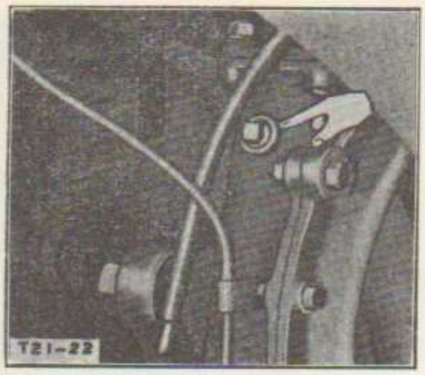


19. Wheel Bearings, Rear.

1 Place

Wheel bearing grease.

Remove wheel, clean and repack bearing ½ full only.

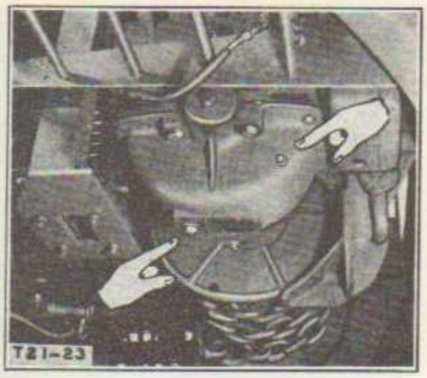


22. Steering Gear Housing.

1 Place

Gear Oil.

Add oil to level of filler plug.
Capacity is 8 pints.

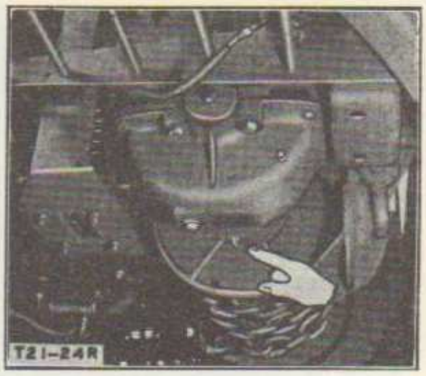


23. Winch Worm Housing.

1 Place.

Gear Oil.

Add oil at top to level of plug on side.
Drain and refill every six months.
Capacity is 8½ pints.



24. Winch Drum Bearing, R. H.

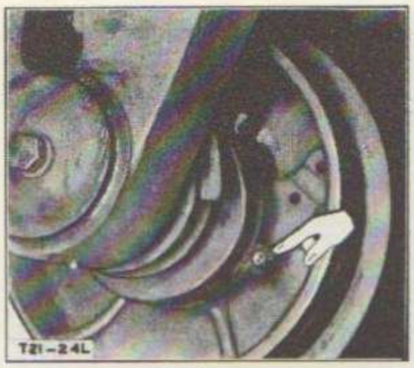
1 Place.

Pressure gun.

Chassis-grease.

Until grease shows at end of drum.

Lubricating Points



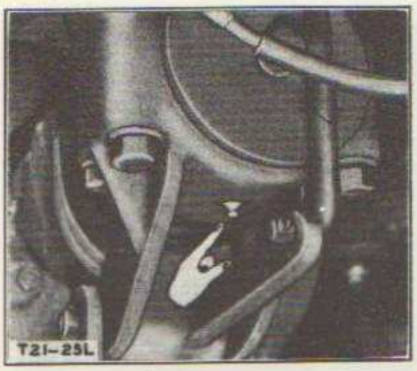
24. Winch Drum Bearing, L. H.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease shows at end of drum.



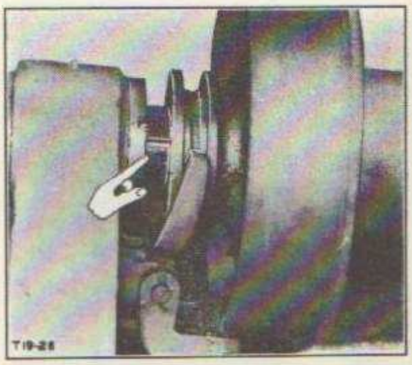
25. Winch Shaft, L. H.

1 Place.

Pressure Gun.

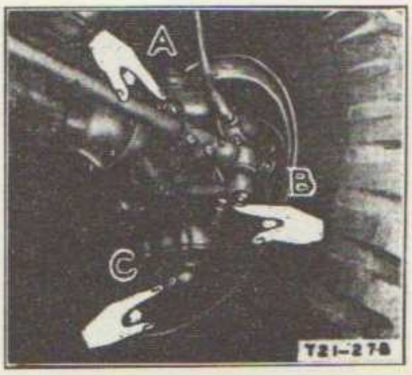
Chassis-grease.

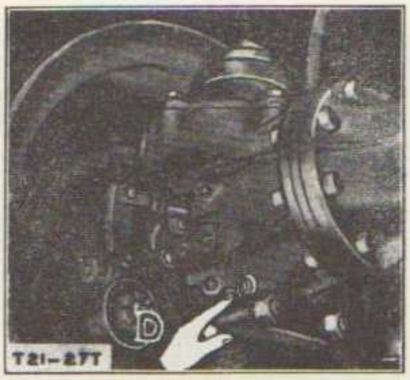
Until grease shows at side of bearinq. Note—R.H. end of shaft automatically receives lubricant from Drum Bearinq fitting 24.



26. Winch Clutch.

If clutch sticks on shaft, clean shaft with Kerosene and re-oil with SAE 10 enqine oil.





27. Front Axle End Bevel Gear Housing

2 Places.

Gear Oil.

Add oil to level of upper (A) and lower (B) fillers. Drain at points (C) and (D) and refill semi-annually, or sooner, depending on operation. Clean two breathers at top of qear housings on wheel side. Capacity of upper case is 2 pints and of lower case 3 pints.

Note: Plug (A) is on front at left hand side and on rear at right hand side. Plug (D) is on front at right hand side and on rear at left hand side.

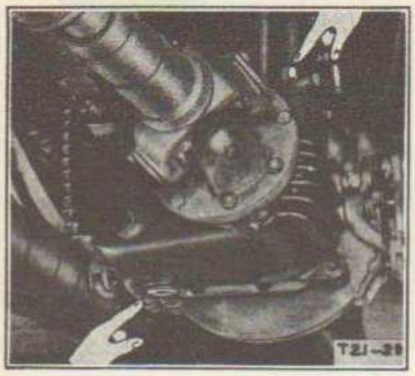
28. Transmission

1 Place.

Gear Oil.

Check oil level. If low, add oil to level of filler pluq on side. Clean vent. Drain and refill semi-annually. Capacity is 28 pints.

Lubricating Points

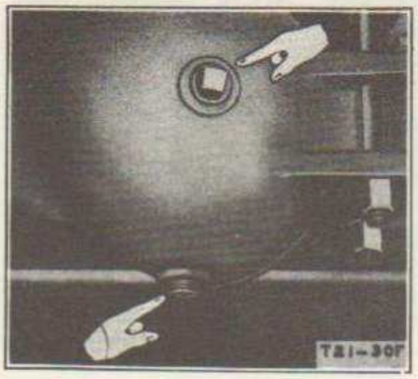


29. Transfer Case.

1 Place.

Gear Oil.

Check oil level. If low, add oil to level of filler plug on side. Clean vent. Drain at bottom plug. Refill semi-annually. Capacity is 30 pints.

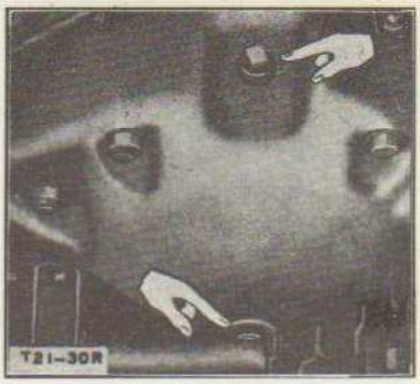


30. Axle Housing, Front.

1 Place.

Gear Oil.

Check oil level. If low, add oil to level of filler plug on side. Clean vent. Drain at bottom plug. Refill semi-annually. Capacity is 15 pints.

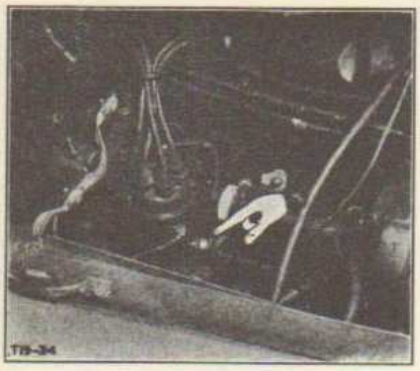


30. Axle Housing, Rear.

1 Place.

Gear Oil.

Check oil level. If low, add oil to level of filler plug on side. Clean vent. Drain at bottom plug. Refill semi-annually. Capacity is 22½ pints each.

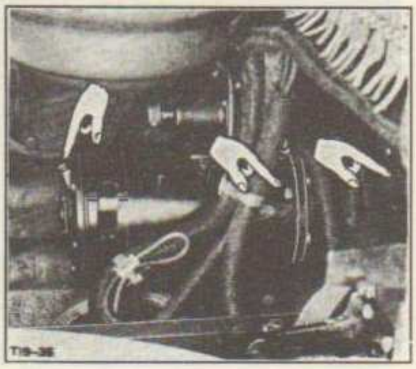


34. Distributor.

1 Place.

Chassis-grease.

Screw grease cap down one turn. Every six months remove rotor and add a few drops of oil to wick, and lightly grease breaker cam. Add drop of oil to pivot pin.



36. Starting Motor.

3 Places.

Engine Oil.

Add 4 or 5 drops light engine oil to each cup. Remove starting motor to oil inner cup.

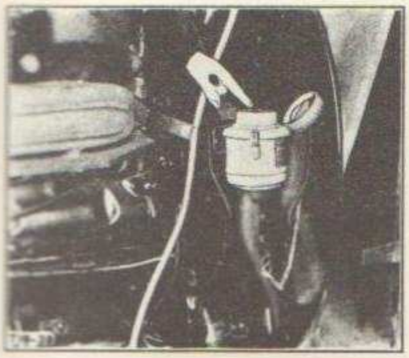
38. Engine Air Cleaner

1 Place.

Engine Oil.

Dis-assemble and follow instructions on cleaner.

Lubricating Points



39. Crankcase.

1 Place.

Engine Oil.

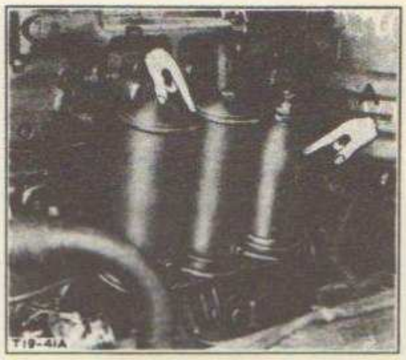
Check level daily. If low, add oil to high level mark on dipstick. Drain and refill every 1000 miles. Wait 15 minutes to allow oil to drain down before refilling. Capacity of crankcase is 19 quarts.

40. Crankcase Breather.

1 Place.

Engine Oil.

Disassemble, remove oil and refill to level of bead. Wash element in kerosene, dip in oil, drain surplus and replace.



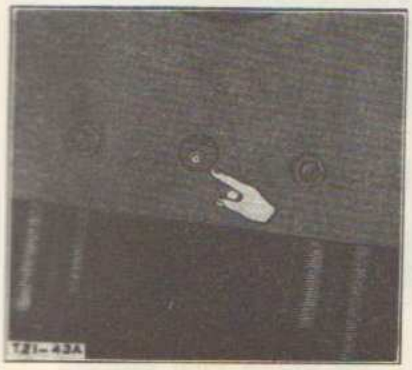
41. Oil Filters.

Primary "A" Filter

Daily—Stop engine and turn cleaning handle in clockwise direction until it stops. Then turn handle back to starting position. Repeat this operation four times. Every 1000 miles or monthly—Drain by removing plug. Replace plug and add extra quart of oil to engine before starting.

Secondary "B" Filters

When oil on dipstick becomes dark, remove cover, remove plug to drain sludge, and reinstall plug. Remove element and install new military standard element. Install new cover gasket and reinstall cover. Start engine and check for leaks.



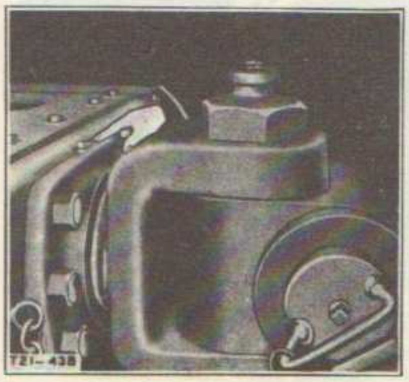
43. Pintle Hook Collar, Front.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease appears beside collar or pressure increase is felt.



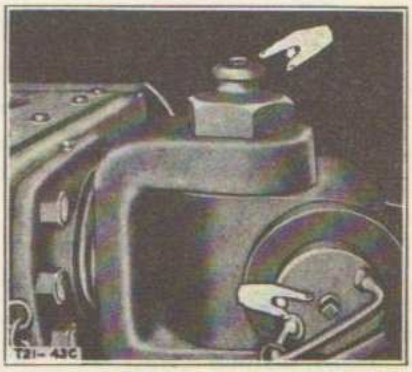
43. Pintle Hook Collar, Rear.

1 Place.

Pressure Gun.

Chassis-grease.

Until grease appears beside collar or pressure increase is felt.



43. Draw Bar Pins.

2 Places.

Engine Oil.

Remove plugs from ends of pins and saturate wicks with engine oil.

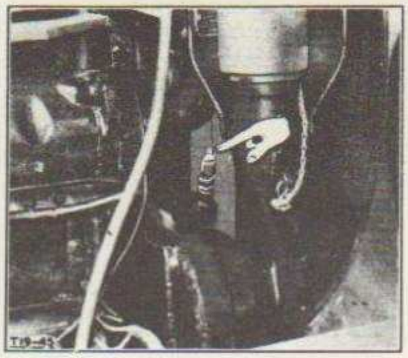
Lubricating Points

44. Fan Hub.

1 Place.

Chassis-grease.

Screw cap of grease cup down one turn.



45. Engine-Mounting Trunnion.

1 Place.

Pressure Gun.

Chassis-grease.

Add grease until pressure is felt or grease comes out at side of trunnion.

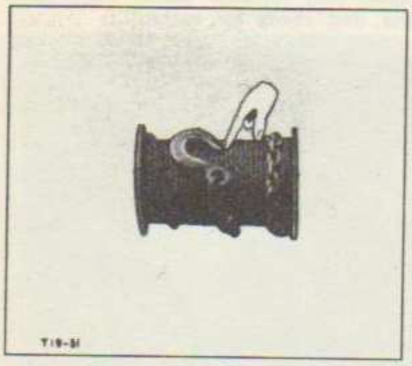
50. Clutch-Release Bearing.

1 Place.

Hand grease gun.

Chassis-grease.

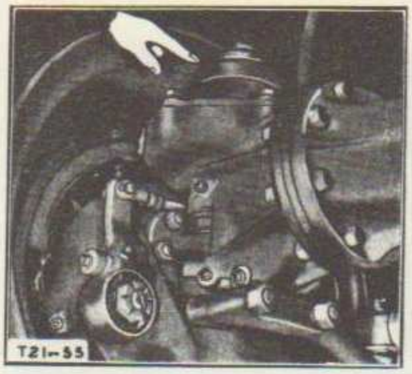
Remove plug, and add grease until pressure is felt in the gun. Do not over-lubricate. Replace plug.



51. Winch Cable.

Used crankcase oil.

Pour oil on cable weekly or after each exposure to water. Wipe off excess. Each month unreel, inspect, clean and reoil entire cable by wiping with oily rag. This is also to be done after cable is exposed to mud.

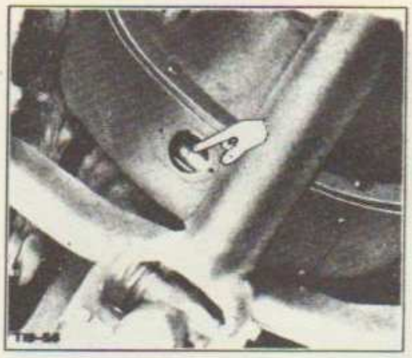


55. Front Axle Ends.
Upper Bevel Gear Bearing

1 Place.

Wheel Bearing Grease.

Remove cap. Clean bearing and cavity. Pack bearing and fill cavity to "top of bearing" level. Do not fill entire bearing cavity.



56. Clutch Pilot Bearing.

1 Place.

Hand grease gun.

Chassis-grease.

Remove cover plate from flywheel housing. Crank engine until plug in flywheel is accessible. Install fitting and add grease until pressure is felt. Replace plug and cover.

Lubricating Points

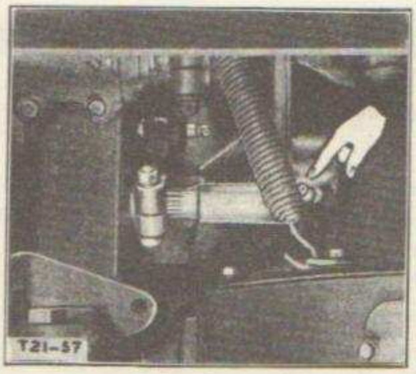
57. Clutch Release Shaft, R.H.

1 Place.

Hand grease gun.

Chassis-grease.

Until increased pressure is felt in gun.



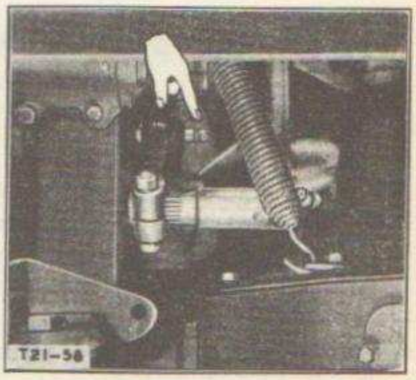
57. Clutch Release Shaft, L.H.

1 Place.

Hand grease gun.

Chassis-grease.

Until increased pressure is felt in gun.



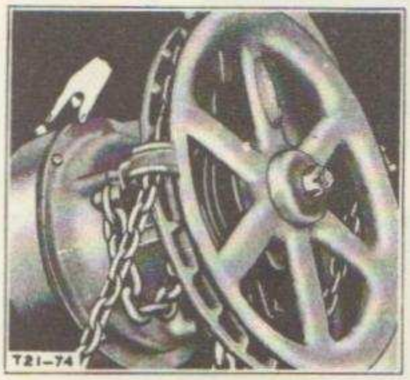
58. Clutch Pedal Cam Roller.

1 Place.

Pressure Gun.

Chassis-grease.

Until increased pressure stops flow of grease, or forces it to leak out side of roller.



74. Chain Hoist

1 Place.

Gear Oil

Drain and add ½ pint new oil every six months.

Note: Hoist in body not shown on Lubrication Chart.

Special Lubrication

At 1000 Miles

Apply several drops of engine oil to all clevises.

Oil all door hinges, hood hinges, hood locks and door catches

Oil Power-take-off and Transfer Case range shifter levers and Front Axle shifter lever beneath cab.

Semi-annually

Remove chain from winch drive semi-annually or sooner depending upon operation. Clean chain and sprockets with kerosene. Dip chain in engine oil. Allow excess oil to drain before replacing on sprockets.

Add shock absorber fluid to the level of the filler plug.

Pre-lubricated Parts

Clutch pedal is lubricated only at assembly by painting grease on the bushing and pin. If it has been dis-assembled for other reasons, it can be re-lubricated in this same way.

GROUP 01: ENGINE

Note: In the following text, the Timing Gear End of Engine is referred to as "Front", the Flywheel End as "Rear". Cylinder No. 1 is at the front end.

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

(See exterior and sectional views of engine on pages immediately following.)

The Mack Thermodyne (heavy duty, high output) engine is of six cylinder, four cycle, overhead valve design.

Cylinder Block

All six cylinders are cast in line and in one block which is integral with the upper half of the deep section, stiff crankcase. This casting is of special alloy cast iron, heat treated in electric continuous furnaces to fully relieve shrinkage and machining stresses.

Particular emphasis upon long life and reliability of the bearings has been placed thruout the entire engine design. Starting with the extremely rigid one piece cylinder block and crankcase with its amply-ribbed bulkheads, its deep lower section and a thick reinforcing rib along the side at crankshaft height, the firm mounting of the main and camshaft bearings is assured. Full length water jackets contribute further to the rigidity of the block and to efficient cooling.

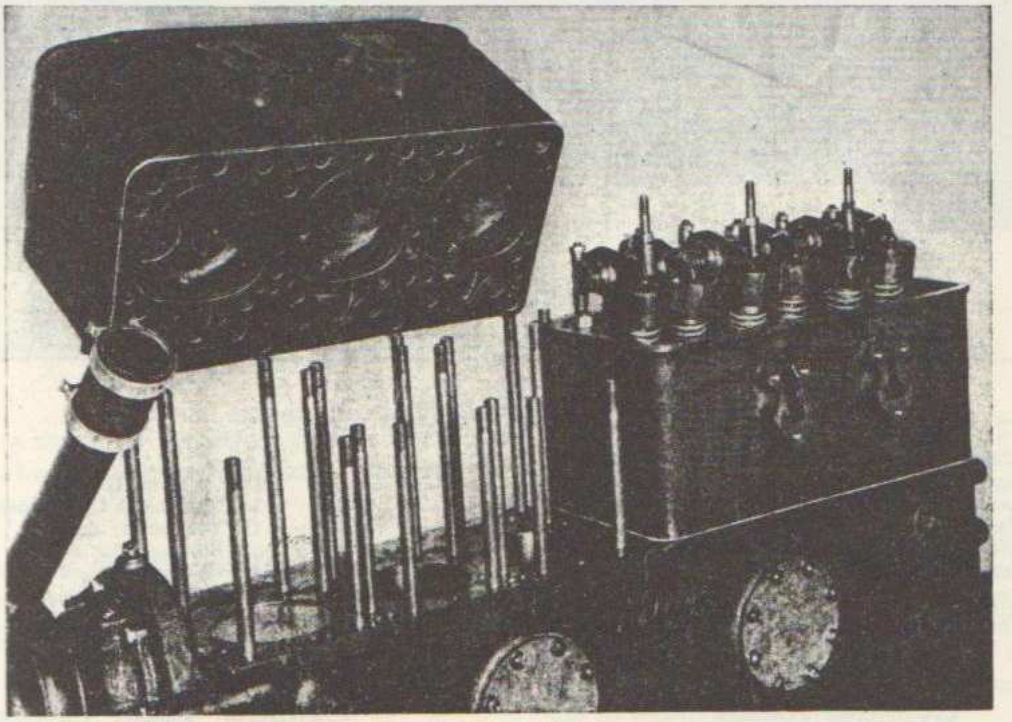


Fig. 1—View of Cylinder Heads and Valve Mechanism

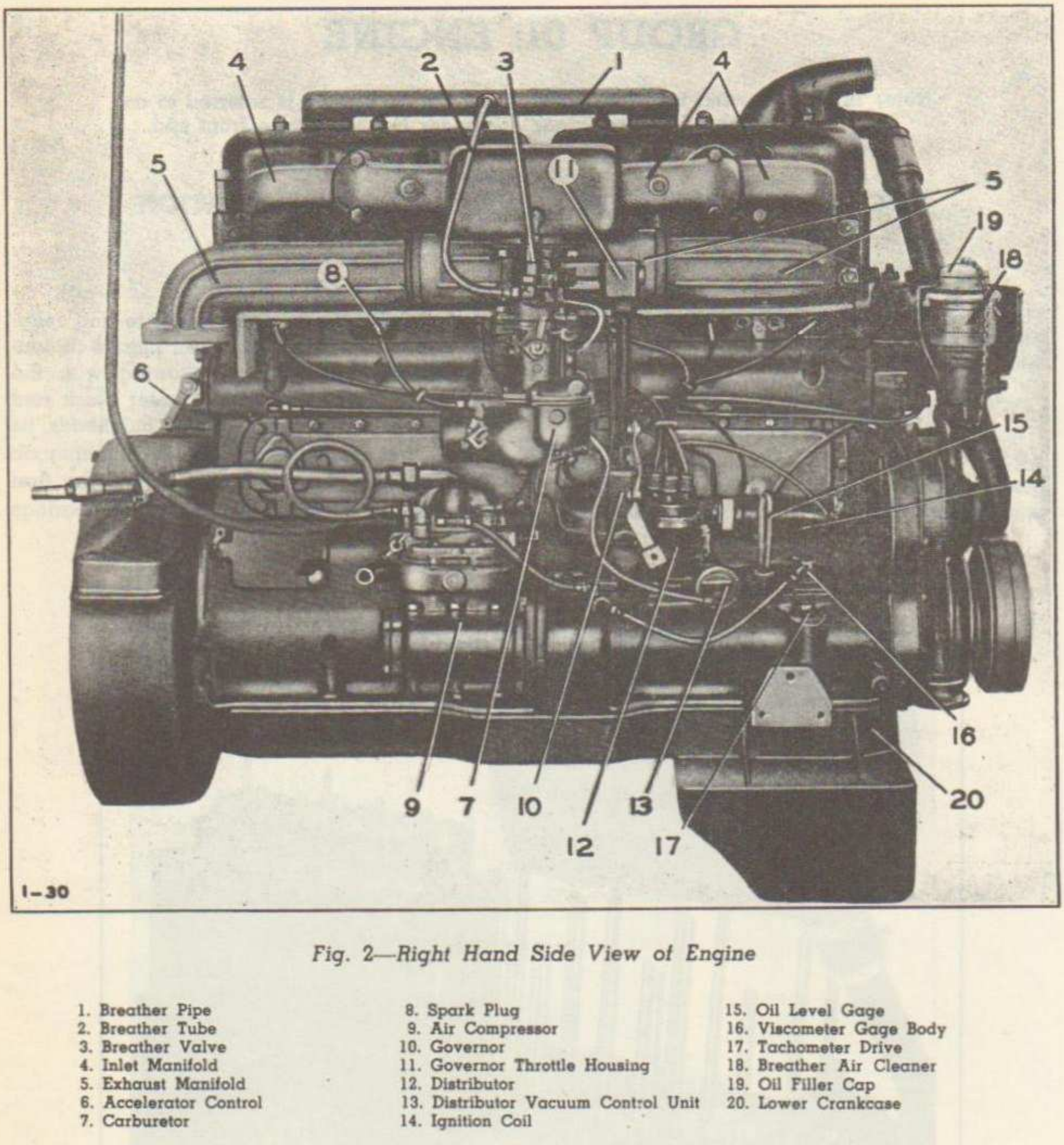


Fig. 2—Right Hand Side View of Engine

1. Breather Pipe
2. Breather Tube
3. Breather Valve
4. Inlet Manifold
5. Exhaust Manifold
6. Accelerator Control
7. Carburetor
8. Spark Plug
9. Air Compressor
10. Governor
11. Governor Throttle Housing
12. Distributor
13. Distributor Vacuum Control Unit
14. Ignition Coil
15. Oil Level Gage
16. Viscometer Gage Body
17. Tachometer Drive
18. Breather Air Cleaner
19. Oil Filler Cap
20. Lower Crankcase

Cylinder Heads

The cylinder heads are of special alloy cast iron, heat treated, in two interchangeable blocks and each block is held down by twenty large studs. These studs are installed finger tight in the cylinder block and the stud nuts tightened as instructed in "Section 5: Repairs." This enables service to take out the studs and remove the heads to the side.

Cylinder Head Gaskets

Cylinder head gaskets are made of layers of sheet steel and sheet asbestos. All water holes and cylinder bore holes are edged with sheet copper grommets; and gasket durability is favored by the arrangement of the studs and water parts about the cylinder bores in that it affords liberal gasket areas around all openings.

Crankshaft

The crankshaft is of heavy drop forged, case hardened steel, having a glass-hard outer surface with a soft tough core. It is fully counterweighted by twelve integral weights, and balanced both statically and dynamically.

Crankpins are bored out to reduce weight and centrifugal force on the bearings and further, to aid in cooling the pins.

Crankshaft Thrust Washers

The crankshaft thrust is taken at the center main bearing, separate thrust washers being used at each side of the bearing.

Crankshaft Oil Seal

There is a seal of the slinger type at the crankshaft rear bearing, about the shaft flange

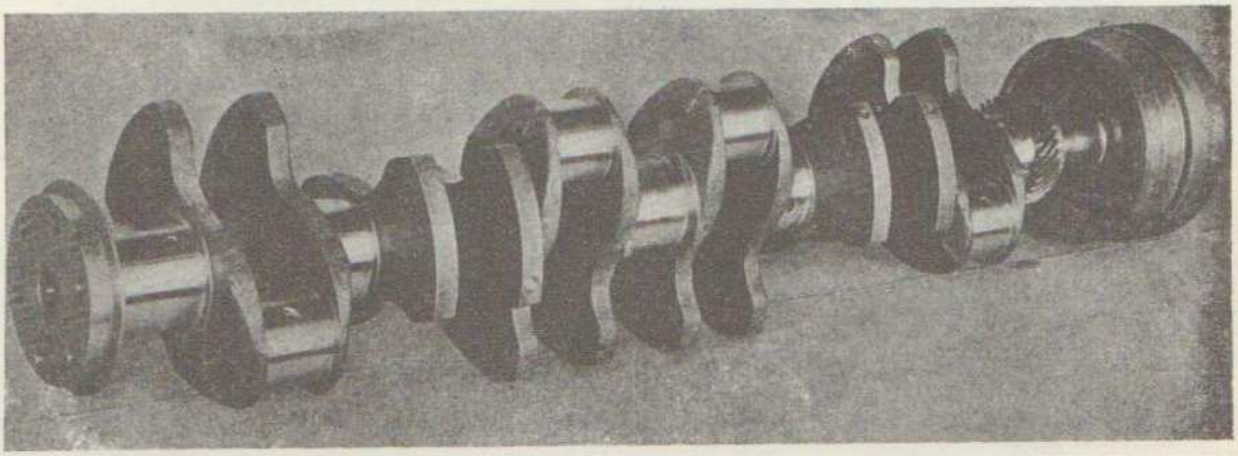


Fig. 3—View of Crankshaft, Showing Hollow Crankpins, Integral Counterweights and Vibration Damper

to which the flywheel is bolted. The slinger housing matches the sectional contour of the flange periphery with its integral slinger and is assembled free, but with little more than running clearance about the flange. No composition packing is employed; but the slinger housing carries a lead sealing ring. This arrangement has proved to be entirely effective in preventing oil from the bearing from entering the clutch bell housing and from fouling the flywheel and clutch.

The shaft is mounted by seven precision-type bearings of large size, providing ample bearing surfaces.

The flywheel is attached to the rear end of the crankshaft by six large-size, closely-fitted bolts of special steel.

Crankshaft Main Bearings

Seven large, steel-backed, copper-lead lined bearings of the thin-shell, renewable, precision type are used. The upper and lower halves differ, but cannot be assembled incorrectly due to the notching.

Flywheel

The flywheel is of special cast iron and of ample weight to maintain an even cycle which tends towards a smooth running engine.

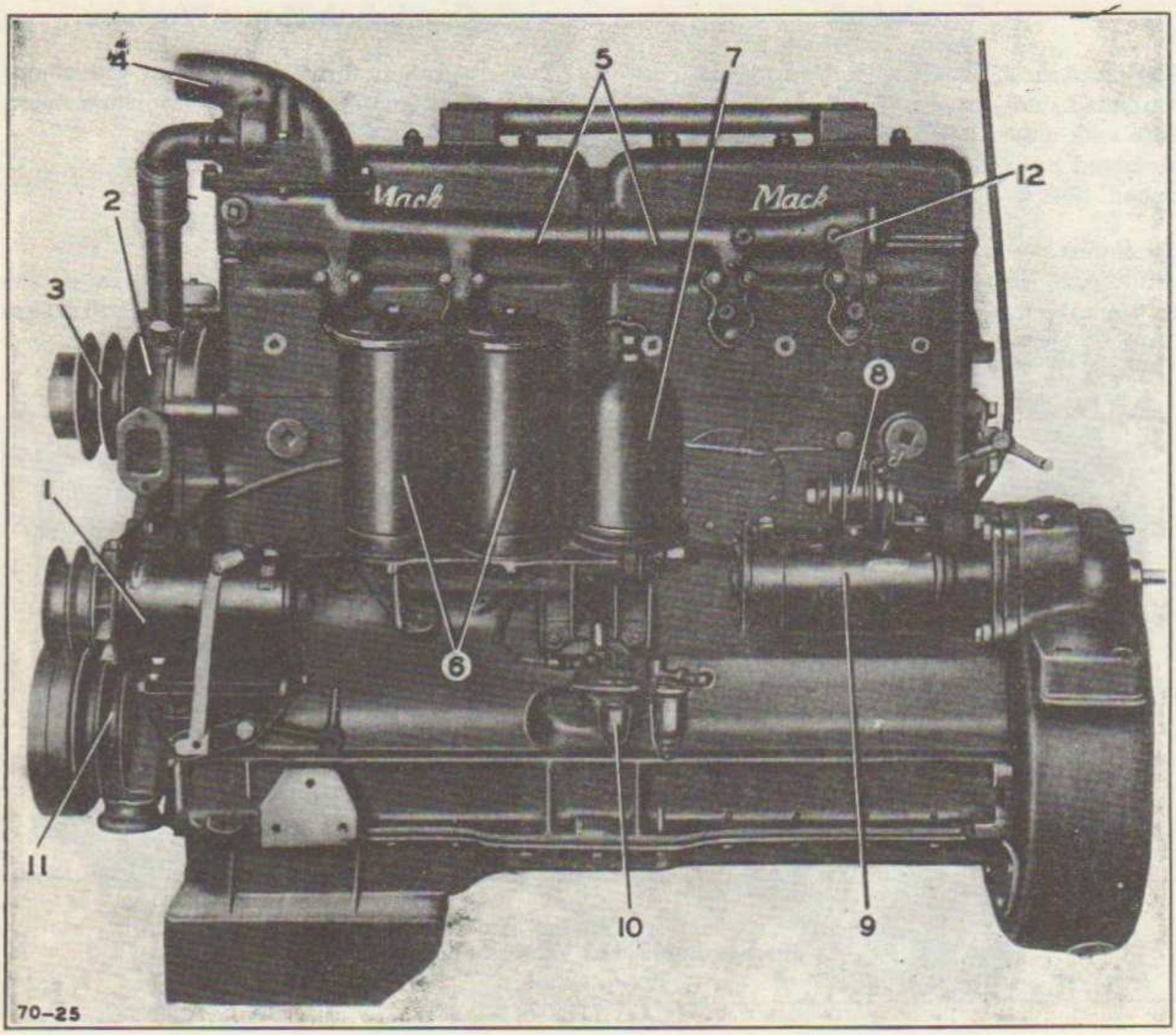


Fig. 4—Left Hand Side View of Engine

1. Generator
2. Water Pump
3. Fan Driven Pulley
4. Water Outlet
5. Water Outlet Manifold
6. Secondary Oil Filter
7. Primary Oil Filter
8. Starter Magnetic Switch
9. Starting Motor
10. Fuel Pump
11. Fan Driving Pulley
12. Air Cleaner Bracket Screw Holes

Vibration Damper

A torsional vibration damper is incorporated with a double fan belt pulley at the front end of the crankshaft. This arrests the high frequency vibrations emanating from the engine.

Connecting Rod

The connecting rod and cap are of drop-forged, chrome-molybdenum steel, heat treated. Rod is of I-beam section. It is long, and is machined with such precision as to secure perfect weight balance and uniform weight distribution. Connecting rods do not vary more than ¼ of an ounce in weight insuring a smooth running engine, free from vibration.

The large or cap end of the rod is parted at an angle, to permit withdrawal of piston and rod upward thru the cylinder bore, without disturbing the crankshaft and to permit increased crankpin diameter and stiffened support for the rod bearings.

To insure an accurate and firm joint, the rod and cap have a tongue and groove at the parting line.

Connecting Rod Bearing

The connecting rod bearing is similar to the main bearings, being of the same material and of the thin-shell, renewable, precision type.

Piston

The piston is long, of the T-slot, cam-ground form, cast of aluminum alloy, which material reduces reciprocating weight and promotes rapid cooling. The slot does not extend to the end of the piston; also a large thrust surface area is provided on this piston.

Scientific design of sections and distribution of metal results in ample strength and efficient heat conductivity.

Piston pin bores in all engines are grooved for snap rings; and thus provision for them is included in those engines originally equipped with aluminum buttons for retaining piston pins.

Piston Rings

Five piston rings of the concentric, peened type are used. Three 1/8" wide compression rings and a 3/16" oil control ring are carried above the piston pin. A 3/16" compression-type ring is placed below the piston pin near the bottom of the skirt.

Piston Pin

The piston pin is of the full-floating type and its retention may be either aluminum buttons, with spherically ground ends — which limit the amount of end float — or by snap rings. It is important, however, that the proper piston pin be used in each case.

Timing Gears

The timing drive consists of but three gears: one each for the crankshaft, the camshaft, and the accessory drive. The accessory shaft which is on the right side of engine drives the air compressor, the governor, and the distributor.

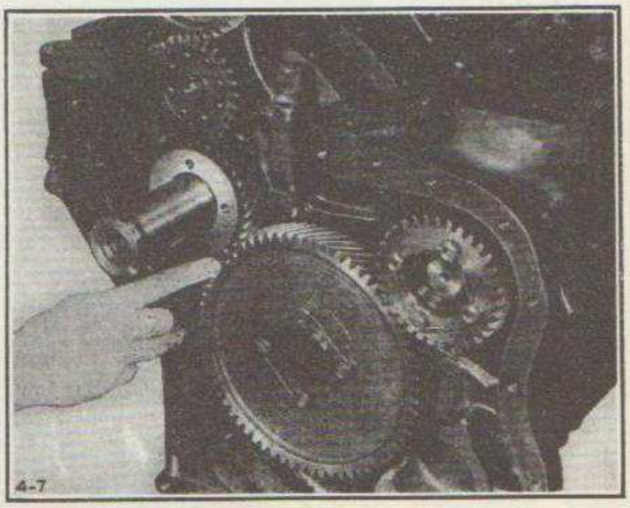


Fig. 5—Timing Gears—and Oil-pump Drive

The steady running of this engine is attributed to the precision and directness of the simple timing and accessory drive, which is connected with the crankshaft thru but two gear meshes of the most accurate type, thereby holding lost motion to an absolute minimum.

All timing gears are end-grain, upset, (whereby the fiber pattern of the steel at the teeth is radial, affording highest tooth strength and minimum distortion in heat treating) alloy steel, whose helically cut teeth are case hardened and then generator ground to perfect form and surface, thus providing durability and silence together with a minimum of backlash.

Accessory Shaft

Helical gears are provided on the accessory shaft to drive the accessories.

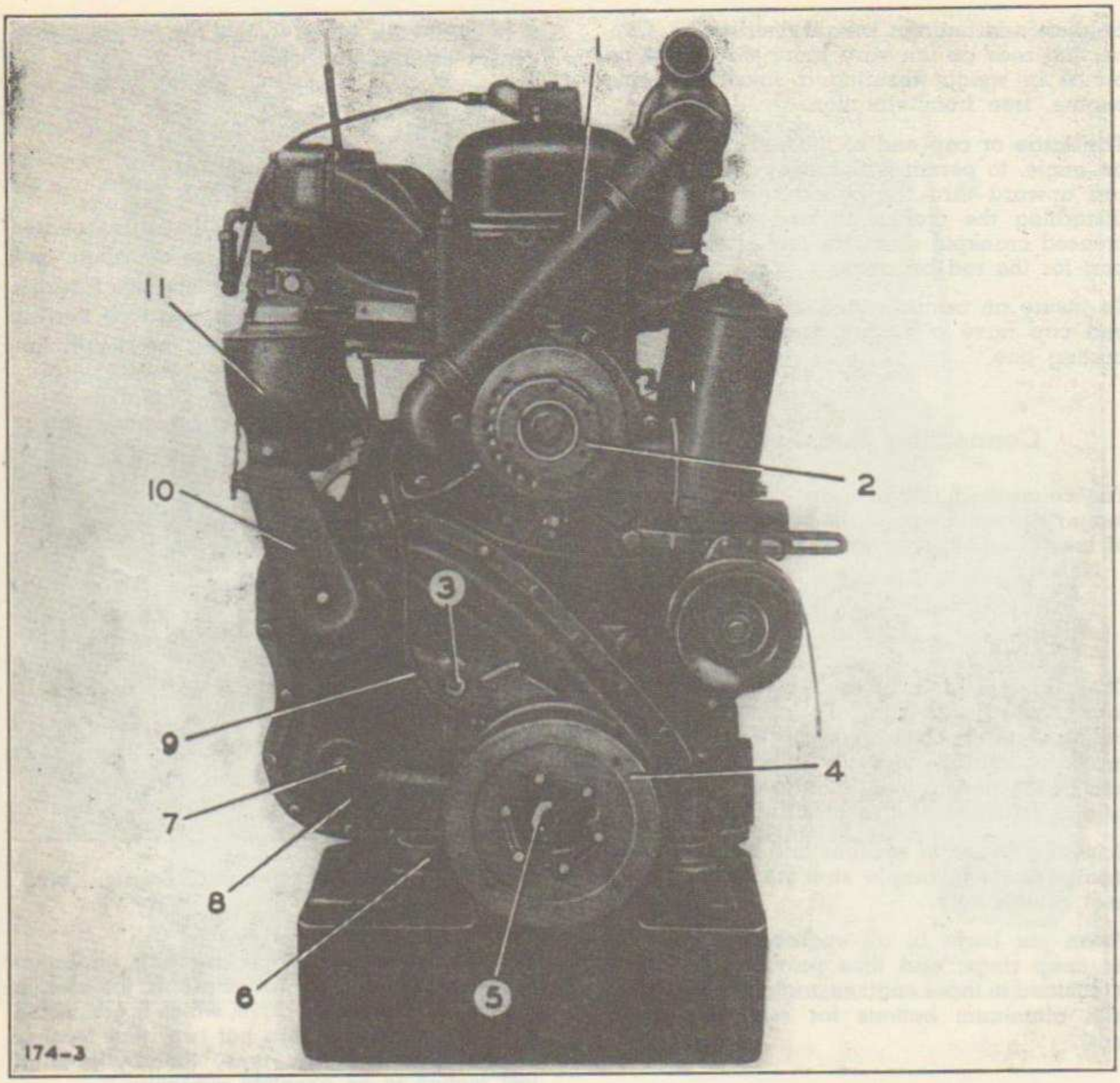


Fig. 6—Front End View of Engine

1. Water By-Pass Connection
2. Fan Hub
3. Camshaft Thrust Adjustment
4. Vibration Damper
5. Starting Crank Jaw
6. Engine Front Support
7. Accessory Shaft Thrust Adjustment
8. Timing Gear Cover
9. Support Lubricating Tube
10. Breather Intake & Oil Filler
11. Breather Shield

The shaft runs on two thick-wall, steel-backed, high-lead-babbitt-lined bushings similar to those used with the camshaft.

Camshaft

The camshaft is of drop-forged steel, pack-carburized and case-hardened. It runs on seven, thick-walled, steel back, high-lead-babbitt-lined bushings.

The lifters used with this camshaft have Ferrox treated faces, which during the run-in period, lap the noses of the cams to a high polish for long wear.

Valve Lifter

The valve lifter is hollow and of mushroom pattern with a chilled iron face and with cup-shaped upper end to receive the spherical end of the push rod.

The lifter is Ferrox treated as explained under "Camshaft."

Push Rods

The inlet valve push rod is of seamless steel tubing. The exhaust valve push rod is an Invar steel tube.

Rocker Arm

The push rod with cup-shaped end to receive the spherical tappet screw transfers the lift from the lifter to a drop-forged rocker arm on an over-head shaft, increasing the lift from .325 to .512 for the inlet, and from .335 to .512 for the exhaust, the increase being due to the rocker arm ratio of 1.6 to 1.

Valves

The Mack Stabl-ite exhaust valves with austenitic steel heads butt-welded to chrome nickel steel stems, seat on cylinder head inserts, with a face angle of 30 degrees.

Inlet valves of chrome-nickel steel seat directly on the cylinder head and are also of 30-degrees face angle. The valves are located in tandem and inclined slightly.

Valve Guides

The valve stems operate in guides pressed into the cylinder head. These guides may be renewed when wear becomes excessive.

Valve Springs

Dual concentric springs are used, thus reducing the fibre stresses in the springs and at the same time eliminating the possibility of a valve dropping into the cylinder due to a broken spring.

The springs are wound on a graduated helix and in opposite direction thus effectively preventing valve spring surge.

Valve Guide Cup

A cup or thimble is installed over the upper end of each inlet and exhaust valve stem and is held in place between the end of the inner spring and the washer. The cup prevents oil from being sucked past the valve stem and into the combustion chamber.

Valve Thrust Cup

The valve rocker arm bears upon a large cup on the outside of the valve springs. This cup operates in a guide and in turn bears upon the valve stem. Thus the stem is unaffected by any side motion from the rocker arm.

Valve Key and Washer

An airplane type key of two pieces, and of the same taper as the valve spring key washer used with them, is employed.

This type key eliminates key and valve-stem wear and is easily removed and installed.

Exhaust Valve Insert

The exhaust valve insert used is of the Mack Permafit type made of Niferite and faced with Stellite.

The high-durability valve and seat insert avoids the necessity for frequent "valve jobs."

This valve insert will give exceedingly long life. Should it require facing after high mileage, it is necessary to grind, as a reamer will not cut the hard surface of the Stellite.

Valve Timing

(See Figures 8 and 9)

The cylinder firing order is 1-5-3-6-2-4. The valve timing is controlled by the camshaft and timing gears, and is not adjustable.

The valves open (O) and close (C) as represented in the following diagram on page 01-9 which pertains to the crankshaft when view is from the front toward rear of engine.

Valve timing provides 13½ degrees of overlap; i.e., the exhaust valve remains open 13½ degrees after the inlet starts to open. This, together with induced turbulence of the exhaust gases resulting from the offset combustion chamber and the direct flow to the exhaust valve, provides clean scavenging and rapid filling on the intake stroke. This amount of

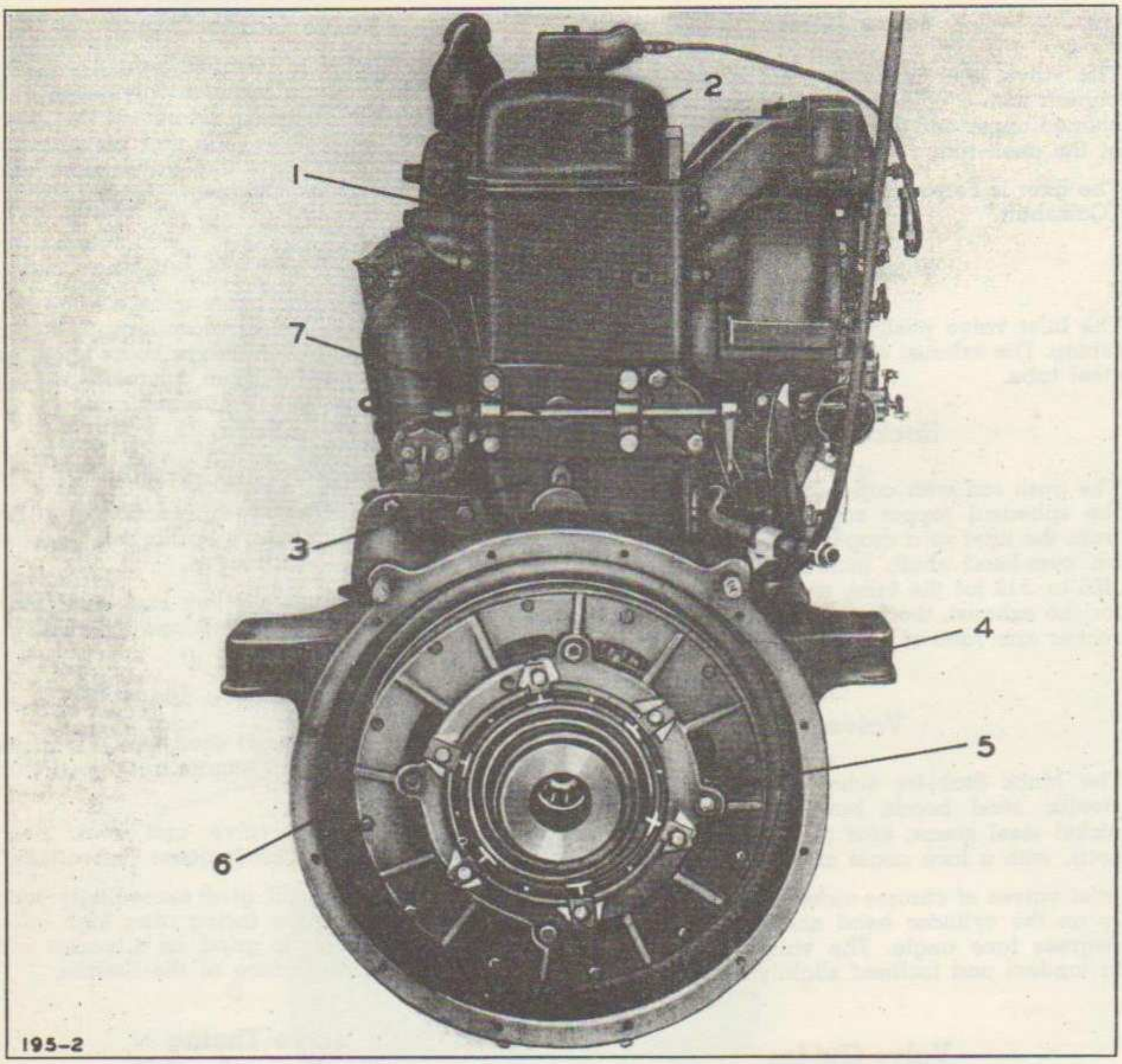


Fig. 7—Rear End View of Engine

1. Cylinder Head
2. Valve Cover
3. Cylinder Block
4. Engine Rear Support
5. Clutch
6. Starter Gear
7. Accelerator Control Cross-shaft

Fig. 8—Valve Order

12	11	10	9	8	7	6	5	4	3	2	1	Valve
O IN	O EX	O IN	O EX	O IN	O EX	O IN	O EX	O IN	O EX	O IN	O EX	FRONT OF ENGINE
6		5		4		3		2		1		Cylinder

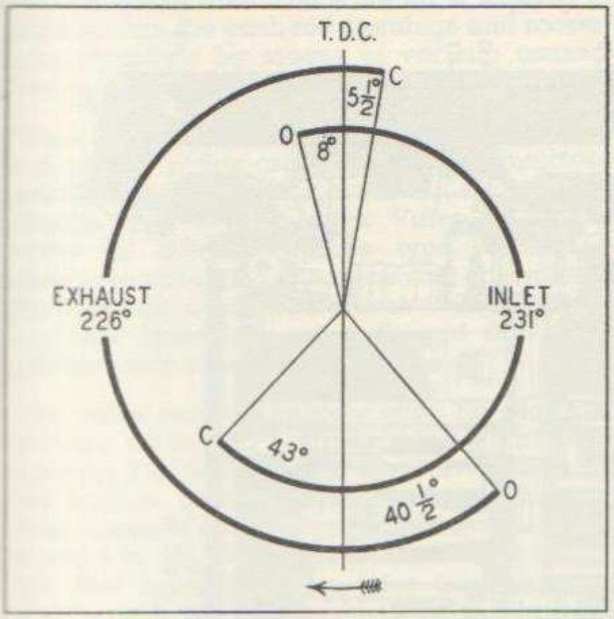


Fig. 9—Valve Timing Diagram

overlap has been very carefully determined to provide the maximum of the above benefits without any tendency to blow back into the intake.

Engine Supports

The engine is supported at four places in rubber supports to insulate it from the frame.

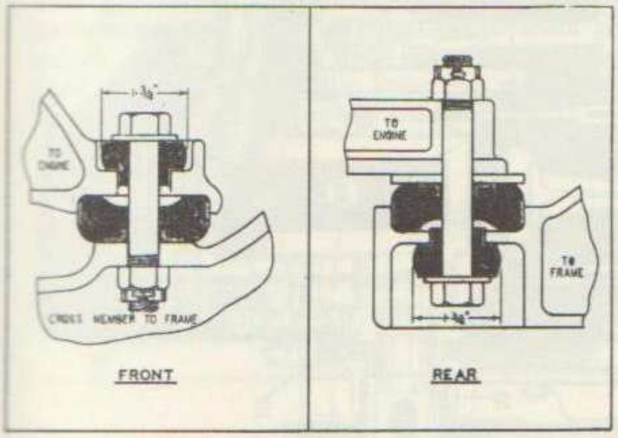


Fig. 10—Sectional Views of Engine Supports

The two front rubbers are at the ends of the trunnion support, which has a cylindrical, free fit on the timing gear cover hub. The two rear supports are in the form of perches on the bell housing, with rubbers arranged in the same manner as at the front.

Inlet Manifold

Of three-piece construction, the inlet manifold has been designed for the most favorable distribution and for minimum resistance to flow. The manifold is of the individual six-port type giving even gas distribution, affording maximum gasoline economy since there are no inherently lean cylinders requiring a rich carburetor setting. High-speed performance is also considerably improved.

Manifold Heat Control

The lower and central portion of the inlet manifold is of T-form, having an exhaust-jacketed riser from the updraft carburetor and outlets to the two branch manifolds secured respectively to the two cylinder heads. The exhaust-jacketed riser serves as a vaporizer, affording heat graduated to the needs of the engine on the gas-inertia principle. The result is that ample heat is imparted at light loads and low throttles, but very little on hard pulls and with the throttle well open. The entire action is accomplished without valves or other moving parts, and consequently there are no adjustments to be made. The upper branches are arranged to afford as nearly perfect distribution as modern science can devise.

Crankcase Ventilation

Thoroly effective ventilation is obtained by entrance of air, via the oil-wetted type breather cap (1) of the oil-filler spout, into the front of

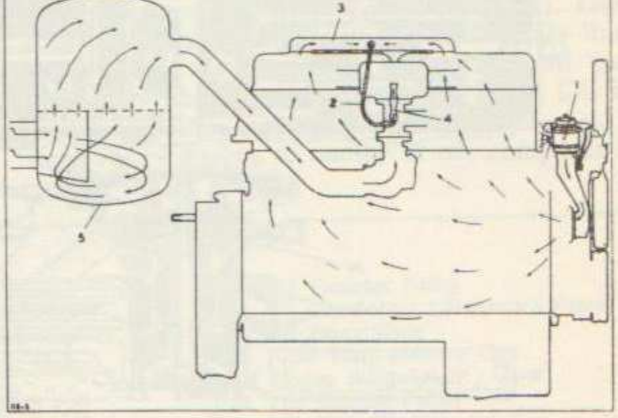


Fig. 11—Diagram of Crankcase Ventilation

1. Oil Filler
2. Tubing
3. Breather Pipe
4. Metering Valve
5. Air Cleaner

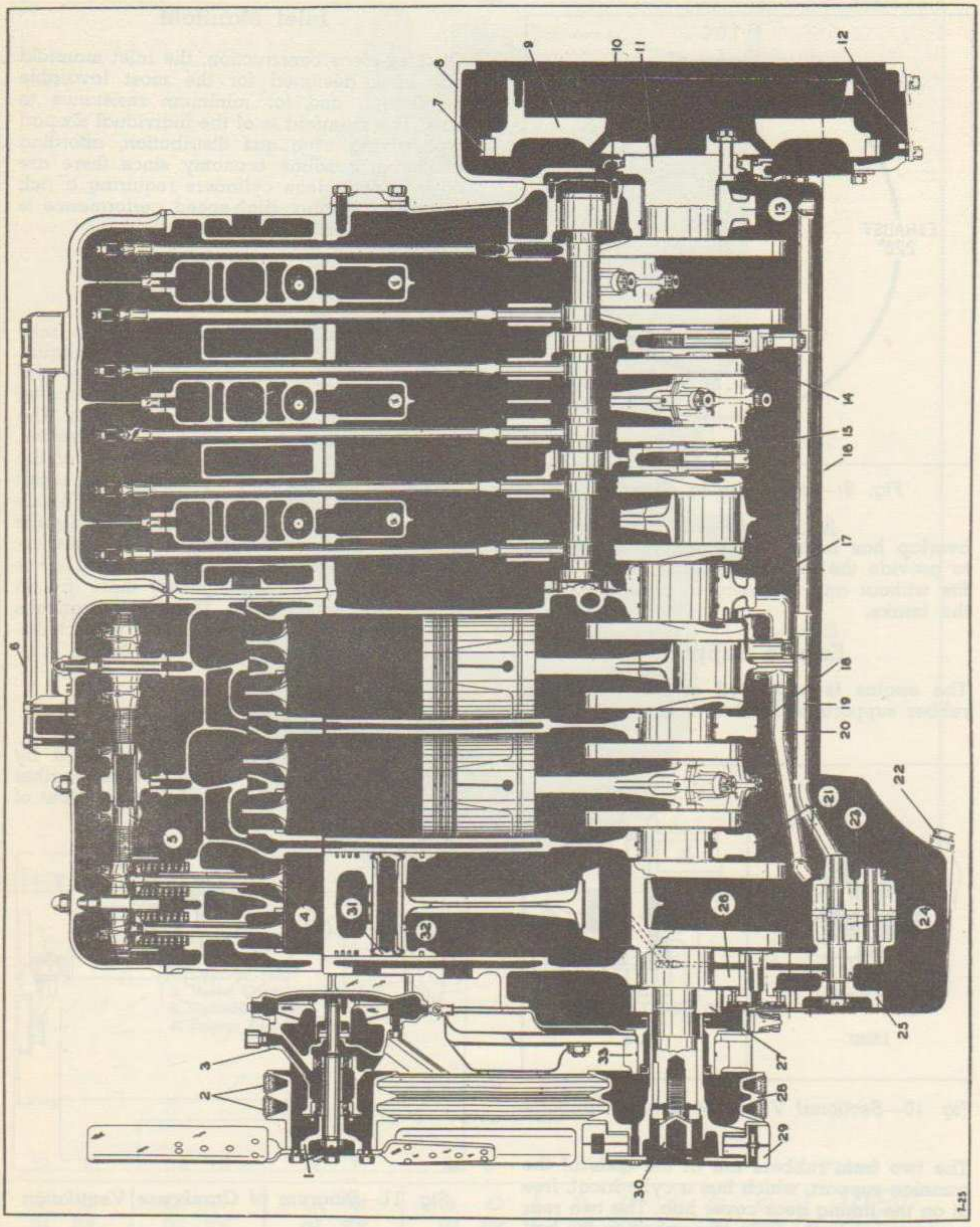


Fig. 12—Longitudinal Section Thru Engine

the crankcase from where the air is induced to pass up thru the push-rod openings and rocker-arm chambers by means of vacuum connection to the intake manifold.

The tube (2) from the breather pipe (3), on top of the rocker-arm covers, communicates with the manifold thru a valve (4) attached thereto. This is a Breather Valve, a gravity valve of differential-pintle type, which responds to vacuum fluctuations and accordingly functions as a governing control for the venting and breathing action thruout the entire performance range of the engine.

The valve remains entirely open for manifold vacuum up to 4 to 5 in. Hg. (4 to 5 inches of mercury) at which point the valve, lifted by the suction, partially restricts the orifice and thus causes a sharp drop in air flow—between 4 and 6 in. Hg. From this point to idling speed, the flow of air thru the valve increases uniformly with the manifold vacuum. Maximum efficiency is when vacuum has reached 9 in. Hg. this being at 1000 R.P.M., full load; at this and higher speeds, there is then a positive flow of clean air thru the crankcase. In conjunction with the valve, connections have been so located and tube, fittings and breather pipe so proportioned that the system is in functional balance under all operating conditions.

To prevent passage from the crankcase of any elements harmful to them into the engine cylinders, there are air-cleaning elements at each end of the breather pipe, at its junctions with the rocker-arm covers. There are also baffle plates at these points. The system requires little attention and that infrequently, as it is only necessary to keep the valve free and to service the filtering elements.

Exhaust Manifold

The exhaust manifold is cast of a special heat-resisting semi-steel alloy. Its three parts are connected by closely-fitted telescopic joints which without resort to packing have been highly successful. Without permitting any leakage, these joints provide for expansion, thereby greatly relieving the manifold of strain. In the design of the manifold, the freest flow and maximum immunity to cracking have been combined.

Engine Oiling System

(See Figures 13, 14 and 16)

The engine is lubricated by a full-pressure, wet-sump system. The oil supply is carried in the crankcase pan, and is circulated thru rifle-drilled passages in the case by a gear-type pump. The suction line (36) connected to a gear-type transfer pump (35) delivers any oil from the rear of the crankcase to the crankcase oil sump. The pressure pump (1) takes the oil from the crankcase oil sump, thru the screen (2), and delivers it thru (21) under 50 pounds pressure to the primary filter, thence to the center of a ¾-inch-diameter main gallery line (3), located at the bottom of the water jacket where it is directly cooled.

From the gallery line, passages (7) evenly distribute oil to each of the seven crankshaft main bearings, thence thru drilled holes in the shaft to the six connecting rod bearings. Passages (5) lead oil under pressure from the main bearings to the seven camshaft bearings. Oil is fed by line(26) from the camshaft bearings to its thrust washer and button and thru line (24) to the accessory shaft front bearing and thrust washer and button.

Oil from pump outlet line (21) is also fed under pressure to lines (39) and (22). Line (39) feeds the governor idler gear while line (22) feeds the governor line (23) and the accessory shaft rear bearing line (22). Oil is fed thru center of accessory shaft line (25) from rear bearing to center of air compressor

1. Fan Hub
2. Fan Belt
3. Water Pump
4. Inlet Valve
5. Rocker Arm Shaft
6. Cover Breather Pipe
7. Starting Gear
8. Flywheel Housing
9. Flywheel
10. Oil Slinger Housing
11. Crankshaft
12. Timing Indicator Pointer
13. Rear Main Bearing Cap
14. Sixth Main Bearing Cap
15. Fifth Main Bearing Cap
16. Lower Crankcase
17. Center Main Bearing Cap
18. Third Main Bearing Cap
19. Inlet Tube (Oil Transfer Pump)
20. Outlet Tube (Oil Pressure Pump)
21. Second Main Bearing Cap
22. Drain Plug
23. Oil Transfer Pump
24. Oil Circulating (Pressure) Pump
25. Oil Pump Gear
26. Front Main Bearing Cap
27. Timing (Crankshaft) Gear
28. Fan Driving Pulley
29. Vibration Damper
30. Starting Crank Jaw
31. Piston Pin Button (Alternate — Snap Ring)
32. Piston Pin
33. Engine Front Support

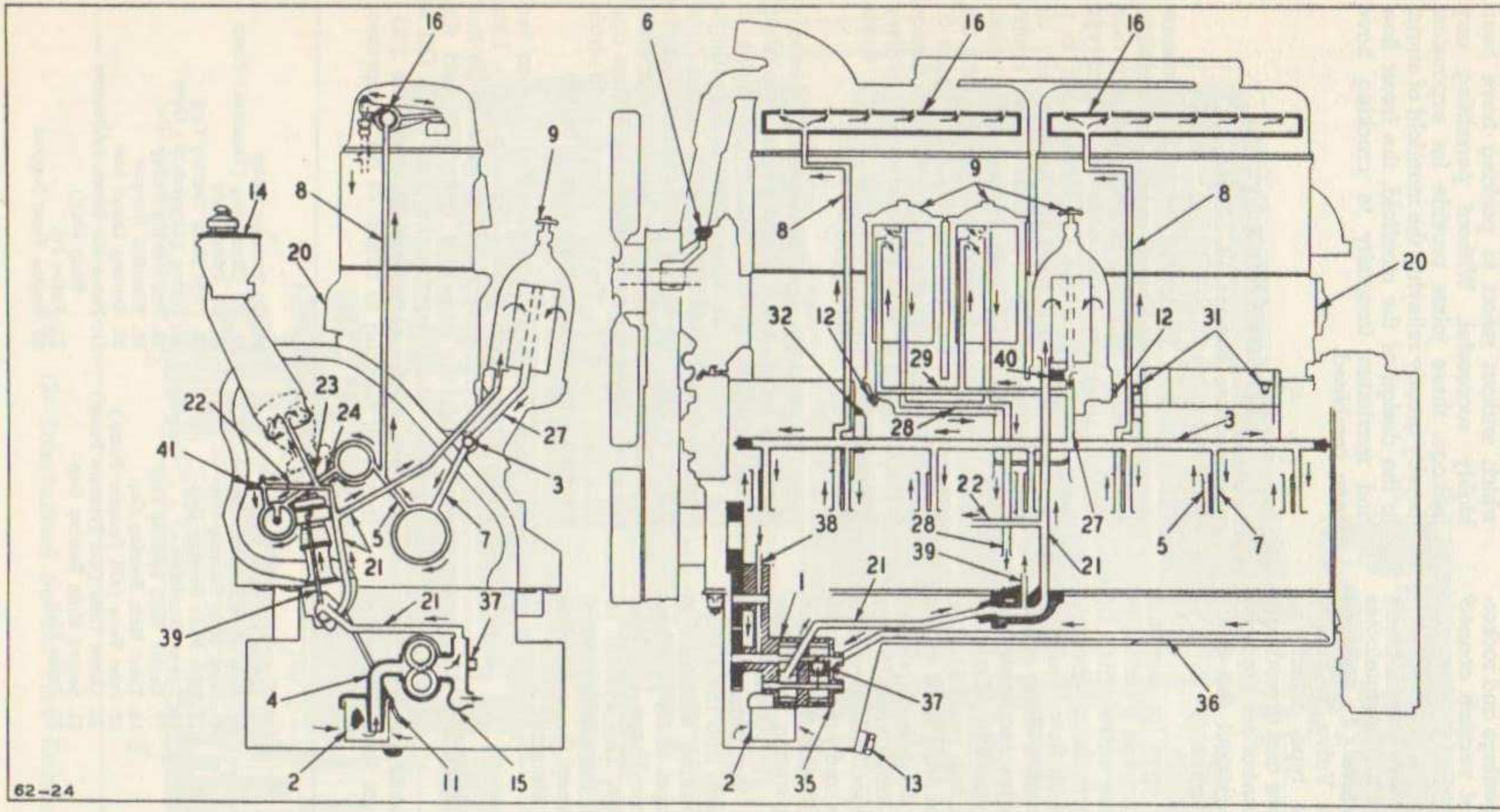


Fig. 13—*Engine Oil Circulation Diagram*

(*See also diagram on page 01-13*)

1. Oil Circulating Pump
2. Pump Screen
3. Main Oil Line
4. Circulating Pump Inlet
5. Main Bearing to Camshaft Bearing Line
6. Water Pump Bearing Grease Filler
7. Main Oil Line to Main Bearings
8. Rocker Arm Oil Feed Line
9. Oil Filters
12. Oil Filter Drain Plug
13. Crankcase Drain Plug
14. Crankcase Oil Filler
15. Circulating Pump Pressure Relief Valve
16. Rocker Arm Shaft
21. Circulating Pump Pressure Line
22. Accessory Shaft Rear Bearing Line
27. Primary Filter Line to Main Oil Line
28. Secondary Filter Return to Crankcase Line
29. Secondary Filter Inlet Line
31. Starting Motor Oil Cups
32. Generator Oil Cup
35. Oil Transfer Pump
36. Oil Transfer Pump Inlet Line
37. Oil Transfer Pump Outlet
38. Main Bearing to Oil Pump Shafts Line
39. Governor Idler Gear Line
40. Primary Filter Pressure Relief Valve.
41. Pressure Gage Connection

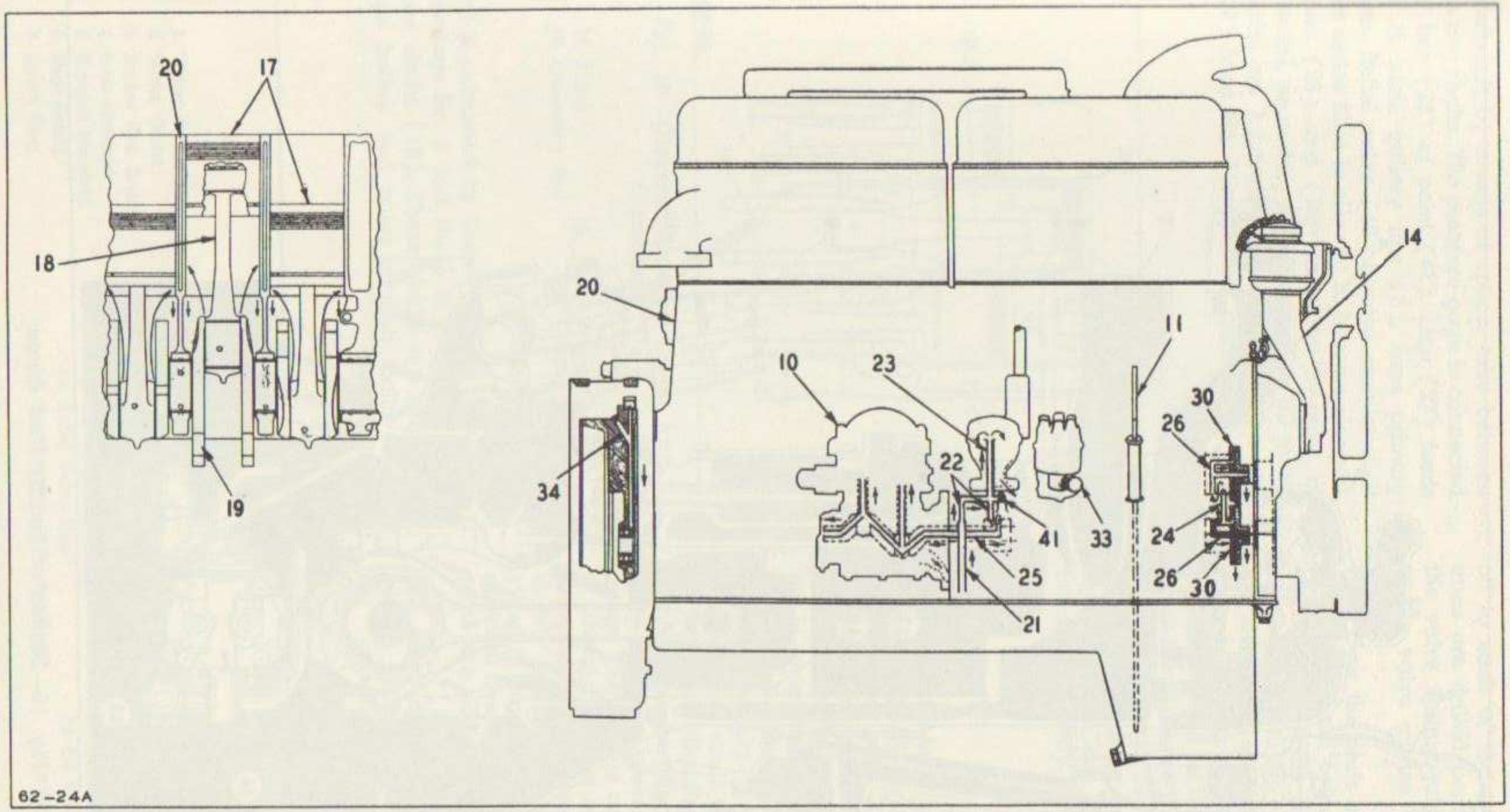


Fig. 14—Engine Oil Circulation Diagram

(See also diagram on page 01-12)

10. Air Compressor
11. Oil Level Indicator Gage
14. Crankcase Oil Filler
17. Piston
18. Connecting Rod
19. Crankshaft
20. Cylinder
21. Circulating Pump Pressure Line
22. Accessory Shaft Rear Bearing Line
23. Governor Oil Feed Line
24. Camshaft Bearing to Accessory Shaft Front Bearing
25. Accessory Shaft Rear Bearing to Air Compressor
26. Camshaft and Accessory Shaft Thrust Button and Collar Line
30. Thrust Washer
33. Distributor Grease Cup
34. Clutch Pilot Bearing Grease Hole
41. Pressure Gage Connection

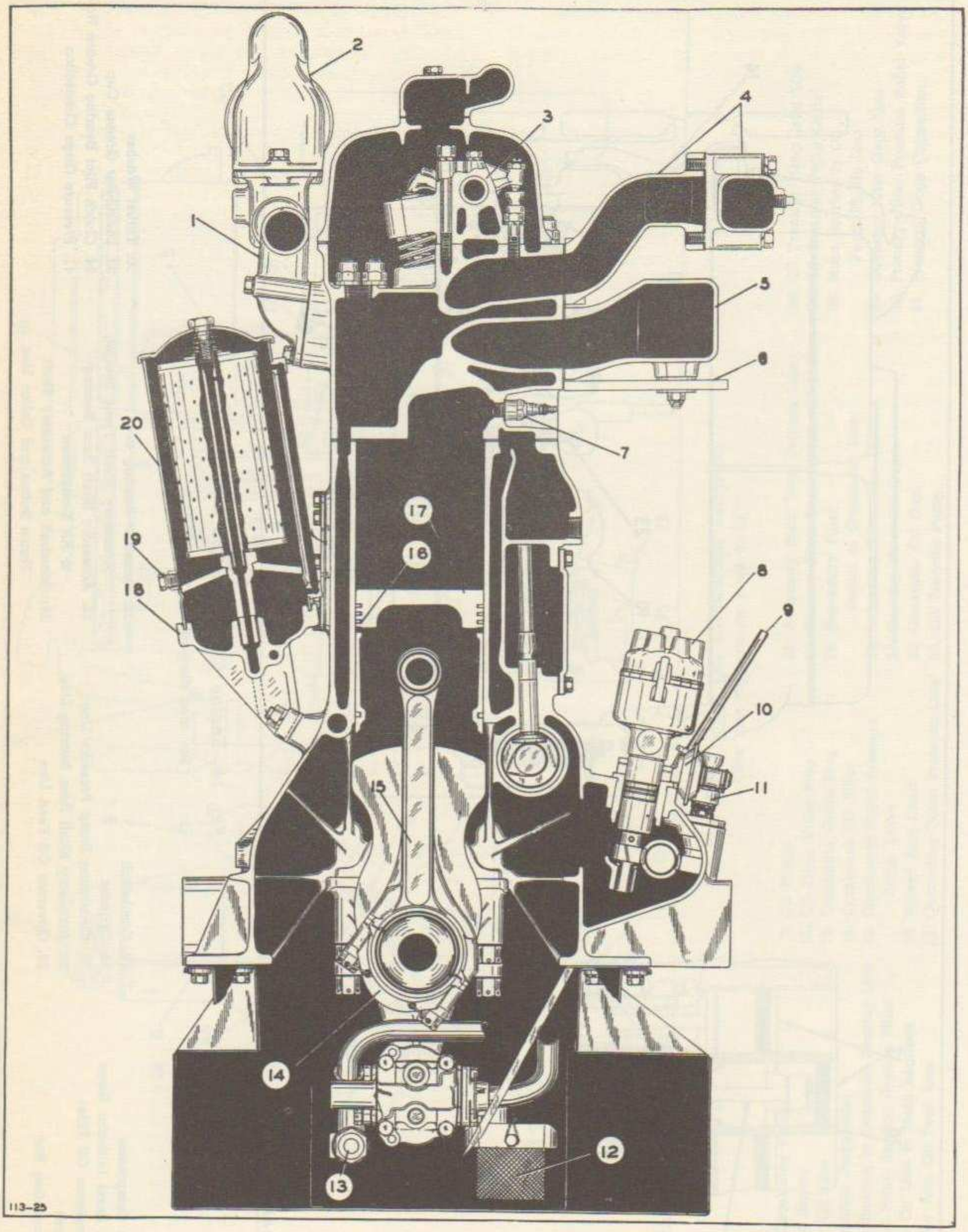


Fig. 15—Section of Engine Thru Piston

crankshaft by means of spacer tube between the two shafts. The pressure gage is connected off line (22) at point (41). Line (27) feeds oil to main gallery line (3), from primary filter. Relief valve (40) insures circulation if this series filter is allowed to become clogged. Lines (28) and (29) form the by-pass, or parallel, secondary-filter circuit. The oil pump shafts are lubricated by oil led by the line (38) from No. 1 crankshaft bearing.

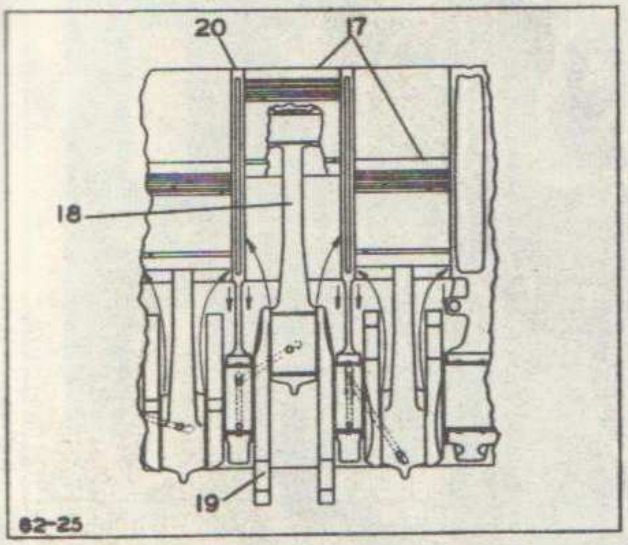


Fig. 16—Diagram Showing Oiling from Crankshaft

17. Piston
18. Connecting Rod
19. Crankshaft
20. Cylinder Block

Oil is circulated by lines (8) from crankshaft bearings No. 2 and No. 5 to the valve rocker arm shafts (16). These shafts are stationary and hollow and holes in their walls supply oil to each of the twelve rocker arms. The arms are drilled permitting an oil feed over the valve spring guides, or thrust cups, and to the valve guides.

Cups over the ends of the inlet valve guides prevent oil from being sucked past the valve stems and into the combustion chamber. Oil also trickles into the cups of the upper ends of the lifter push rods and flows down the rods to the lower cup at the lifters. Suitable baffles and gutters cast on the inside of the crankcase direct the drainage from throw-off to lubricate the timing gears. The cylinders are lubricated by oil spray from the crankpin bearings, a squirt hole in the connecting rod providing intermittent spray.

Oil Pump

The oil pump is of gear type, and is driven by helical gears, thru an idler from the crankshaft timing gear. Oil pressure pump and transfer pump are in tandem, in one unit on the same shafts, but, of course, pumping gears are in separated chambers. Including the idler arrangement, the pump is a self-contained unit which is simply yet sturdily attached — by means of the studs thru No. 1 bearing cap— so that drive alignment is assured. Shafts and pump gears are proportioned for great durability and the preservation of proper clearances. The idler is carried on a long bearing of liberal diameter and a special oil feed is provided for this bearing and the one immediately adjacent to the driven gear. By provision of proper channels in the parts, and the constant flow of oil thru the pump, all internal parts are copiously lubricated.

The large opening at the lower end of the suction pipe is enclosed by a screen. This

1. Water Manifold
2. Water Outlet
3. Rocker Arm Bracket
4. Inlet Manifold
5. Exhaust Manifold
6. Heat Shield
7. Spark Plug
8. Distributor
9. Oil Level Gage
10. Vacuum Advance Unit
11. Tachometer Drive Housing
12. Oil Pump Inlet Screen
13. Relief Valve Cap
14. Connecting Rod Bearing Cap
15. Connecting Rod
16. Piston Ring
17. Piston
18. Oil Filter Base
19. Drain Plug
20. Oil Filter (One of two secondary units)

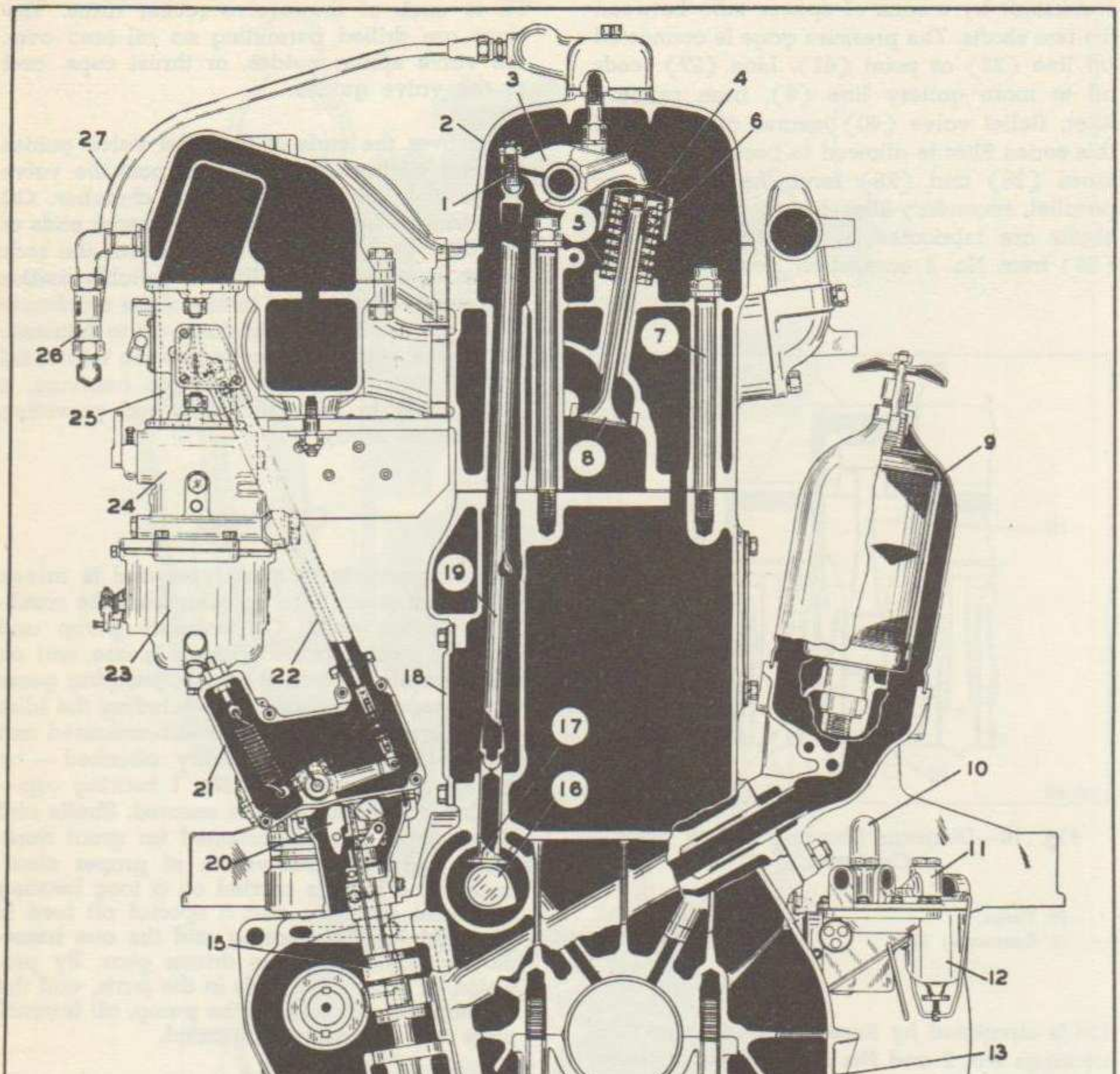


Fig. 17—Section of Engine Thru Valves

screen is not attached directly to the end of the pipe but, in fact, it encloses a space of considerable size in which the pipe terminates. Consequently the screen is of large area.

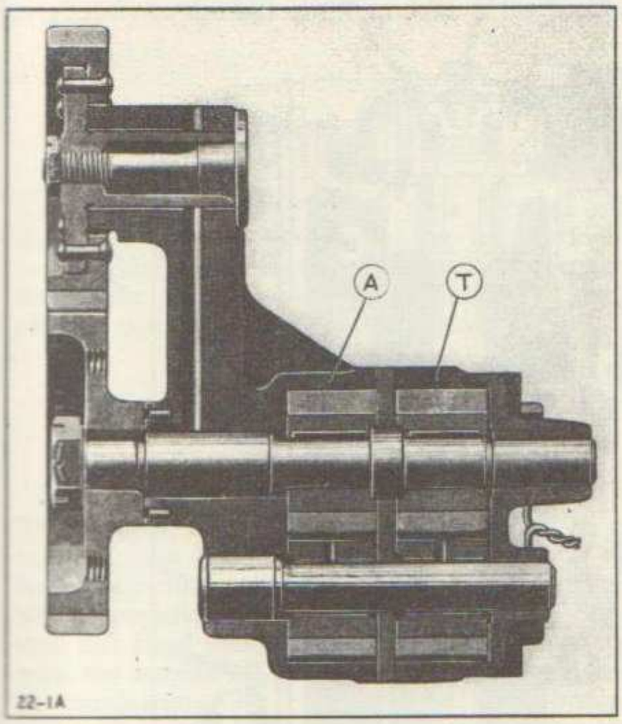


Fig. 18—Sectional View of Oil Pump

A. Pressure Pump
T. Transfer Pump

Oil Pressure Relief Valve

A pressure relief valve is built into the oil pressure pump, and is not adjustable. Its function is to prevent excessively high-pressures from being built up, particularly when the engine and oil are cold.

This valve has been designed to perform correctly over extremely long periods without attention and it should not be disturbed except when abnormally high or low pressure warrants its investigation.

Viscometer

The engine is provided with a viscosity meter oil gage. The function of this gage is to show how "heavy" or how "light" the lubricating oil may be at all times.

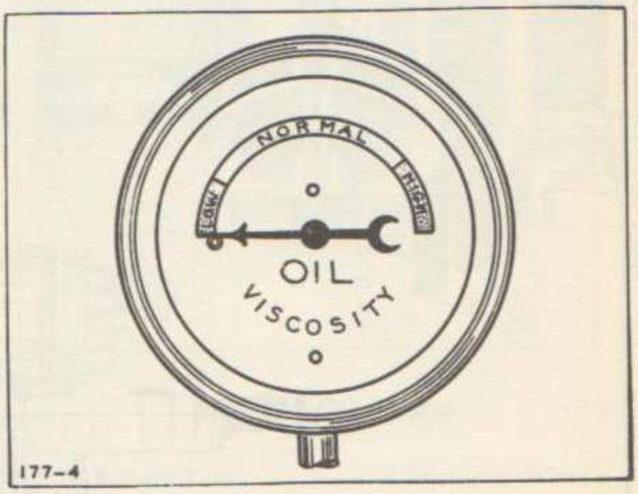


Fig. 19—Viscometer Dial

To operate properly the Viscometer requires a minimum oil pressure of 10 pounds per square inch. With the engine idling slowly the oil pump may fail to produce this pressure. The viscosity indication will therefore be low. Upon accelerating the engine from idle, the viscosity gage pointer will advance to a definite position where it will remain regard-

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1. Valve Tappet Screw
2. Rocker Arm Cover
3. Valve Rocker Arm
4. Valve Thrust Cup
5. Valve Outer Spring
6. Valve Inner Spring
7. Cylinder Head Stud
8. Exhaust Valve
9. Oil Filter (Primary)
10. Air Dome
11. Fuel Pump
12. Pump Bowl
13. Cylinder Block and Upper Crankcase
14. Governor Idler Shaft Housing
15. Governor Drive
16. Camshaft
17. Valve Lifter
18. Valve Lifter Cover
19. Valve Lifter Push Rod
20. Governor Weight
21. Governor Case
22. Governor Rod Tube
23. Carburetor
24. Throttle Body
25. Valve Box
26. Breather Valve
27. Breather Tube

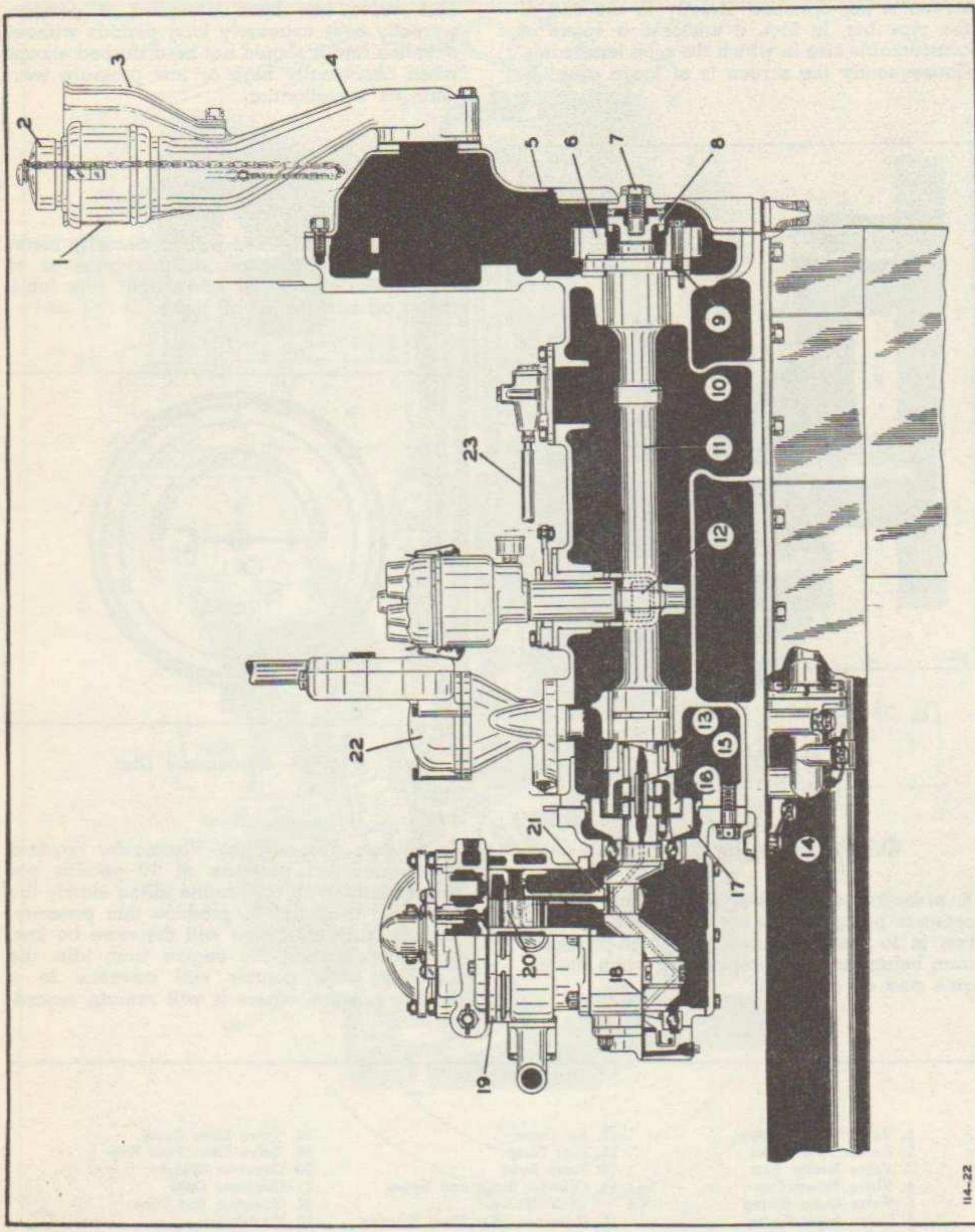


Fig. 20—Section of Engine Thru Accessory Drive

less of further increase in engine speed. This is the true viscosity of the oil and all lower readings should be ignored. Ideal lubrication is indicated when, with engine warmed up to its normal operating temperature, the hand of the viscosity gage is at about the middle, or slightly to the left of the middle of the scale.

Oil Level Gage

An oil gage of the "stick" type located on the right side of the crankcase is provided for checking the crankcase oil level. It is easily accessible to encourage proper attention and plainly marked to facilitate reading of oil level.

Oil Filters

The welfare of the engine is dependent to a considerable degree upon the cleanliness of the lubricating oil. While the air cleaner, when properly serviced, functions to keep dust and dirt from entering the engine and mixing with the engine oil, carbon and other products of combustion, as condensation and water, mix with the oil to form sludge. Because such contamination of the oil not only impairs lubricating qualities but otherwise has injurious effects, it is highly important that the oil filter be an efficient device for its removal.

Efficient filtering performance has been fully achieved thru a unique arrangement of three units compactly grouped for base mounting. Filter-base passages register with passages in the crankcase and thus no external piping or tubes are employed as communications between filter and engine.

Primary filtration is by the filter unit (1) which is in series with the oil lines and which thus receives its oil directly from the oil pressure pump.

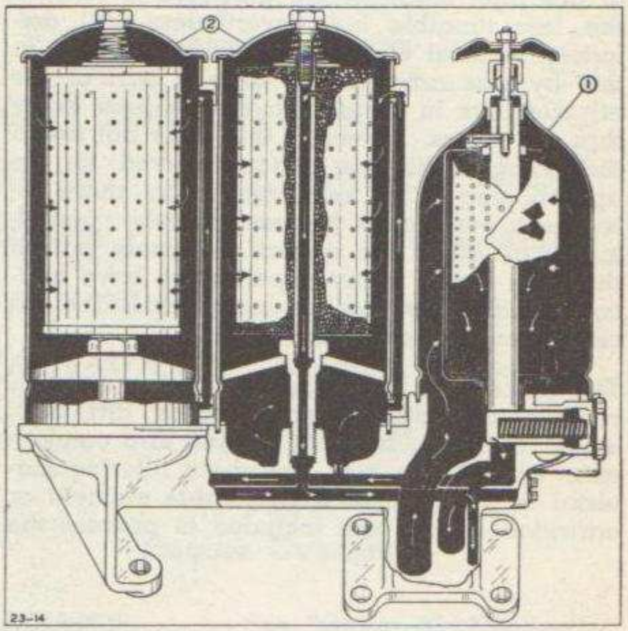


Fig. 21—Oil Filters

1. Primary Filter 2. Secondary Filters

Tho in series with the main oil lines, this filter will never jeopardize circulation because of any clogged condition its neglect may allow to develop, as the built-in pressure relief valve insures the flow via a by-pass functioning whenever the pressure rises to a point indicative of a hazardous restriction within the filter.

1. Breather Air Cleaner
2. Oil Filler Cap
3. Breather Shield
4. Breather Intake (Oil Filler)
5. Timing Gear Cover
6. Accessory Shaft Gear
7. Accessory Shaft Thrust Adjustment
8. Accessory Shaft Thrust Button
9. Accessory Shaft Thrust Washer
10. Tachometer Drive Gear
11. Accessory Shaft
12. Distributor Drive Gear
13. Governor Drive Gear
14. Governor Idler Housing
15. Air Compressor Oiling Tube
16. Air Compressor Sprocket
17. Air Compressor Coupling
18. Air Compressor Crankshaft
19. Air Compressor
20. Air Compressor Piston
21. Air Compressor Connecting Rod
22. Governor
23. Viscometer Tube

In this stage are removed all large particles such as pieces of carbon, etc. The oil then passes into the main oil lines.

However, secondary filtration occurs simultaneously within the other two filter units (2). These are of the by-pass type, accordingly particularly suited for the second stage which in this filter arrangement purposes to remove the less tangible but nevertheless still definitely harmful elements of contamination. In this by-pass arrangement only a part of the oil which is in circulation at the time flows thru the filters. However, this does not mean that complete filtering is not achieved; for the apportioning of oil for passage thru these filters is a continuous process whereby, periodically, all oil in the system ultimately passes thru this stage. Many experiments have indicated that a by-pass arrangement is the excelling means for cleaning oil.

The process of slow filtration and absorption removes colloidal and solid carbon, dirt, dust, water, fuel, etc., from the engine thru employment of a dense, soft, absorbent filtering material in the form of a renewable element or cartridge. Means are included to prevent the collapse or compression of the element so that it remains free to "load" with the materials to be removed from the oil. It stands to reason therefore that after the cartridge has become "loaded" or full, that the oil can no longer pass thru it, and consequently the engine oil will not be filtered and the engine will be subject to damage.

While the filter provided is an extremely efficient one, it rests with the operator to maintain its efficiency thru correct periodic attention. Efficiency will decline and benefits to the engine will seriously diminish or possibly even cease unless filter is systematically serviced, see "Section 5: Repairs," "Oil Filters."

Tachometer Drive

The drive for the tachometer is a unit assembly which is piloted for alignment and flange fastened into the portion of the engine upper crankcase which houses the accessory shaft. Its shaft extends downward and has at its lower end the helical gear of the right-angle drive off of the accessory shaft. Lubrication is from the engine crankcase.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Loss of Power

COMPRESSION POOR .... Leaking Valves, Worn Piston Rings, Worn Cylinder Bore, or Worn Pistons.

IGNITION SYSTEM DEFECTIVE .... Spark Plugs, Distributor Points, or Cracked Wire Insulation.

CARBURETOR .... Not Adjusted Correctly.

GASOLINE PUMP .... Diaphragm, or Check Valves.

SPARK PLUGS .... Dirty or Missing.

AIR CLEANER .... Dirty.

GASOLINE .... Low Octane

OVERHEATING Radiator, Pump, Thermostat, or Connection.

LUBRICATING OIL .... Poor Quality.

Low Compression

VALVES .... Stem and Lifter Clearance, or Sticking.

VALVE GUIDES .... Worn.

VALVE SPRINGS .... Lost Tension, or Broken.

VALVE TIMING .... Incorrect.

CYLINDER HEAD GASKET .... Leaking.

PISTON RINGS .... Worn or Broken, or Improperly Fitted.

PISTONS .... Worn, Cracked, Improperly Fitted, or Scored.

Cylinder and Piston Wear

OIL .... Poor Grade, Lack of, or Dirty.

OVERHEATNG .... See "Group 05: Cooling".

SPRAY HOLE .... On Wrong Side.

PISTON OR RINGS .... Improperly Fitted, Cracked, or Broken.

Cylinder and Piston Wear (Cont'd.)

AIR CLEANER........Inefficient, or not working.

CARBURETOR........Mixture too rich.

Main Bearing Failure

CRANKSHAFT JOURNALS........Out of Round, or Rough.

OIL HOLES........Restricted.

BEARINGS........Sprung, Loose, or Incorrectly Fitted.

CRANKSHAFT........Out of Line.

OIL........Lack of, Dirty, Low Pressure, or Poor Grade.

OIL PUMP........Failure (see "Oil Pressure Pump Failure").

Connecting Rod Bearing Failure

CRANKSHAFT........Pin Rough, Worn, or Out of Round.

BEARINGS........Sprung, Loose, or Incorrectly Fitted.

RODS........Bent.

OIL........Lack of, Dirty, Low Pressure, or Poor Grade.

OIL PUMP........Failure (see "Oil Pressure Pump Failure").

Burned Valves and Seats

TAPPET CLEARANCE........Too Little.

SPRINGS........Weak or Broken.

VALVE TIMING........Incorrect.

GUIDES........Sticky, or Worn.

Burned Valves and Seats (Cont'd.)

VALVES........Wrong Type.

OVERHEATING........See "Group 05: Cooling"

Sticking Valves

VALVE TAPPET CLEARANCE........Incorrect.

GUIDES........Too Tight, or Gummed.

SPRINGS........Weak, or Broken.

VALVE STEMS........Scored, or Dirty.

VALVE LIFTERS........Too Tight, or Gummed.

OIL........Lack of, Dirty, or Poor Grade.

Engine Overheats

RADIATOR........See "Group 05: Cooling".

OIL........Lack of, or Poor Grade.

CARBURETOR........Mixture Too Lean.

AIR CLEANER........Dirty.

IGNITION........Out of Time.

SPARK PLUGS........Missing Fire.

VALVE TIMING........Incorrect.

Oil Consumption Excessive

PISTON RINGS........Broken, Worn, Stuck or Incorrectly Fitted.

CYLINDER BORE........Out of Round, Tapered, or Scored.

MAIN AND CONNECTING ROD BEARINGS........Loose, Incorrectly Fitted, or Too much End-play.

OVERHEATING........See "Group 05: Cooling".

Oil Consumption Excessive (Cont'd.)

OIL............Too Light, or Poor Grade.

OIL PRESSURE............Too High.

ENGINE LOADED............Idling Too Long a Time.

OIL LEVEL............Too High.

LEAKS............At Gaskets, or Seals.

Low Oil Pressure

OIL............Poor Grade, or Too Light.

PRESSURE RELIEF VALVE............Stuck Open, or Weak or Broken Spring.

OIL PUMP SCREEN............Dirty, or Clogged.

MAIN AND CONNECTING ROD BEARINGS............Worn, Incorrectly Fitted, or Loose.

OIL PUMP GEARS............Worn Badly.

Excessive Oil Pressure

PRESSURE RELIEF VALVE............Stuck Closed.

OILING SYSTEM............Restriction.

Oil Pressure Pump Failure

GEARS............Badly Worn.

SHAFT BEARING............Badly Worn.

HOUSING............Leakage from Pressure Pump into Transfer Pump, or Out of Housing.

PRESSURE RELIEF VALVE............Stuck Open.

Oil Transfer Pump Failure

GEARS............Badly Worn.

HOUSING............Leakage.

Knock or Pinging

DISTRIBUTOR............Advanced Too Far.

SPARK PLUGS............Dirty or Missing.

CARBURETOR............Out of Adjustment.

VALVE TAPPET CLEARANCE............Excessive.

VALVES............Wrong Type.

VALVE SPRINGS............Weak, or Broken.

PISTONS AND RINGS............Badly Worn.

PISTON PINS............Badly Worn.

GASOLINE............Poor Grade.

Crankcase Ventilation Faulty and/or Idling Uneven

BREATHER VALVE............Stuck, or Gummed.

CONNECTIONS AND TUBE............Leakage.

FILTERING ELEMENTS............Loaded.

SECTION 3: ADJUSTMENTS

Cylinder Heads

(See Figures 22, 23 and 24)

The tightening down of cylinder heads is an important item in connection with the maintenance of the engine. Care should be taken that all stud nuts are "pulled up" evenly and to the correct tension.

The proper method of tightening cylinder head nuts is shown by the following diagram. Start with Nut No. 1 and progress numerically—No. 2, No. 3, etc.

The proper tension on the cylinder head stud nuts can be obtained by using a tension indicating wrench.

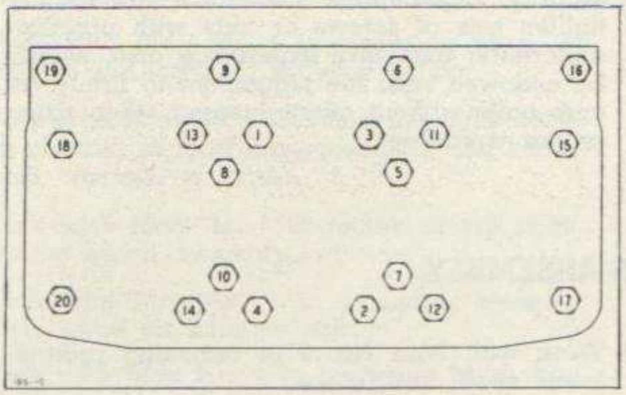


Fig. 22—Diagram Showing Sequence for Tightening Cylinder Head Nuts

Do not tighten the nuts fully the first time around.

Go over the nuts several times. The wrench should indicate 125 to 130 lb.-ft. as the nuts are finally tightened.

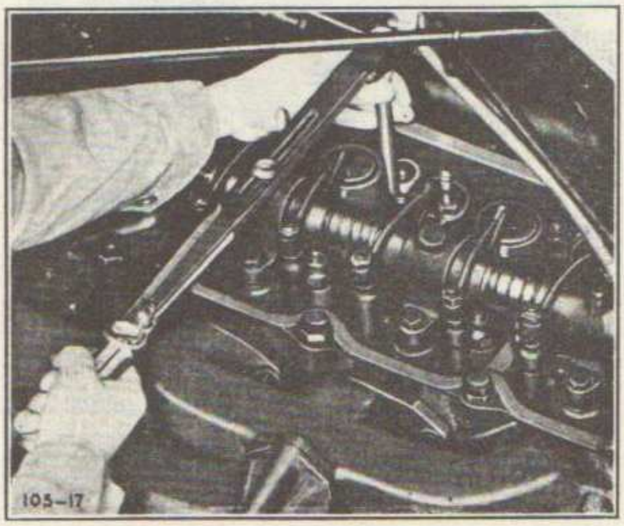


Fig. 23—Tightening Cylinder Head Nut
(Tools—Mack Part No. 17-T-169A and J. H. Williams Part No. S-57)

After the first day's operation, check the nuts once more, then faithfully check them every 6000 miles.

The valve tappet clearance should be carefully set at the same time. The correct settings for valves will be found in this section under "Valve Tappet Clearances". Special attention is called to setting the valve clearance in order to save expensive repairs involving cylinder blocks, cylinder heads, pistons, valves, etc.

It is very important to handle cylinder heads carefully so as not to mar or scratch the surface mating to the cylinder block; also to be careful not to mar the deck of the block itself. This is extremely important and cannot be overstressed. Every precaution should be used to preserve the original manufacturing finish.

Valve Tappet Clearances
(See Figure 24)

The valve tappet clearance, which exists between the valve rocker arm end and the valve stem, is measured with a feeler gage between the arm end and the valve thrust cup, and is adjusted by means of the rocker arm

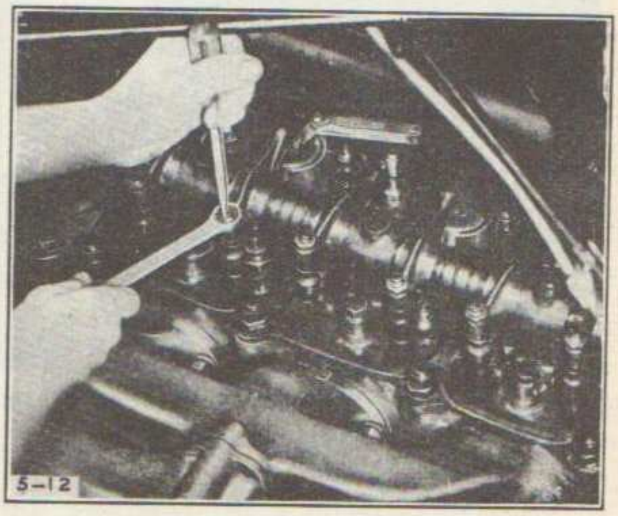


Fig. 24—Adjusting Rocker Arm Tappet Screw

tappet screw. A combination socket wrench and screw driver will greatly aid in adjusting the tappet screw. The clearances, with the engine cold are .008 to .010 for the inlet valves, and .014 to .016 for the exhaust; at hot idle, inlet is .006 to .008, and exhaust is .022 to .024.

Cold settings are those determined at room temperatures (approximately 70° F.) and are given only for preliminary checking. Valves should be adjusted at idling heat, when water and oil have reached steady temperatures. A cold engine will require about ½ hour of idle running to warm up. An engine of a truck just in off the road should be allowed to idle about 15 minutes.

Tightening Units

There are several units, besides the cylinder heads and bearings, which require tightening evenly and to a sufficient tension to assure security. Experienced mechanics can readily tighten sets of screws or nuts with practical uniformity; and, thru experience also, should be endowed with the judgement to firmly secure units without overtightening when using proper wrenches.

SECTION 4: DIS-ASSEMBLY

Removing Engine From Chassis

Five men may be employed to advantage to remove the engine from the chassis in short time. The duties of each man are listed below. Each man is to perform the duties listed for him simultaneously with the others so that all will finish at the same time.

Fig. 25—Five-man Crew Beginning Work of Engine Removal

Man No. 1 Working at Left Front

Drain water by removing pet cock.

Remove palnuts, nuts, and rubbers from radiator support studs.

Remove clamp on lower radiator pipe.

Remove radio bond—lower radiator pipe

Remove radio bond—radiator to frame.

Work with Man No. 2 in removing radiator lower shell cross piece.

Work with Man No. 2 in removing bolts holding headlamp and radiator guards and remove headlamp guard.

Work with Man No. 2 in fastening sling to radiator and lowering radiator to floor.

Work with Man No. 2 in removing bolts holding radiator support cross-members and headlamp bracket to frame.

Work with Man No. 2 in removing top bolts holding winch assembly to frame.

Work with Man No. 2 in loosening bumper angle irons on bumper side.

Work with Man No. 2 in removing bolts thru winch gusset to frame.

Guide winch at front; handle slings.

All five men co-operate in removal of winch from chassis, see Figure 26.

Guide engine at front; handle slinging of engine.

All five men co-operate in removal of engine from chassis, see Figure 27.

Man No. 2 Working at Right Front

Disconnect air line brush guards.

Remove air line clamps; at right and left.

Receive hood from Men Nos. 3 and 4 and place on floor.

Remove bolts—headlamp grille to radiator bracket.

Work with Man No. 1 in removing radiator lower shell cross piece.

Work with Man No. 1 in removing bolts holding headlamp and radiator guards and remove headlamp guard.

Work with Man No. 1 in fastening sling to radiator and lowering radiator to floor.

Work with Man No. 1 in removing bolts holding radiator support cross-members and headlamp brackets to frame.

Work with Man No. 1 in removing top bolts holding winch assembly to frame.

Work with Man No. 1 in loosening bumper angle irons on bumper side.

Work with Man No. 1 in removing bolts thru winch gusset to frame.

Operate hoist lifting winch.

All five men co-operate in removal of winch from chassis, see Figure 26.

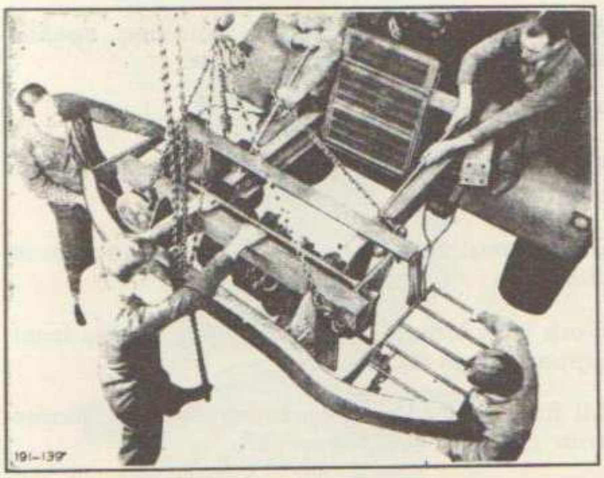


Fig. 26—Removing Winch from Chassis

Operate hoist lifting engine.

All five men co-operate in removal of engine from chassis, see Figure 27.

Man No. 3 Working at Left Side of Engine

Raise hood.

Remove hood radio bond.

Remove hinge bracket bolts.

With Man No. 4, remove and hand hood to Man No. 2.

Remove front, upper radiator tie rod nuts.

Loosen front, lower radiator tie rod bolt.

Remove hose clamp from cylinder head end of hose to radiator.

Remove clamp holding tachometer cable to radiator tie rod.

Remove lower radiator pipe.

Remove fan.

Remove air cleaner clamp and bolts.

Remove air cleaner.

Remove tie rods.

Remove temperature gage fitting at water manifold.

Disconnect Viscometer line from engine.

Disconnect starter cables.

Remove front and rear air lines from quick release valve.

Disconnect wires at magnetic switch.

Disconnect flexible gas line at fuel pump.

Remove generator wires.

Remove generator.

Remove fan belts.

Remove accelerator cotter pin.

Remove front spring hanger tie brace.

Place jack under transmission and block.

Work with Man No. 4 in removing engine front support cross-member nuts.

Pry off winch at left side.

All five men co-operate in removal of winch from chassis, see Figure 26.

Check jack under transmission to make certain of safe support.

Guide engine from left side as engine is lifted.

Work with Man No. 4 in removing engine front support cross-member.

All five men co-operate in removal of engine from chassis, see Figure 27.

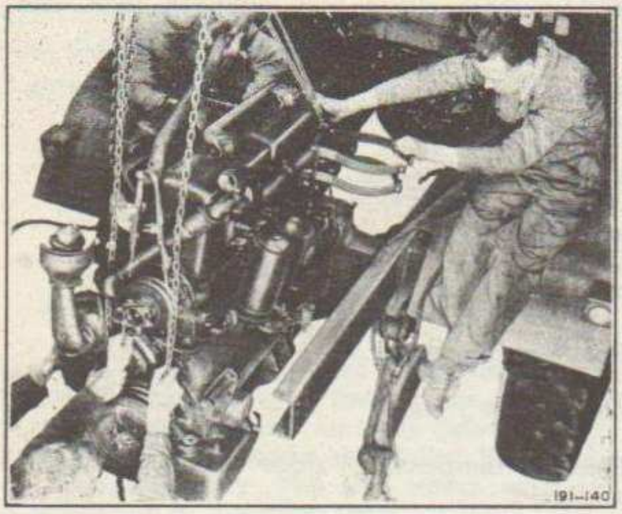


Fig. 27—Removing Engine from Chassis

Man No. 4 Working at Right Side of Engine

Raise hood.

Remove hood radio bond.

Remove hinge bracket bolts.

Aid Man No. 5 with canvas top.

With Man No. 3, remove and hand hood to Man No. 2.

Remove front, upper radiator tie rod nuts.

Loosen front, lower radiator tie rod bolt.

Remove clamp at tachometer cable.

Loosen tachometer cable at exhaust manifold.

Remove tachometer cable.

Remove capscrew at timing gear cover.

Remove switch wire at coil.

Remove radio bond at fender.

Remove choke wire at carburetor.

Remove capscrew at intake manifold.

Loosen horn and turn it away from engine.

Loosen hose clamp at air cleaner pipe.

Remove air compressor pipe.

Remove capscrew at engine rear valve cover.

Remove governor line at air compressor.

Remove air line at junction valve.

Remove radio bond—exhaust pipe to frame.

Remove radio bond—exhaust pipe to engine.

Disconnect line at flexible pipe on main air line.

Disconnect oil gage pressure line at engine.

Remove clamp at oil gage pressure line.

Bend line away from engine.

Remove four nuts from exhaust pipe.

Work with Man No. 3 in removing engine front support cross-member nuts.

Pry off winch at right side.

All five men co-operate in removal of winch from chassis, see Figure 26.

Guide engine from right side as engine is lifted.

Work with Man No. 3 in removing engine front support cross-member.

All five men co-operate in removal of engine from chassis, see Figure 27.

Man No. 5 Working In and Around Cab

Drain air tanks.

Drain oil.

With aid of Man No. 4, roll canvas top forward.

Disconnect batteries.

Remove radiator tie rod nuts.

Disconnect accelerator pedal.

Disconnect brake pedal.

Remove steering post cover plate.

Remove toe board.

Loosen muffler.

Remove pilot bolt nuts.

Remove bell housing studs.

Remove propeller shaft at winch.

Remove engine front support nuts.

Remove clamp from engine support.

Assist forward movement of winch from top.

All five men co-operate in removal of winch from chassis, see Figure 26.

Working inside of cab, pry engine free of transmission and guide engine at rear.

All five men co-operate in removal of engine from chassis, see Figure 27.

DIS-ASSEMBLY OF ENGINE

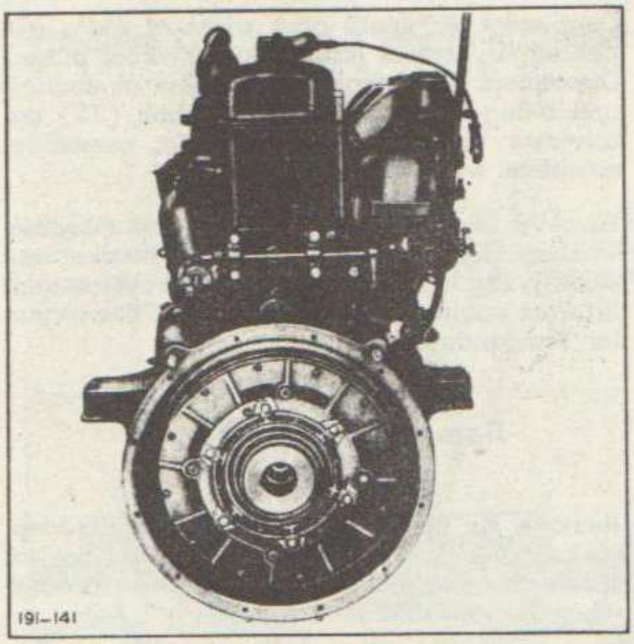


Fig. 28—Rear View of Engine as Removed from Chassis

Removing Clutch

(See Figures 29 and 30)

Remove twelve clutch cover cap screws (1), see Figure 29.

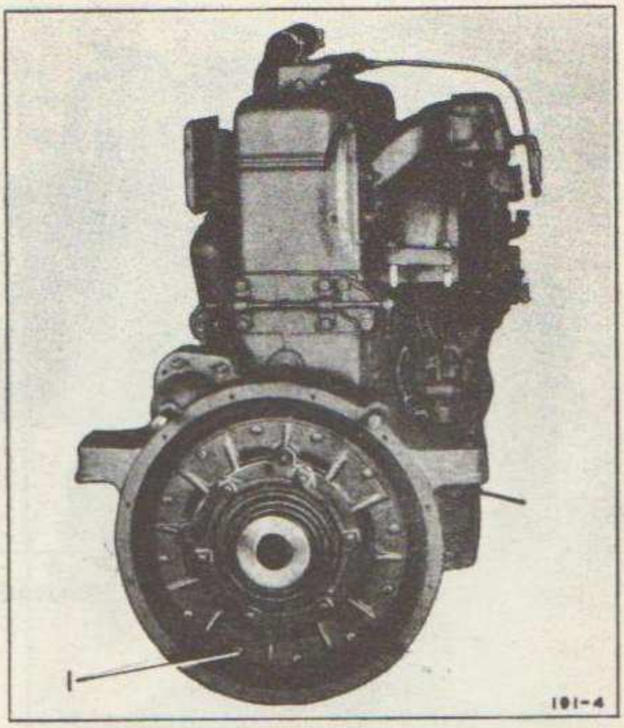


Fig. 29—View Identifying Clutch Cover Capscrews

(See Figure 30)

Lift out complete clutch cover assembly (1). Then take out disk assembly (2).

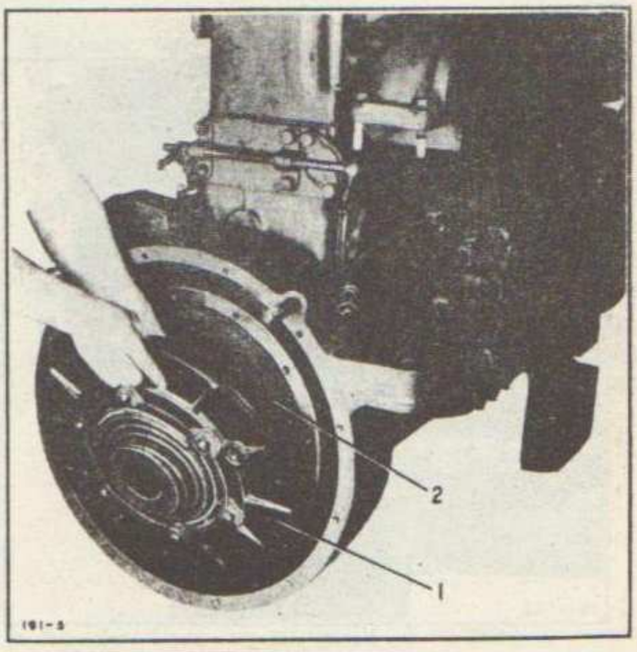


Fig. 30—View Showing Clutch Being Removed

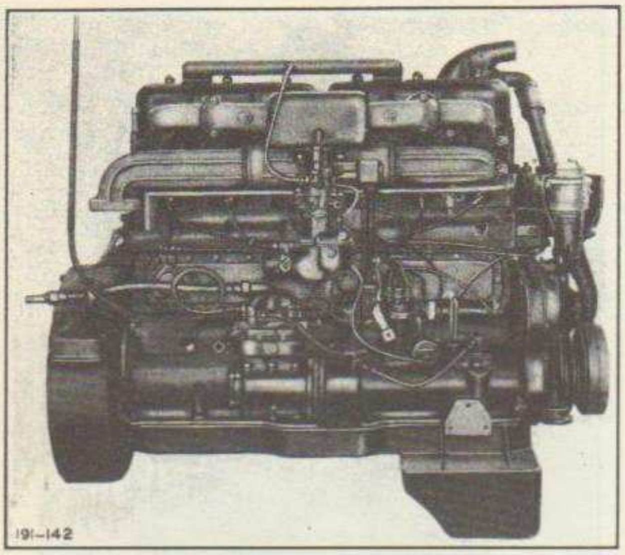


Fig. 31—Right Side View of Engine as Removed from Chassis

Removing Oil Level Indicator
(See Figure 32)

Pull out oil level stick (1), upward.

Removing Viscometer
(See Figure 32)

Disconnect gage line fitting (2) at viscometer (3). Disconnect oil pipe (4) from (3) and at fitting (5) and remove. Remove two hex head cap screws (6) from mounting plate (7) and remove viscometer (3) from engine.

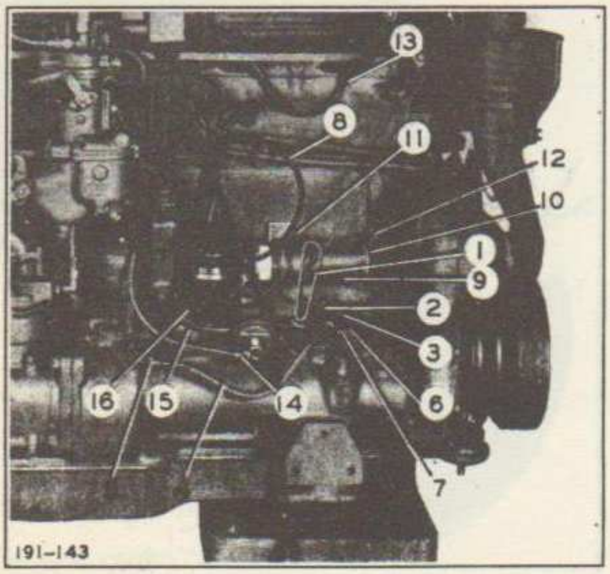


Fig. 32—View Showing Distributor and Adjacent Accessories

Removing Coil and Radio Condenser
(See Figure 32)

Disconnect high tension wire (8) from distributor at coil (9). Remove condenser lead (10) from coil terminal. Remove two hex nuts (11) holding coil strap to adapter bracket. Remove coil (9). Save serrated washers removed from front and back of strap on both studs. Note that coil adapter bracket is mounted with notch toward front of engine, to assure proper coil location. Remove radio suppression condenser (12) and bracket by removing cap screw from valve cover plate, being sure to preserve serrated washers for remounting.

Removing Distributor and Spark Plug Wires
(See Figure 32)

Disconnect six spark plug wires at plugs by pulling suppressor terminals (13) from plugs. Disconnect distributor vacuum line at control unit fitting (14). Loosen clamp bolt (15) on advance arm. Lift out distributor assembly complete with wires.

Remove two cap screws (16) and serrated washers. Lift off control unit and bracket assembly. Pry loose distributor shaft housing and lift from engine. Be sure to preserve dowel pin for remounting.

Removing Spark Plugs
(See Figure 32)

Remove six spark plugs using special deep socket wrench. Care should be taken not to break the porcelains. Save gaskets for use when re-assembling.

Removing Carburetor
(See Figure 33)

Disconnect accelerator rod (1) at both ends by removing cotter and clevis pins from carburetor lever (2) and cotter pin and washer from accelerator shaft lever (3). Disconnect vacuum pipe (5) at governor throttle housing fitting. Disconnect vacuum pipe (4) at gover-

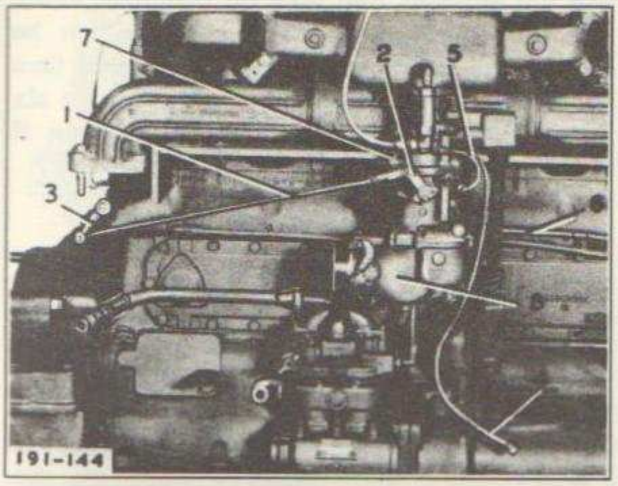


Fig. 33—View in Region of Carburetor

nor throttle housing fitting. Disconnect fuel line (6) at carburetor inlet fitting. Remove two flange stud nuts (7) and take off carburetor (8).

Remove Center Inlet Manifold Section

(See Figures 34 and 35)

(See Figure 34)

Disconnect breather tube (1) at both ends and remove. Remove breather valve and fitting assembly (2) from manifold (3) by unscrewing reducer bushing (4).

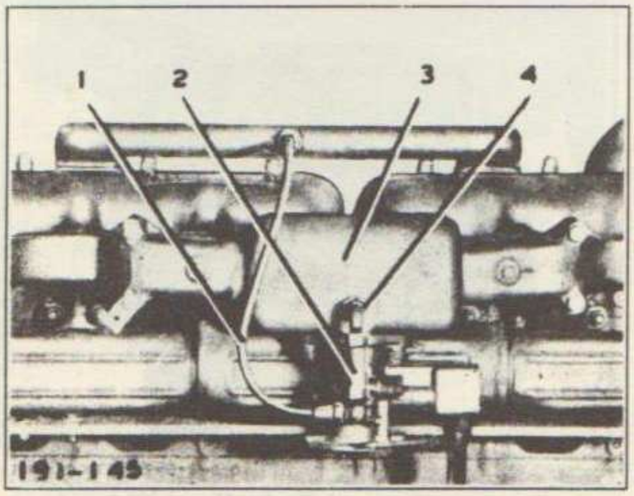


Fig. 34—View of Breather Valve and Inlet Manifold

(See Figure 35)

Loosen and swing down governor throttle housing plate (1). Disconnect governor rod from governor butterfly lever by removing staked set screw (2).

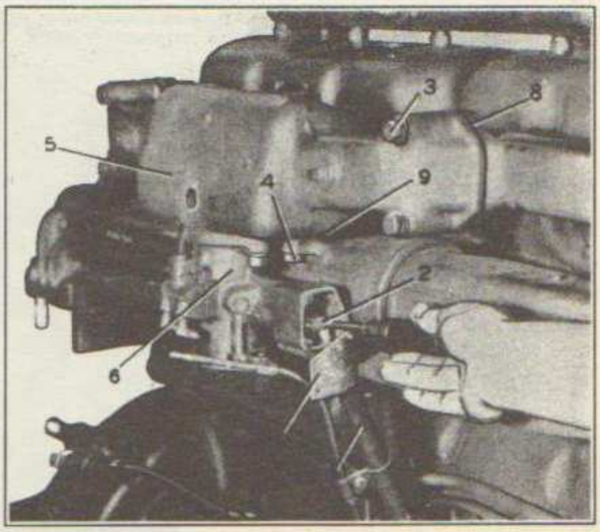


Fig. 35—View of Control Arrangement at Governor Throttle Housing

Note: It is advisable to re-install this screw in lever immediately to prevent its loss.

Remove two cap screws (3) at each end of center inlet manifold. Then remove two cap screws (4) holding front of vaporizer flange to exhaust manifold. Next remove two bolts from rear of vaporizer flange by using an off-set box socket wrench to hold units and a socket wrench to turn bolts. Lift off inlet manifold center section (5) with governor throttle housing (6), exercising extreme care that governor rod and tube (7) are not damaged. Preserve two end gaskets (8) for re-use but discard vaporizer flange gasket (9). This must be renewed at each overhaul.

Removing Governor

(See Figure 36)

Remove four cap screws (1) holding governor assembly (2) to crankcase. Lift out governor and save gasket for re-assembly.

Removing Air Compressor
(See Figure 36)

Remove water pipe clamp (3) from bracket on cylinder block and disconnect both water pipes (4) at both ends. Remove flange screw lock

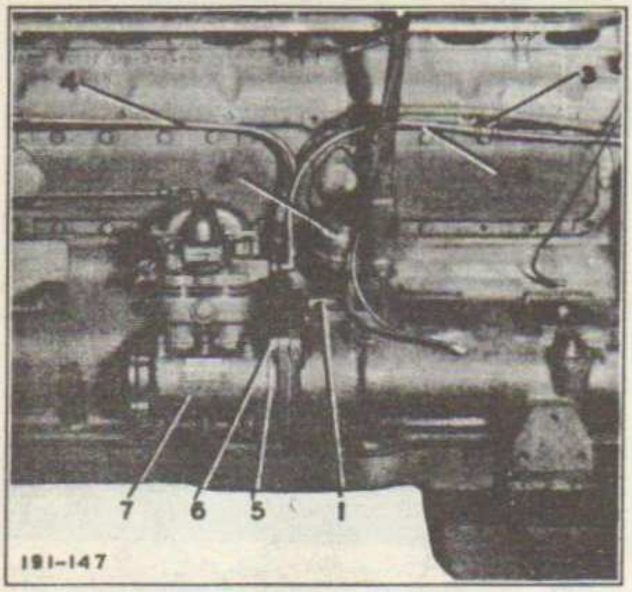


Fig. 36—View Showing Governor and Air Compressor

wire (5) and three flange mounting screws (6). Take off compressor (7) and coupling by pulling straight back toward rear of engine. Save gasket for re-assembly.

Removing Exhaust Manifold
(See Figure 37)

Remove three cotter pins and castellated nuts (1) from shield studs. Drop shield (2). Save flat washers (3) top and bottom for re-use.

Note: These nuts are backed off one quarter turn from hand tight to allow shield to shift on studs when manifold is hot.

Remove manifold front flange nut (4) which disconnects viscometer gage line bracket (5) and tachometer cable bracket (6). Remove remaining eleven exhaust manifold flange nuts and flat washers and take off complete manifold. For renewal of parts, sections can be separated easily as they are assembled thru sliding telescopic joints. Carefully remove six flange gaskets; they may be used again if their condition is good.

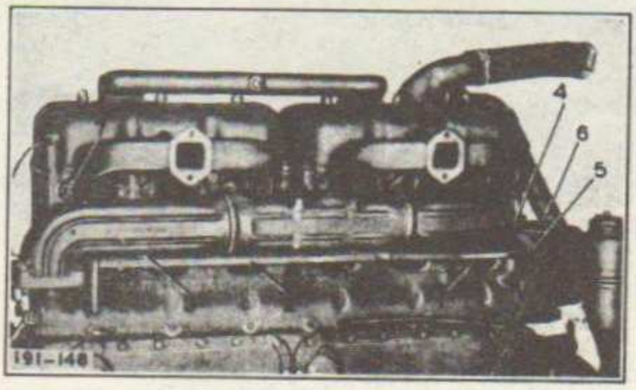


Fig. 37—View Showing Manifolds and Heat Shield

Removing Front and Rear Inlet Manifold Sections
(See Figure 37)

Remove twelve flange nuts (7) from front and rear sections. Remove manifold sections. Preserve gaskets for re-use.

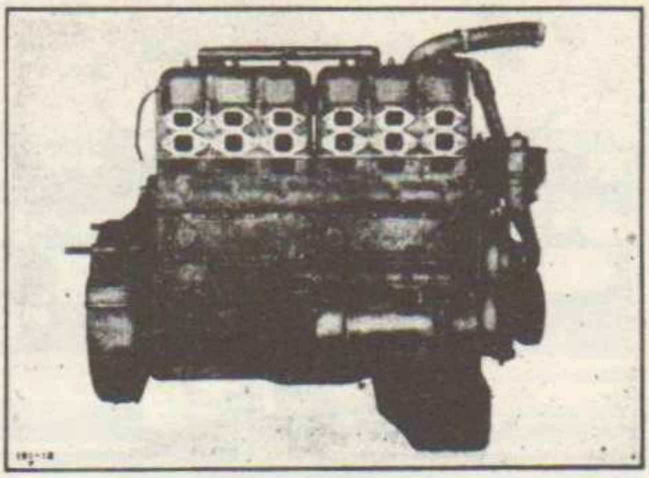


Fig. 38—View of Right Hand Side of Engine, Stripped

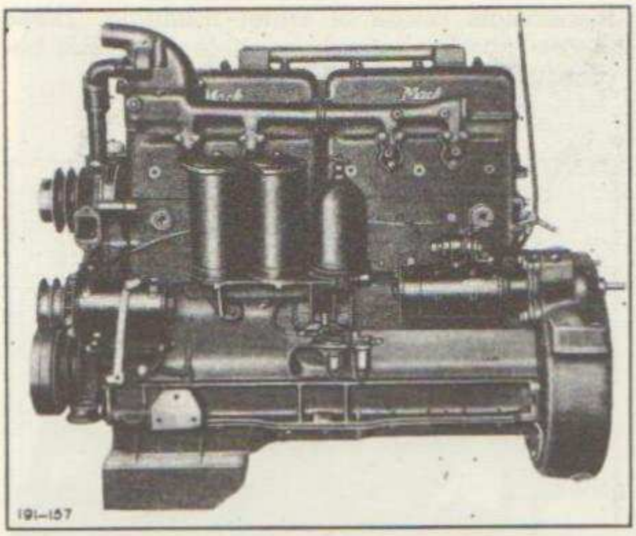


Fig. 39—Left Side View of Engine as Removed from Chassis

Removing Starting Motor
(See Figure 40)

Remove four starter flange cap screws (1) and washers. Withdraw starter and drive assembly (2).

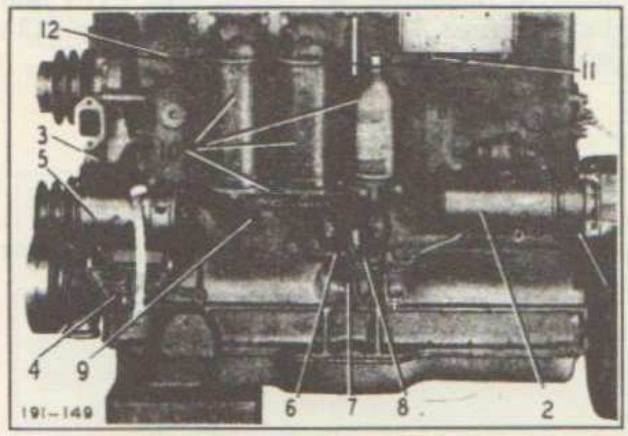


Fig. 40—View Showing Units and Parts To Be Removed from Left Side of Engine

Removing Generator
(See Figure 40)

Remove adjusting link cap screw (3) and washer from water pump. Remove two bracket cap screws (4) and washers. Lift off generator (5) complete.

Removing Fuel Pump
(See Figure 40)

If still in place, disconnect fuel supply line at fuel pump. Disconnect fuel line fitting (6) on pump. Remove two mounting flange cap screws (7) and flat washers. Take off pump (8). Remove and save for re-assembly ⅛" thick insulating spacer and two gaskets.

Removing Oil Filter
(See Figure 40)

Remove five filter bracket stud nuts (9) and lock washers. Lift off filter assembly (10) and gasket.

Removing Viscometer Gage Line and Fuel Line
(See Figure 40)

Remove two gage line clamp screws (11) and lock washers. Take off tubing assembly (12).

Detaching Fuel Line
(See Figure 41)

Remove fuel line clamp screw (1).

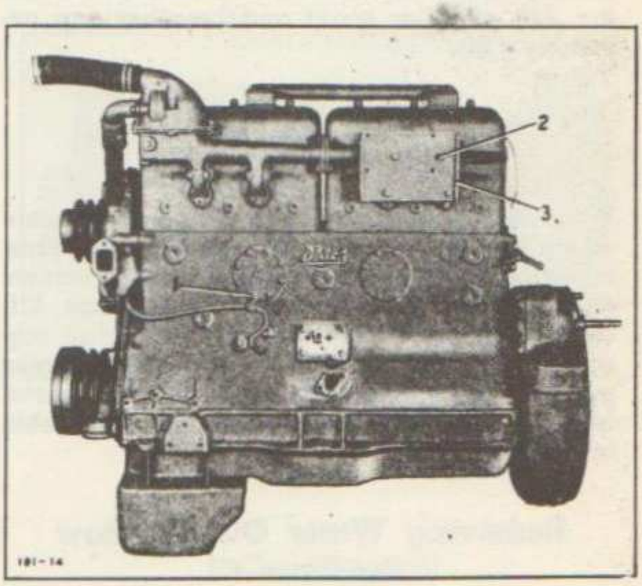


Fig. 41—View of Left Side of Engine with Major Units Removed

Removing Air Cleaner Bracket
(See Figure 41)

Remove four cap screws (2) and lock washers to take off cleaner bracket (3).

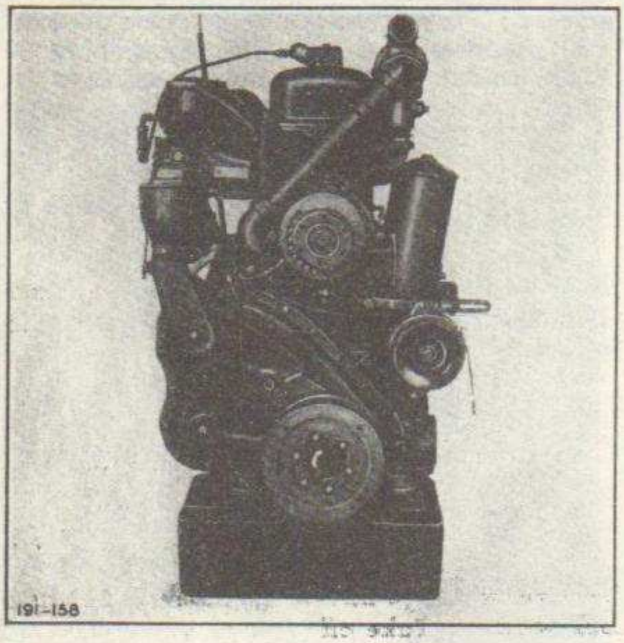


Fig. 42—Front View of Engine as Removed from Chassis

Removing Oil Filter Spout Assembly
(See Figure 43)

Remove three cap screws (1) and lock washers. Lift off filler spout and breather cap assembly (2).

Removing Water Pump
(See Figure 43)

Remove two cap screws (3) and lock washers which loosens upper end of thermostat by-pass tube. Remove gasket. Remove two cap screws (4) and lock washers from lower flange. Lift off by-pass tube (5). Remove four large cap screws (6) and lock washers holding water pump to cylinder block. Take off pump assembly (7). Remove gasket at water inlet hole in cylinder.

Removing Water Outlet Elbow
(See Figure 43)

Remove four cap screws (8) and lock washers on outlet elbow and lift off (9). Remove two thermostats inside of water manifold. These thermostats are interchangeable so cannot become mixed. Remove gasket (10).

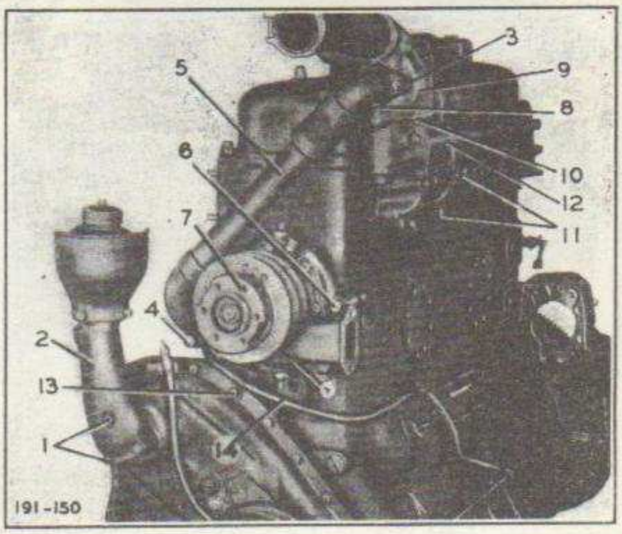


Fig. 43—Front and Left View of Engine, Identifying Parts To Be Removed

Removing Water Outlet Manifold
(See Figure 43)

Remove remaining ten cap screws (11) and lock washers. Lift off manifold assembly (12) and gaskets.

Detaching Fuel Line
(See Figure 43)

Remove clamp screw (13) on timing gear cover. Take off fuel line (14).

Removing Cylinder Head Breather Pipe
(See Figure 44)

Remove four cap screws (1) and flat washers. Lift off breather pipe (2) with baffle plates in place. Run a knife blade under baffles to prevent their sticking to cylinder head cover.

Removing Cylinder Head Covers
(See Figure 44)

Remove six acorn nuts (3) and flat washers. Lift off both covers (4) and gaskets (5).

Fig. 44—View Indicating Parts To Be Removed to Expose Valve Mechanism—also Oil Line Bushing (6)

Removing Rocker Arm and Bracket Assemblies

(See Figure 45)

Remove six cap screws (1) and six studs (2) with flat washers. Lift off both rocker arm assemblies (3). Remove six inlet push rods (4)

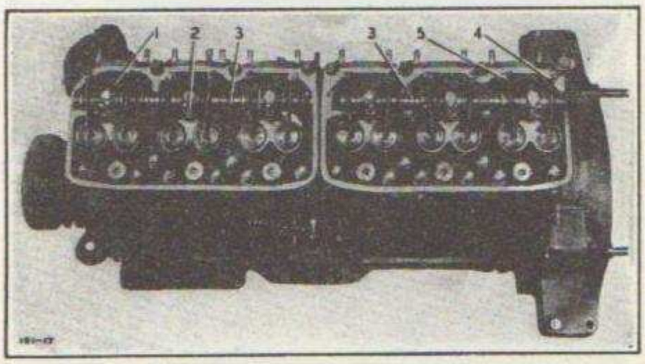


Fig. 45—View Identifying Valve Mechanism Parts

marked "IN-114A" and six exhaust push rods (5) marked "EX-124". When re-assembling care must be exercised to return them to their proper locations.

Removing Cylinder Heads

(See Figure 46)

Remove cap screws (1) and radio bond strap (2) with serrated washers on both sides of spacer nut at right rear corner of rear cylinder head. Remove forty cylinder head stud nuts (3) and forty flat ground washers. Lift off both cylinder heads (4) complete with valves and

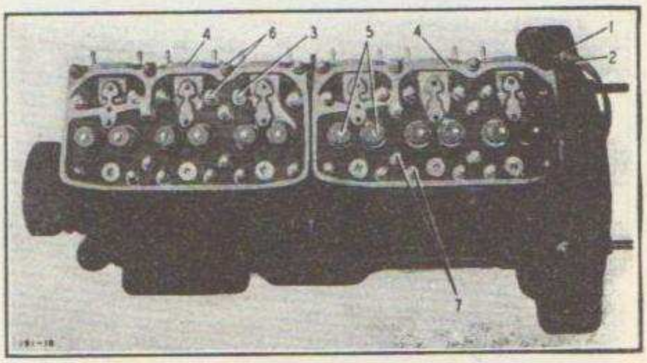


Fig. 46—View of Cylinder Heads Stripped of Valve Mechanism

springs (5). Remove twenty-four long (6) and sixteen short (7) studs and head gaskets. Studs are loosely threaded in cylinder block and can be removed by hand. Be sure when studs are replaced that the long and short studs are returned to their correct positions.

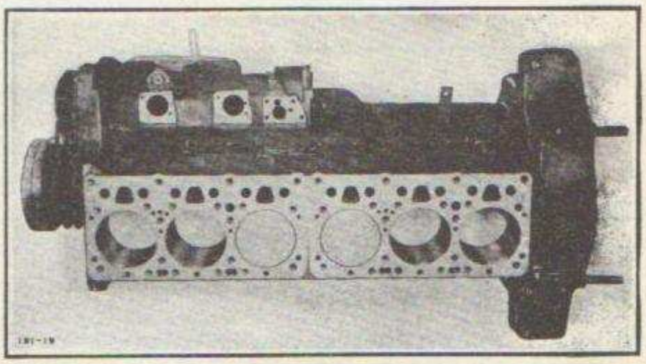


Fig. 47—View Showing Top of Engine Stripped

Removing Lower Crankcase

(See Figure 48)

Remove four dust shield cap screws (1) and lock washers from lower front of flywheel housing. Slide out shield (2) with outer felt strip. Remove inner felt seal. Remove two slotted filister head screws from front and two from rear of lower crankcase (3) using a screw driver. Remove remaining twenty-six hex head cap screws (4) and lock washers.

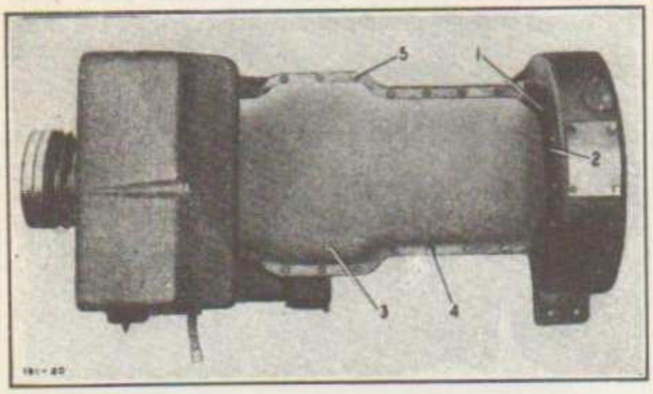


Fig. 48—Bottom View of Lower Crankcase or Pan

Note that long screw (5) is used on left hand side of engine just to the rear of rear reinforcing rib near center of upper crankcase. Remove lower crankcase and gasket.

Removing Oil Pump and Suction Tube Assembly
(See Figure 49)

Remove lock wire and cap screw (1) which holds inlet tube (2) to No. 6 main bearing cap.

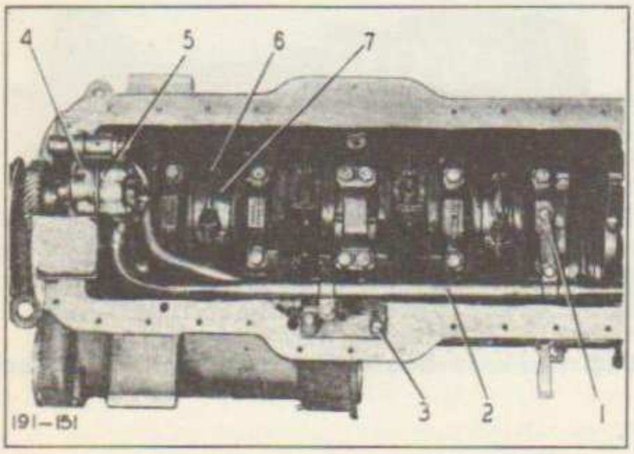


Fig. 49—View into Upper Crankcase

Remove lock wire from four governor drive shaft housing cap screws (3). Remove the three screws that are accessible, leaving fourth screw tight until later. Remove lock wires and two main bearing cap screws from front main bearing cap (4). Loosen oil pump assembly (5). Now loosen fourth cap screw on governor drive shaft housing at the same time raising oil pump and tube assembly (5) which can then be lifted out of crankcase complete.

Removing Connecting Rod Caps
(See Figure 49)

Work on two rods at a time, the two that the crankshaft position makes accessible.

Remove lock wires and two connecting rod cap screws (6) from each of six rods. Remove six rod bearing caps (7) by tapping lightly.

Removing Piston and Connecting Rod Assemblies
(See Figures 50 and 51)

Push connecting rod and piston assemblies (1 in Figure 50) out thru top of cylinder bores. Replace bearing caps on rods immediately to prevent mixing bearing shells.

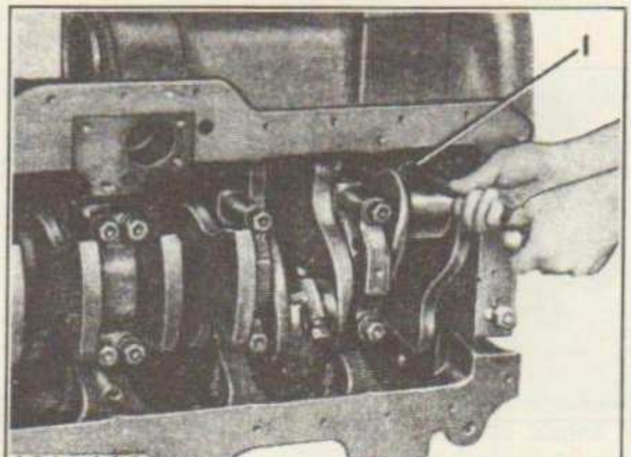


Fig. 50—View Showing Rod Being Pushed Thru Bore

Note: Shells are marked 1, 2, 3, etc. and with T, for top and L, for lower, in oil channel.

Great care must be exercised when removing pistons from bores (1 in Figure 51) that piston rings (2) are not damaged.

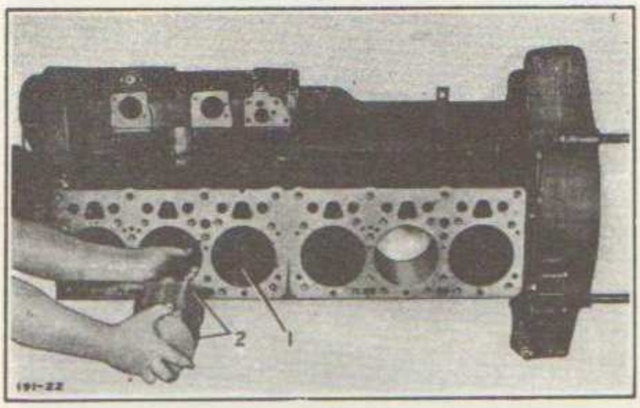


Fig. 51—View Showing Removal of Piston from Cylinder Block

Note: Procedure following removal of pistons is best with engine in inverted position.

Vibration Damper and Hub Assembly —Removing Fastenings

(See Figure 52)

Remove lock wires (1) and two cap screws (2). Remove starting jaw lock (3). Secure flywheel in position by inserting pin or bolt thru clutch ventilating hole in flywheel so that it engages rib in flywheel housing. Then remove starting jaw (4) using a heavy duty, long handled 1⅝" socket wrench and a hammer to "shock-break" it loose.

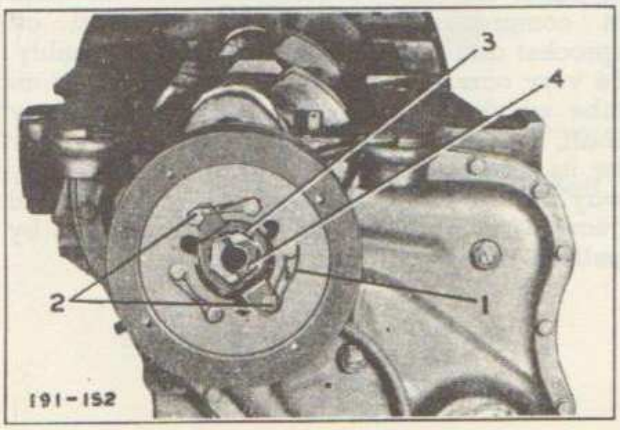


Fig. 52—Front End View Showing Vibration Damper

Removing Vibration Damper and Hub Assembly

(See Figure 53)

Insert an adapter pin (1), ¾" in diameter and 7 in. long, in starting jaw hole in crankshaft. Install two pulling screws (2) of puller in vibration damper screw holes so that end of spindle (3) engages end of adapter pin (1). Rotate spindle thus drawing vibration damper and hub assembly off end of crankshaft.

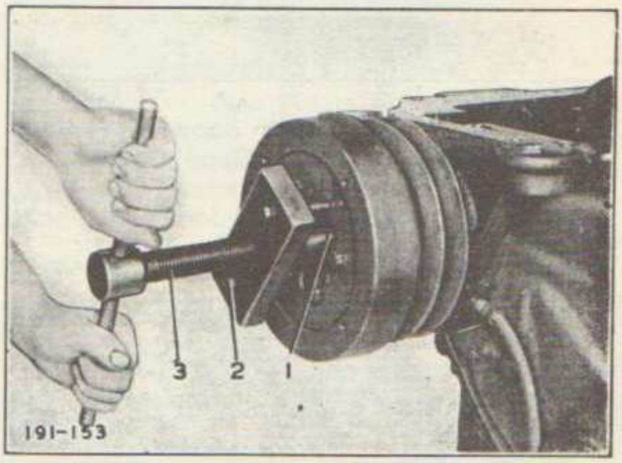


Fig. 53—View Showing Puller Applied to Vibration Damper

(Tool—Federal Stock No. 41-P-2905-60)

Removing Timing Gear Cover

(See Figure 54)

Remove lubricating tube clamp bolt (1). Pry open clamp (2) thus releasing tube (3). Reinstall bolt in clamp to prevent its loss. Slide engine front support (4) and lubricating tube assembly (3) off gear cover hub. Remove remaining sixteen cap screws (5) and flat washers. Lift off gear cover (6) and engine front support lubricating tube clamp. Note location of clamp.

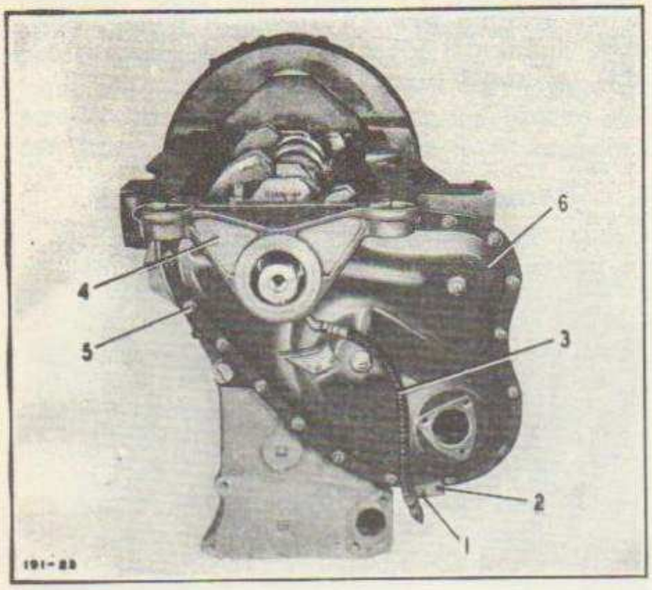


Fig. 54—Front End View Showing Front Support and Timing Gear Cover

Removing Tachometer Drive
(See Figure 55)

Remove two tachometer drive flange cap screws (1) and pull out drive assembly (2).

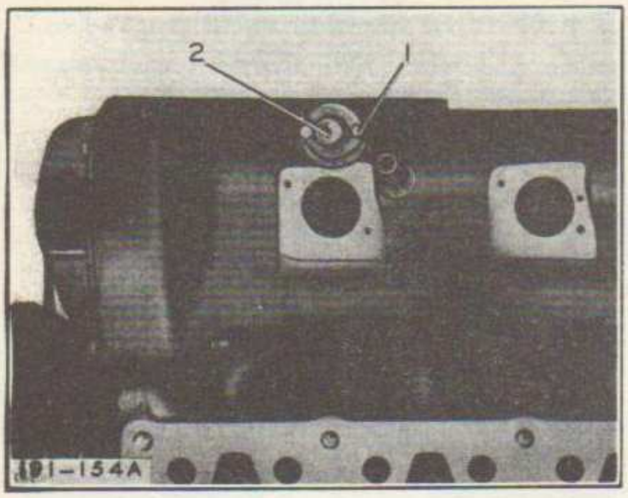


Fig. 55—View Showing Tachometer Drive

A Method for Lifting Engine
(See Figure 56)

The engine may be lifted by the connecting rod journals provided measures are taken not to mar or damage them in any way. The illustration shows a convenient form of hook which is not difficult to make but such a hook must be lined with brass or some other soft metal, or leather attached with soft rivets. The

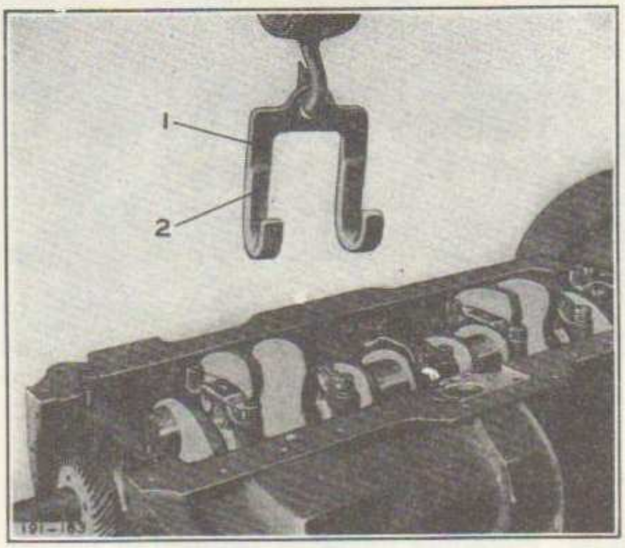


Fig. 56—Illustration of a Hook Implement for Lifting Engine

illustrated part (1) has its hooks lined by brazing (2). Never use any steel device without providing protection for the journals.

Removing Accessory Driveshaft
(See Figures 57 and 58)

Bend down ears of compressor driving sprocket nut lock and remove nut. Install pulling screws of puller tool in two holes provided for them in compressor driving sprocket. Pull off sprocket and governor driving gear assembly. Be very careful not to damage compressor oil tube which protrudes from end of accessory shaft. The compressor depends upon this tube for its lubrication and if it is damaged in any way it must be renewed. Accessory shaft, and gear (1), Figure 58, can now be removed by pulling out from front of engine.

Removing Camshaft
(See Figure 58)

Remove camshaft, and gear (2), by pulling straight forward from front of engine. Support

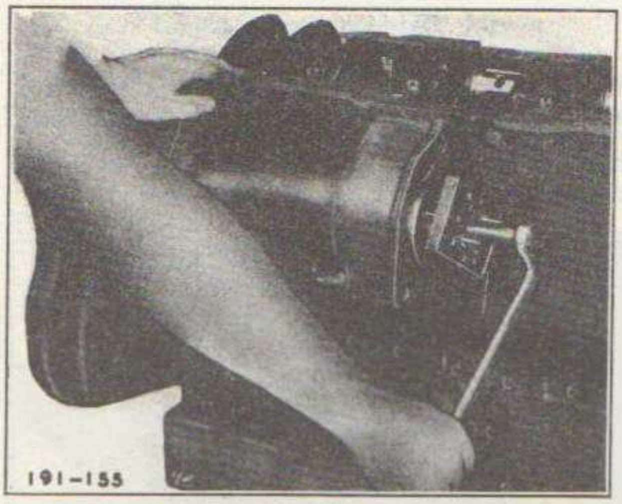


Fig. 57—View Showing Puller Applied to Accessory Driveshaft
(Tool—Federal Stock No. 41-P-2905-60)

shaft with free hand between main bearing webs inside crankcase to prevent damaging camshaft bushings during removal.

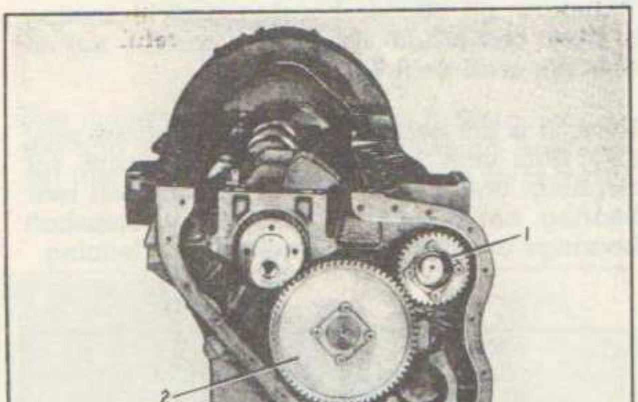


Fig. 58—View Identifying Accessory ***Shaft*** *and Camshaft Gears*

Removing Valve Lifters

(See Figure 59)

Valve lifters (1) can now be lifted out. They should not be mixed.

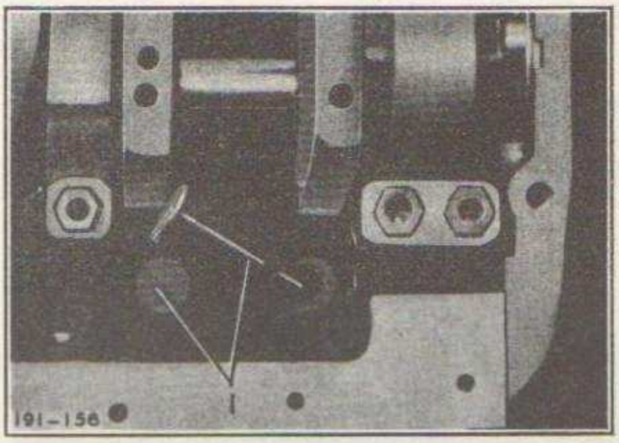


Fig. 59—View Showing Valve Lifters

Removing Flywheel

(See Figure 59)

Take out cotter pins and unscrew nuts from six flywheel bolts (1). Remove flywheel (2) using puller tool (3), being extremely careful

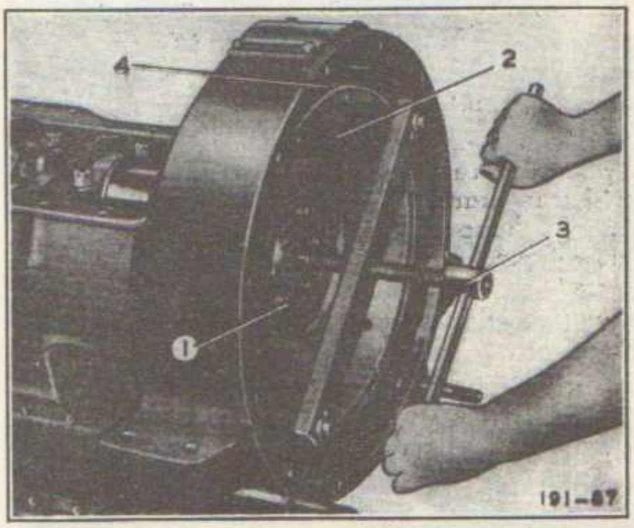


Fig. 60—Pulling Flywheel
(Tool—Mack Part No. 17-T-1432)

that neither the bolts nor bolt holes are damaged. The bolts have a tight body-fit and it is important that this be preserved. Care should also be taken that timing indicator pointer (4), at bottom of bell housing, is not bent when flywheel is removed. The greater hazard to this part is when engine is in upright position. This pointer is not an expensive part but disturbance of it destroys its usefulness for timing the engine.

Removing Flywheel Housing
(See Figure 61)

Also known as bell housing and engine rear support, the flywheel housing (1) is secured with capscrews (2) and there are dowel pins (3) for its positioning.

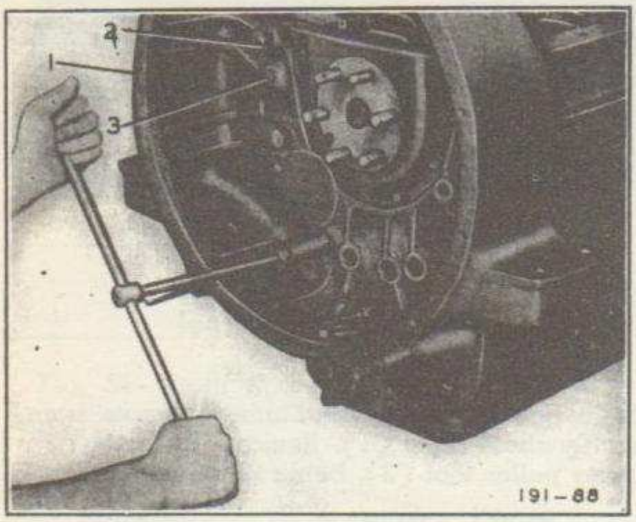


Fig. 61—View Showing Removal of Rear Support Capscrews

Remove eight housing capscrews (2) and lock washers. Remove housing by tapping it lightly at several places. Leave dowels (3) in place in crankcase. It is important that housing be tapped evenly to avoid damage to dowel pins as these have been carefully located and fitted so that housing flange will be precisely concentric with crankshaft and flywheel.

Removing Oil Slinger Housing
(See Figures 62 and 63)

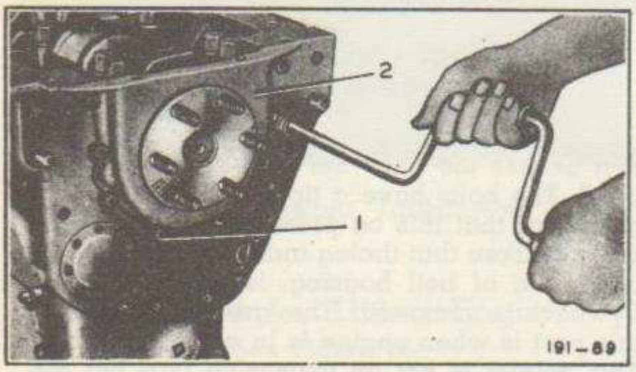


Fig. 62—View Shov'ing Removal of Capscrews from Oil Slinger Housing

(Refer to Figure 62)

Remove eight capscrews (1) and lockwashers and carefully loosen oil slinger housing (2).

Fig. 63—Illustrating Removal of Oil Slinger Housing

(Refer to Figure 63)

Withdraw oil slinger housing and in freeing it from crankshaft flange be careful not to damage lead seal (1).

Note: It is not necessary to remove screw plug (2) from end of main oil line except for cleaning; and end cover (3) at camshaft rear bearing need only be removed if camshaft bearings are to be renewed, or for cleaning.

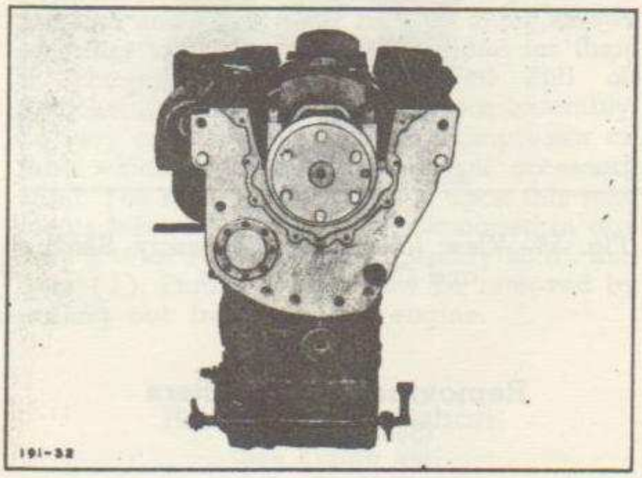


Fig. 64—Rear View of Engine with Flywheel Housing and Oil Slinger Housing Removed

To Clean Engine Oil Lines
(See Figure 65)

If it is necessary to clean engine oil lines, cylinder oil line bushing (6) shown at filter pad on left side of engine as shown on Figure 44.

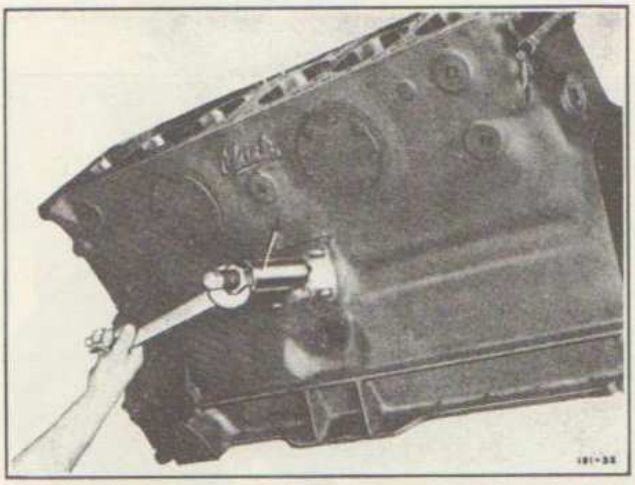


Fig. 65—Illustrating Removal of Oil Line Bushing

(Tool—Mack Part No. 17-T-1430)

Use puller having a ¾" 5-16 N.F. threaded spindle and spacer sleeve (1). Bushing has internal thread at outer end to facilitate its removal.

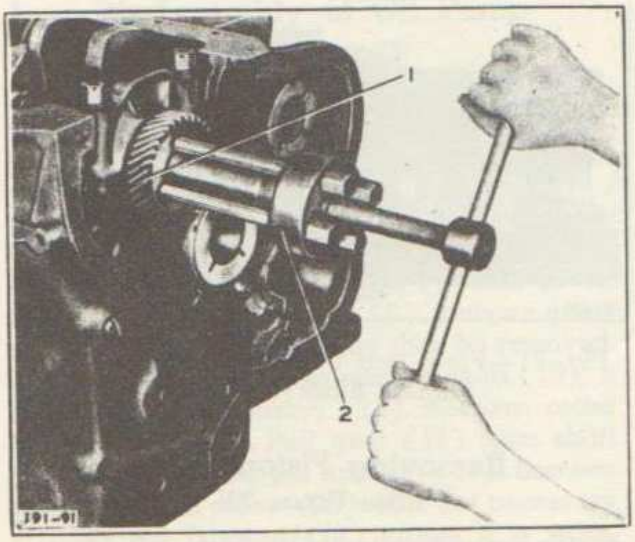


Fig. 66—Pulling Crankshaft (Timing) Gear

(Tool—Federal Stock No. 41-P-2905-60)

To Remove Crankshaft (Timing) Gear
(See Figure 66)

If it is necessary to remove crankshaft gear (1) it should be done at this point of procedure, using puller tool (2). Its removal is not necessary to removal of crankshaft.

Removing Crankshaft
(See Figure 67)

Note: The two long screws thru the front main bearing cap were removed to take off the oil pump as they serve to secure both pump and cap.

Cut and remove lock wires and remove all capscrews (1) which secure main bearing caps (2). Tap caps lightly, from front and rear, to free them from their tongue fits to the crankcase. Remove all caps and cap bearing shells. Any shells (3) which do not come out with caps should be carefully lifted off

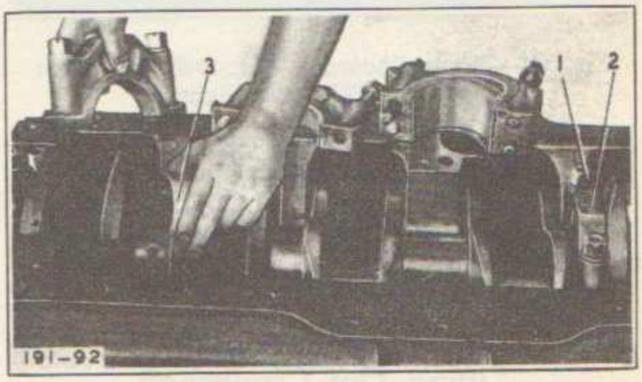


Fig. 67—View Showing Removal of Main Bearing Caps and Shells

shaft. Caps are numbered for correct re-assembly but shells must be carefully retained with caps as their positions must not be changed after engine has once been assembled and run. For greater surety and convenience they may be marked by scribing—not on the bearing surface, of course. Do not use a punch with hammer as shells may be damaged. Center and rear caps have a flange which affords easy removal thru prying directly upward with a small bar.

Removing Thrust Washers
(See Figure 68)

The thrust washer halves which bear against bearing cap are freed from assembly when cap is removed—see Figure 67.

Referring to Figure 68, remove halves of thrust washers (1) in crankcase by pushing them around with a thin implement (2), such as a steel measuring scale, while slowly turning crankshaft (3) until halves are turned sufficiently to afford a finger grip.

Fig. 68—View Showing Removal of Upper Halves of Thrust Washers

The upper and lower halves are different but washers at both sides of the bearings are alike. The lower, the cap halves, are locked by pin studs in the side faces of cap and thus the two-piece washers are prevented from turning.

Lifting Out Crankshaft

(See Figure 69)

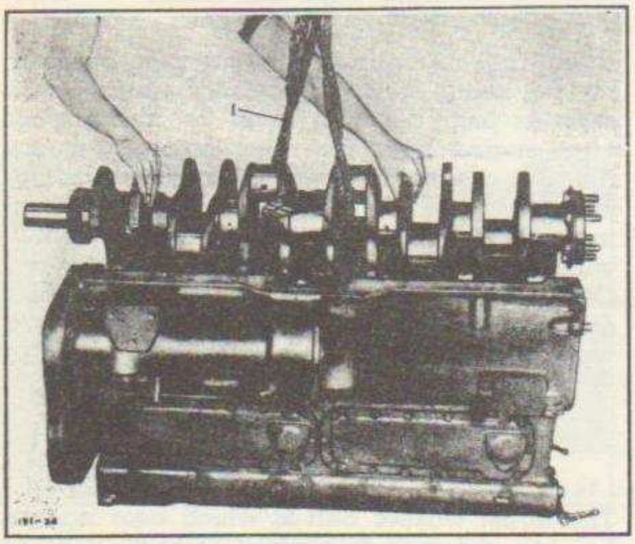


Fig. 69—Lifting Crankshaft from Bearings

Lift out crankshaft by using a rope sling (1) looped around the third and fourth connecting rod journals.

Removing Main Bearing Upper Half Shells

(See Figure 70)

Remove upper halves of main bearing shells (1), which must be retained with their respective caps and lower halves of shells to

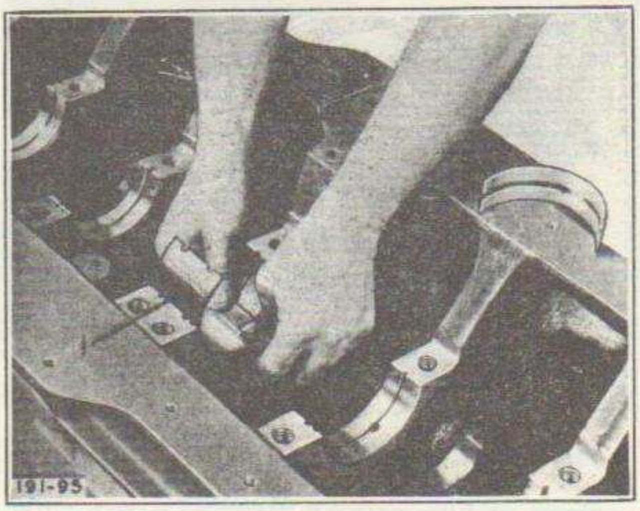


Fig. 70—Removing Main Bearing Shells

prevent mixing and changes of position. Shells may be marked by scribing as mentioned in connection with cap shells.

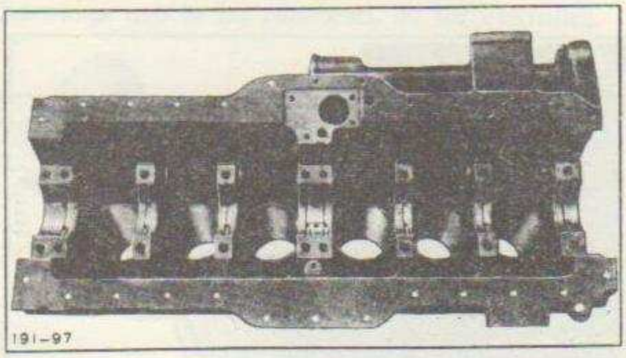


Fig. 71—View into Upper Crankcase With Engine Block Stripped

Removing Piston Rings

(See Figure 72)

A ring-expanding tool (1), Perfect Circle size 5", should be used when piston rings (2) are to be removed. Working without such a tool may result in breakages. Care should be taken that rings are not expanded more than necessary for removal as they may be broken or deformed.

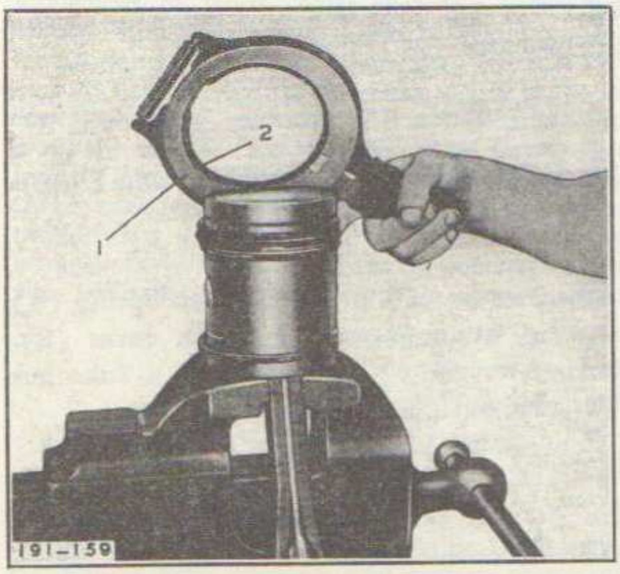


Fig. 72—Removing Piston Rings

(Tool—Perfect Circle size 5")

The ring installer tool has a limited movement and is therefore the safest type of tool for working on piston rings.

Dis-Assembly of Oil Pump

(See Figure 73)

Oil pump dis-assembly is best made at a bench.

Remove oil pump housing screw lock wire. Remove capscrews (1) and housing (2). Remove pump gears (3) and (4), then cover, or spacer, (5), and washer (6). Remove gears (7) and (8). Shaft (9) may then be removed. It is seldom necessary to remove shaft (10); it is pressed into housing (11). Remove cotter pin and nut (12). Pull gear (13) from shaft (9). Remove cotter pin and nut (14). Remove gear (15) and screw (16). It is not necessary to press out bushing (17) unless it is worn. Remove washer (18). It is not necessary to press out bushing (19) unless it is worn.

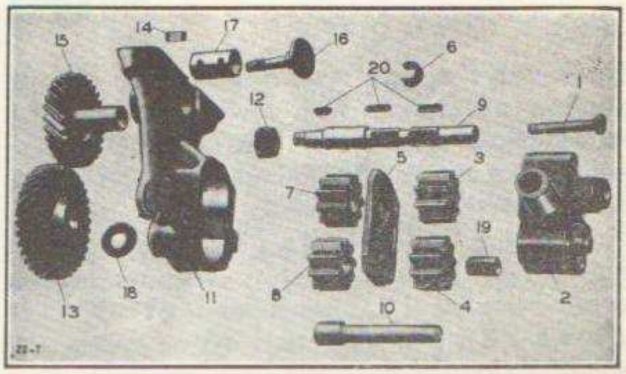


Fig. 73—Exploded View of Oil Pump

1. Capscrew	11. Housing
2. Housing	12. Driving Shaft Nut
3. Pumping Gear	13. Drive Gear
4. Pumping Gear	14. Drive Idler Nut
5. Cover (Spacer)	15. Drive Idler
6. Washer	16. Drive Idler Screw
7. Pumping Gear	17. Drive Idler Bushing
8. Pumping Gear	18. Thrust Washer
9. Driving Shaft	19. Pump Gear Bushing
10. Idler Shaft	20. Keys

Removing Valves

(See Figure 74)

Valve removal is most conveniently accomplished by a tool of the order shown in illustration.

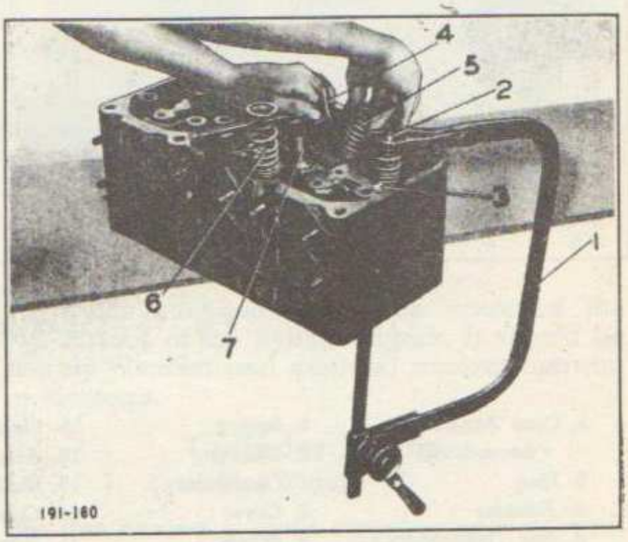


Fig. 74—View Showing Valve Spring Compressing Tool

(Tool—Federal Stock No. 41-L-1408)

Place valve spring compressing tool (1) in position as shown, with lower part against valve head and upper part against valve spring washer (2). Compress springs and while they are compressed remove the two valve spring washer keys (3), thus releasing valve (4) from assembly. Remove valve spring washer (2), inner and outer valve springs (5) and (6) and valve guide oil shield (7).

DIS-ASSEMBLY OF PRIMARY OIL FILTER
(See Figure 75)

Remove handle (21) on top by removing nut (23). Loosen stuffing box, or gland, nut (19). Remove nut (16) and gasket (15). Remove case (14). Pull out bar (10) and arm (12). Remove filter element (11) by unscrewing, in a counter-clockwise direction. Remove relief valve cap (30) and take out spring (28) and plunger (27).

DIS-ASSEMBLY OF SECONDARY OIL FILTER
(See Figure 75)

Loosen screw (9), at top of filter. Spring (6) may be left on screw (9), with cover (8). Remove cover (8) and gasket (7). Take out filter element (5).

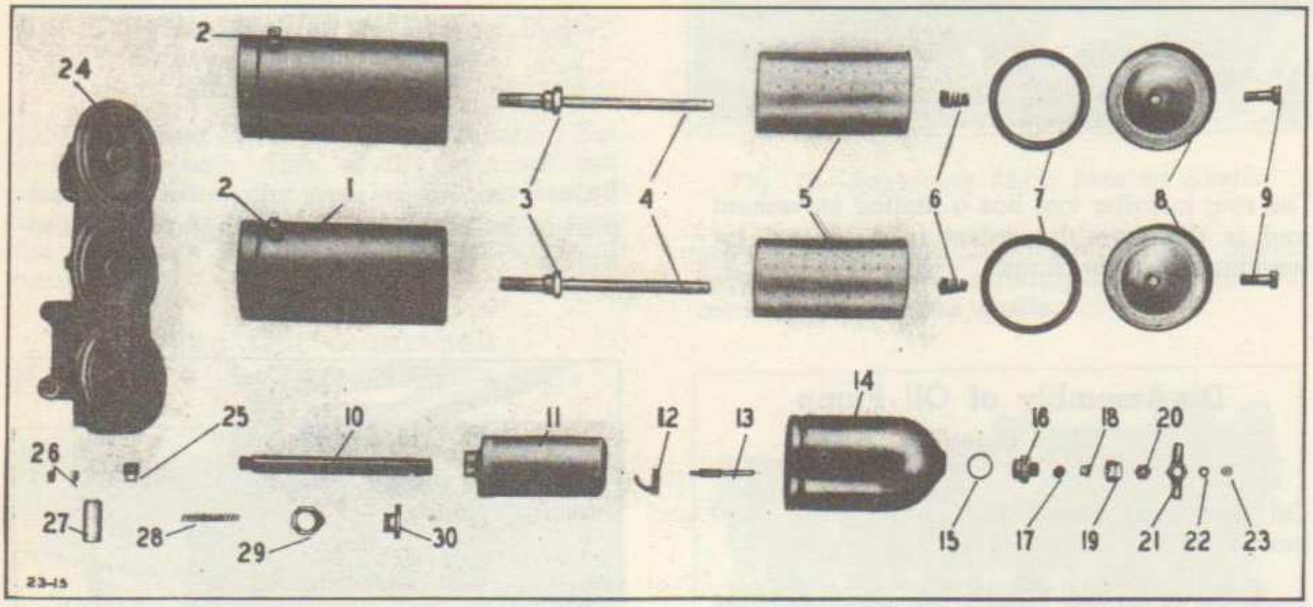


Fig. 75—Exploded View of Oil Filter

1. Core Assembly (Secondary)
2. Plug
3. Adapter
4. Bar (Secondary)
5. Element (Secondar-)
6. Spring
7. Gasket (Secondary)
8. Cover
9. Screw
10. Bai Assembly (Primary)
11. Element (Primary)
12. Arm
13. Shaft
14. Case (Primary)
15. Gasket (Primary)
16. Nut
17. Packing
18. Gland
19. Nut
20. Washer
21. Handle
22. Lockwasher
23. Nut
24. Bracket
25. Plug
26. Plug
27. Plunger
28. Spring
29. Washer
30. Cap

SECTION 5: REPAIRS

NOTE: Before re-assembling, all parts should be thoroly cleaned, using suitable solvents when necessary, to remove all traces of dirt and oil; and inspected carefully for cracks or evidences of wear. Parts showing wear that would impair their usefulness or would have a detrimental effect upon other parts in assembly should be renewed. Most gaskets and oil seals are preferably renewed. All cotter pins, star washers and locking wires must be renewed to insure against failure. All bearing points, thrust washers, gears, oil seals, etc., should be generously coated with oil. This will insure immediate lubrication of these parts and prevent seizure when first starting.

Cylinder Block

(See Figures 76 and 77)

While the block is so designed and of such material that cracks are a rarity even after extremely high mileage and severe operating conditions, advantage should be taken when engine is dis-assembled to make a searching examination of the entire block (29, Figure 77) for cracks and fissures. It may be expected that even the smallest crack, if not repaired, will become larger during continued operation and eventually cause such failure that a new block may be required. The location, the extent and the nature of a crack all must be considered in determining if a permanent repair can be effected. A small repair may be the means of continuing a block in service indefinitely; neglect of a minute crack may lead to block renewal.

Cylinder bores should be carefully inspected. Surfaces must, of course, be in good condition, free from any damage such as scoring. Even tho bore surfaces are perfect, after long operating periods, cylinders should be checked for wear. An inside micrometer is used for this; or, for greater convenience and quick accuracy, an indicating or dial-type gage may be used. Measurements should be in several directions at a number of places thruout the bore length, so as to discover any out-of-round and/or taper. A thoro inspection can be both of certain accuracy and quick with a dial type of gage as variations are easily read thruout a complete traverse of the bore surface which requires but little time. As the preceding indicates, wear detrimental to operation must be considered in terms of micro measurements.

(See Figure 76)

The standard size cylinder bore is honed to 5.0000-5.0005. It is permissible to rebore up to .060 oversize. Reboring should be only to the extent of restoring bore accuracy, and in accordance with oversize pistons and running clearance as covered under the subject of "Piston" in this section.

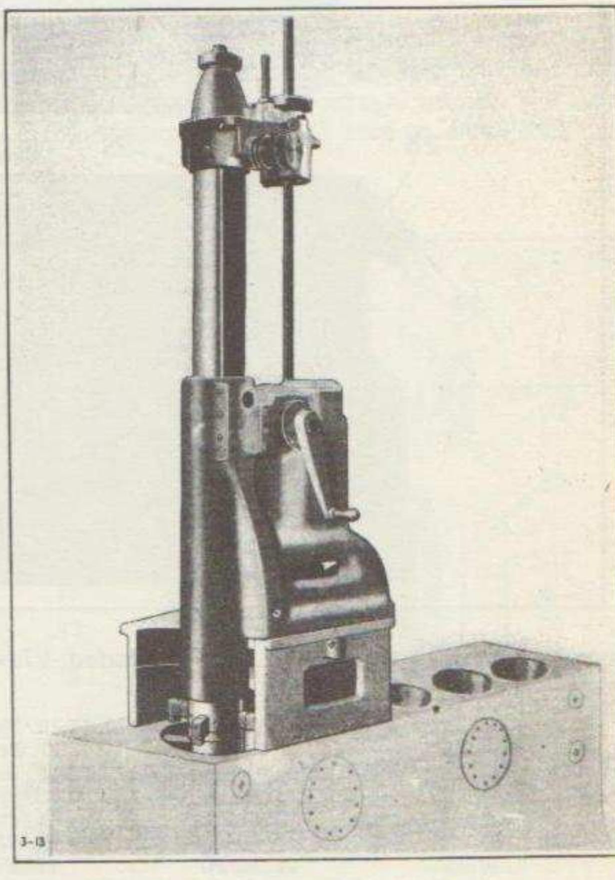


Fig. 76—Reboring Cylinder Using Motor-driven Boring Bar
(Tool—Federal Stock No. 40-M-6)

Particular attention should be accorded the top surface of the cylinder block. It should be thoroly cleaned and guarded against marring or damage.

Cylinder Heads

(See Figure 77)

Besides having a thoro cleaning with particular attention given to the condition of their bottom surfaces, cylinder heads should be carefully examined for cracks. It is seldom necessary to renew a head even after long service.

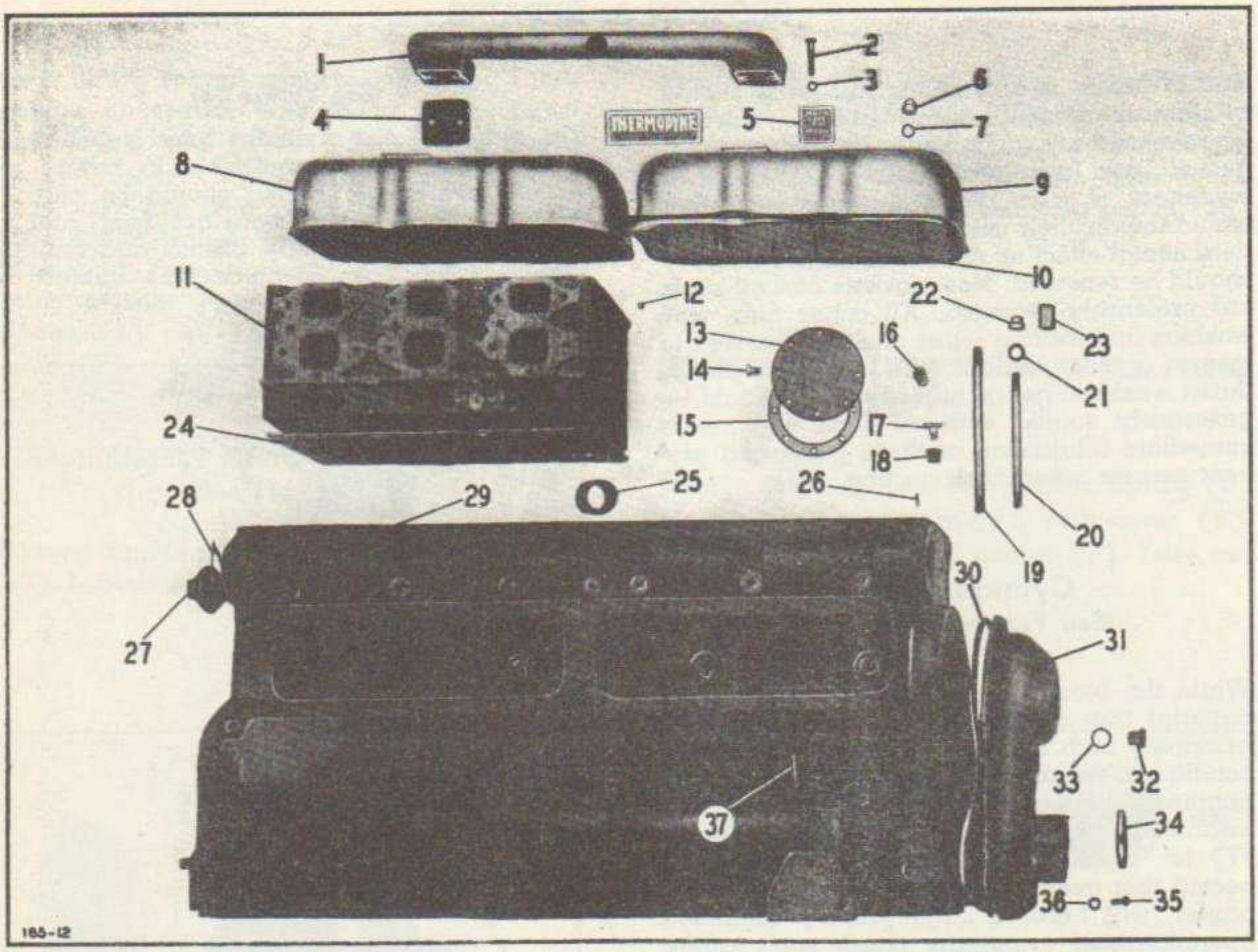


Fig. 77—Exploded View of Cylinder Block and Head

1 Breather Pipe
2. Screw
3. Washer
4. Baffle
5. Instruction Plate
6. Nut
7. Washer
8. Cover (Rear)
9. Cover Assembly (Front)
10. Gasket
11. Head
12. Plug
13. Cover
14. Screw
15. Gasket
16. Plug
17. Drain Valve
18. Reducer
19. Stud (Long)
20. Stud (Short)
21. Washer
22. Nut
23. Nut
24. Head Gasket
25. Valve Insert
26. Dowel
27. Cover
28. Gasket
29. Cylinder Block
30. Gasket
31. Cover Assembly
32. Plug
33. Washer
34. Retainer
35. Screw
36. Washer
37. Guide

Cylinder Head Gaskets

(See Figure 77)

It is preferable to use new head gaskets. A gasket about which there is any question should never be used. Even if gaskets show no evidence of burns or other defects, re-use is an expedient rather than the choice.

Beyond cleaning no attempt should be made to re-condition a gasket. Endeavor to have new gaskets on hand when making repairs.

Crankshaft

(See Figure 78)

After high mileage, it may be necessary to regrind crankshaft journals and install under-size bearings. Finished bearings are furnished for this purpose, in under-size of .010-.020-.030, .040 and .050.

Check and straighten the shaft, if necessary. This, however, should not be attempted without adequate facilities including a precision indicator, as crude means can promise no success.

Then grind the journals to the desired size shown in the following table, to be not more than .0005 larger or .0005 smaller—and preferably to be larger rather than smaller. Check micrometer with gage before beginning work.

SIZE	#1, 2, 3, 5 & 6	#4 & 7
Standard	3.4975	3.4965
.001 Under	3.4965	3.4955
.002 Under	3.4955	3.4945
.010 Under	3.4875	3.4865
.020 Under	3.4775	3.4765
.030 Under	3.4675	3.4665
.050 Under	3.4475	3.4465

Journal Diameters

Crankshaft Main Bearings

(See Figures 78, 79 and 80)

If the crankshaft main bearings have to be renewed, be sure to wipe all dirt and oil from bearings and also from the bores in crankcase and caps before installing the bearing shells. These precision bearings do not require boring or scraping and the burnished finish should not be marred by such methods.

The desired running clearance for bearings, numbers 1, 2, 3, 5 and 6 is .0015 free to .0035 lock. For the larger bearings, numbers 4 and 7, the clearance is .0025 free to .0045 lock.

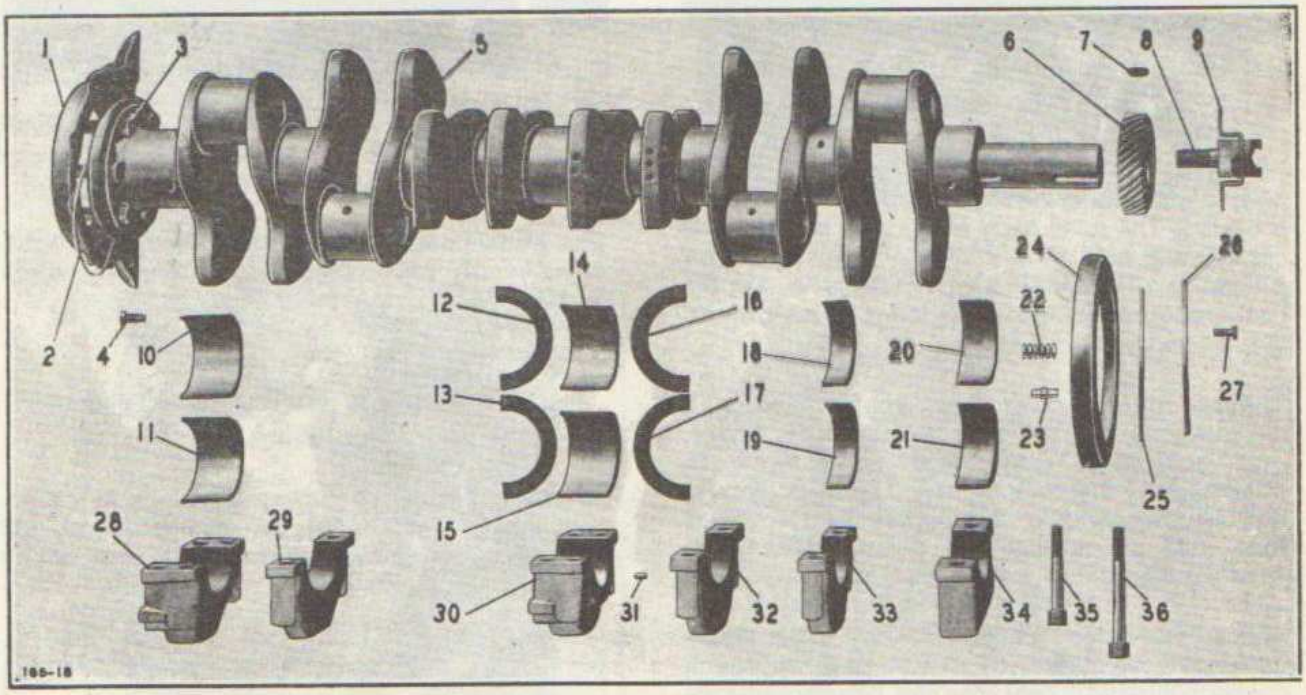


Fig. 78—Exploded View of Crankshaft Assembly and Bearings

1. Oil Seal Housing
2. Oil Seal Ring
3. Flywheel Bolt
4. Screw
5. Crankshaft
6. Gear
7. Key
8. Crank Jaw
9. Jaw Lock
10. Rear Bearing (Upper)
11. Rear Bearing (Lower)
12. Thrust Washer
13. Thrust Washer
14. Center Bearing (Upper)
15. Center Bearing (Lower)
16. Thrust Washer
17. Thrust Washer
18. Int. Bearing (Upper)
19. Int. Bearing (Lower)
20. Front Bearing (Upper)
21. Front Bearing (Lower)
22. Spring
23. Dowel
24. Ring (2)
25. Friction Ring (2)
26. Plate
27. Screw
28. Cap
29. Cap
30. Cap Assembly
31. Pin
32. Cap
33. Cap
34. Cap
35. Screw
36. Screw

Note: Fan driving pulley, an integral portion of which is the vibration damper hub, is shown on Figure 12 (28).

After installing new bearings, it is important to check the running clearance (tightening one bearing cap at a time) by inserting a piece of brass shim stock (½" wide and ¼" shorter in length than that of the bearing being tested) between the bearing and the shaft,

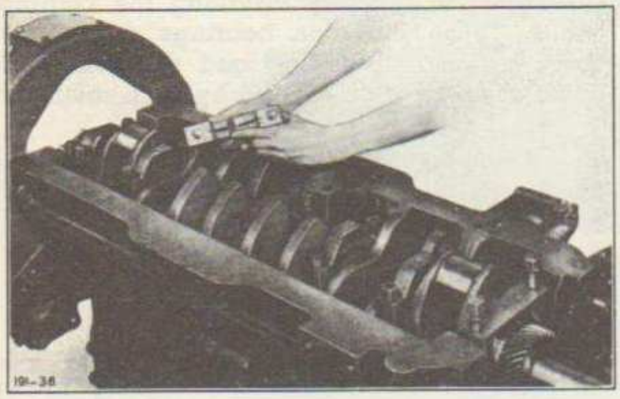


Fig. 79—Installing Center Main Bearing Cap—Checking with Shim Stock

and turning shaft several complete revolutions by hand. The shim may be placed in the more convenient half of the bearing, but must be placed in a fore and aft position with respect to the engine. Do not wrap length-wise around the bearing.

The bearing must be free when tested with shim equal in thickness to the free figure, and lock when tested with shim equal in thickness to the lock figure. The lock should not require use of a shim appreciably greater than .001 above the lock figure given. If it does clearance is excessive.

When testing for lock, proceed by using shims progressively thicker by .001 so as to approach the lock slowly. Otherwise the bearing surface may be damaged. Brass shim stock is available commercially in .0005 steps, from .001 to .005 thick.

EXAMPLE

With a .0015 shim, bearing number 1 should be free of any drag when shaft is rotated by one hand grasping the counterweight; with a .0030 shim, perceptible drag should be felt and with a .0035 shim considerable effort should be required to "break" the "lock" and continue turning, when grasping flywheel, or using hand crank.

The need for accuracy in bearing fitting cannot be overstressed, if long life is expected. Make measurements carefully and hold all clearances to within the tolerance given. No shims are used, and under no circumstances should the crankcase or main bearing cap be filed to compensate for bearing wear.

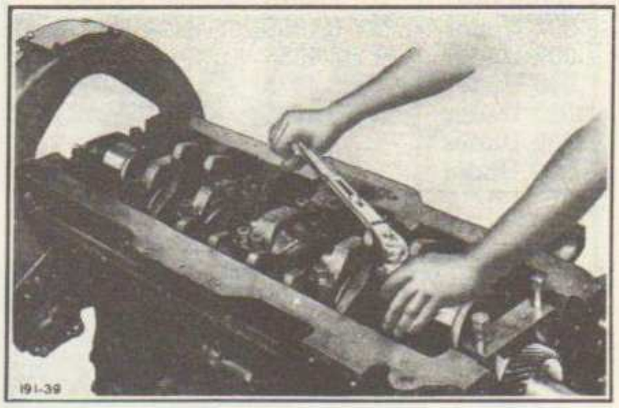


Fig. 80—Tightening Main Bearing Capscrews
(Tool—J. H. Williams Part No. S-57)

The main bearing cap screws should be tightened evenly and to the correct tension, which is 100 to 105 pound-feet.

Crankshaft Thrust Washers

(See Figure 81)

When crankshaft end-play develops to an extent that it is apparent, thrust washers should be inspected and if appreciably worn they should be renewed.

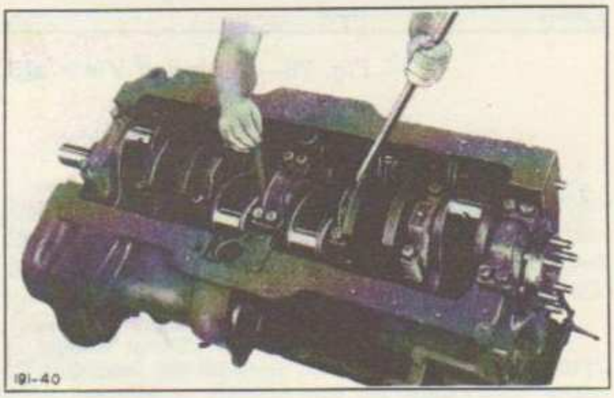


Fig. 81—Checking Thrust Washer Clearance with Feeler Gage
(Tool—Federal Stock No. 41-G-400)

They may be rotated in place in a manner similar to the bearing shells and also without removing the crankshaft. The upper and lower halves are different, but the same washers are used for both sides. A pin located in the lower half prevents the washers from turning. The end play for crankshaft is .004 to .011, and is adjusted by means of two thicknesses of washers .090-.091 and .092-.093.

Care should be taken in determining the clearance. This can best be measured by first moving the crankshaft as far as it will go in one direction and then, after washers have been put in place, running a feeler gage of correct thickness completely around both halves of the bearing. Re-check clearance after cap has been bolted up tightly but before screws are wired.

Crankshaft Oil Seal

(See Figures 82 and 83)

If a new crankshaft is installed, insert a new lead ring in the slinger housing. When re-installing the same crankshaft, the old lead ring may be left in place if careful examination indicates it to be free from nicks, cuts or low spots. If damaged in any way, renew it as follows:

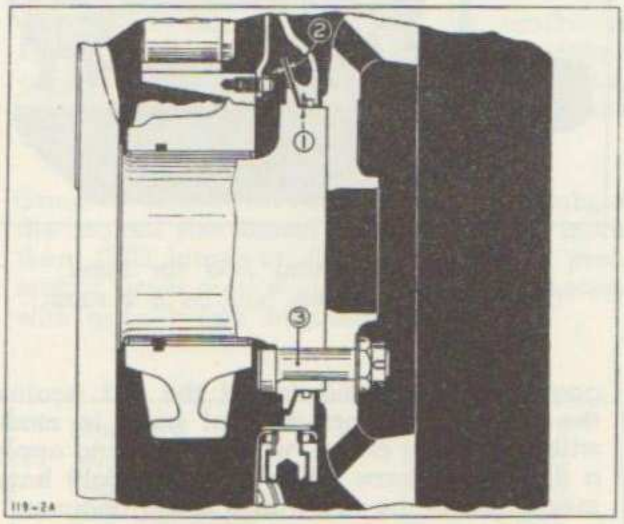


Fig. 82—Sectional View Thru Rear Oil Seal

1. Radial Clearance 2. End Clearance 3. Flywheel Bolt

Using the tips of the fingers, carefully press a new lead ring into the groove of slinger housing until it is well seated all around with ends just touching. Clamp the housing in a vise and with a steel roller such as a discarded piston pin held tightly with both hands, draw roller with uniform pressure around lead ring to flatten it evenly and just enough to permit

Fig. 83—View Showing Method for Sizing Lead, Oil-sealing Ring

the housing and insert assembly to be subsequently tapped lightly in place on the crankshaft, so that the flange actually sizes the lead insert to a metal-to-metal fit around the shaft. Then complete installation as given under "Section 7: Re-assembly", "Oil Slinger Housing."

The lead ring will project about .008" beyond the bore of the housing to take up the radial clearance (1) in Figure 82. The end clearance (2) is .035-.045". The flywheel bolts (3) have a drive fit of .002" in the crankshaft flange.

Flywheel

(See Figure 108)

Barring damage due to accident, the flywheel seldom needs repairs.

If the clutch disk surface has become scored, rough, or has suffered from heating it should be refinished, see "Group 02: Clutch".

The starter ring gear should be renewed if the teeth are damaged or badly worn. This part is removed by heating with a torch to expand it. The heating of a new gear, to shrink it onto the flywheel, should be done carefully. The entire gear should be heated evenly and only enough to permit tapping onto its seat. Excessive heat will destroy the qualities given the gear by its heat treatment. Guard against heating to an extent that the gear shows any color change. Gear must be seated firmly against the flywheel shoulder and be tight when allowed to cool.

Vibration Damper

(See Figure 84)

At the time of major overhauls, the vibration damper should be inspected for wear, both in the hub diameter as well as the friction disks. Excessive wear, particularly at the hub, would not only prevent the damper from functioning as it should, but would bring about an out-of-balance condition thru oscillation, which would cause severe vibration resulting in what might be inaccurately diagnosed as wear in timing gears.

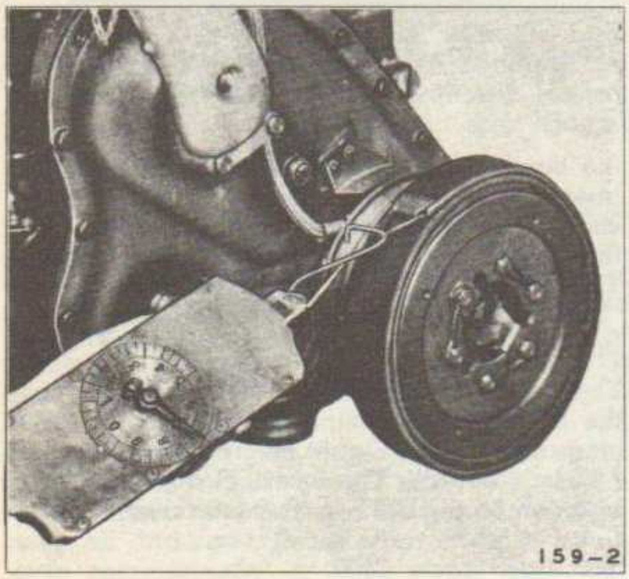


Fig. 84—Testing Vibration Damper

Friction disks may be tested by wrapping a strong canvas tape around the circumference of the damper and attaching a scale to the end of tape. A pull of 100 pounds should be required to overcome the initial "stick" and when turning has commenced, a pull of 60 pounds should be required to continue turning.

When damper resists too weakly, investigate for weak springs and/or worn friction disks. Renew defective parts. When resistance is too strong dis-assemble and thoroly clean friction surfaces.

Connecting Rod

(See Figures 85 and 86)

Check alignment of connecting rod. It should be inspected for bend and twist. When existent, these are seldom to any great degree and therefore precision facilities are necessary for their detection and correction. Rod must be straightened before checking for twist.

(See Figure 85)

When checking for bend, the rod is chucked in the center of the expanding sleeve with the gage positioned endwise of the rod against the piston pin. Correction of bend is made with a bending clamp, using a screw to apply a downward force while applying light hammer blows to the rod with a small hammer.

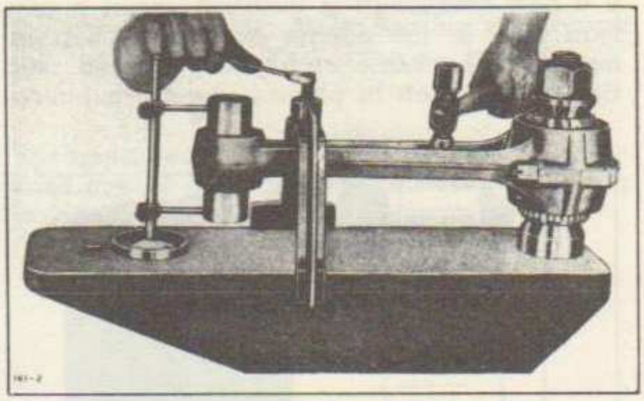


Fig. 85—Correcting Rod for Bend
(Tool Federal Stock Nos. 41-A-135 & 41-P-2730)

After bending, twisting or hammering a rod, always turn the nut back to release the rod and then tighten it up again, in a neutral position, before rechecking.

(See Figure 86)

When checking for twist, place the gage sidewise of the rod against the piston pin. Correct twist by using a bending bar and light hammer blows. A heavy hammer should never be used.

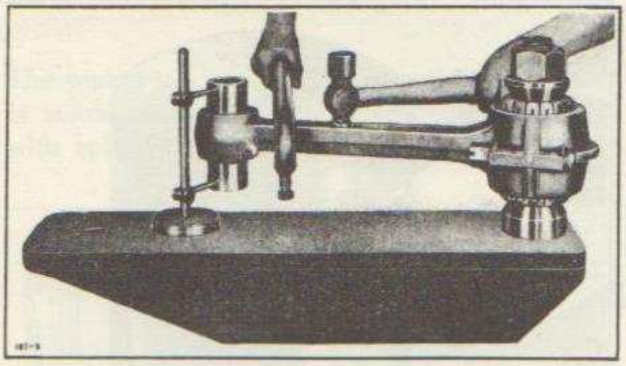


Fig. 86—Correcting Rod for Twist

A rod which is in poor condition should be renewed.

Bearings are separately covered, see "Connecting Rod Bearing" and "Piston Pin" in this section.

Connecting Rod Bearing

(See Figures 87, 88 and 89)

The connecting rod bearing. are similar to the main bearings, and the same instructions as given for the main bearings should be used, except regarding dimensions of the crankpins which are as given here.

Grind the crankshaft connecting rod journals to the desired size shown below, to be not more than .0005 larger or .0005 smaller—and preferably larger than smaller. Check micrometers with gage before beginning work.

Standard	2.9975
.001 Undersize	2.9965
.002 Undersize	2.9955
.010 Undersize	2.9875
.020 Undersize	2.9775
.030 Undersize	2.9675
.050 Undersize	2.9475

Crankpin Diameters

The running clearance for these bearings is .0015 free and .0030 lock. The "lock" should not require shims appreciably greater than .0040. Tighten capscrews evenly and to the proper tension of 145 to 150 pound-feet. The side play should be from .006 to .012.

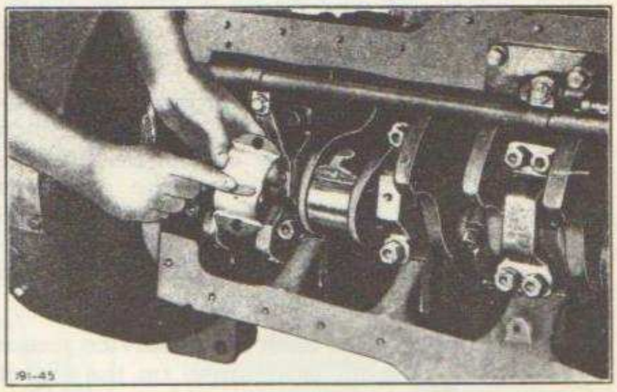


Fig. 87—Checking Connecting Rod Bearing Clearance with Shim Stock

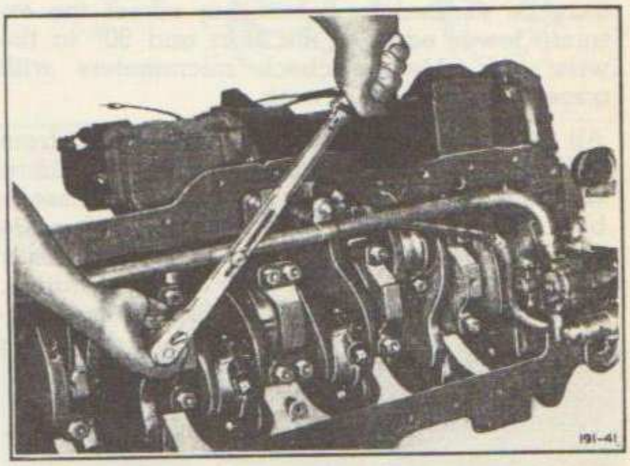


Fig. 88—Tightening Connecting Rod Caps
(Tool—J. H. Williams Part No. S-57)

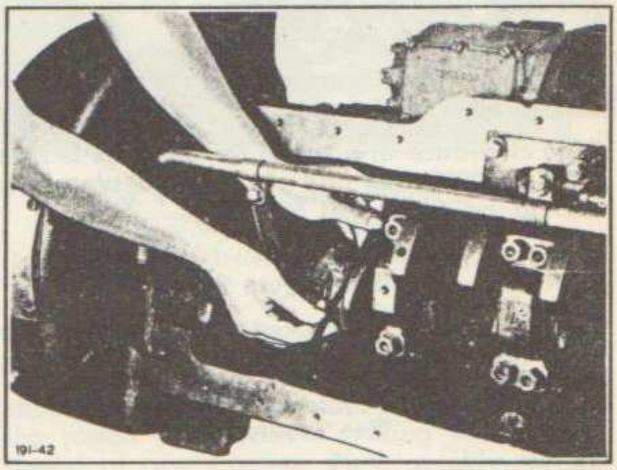


Fig. 89—Checking Connecting Rod Side Clearance with Feeler Gage
(Tool—Federal Stock No. 41-G-400)

Piston
(See Figure 92)

Pistons are available in standard and oversizes of .010, .020, .030, .040, .050 and .060. Since they are cam ground, they cannot be "turned-down to fit an odd size bore. The cylinders must be rebored to fit the specific oversize piston with allowance made for running clearance, when measured with a feeler gage of .004, see "Cylinder Block" in this section.

The exact diameter of each Mack service piston to half a thousandth is stamped on the top of the piston. To this must be added the clearance to determine the size to bore cylinder, which may be done in a portable boring tool. Cylinders, after boring, should be honed smooth with proper honing tool. The piston size may be verified by measuring across the extreme lower edge of the skirt and 90° to the wrist pin. Always check micrometers with gage before starting work.

All Mack oversize pistons are made from individual patterns, being cored to obtain a common wall thickness. An engine is assembled with pistons which do not vary more than ¼ of an ounce in weight. This insures a smooth running engine free from vibration. This may not be so if pistons other than genuine Mack are used, a caution deserving attention when pistons are renewed.

Piston Rings
(See Figures 90 thru 94)

Care should be exercised when installing the oil rings to see that the beveled edge marked "Top" is placed toward the top of the piston. Oversize rings are available in the same sizes as given for the pistons above.

The width of compression rings is .123-.124 and of oil control and oiling rings, .1855-.1865.

Side clearance in grooves for all rings is from .0015 to .0035. The gap of these butt-type rings should be from .020 to .030.

(See Figure 90)

Side clearance is checked with a feeler gage with ring in piston slot.

(See Figure 91)

Ring is checked for gap clearance, with a feeler gage with ring inserted in the cylinder bore parallel with and about 1" below top surface of block.

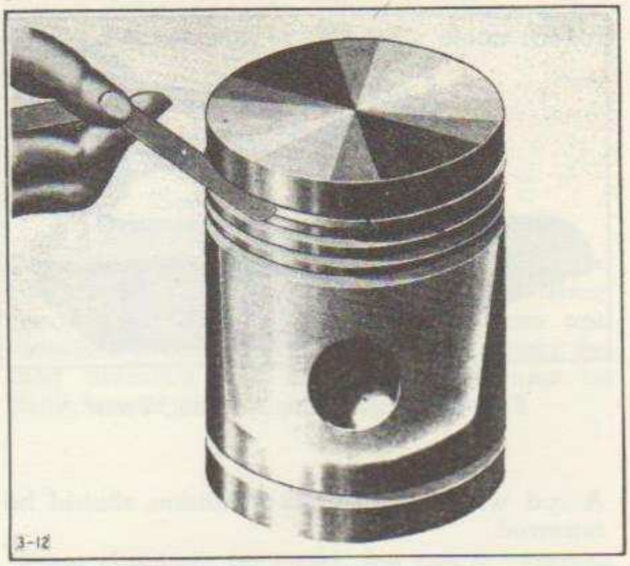


Fig. 90—Checking Piston Ring Groove Clearance with Feeler Gage
(Tool—Federal Stock No. 41-G-400)

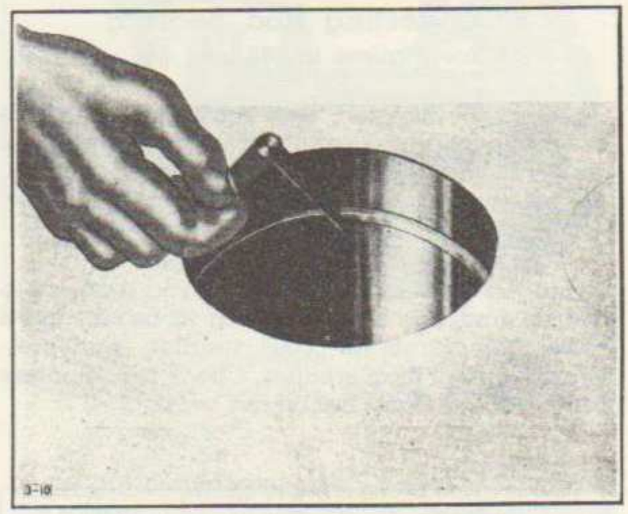


Fig. 91—Checking Piston Ring Gap Clearance with Feeler Gage
(Tool—Federal Stock No. 41-G-400)

(See Figure 93)

A ring installer should be used when putting rings on pistons. Rings may be distorted or broken if this tool is not used.

(See Figure 94)

When inserting pistons in cylinders a ring compressor should be employed. It facilitates the operation and insures against injury of ring surfaces and edges.

Piston Pin
(See Figure 92)

The piston pin is of the full-floating type, and is retained by telescoping aluminum buttons with spherically ground ends, or as an alternate, snap rings for which there is provision in all pin bores. Be sure to use proper piston pin in each case, see Figure 123.

The end float is from .008 to .017.

It is 1 7/16" in diameter, the standard pin being ground and lapped to size of 1.4369-1.4372.

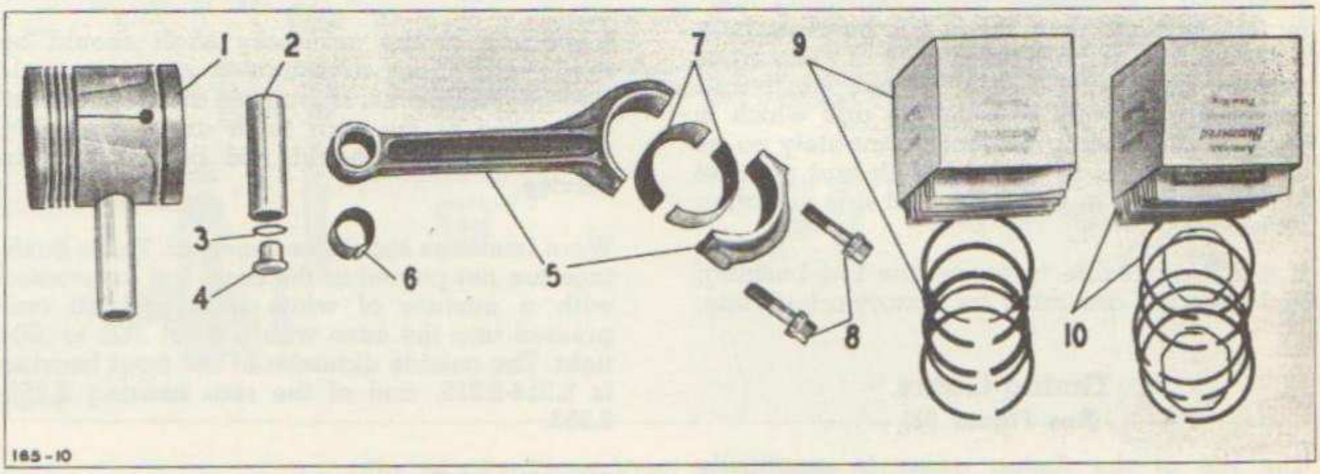


Fig. 92—Exploded View of Piston and Connecting Rod Assembly

1. Piston and Piston Pin Service Assembly
2. Piston Pin
3. Spacer
4. Button (alternate, snap ring)
5. Rod Assembly
6. Bushing
7. Bearing
8. Screw
9. Rings
10. Rings

Fig. 93—Inserting Piston Using Ring Compressor
(*Tool—Federal Stock No. 41-C-2550*)

Fig. 94—Expanding Piston Ring Using Ring Installer
(*Tool—Perfect Circle size 5"*)

The pin is fitted directly into the piston bosses with a press of .0002 as expained below. Pins should be selected to obtain this fit. First place the piston in a pail of boiling water for a period of two minutes. Then quickly try pin in piston. It should slide in with a slight push of the thumb.

The pin runs in a thin-shell of hard rolled bronze, burnished into the connecting rod and diamond-bored to give a running clearance of from .0003 to .0004. At ordinary room temperature, of about 70° F., the pin should slide in the connecting rod bushing with slight push of the thumb.

Piston pins are turnished in oversize of .003 and .005. Check the rod for alignment and straighten if necessary, see "Connecting Rod" in this section; then the worn bushing may be ground in a hole grinding tool. This must only be done with a suitable tool, which will hold the rod firmly in a fixture and which is capable of grinding the hole accurately so as to be concentric its entire length and parallel to the crankpin in both plan and side elevation views.

It is not advisable to renew the rod bushing; exchange rod assembly for factory-rebuilt one.

Timing Gears
(See Figure 95)

The life of the timing gears is practically unlimited and rarely is it necessary to renew gears because of wear or noise. They do, however, deserve inspection during overhauls.

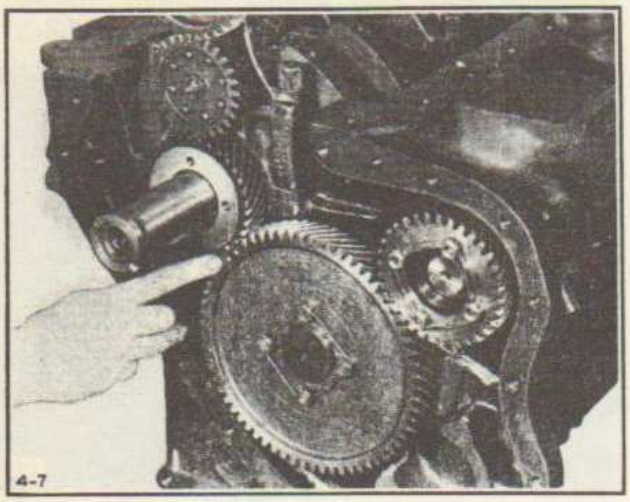


Fig. 95—View Showing Teeth Marked for Correct Valve Timing

The back-lash of these gears is held between .0005 and .0015. The gears are center-punch marked, and when the tooth of the gear having the single mark is located between the two marked teeth of the meshing gear, the valves will be timed correctly, if the letter (O) stamped on both crankshaft flange and flywheel are lined up, see "Section 7: Re-assembly."

These gears are manufactured to run in sets, and should preferably be replaced in sets fc best performance.

Accessory Shaft
(See Figure 96)

Inspection of the accessory shaft should be made with close examination of its journals and gear elements. If journals are in poor condition and/or the gear teeth are appreciably worn the shaft should not be retained in service.

Worn bushings should be renewed. These bushings are not pinned in the case, but are coated with a mixture of white lead and oil and pressed into the case with a fit of .002 to .004 tight. The outside diameter of the front bearing is 2.314-2.315, and of the rear bearing 2.252-2.253.

They are of the prefinished type and are fitted with a running clearance of from .0015 to .003, the desired clearance being .0025. The size of accessory shaft front journal is 2.061-2.062, and of the rear journal 1.998-1.999. The end play of from .008 to .014 is adjusted by backing off the thrust button ¼ turn from finger tight.

When renewing these bushings be sure to line up oil hole with oil feed line in case.

Camshaft
(See Figure 97)

All cams and journals should be carefully examined. Journal conditions that are detrimental to accuracy and durability of bearings and/or cams which show evidences of surface failure or considerable wear are reasons for renewal.

Worn bushings should be renewed. These bushings are not pinned in the case, but are coated with a mixture of white lead and oil and pressed into the case with a fit of from .002 to .004 tight. The outside diameter of bearings is 2.626-2.627.

They are of the prefinished type and are fitted with a running clearance of from .0015 to .003, the desired clearance being .0025. The size of camshaft journals is 2.251-2.252. The end play of from .008 to .014 is adjusted by backing off the thrust button ¼ turn from finger tight.

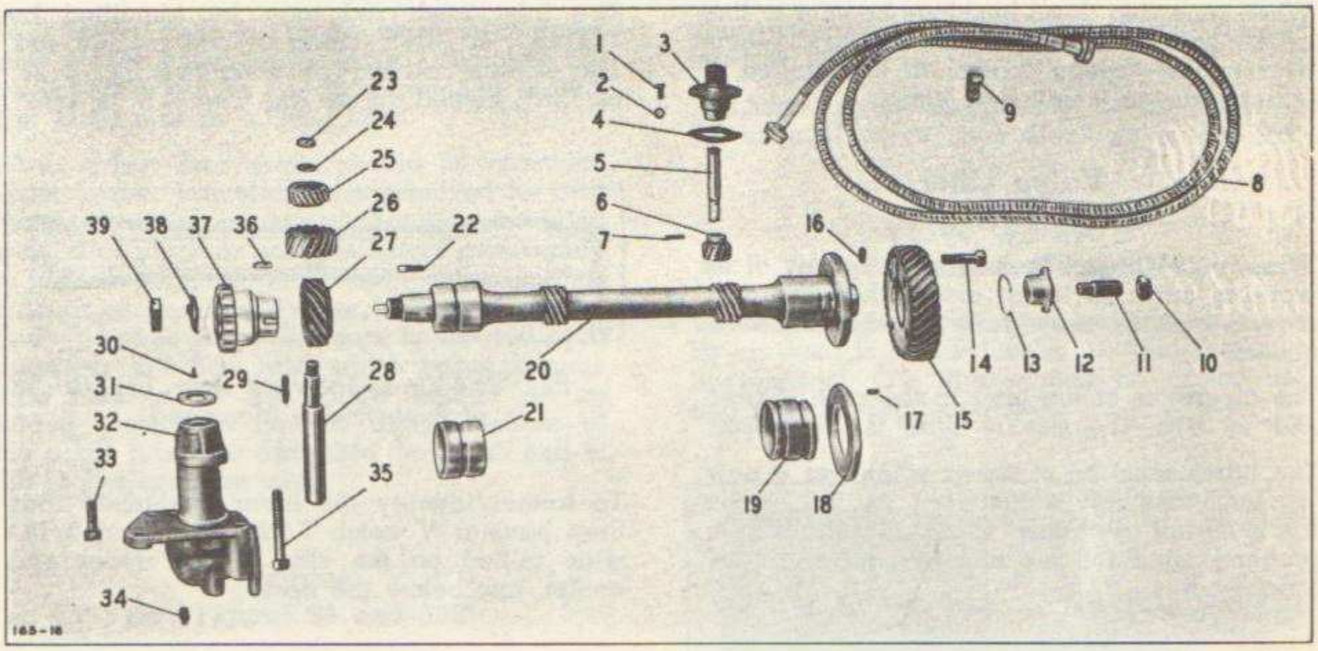


Fig. 96—Exploded View of Accessory Drive

1. Screw
2. Washer
3. Tachometer Drive Housing
4. Gasket
5. Tachometer Drive Shaft
6. Tachometer Drive Gear
7. Pin
8. Cable
9. Cable Clamp
10. Nut
11. Thrust Screw
12. Thrust Button
13. Snap Ring
14. Screw
15. Driving Gear
16. Key
17. Pin
18. Thrust Washer
19. Front Bushing
20. Accessory Shaft
21. Rear Bushing
22. Key
23. Nut
24. Washer
25. Governor Gear (Upper)
26. Governor Gear (Lower)
27. Governor Gear (Driving)
28. Governor Idler Shaft
29. Key
30. Pin
31. Washer
32. Governor Idler Shaft Housing
33. Screw
34. Plug
35. Screw
36. Key
37. Compressor Sprocket
38. Nut
39. Lock

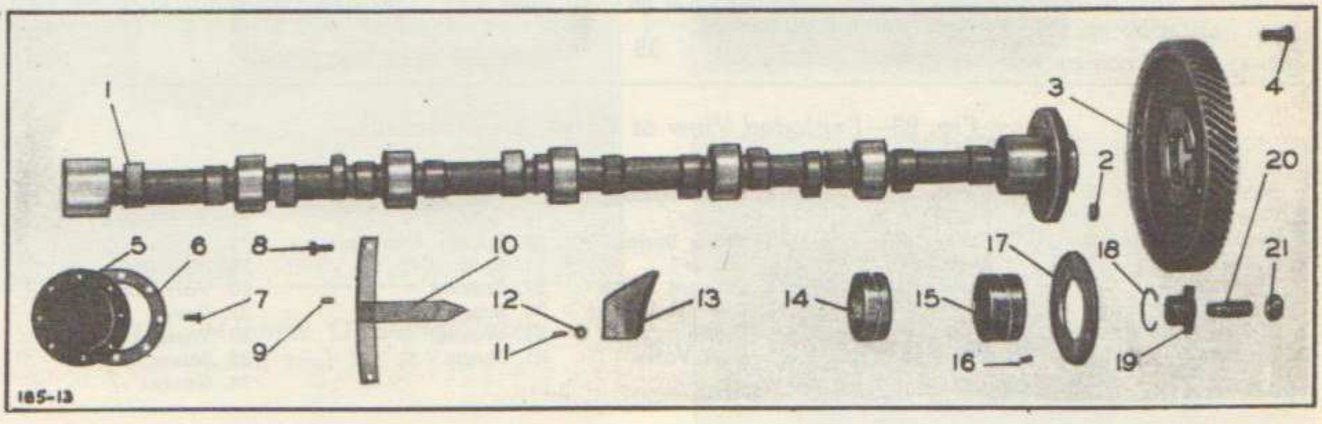


Fig. 97—Exploded View of Camshaft Arrangement

1. Camshaft
2. Key
3. Gear
4. Screw
5. Rear Cover
6. Gasket
7. Screw
8. Screw
9. Dowel
10. Timing Indicator (Flywheel)
11. Screw
12. Washer
13. Timing Indicator
14. Intermediate Bushing
15. Front and Rear Bushing
16. Pin
17. Thrust Washer
18. Snap Ring
19. Thrust Button
20. Thrust Screw
21. Nut

When renewing these bushings be sure to line up oil hole with oil feed line in case. Whenever a new "green" camshaft is installed, it is important to install new lifters.

Valve Lifter
(See Figure 98)

When valve lifter becomes worn at any of its working surfaces to an extent that accuracy of valve action may suffer, it should be renewed.

The clearance of the lifter in the case is from .001 to .002. The size of lifter is .6855-.6860.

The lifters must be renewed whenever a new "green" camshaft is installed, as the Ferrox treatment of the new lifters is required to properly condition the noses of the cams for long wear.

The inlet push rod may be identified by "#114A" or "IN". being etched on the rod. The exhaust rod may be identified by "#124" or "EX". etched on the rod. The O.D. is 9/16".

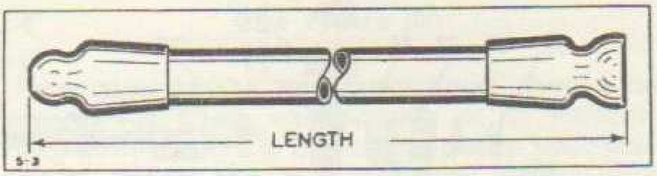


Fig. 99—View Showing How Length of Push Rod is Measured

To further identify the Invar (exhaust) rods they have a V notch 1/32" wide and 3/16" wide milled on the side of the upper end socket, just below the neck.

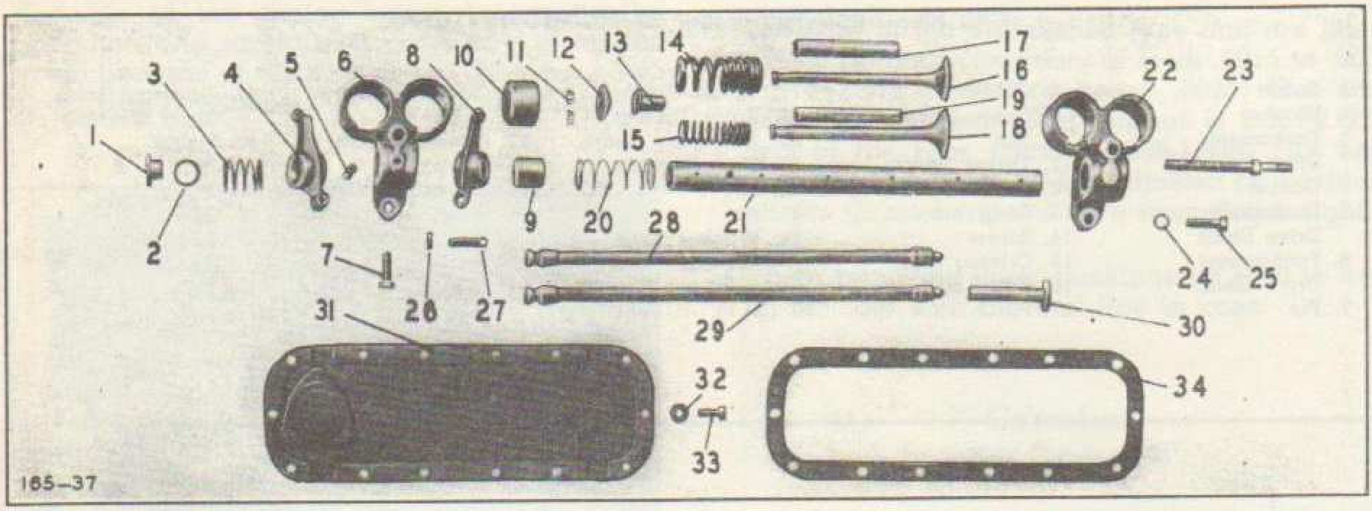


Fig. 98—Exploded View of Valve Arrangement

1. Shaft Cap
2. Cap Washer
3. Rocker Arm Spring
4. Rocker Arm (Exhaust)
5. Bushing
6. Bracket
7. Set Screw
8. Rocker Arm (Inlet)
9. Rocker Arm Bushing
10. Thrust Cup
11. Key
12. Spring Washer
13. Oil Shield
14. Valve Spring (Outer)
15. Valve Spring (Inner)
16. Exhaust Valve
17. Exhaust Valve Guide
18. Inlet Valve
19. Inlet Valve Guide
20. Rocker Arm Spring
21. Shaft
22. Bracket
23. Screw
24. Washer
25. Screw
26. Arm Screw Nut
27. Arm Screw
28. Exhaust Rod
29. Inlet Rod
30. Valve Lifter
31. Cover
32. Washer
33. Screw
34. Gasket

Push Rods
(See Figures 98 and 99)

The ball and the socket ends of the push rods are subject to wear. However, if contact surfaces remain in good condition the rods are good for extremely long service as valve tappet adjustment can compensate for reasonable wear.

Both rods are 18-29/64" plus or minus 1/32" long when measured as shown below.

Rocker Arms
(See Figure 98)

Excessive clearance should not be allowed to exist at the rocker arm bushing as this introduces play in the valve-operating mechanism.

New rocker arm bushings must be reamed after pressing into rocker arms. Clearance between rocker arm and shaft is from .001 to .002. The shaft size is 1.1286-1.1291.

Worn rocker arm shafts should be renewed. When rocker arm shafts are removed for any reason, it is recommended that they be filled with oil as much as possible before reassembly to the engine, so that feed will occur as quickly as possible. Proper lubrication of the push rod ends and valve cups is secured by a relatively low flow rate, which requires some little time to fill the hollow shafts. As an added precaution against initial distress of the parts, it is also desirable that each end of the rocker arms be oiled.

Valves
(See Figures 98 and 100)

After thoroly cleaning valves, they should be closely inspected for burring, burns, cracks, etc. Attempts should not be made to recondition valves that are warped or otherwise in poor condition.

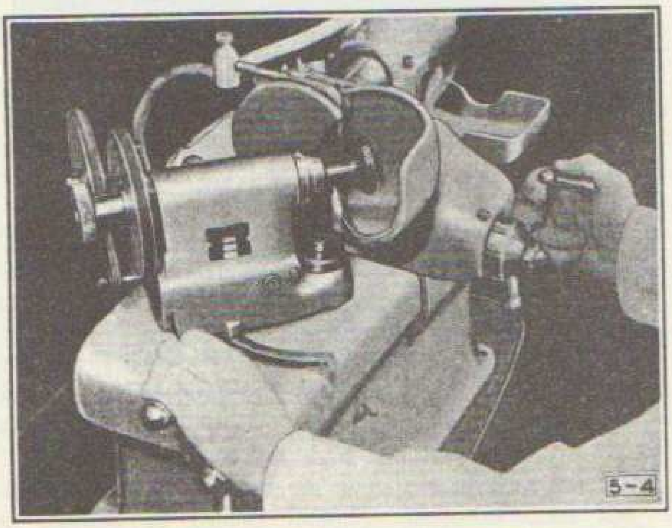


Fig. 100—Machine Grinding Valve
(Tool—Federal Stock No. 40-V-505)

If the valve faces show a run-out of more than .002 when tested with an indicator, valve faces should be accurately ground on a wet-type valve-face grinder. The valve seats should also be reconditioned as explained, see "Exhaust Valve Inserts" in this section.

Valves and inserts reconditioned to within .002 run-out will not require lapping-in as engine performance is not affected until run-out reaches .003.

The inlet valve stem diameter is .497-.498, and the exhaust valve stem diameter is .495-.496.

Valve Guides
(See Figures 98, 101 and 102)

When there is evidence of leakage or blow-by, or wear is noticeable, value guides should be renewed. Old guides may be drifted out and new ones pressed in.

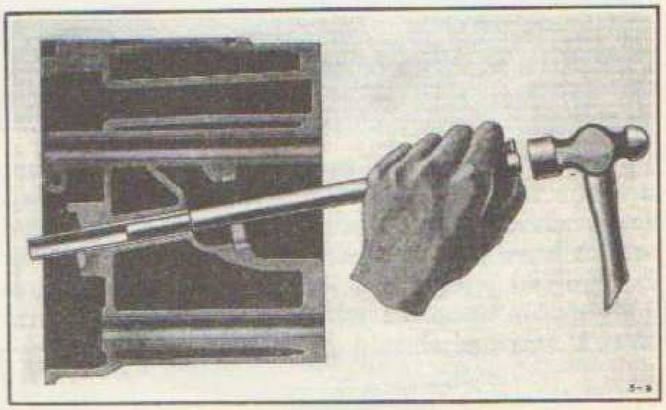


Fig. 101—Removing Valve Guide

Ream new valve guides after installation to diameter specified. Only reamers in first class condition should be used for this operation; and these should not be used for cleaning out guides which have had service and consequently bear carbon deposits.

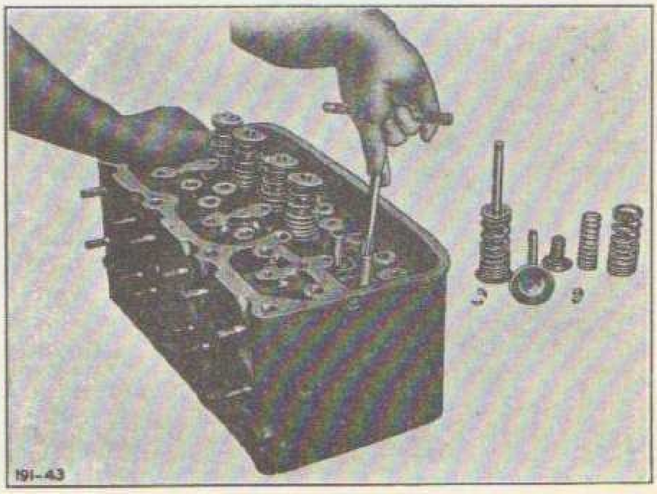


Fig. 102—Reaming Valve Guide
(Tool—Federal Stock No. 41-R-2310)

All guides to be continued in service should be reamed during valve repairs to clean out accumulated carbon. Reamers reserved for this cleaning operation should be kept in good condition.

The valve stem clearance should be checked. The clearance between the inlet valve stem and guide should be .0015 to .0030. The clearance between the exhaust valve stem and guide should be .005 to .007.

The ream size of the inlet valve guide is .4995 to .5000 and the exhaust valve guide is .5010 to .5020.

Valve Springs

(See Figures 98, 103 and 104)

In order to make a proper inspection of the springs they must be thoroly clean. Wire surfaces should be carefully examined. Springs which have pits or other surface defects should be viewed with suspicion as such defects are vulnerable spots at which a crack may start. Weak springs should be discarded.

Fig. 103—Testing Valve Spring
(Tool—Federal Stock No. 41-T-1600)

Valve spring pressure should be checked at each major overhaul period, with testing tool. The figures given below represent those for valve closed:

	Free Length	Compressed		Reject If Less Than
		Length	Lbs.	
Outer	3-1/2	2-21/32	57	52
Inner	2-15/16	2-17/32	34	31

Valve Springs Test Data

Figure 103 illustrates the type of spring testing device which will both quickly and accurately indicate the condition of springs.

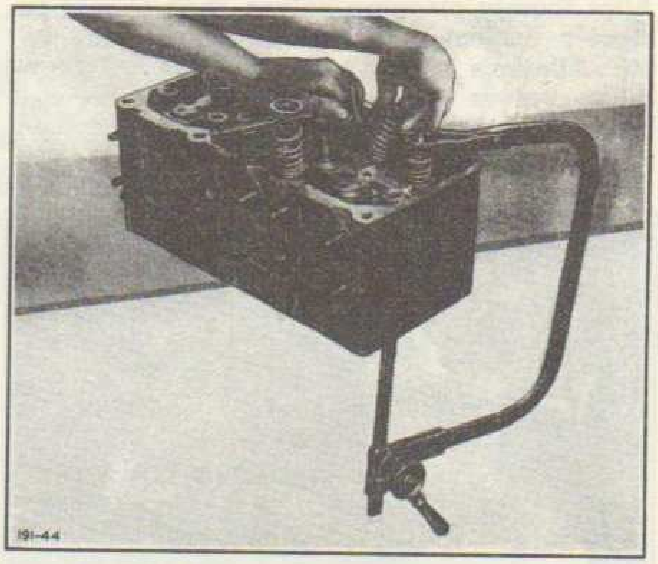


Fig. 104—Showing an Adaptable Type of Valve Spring Compressor
(Tool—Federal Stock No. 41-L-1408)

All springs must be installed with the closed or more tightly wound coils toward the cylinder head, or down. A compression tool is used to remove and reinstall these springs.

Valve Guide Cups

(See Figure 98)

When in correct assembly, valve guide cups are not subject to wear. If thru contact with other parts, they have become worn or damaged renewal should be made.

Valve Thrust Cups
(See Figure 98)

Long service may be expected from the valve thrust caps. They should be inspected for wear where rocker arms bear. Worn or distorted cups should be renewed.

Valve Key and Washer
(See Figure 98)

Tho small parts, the valve key and washer are highly important to valve security and should be renewed if their condition is questionable.

Note: Referring to Figure 104, showing valve spring compressor in use, valve removal tools are such a general requirement for repair work that sources afford a choice of several designs.

Exhaust Valve Insert
(See Figures 105, 106 and 107)

If it is necessary to renew the exhaust valve seat insert, remove old seat and proceed as follows:

The insert is held in the cylinder head with a press fit of from .0025 to .0045. The outside of the insert is copper plated. In order not to remove the copper plating or slight machine marks which will help retain the insert in place, the insert is chilled and pushed into a warm cylinder head.

The insert is placed on a piece of dry ice for a period of about twenty minutes and the cylinder head is warmed by putting hot water in it and playing a torch back and forth over the mounting surface carefully so as not to concentrate the flame at any one point too long. It is then possible to push the insert into place without harming the outside of the insert, and when the cylinder head and insert are at the same temperature, the insert will be held firmly in place.

This insert will give exceedingly long life. Should facing be required after high mileage, it is necessary to grind as a reamer will not

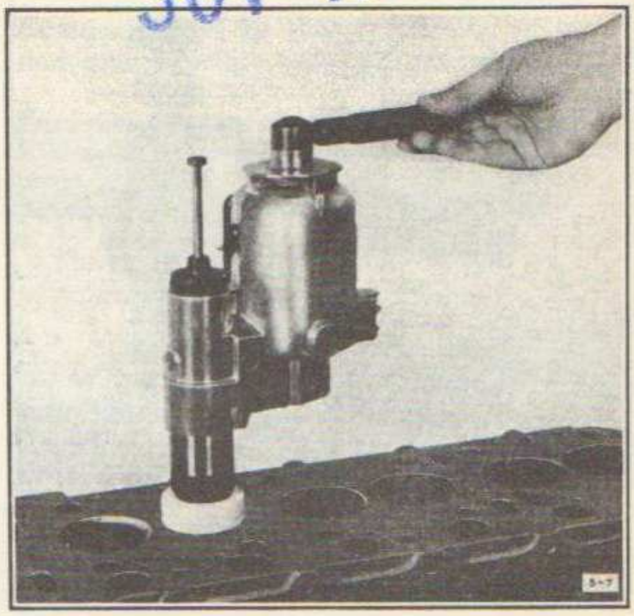


Fig. 105—Reconditioning Insert with Motor-driven Grinder
(Tool—Federal Stock No. 41-V-535)

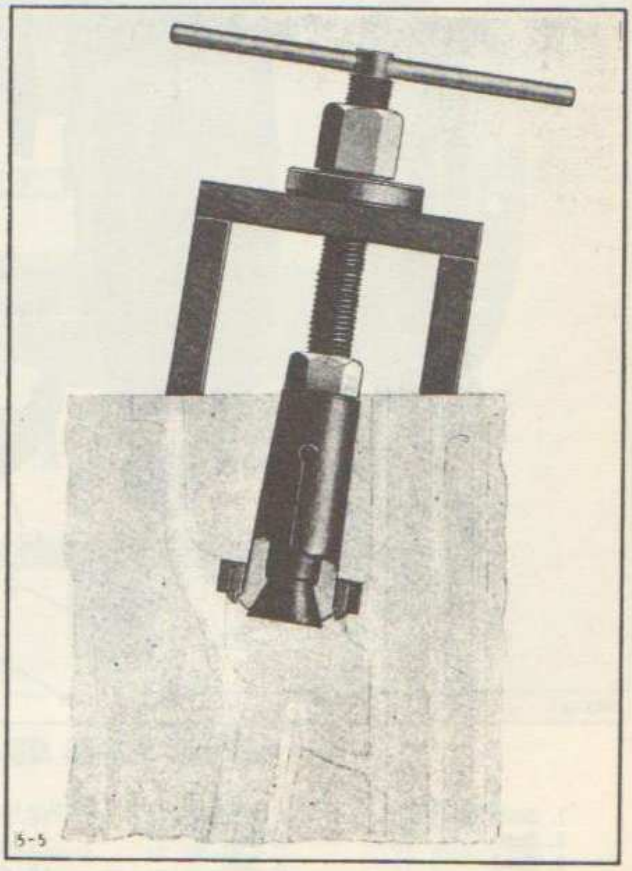


Fig. 106—Extracting Insert
(Tool—Mack Part No. 17-T-1436)

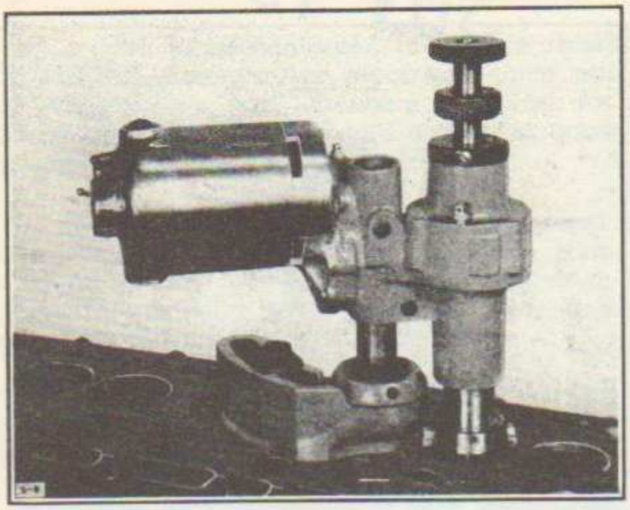


Fig. 107—Counterboring for Oversize Insert
(Tool—Federal Stock No. 41-T-3383)

"touch" the hard surface. A valve insert grinding tool should be used. A 2-1/16" dia. x 30° wheel is required.

Should inserts loosen, .005, .010 and 1/64" oversize service inserts are available for the renewals. For a second renewal 1/32" oversize inserts are required. For exceptional cases there are 3/64" and 1/16" oversize inserts. Counterbores for the installation of oversize inserts should be made with extreme care, to exact diameter for correct fit and to a depth of 7/16", which provides for seating of insert so that it projects about 1/64" from the cylinder head face. Counterboring cutter tools for boring the head for the proper fit of oversize inserts are available.

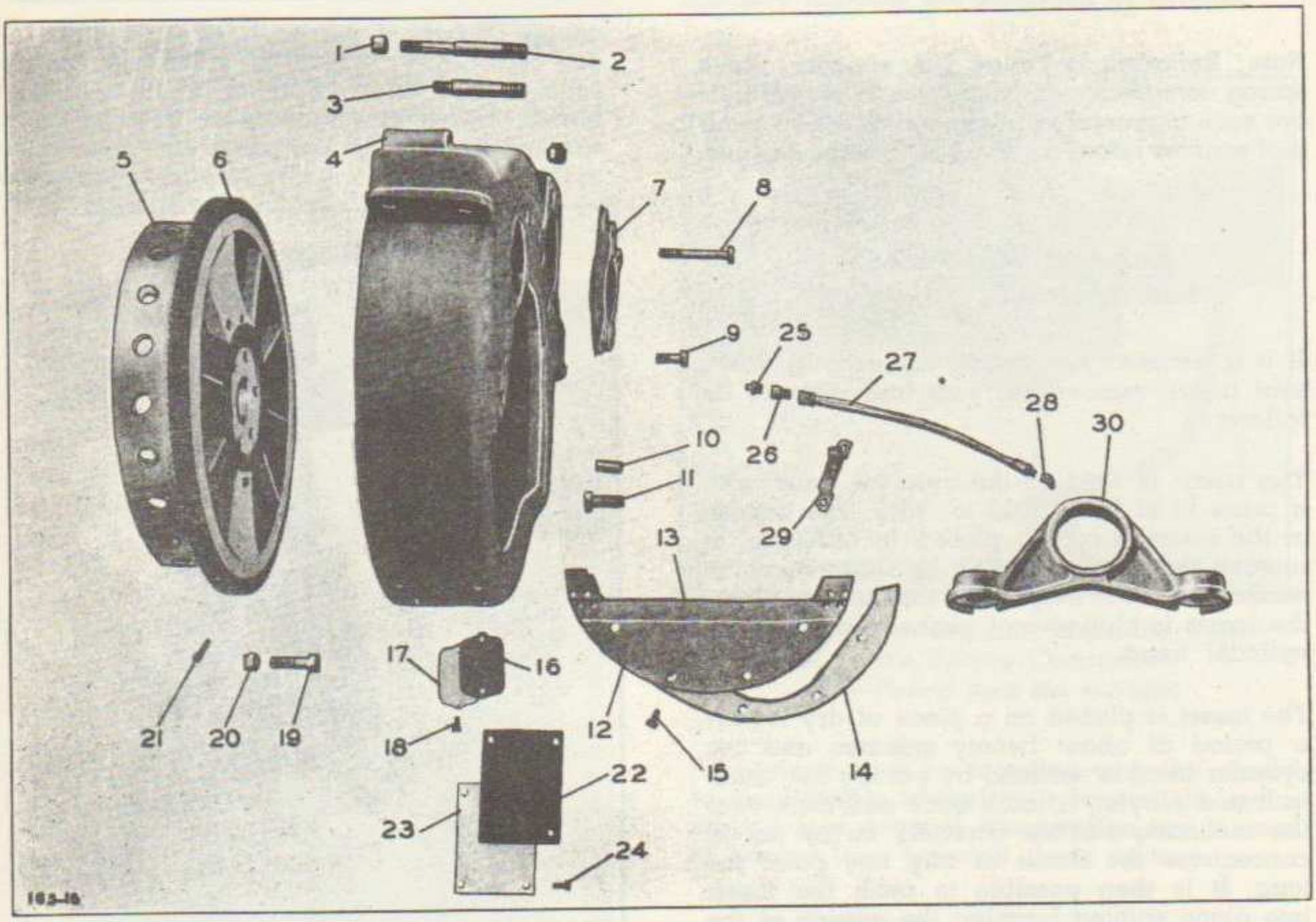


Fig. 108—Engine Mounting Parts and Flywheel

1. Stud Nut
2. Stud
3. Stud
4. Support Assembly (Rear)
5. Flywheel Assembly
6. Starter Gear
7. Adapter
8. Bolt
9. Bolt
10. Dowel
11. Screw
12. Cover
13. Felt (Outer)
14. Felt (Inner)
15. Screw
16. Cover
17. Felt
18. Screw
19. Flywheel Bolt
20. Flywheel Bolt Nut
21. Plug
22. Cover
23. Felt
24. Screw
25. Nipple
26. Adapter
27. Tube
28. Elbow
29. Bracket
30. Engine Front Support Bracket

Valve Timing
(See Figure 119)

It is only necessary to mesh timing gears properly—in accordance with marked teeth—to obtain accurate valve timing, see "Section 1: Description and Principle of Operation" and "Section 7: Re-assembly".

Engine Supports
(See Figure 108)

If rubber parts of engine supports remain free of oil and grease they will render long service. Any rubbers which have split or which have deteriorated to a noticeable degree should be renewed. Obviously, any bolt that is broken must be renewed.

Cavities should be thoroly cleaned of all oil and grease before new rubbers are installed.

Trunnion bearing, at front, should be inspected. It should be free to oscillate. Oiling arrangement should be checked and if necessary passages cleared.

Manifolds
(See Figure 109)

A careful inspection should be made, particularly of the exhaust manifold sections to determine if any cracks have developed.

All bolting flanges should be thoroly cleaned to insure tight joints when re-assembling.

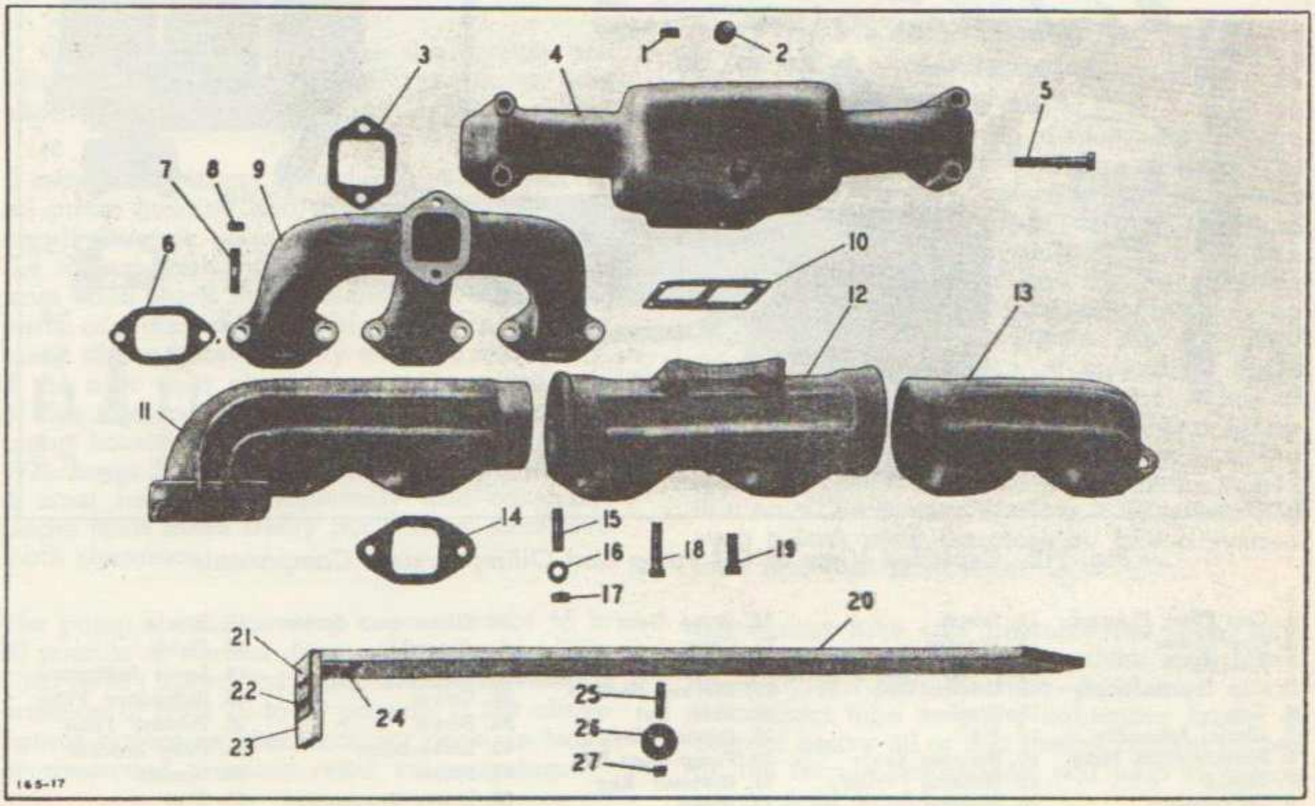


Fig. 109—Exploded View of Manifolds

1. Nut
2. Plug
3. Gasket
4. Inlet Manifold (Center)
5. Screw
6. Gasket
7. Stud
8. Nut
9. Inlet Manifold (Front and Rear)
10. Gasket
11. Exhaust Manifold (Rear)
12. Exhaust Manifold (Center)
13. Exhaust Manifold (Front)
14. Gasket
15. Stud
16. Washer
17. Nut
18. Bolt
19. Screw
20. Heat Shield
21. Bracket
22. Rivet
23. Shield End
24. Bolt
25. Stud
26. Washer
27. Nut

Oiling System

(See Figures 13, 14 and 110)

Advantage should be taken when overhauls are made to thoroly clean oil passages, pipes and fittings. Passages in engine may be blown after removing fitting at oil filter pad. Pump screen should be cleaned. Surfaces of flanged connections, where gaskets are used, should also be well cleaned.

Any parts that have become damaged or whose condition is not conducive to a secure and leak-proof assembly should be renewed.

No pump should be re-installed if its performance has declined thru effects of worn parts. At inspection, particular attention should be given to housing joints, bearing wear and the condition of the pumping gears keeping it in mind that leakage results in reduced pump efficiency.

Extremely long life may be expected of the oil pump provided the oil is kept clean as the pumping gears are constantly bathed in the oil they pump, and a passage from the

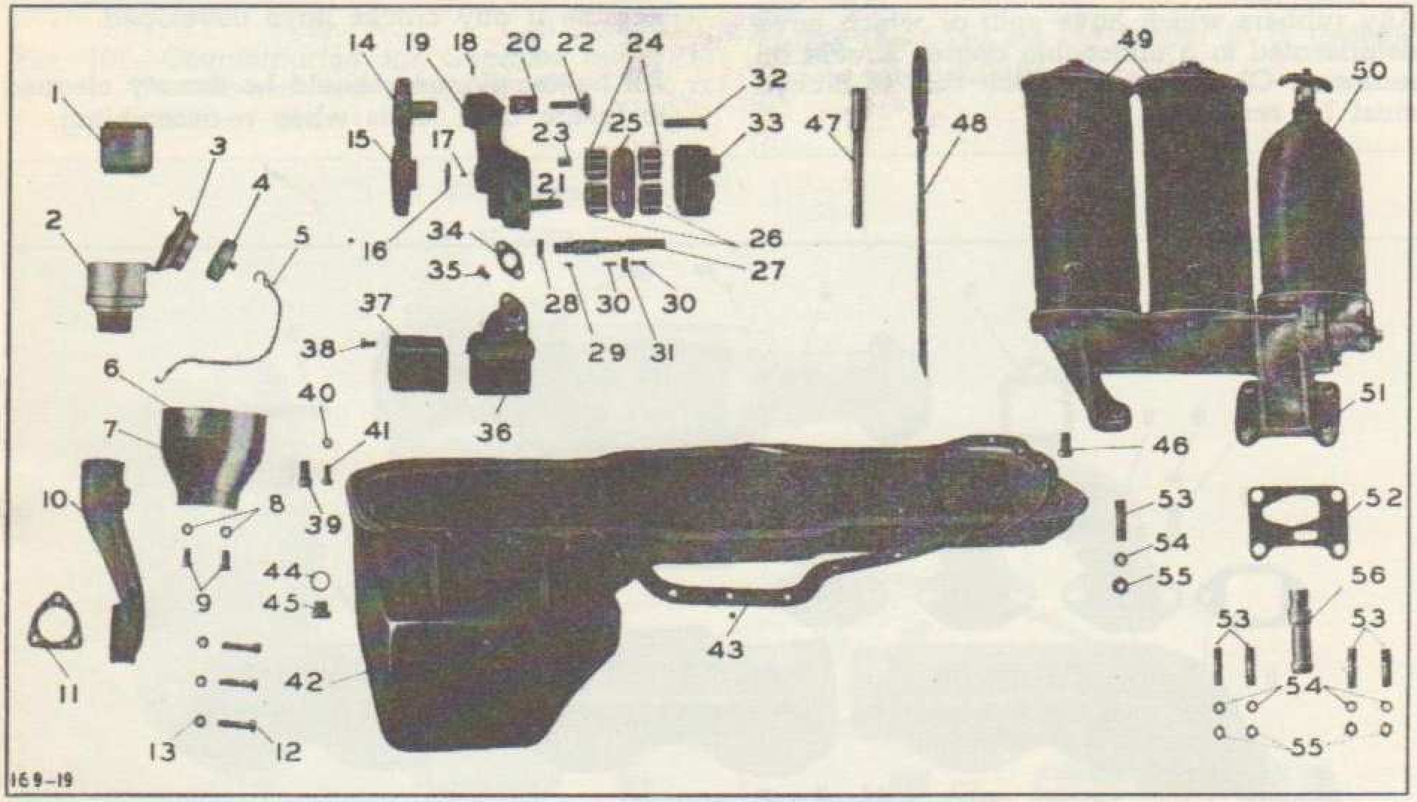


Fig. 110—Exploded View of Oil Pump and Oiling System Components

1. Cap Filter Element
2. Cap Lower Assembly
3. Cap Top Assembly
4. Cap
5. Chain Assembly
6. Specifications Plate
7. Shield
8. Lockwasher
9. Screw
10. Filler
11. Gasket
12. Screw
13. Washer
14. Idler Gear
15. Driving Gear
16. Washer
17. Pin
18. Housing Key
19. Housing (Front)
20. Bushing
21. Pump Idler Shaft
22. Idler Screw
23. Pump Idler Bushing
24. Pump Gear
25. Cover
26. Pump Idler
27. Driving Shaft
28. Shaft Nut
29. Driving Key
30. Pump Gear Key
31. Retainer Key
32. Screw
33. Housing (Front)
34. Inlet Gasket
35. Screw
36. Elbow and Screw Assembly
37. Screen
38. Screw
39. Screw
40. Lockwasher
41. Screw
42. Lower Crankcase
43. Gasket
44. Washer
45. Drain Plug
46. Screw
47. Guide
48. Level Indicator
49. Secondary Filter
50. Primary Filter
51. Filter Bracket
52. Gasket
53. Stud
54. Lockwasher
55. Stud Nut
56. Plug

Oil Pump

(See Figures 18, 73 and 110)

Repairs to oil pump is thru renewal of parts.

oiling system provides pressure oiling for the driving idler gear bearing and the pump driveshaft bearing adjacent to the driven gear. Obviously however, the oil pump can no more escape the ill effects of unclean oil than can other parts. When there is undue wear the oil should be suspected.

In this event drain all oil, flush system, clean primary filter and renew oil filter elements in secondary filters. Dis-assemble pump for thoro inspection.

Length of pumping gears should be 1.213-1.214 and the end clearance, between the gears and the housing, should be .0005-.0020 measured with a feeler gage. The backlash of the gear teeth should not exceed .029. The clearance between the gears and the housing should be .005-.009 on the diameter. Driveshaft, idler shaft and all bearings should also be inspected for wear.

A pump in which wear is discovered should not be re-installed until necessary renewals are made.

If it is necessary to replace the driving and idler gears, on the front of the pump, they should be replaced in pairs.

It may be necessary to add a shim between the oil pump housing and the front main bearing cap if the new gears are on the large side of the tolerances. If necessary, it should be cut from shim stock to the contour of the mating parts, of a thickness suitable to obtain a proper mesh of the gears. It may even be necessary, if the new gear should be on the small side of the tolerances, to grind off the top of the pump housing to obtain a proper gear mesh. Whichever is necessary, shimming or grinding, it must be done competently and carefully. Gears must mesh freely but without excessive tooth clearance.

The pump should develop a pressure of 45 to 60 pounds at normal driving speeds. At idling (300 RPM) speed the pump should develop a pressure of from 10 to 20 pounds. If the above figures do not register, look for possible leaks or weakened pressure relief valve spring.

The pump screen and the entire lower crankcase should be given a thoro cleaning whenever there is occasion to remove the case; and it should be removed for this purpose if there is any reason to suspect that a dirty condition has developed. At these cleanings it is advisable to fill with new oil, clean primary filter and renew filter elements in secondary filters.

Oil Pressure Relief Valve

(See Figure 15)

The oil pressure relief valve rarely needs attention. It must however be free and the spring must be of correct strength. Repair is by renewal of parts.

In the event of difficulty in obtaining sufficient oil the pump should be well cleaned and carefully examined. The free length of spring is 3⅝". It should compress to a length of 2¾" at 25 pounds. Abnormally high or low oil pressures warrant immediate attention—stop the engine at once and correct the trouble before proceeding. A gage pressure of from 45 to 60 pounds should be obtained at normal driving speeds with a thoroly warmed engine. At idling speeds a minimum pressure of 10 to 20 pounds should register.

Viscometer

(See Figure 32)

If there is any reason to suspect the viscometer, an inspection for air leakage should be made. The viscosity, measured differentially by an orifice-and-capillary unit, is shown at the dial unit thru the medium of an air column in the connecting tube; and any air leakage will falsify the indication. A leak not only results in loss of pressure in the tube and thereby affects accuracy of indication, but it may permit oil to rise in the tube which oil opposes the actuating force developed in the engine unit, further tending toward a low indication. Such air leakage may be that small that no oil escapes to disclose it. Elimination of such a leak must therefore be thru a systematic, remedial procedure.

Disconnect tube and examine the tube, tube ferrule and gage stem for nicks and burrs. Blow DOWN thru the tube—to clear it of oil. Re-connect tube to gage, tightening firmly. A drop of heavy oil or thin gasket cement placed on the ferrule beforehand will help to assure an air-tight joint.

To clean the Viscometer unit at engine crankcase, remove large strainer nut and the barrel screen which is enclosed in the unit. Clean screen thoroly; also interior of strainer nut. Make sure that restriction jet in inner lip of strainer nut is clear. It is advisable also to remove the orifice inspection plug and wash out orifice chamber. Also make sure that metering orifice under plug is not obstructed. A piece of wire (not more than .040" in diameter) may be used to clear both metering orifice and restriction jet.

In extreme cases it may be necessary to remove entire Viscometer body and wash it thoroly with kerosene, then blow out chambers, jets and capillary tube with compressed air. Do not disturb the relief valve cap which protrudes into the crankcase. Other than cleaning every 6,000 miles, the Viscometer requires little attention. There are no adjustments to be made.

Oil Level Gage

(See Figure 110)

If it has become bent, the oil level gage (48), or "stick", should be carefully straightened. If the markings are not plain or the gage has suffered damage beyond a slight bend, it is best to renew it.

Oil Filters

(See Figures 21 and 110)

Any evidence of leakage from the filter should be investigated without delay, with gaskets and retaining parts accorded close attention. Parts which have become deformed or which have suffered any damage that makes their servicability questionable should be discarded —not worked upon to attempt reconditioning.

The relief valve, at the primary filter, should be checked to insure that it works freely.

Primary Filter — Service Cleaning

The cleaning operation for the primary filter should be performed at least as often as filter elements of secondary filters are renewed.

Periodic cleaning of filter should be in accordance with instructions in "Group: Lubrication"; but watch should also be kept on the oil level gage for darkening of oil. If oil has become dark, clean filter. It is preferable to also renew oil.

Stop engine when cleaning filter.

Turn cleaning handle, at top of filter, in clockwise direction to its stop position; then back to its starting position. Repeat this operation four times. This, thru the ratchet on the inside, rotates the scraper blade around the outside of the filter element, thereby removing any accumulated dirt. Sediment then drops to the bottom, into the filter bracket, or base.

Remove drain plug and completely drain filter unit.

Re-install drain plug.

Add one quart of oil thru crankcase filler before starting engine.

The foregoing cleans the filter for further duty. This filter need not be removed unless it becomes damaged.

Periodic renewal of filter elements should be in accordance with instructions in "Group: Lubrication"; and the oil level gage should be used for frequent examination of oil as noted under primary filter.

Stop engine before opening filters.

Remove cover.

Remove drain plug and completely drain unit.

Re-install drain plug.

Remove filter element and install new military standard element.

Using a new cover gasket, install cover. Be sure gasket and cover are seated properly and that cover is well secured, as leaks can be disastrous. Make a close inspection for leaks with engine running at its settled idling temperature.

Periodic servicing of the filters is important, and in view of the simplicity of the work and the short time required to care for both the primary and secondary units there should be no excuse for neglecting it.

The period in terms of miles may vary anywhere between 1000 to 2000 miles depending entirely upon the type of operation in which the vehicle is employed and the quality of the lubricating oil used.

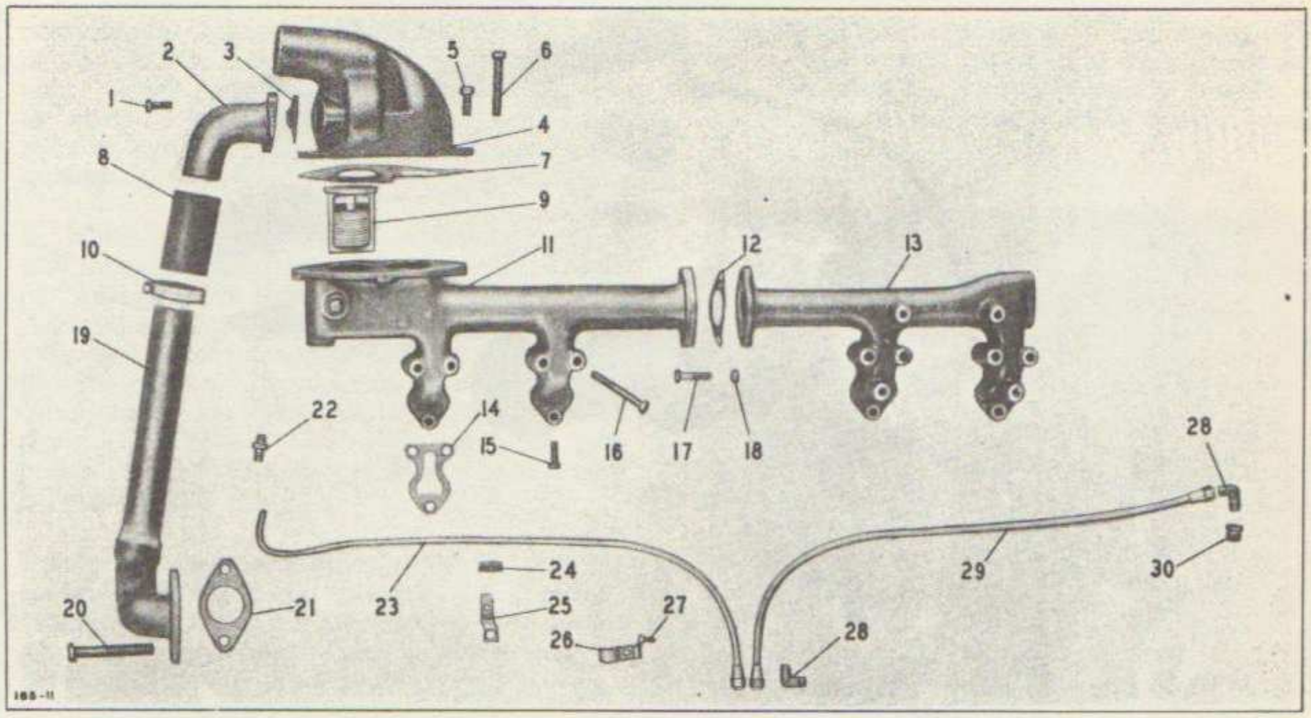


Fig. 111—Exploded View of Water Connections Arrangement

1. Elbow Screw
2. Upper Elbow
3. Gasket
4. Outlet Elbow
5. Elbow Screw
6. Elbow Screw
7. Gasket
8. Hose
9. Thermostat
10. Hose Clamp
11. Manifold Assembly
12. Gasket
13. Manifold (Rear)
14. Gasket
15. Manifold Screw
16. Manifold Screw
17. Manifold Bolt
18. Nut
19. Pipe Assembly
20. Elbow Screw
21. Gasket
22. Tube Connector
23. Water Tube (Compressor)
24. Loom
25. Tube Clamp
26. Tube Clamp
27. Clamp Bolt
28. Tube Elbow
29. Water Tube (Compressor)
30. Reducer

Water Connections
(See Figure 111)

A thoro inspection of all water connection parts should be made in the interests of leak-proof re-assembly. Renew any questionable parts.

Thoroly clean all joint surfaces, tubes and pipes. Clean elbow and pipe at hose connection.

It is preferable to renew gaskets; also hose if it has deteriorated. Damaged or deformed hose clamps should also be renewed. A faulty thermostat should be renewed, see "Group 05: Cooling."

Crankcase Breather
(See Figure 112)

Breather valve should be soaked in varnish remover, or the equivalent, to thoroly clean it. If a stuck valve (10) does not become perfectly free thru this treatment, renew it.

Inspect all connection parts and renew any where condition is questionable in that they may allow leakage.

Thoroly clean baffles (5) and joint surfaces of breather pipe (1) and valve covers. Clean filtering elements (4) in suitable solvent. Clean tube (3) and all fittings.

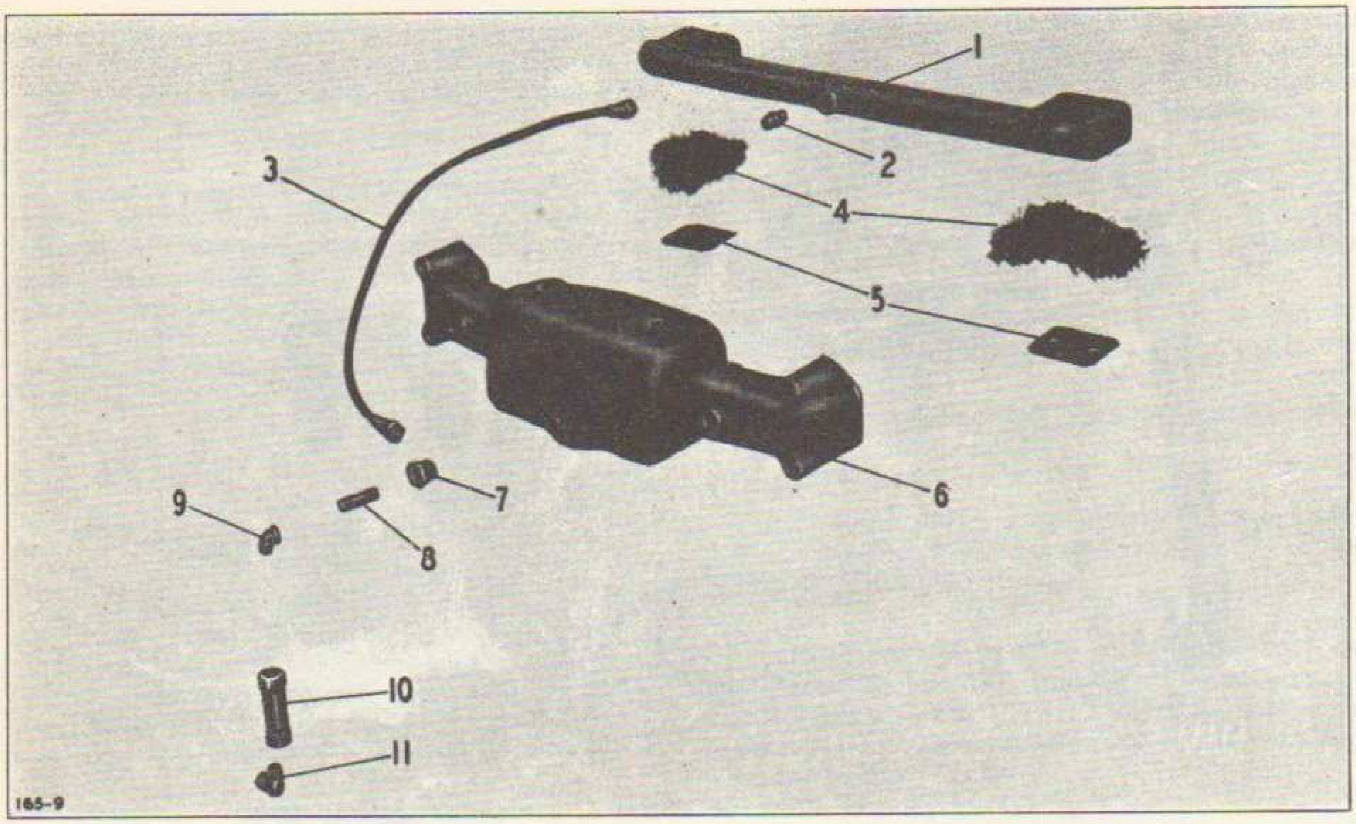


Fig. 112—Exploded View of Inlet Manifold and Breather Arrangement

1. Breather Pipe
2. Tube Fitting
3. Breather Tube
4. Filter Element
5. Baffle
6. Manifold Assembly (Inlet - Center)
7. Reducer
8. Nipple
9. Elbow
10. Breather Valve
11. Tube Fitting

Compression
(See Figure 113)

Before testing with a compression testing gage, unscrew all spark plugs nearly out, then tighten all plugs finger tight and run the engine for a few minutes until warm. By so doing, any carbon which may have fallen off the threads of the spark plugs will be dissipated, thereby preventing it from getting under valves and causing false readings.

The battery should be "up" in order that the speed be as given, as the pressure drops off rapidly with lowered speed.

Open the throttle wide and block it open.

All spark plugs should be removed. The compression tester should be held tightly in the spark plug hole, while the starter turns the engine for five revolutions. The compression tester should read approximately 125 lbs. per sq. in. at 150 R.P.M. The engine should make the same number of revolutions when each cylinder is checked in order to get a true

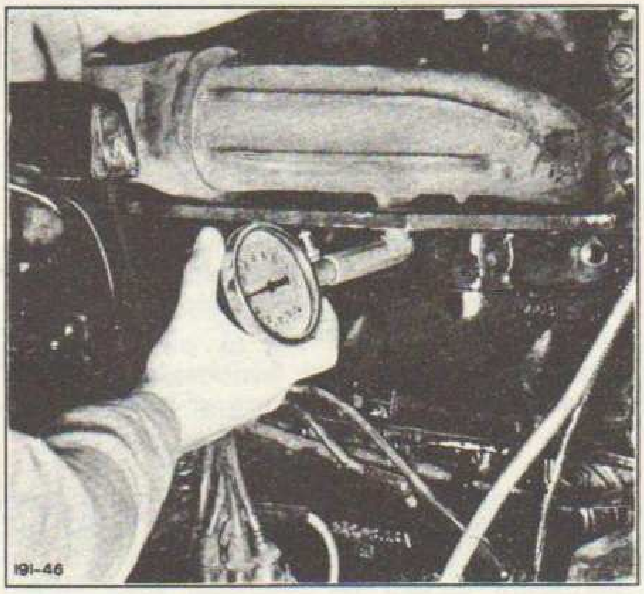


Fig. 113—Testing Compression
(Tool—Federal Stock No. 41-G-124)

comparison. Cylinders should be within 10 lbs. of each other. Low readings on the compression tester, indicate excessive blow-by due to worn or sticking piston rings, warped or sticking valves, or leaking cylinder head gaskets.

If, when making the tests, there is a great difference between cylinders, look for a tight or "riding" valve in the low pressure cylinder. A variation of a few pounds pressure between cylinders is not unusual. If there is a difference of 10% or more between cylinders, or if the compression is less than 115 pounds, then some overhauling, as valve grinding, new piston rings, pistons, or cylinder reboring may be economical.

Note: by squirting a little engine oil thru the spark plug holes onto the top of the pistons (taking care not to get any on the valve seats) more accurate compression readings will be obtained.

Vacuum

(See Figure 114)

Remove the pipe plug in the intake manifold and connect the vacuum gauge as indicated in the photograph. Normal engine vacuum is from 18 to 21 inches of mercury. The gage hand should be steady at any speed above idling speed. At idling speed, it may fluctuate slightly. A low reading at idling speed indicates poor piston rings, late ignition timing or a manifold leak. An unsteady needle at higher speeds indicates sticking valves, weak

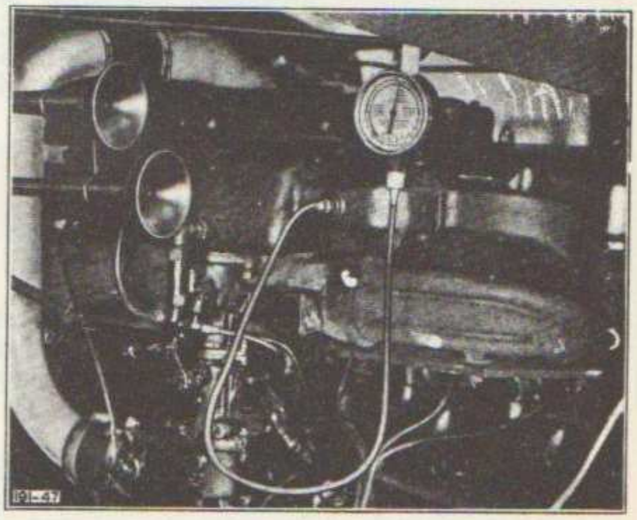


Fig. 114—Testing Vacuum
(Tool—Federal Stock No. 41-G-500)

valve springs, leaking cylinder head gaskets, or faulty ignition. If the engine is rapidly accelerated, the gage hand will fall to zero, then if the throttle is suddenly closed, the hand should rise momentarily to 24 to 26 inches. Less "kickback" indicates poor rings.

SECTION 6: LUBRICATION

When re-assembling the engine be sure to generously coat all bearing components with oil, so that they will have immediate lubrication when first starting. No other lubrication is required to be done during re-assembly.

Any engine which has not had oil put in the crankcase should be prominently marked "NO OIL", to guard against the error of starting engine when dry. An engine should not even be started until the correct oil to the specified full amount—inclusive of filter fill—has been poured into the crankcase. For lubricating instructions other than in preceding paragraph, see "Lubrication" group.

Preparation for Storing and Exporting Engines

Remove cylinder head covers and insert spacers between the exhaust valve rocker arms and valve operating cups so that the exhaust valves cannot seat.

Remove the rams horn section of the inlet manifold and by means of an oil gun feed 1/6 of a pint of lubricating oil into each inlet manifold branch, turn the engine over by means of the starting motor for ½ minute.

Reinstall inlet manifold, remove exhaust valve spacers and reinstall cylinder head covers.

SECTION 7: RE-ASSEMBLY

In general, the procedure for engine re-assembly is the reverse of dis-assembly and it therefore suffices for re-assembly to provide instructions where a prescibed procedure is essential to correct and accurate assembly. Adjustments are, of course, also involved, see "Section 3: Adjustments". For adjustment of fan belt, see "Group 05: Cooling".

Crankshaft

(See Figures 115 and 116)

When placing crankshaft in its bearings, it should be with an awareness that the shaft is a heavy part and that unless it is carefully handled bearings may suffer damage.

After crankshaft has been re-installed and all main bearing caps replaced, check for end-play of shaft. Shift shaft with a bar, endwise, in both directions, to be sure that clearance on either side of center main bearing cap is approximately equal.

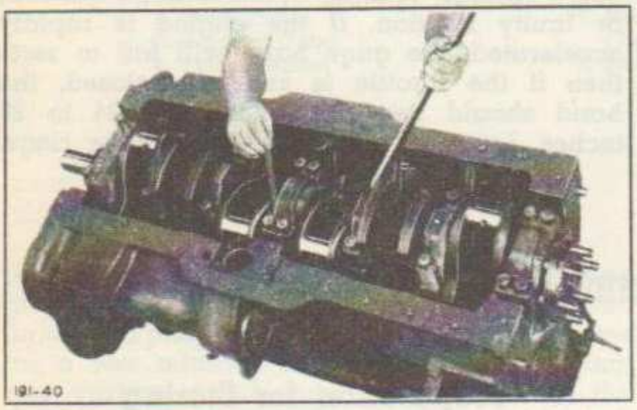


Fig. 115—Checking Crankshaft End-Play
(Tool—Federal Stock No. 41-G-400)

If there is a variation, tap the center main bearing cap lightly with a hammer to equalize clearance when tested with a feeler gage. A long feeler gage should be used so that clearance at top halves as well as lower halves of thrust washers can be checked.

Tighten capscrews to the proper tension, see "Section 8: Specifications". Wire heads except No. 1 cap which will be wired after the oil pump has been re-assembled.

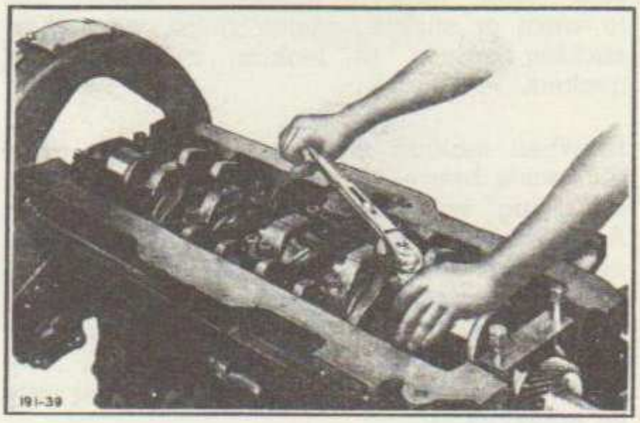


Fig. 116—Tightening Main Bearing Capscrews
(Tool—J. H. Williams Part No. S-57)

Oil Slinger Housing

(See Figure 117)

Service rear oil slinger housing and head insert as covered under "Section 5: Repairs", "Crankshaft Oil Seal". Coat mounting face of housing lightly with thin shellac, tap slinger housing assembly lightly in place, and install attaching screws finger tight.

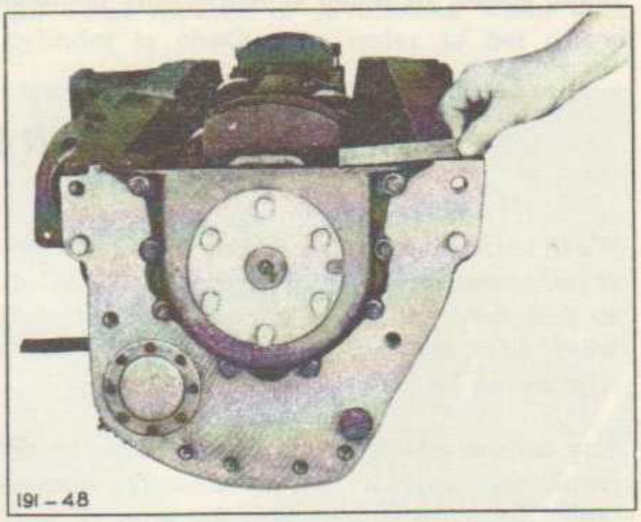


Fig. 117—Aligning Oil Slinger Housing

Using a straight-edge, line up the lower flange of the housing with the flange of the crankcase and tighten screws securely.

Do not attempt to provide perfect concentricity between slinger bore and crankshaft by tapping up, down, or sideways as this simply dents in the lead resulting in oil leakage. Also, do not use a feeler gage around shaft as this will dent the lead and cause oil leakage.

Flywheel
(See Figure 118)

When re-installing flywheel be sure to match the "O" on flywheel with the "O" on the crankshaft flange. Also make certain that flange and flywheel faces are absolutely clean and not burred.

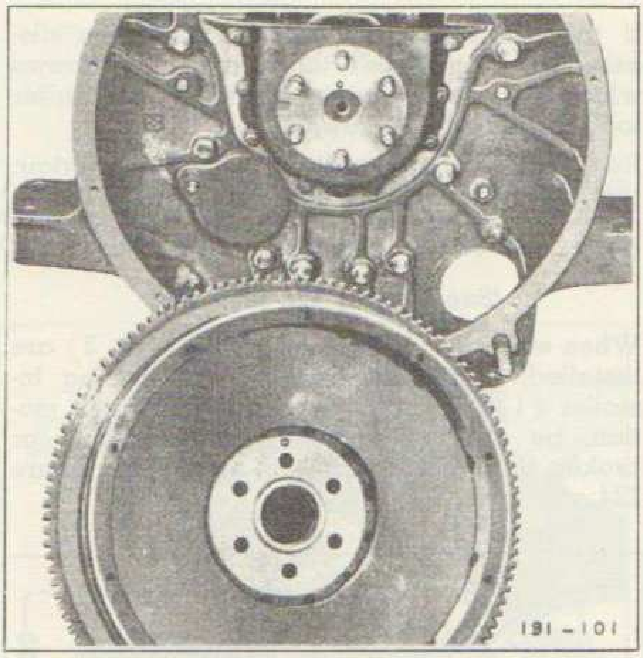


Fig. 118—View Showing Markings on Flywheel and Crankshaft Flange

If any but the original flywheel is installed at re-assembly, the clutch pilot bearing bore and clutch cover mounting face must be checked with a dial-type indicator. Bearing bore must not have a run-out in excess of .002 and mounting face must not have a run-out of more than .006. In regard to the latter, it is important that pressure be exerted against the flywheel, toward the front end of the engine, as the flywheel is turned; for if the crankshaft is permitted to float endwise to the extent of even the small running clearance at the thrust washers, indicator readings will show what may be interpreted as excessive run-out.

Timing Gears
(See Figure 119)

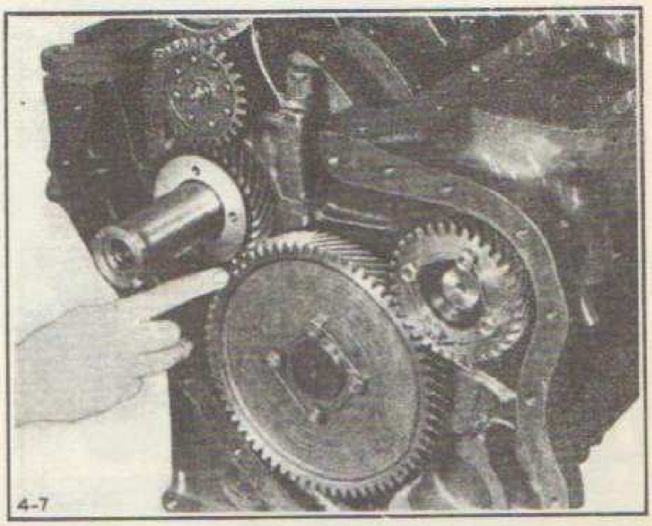


Fig. 119—View Showing Markings on Timing Gears

At the time of replacing timing gears, be sure to mesh the tooth on the crankshaft gear with the center punch mark between the two teeth on the camshaft gear having punch marks, as shown.

Timing Gear Cover
(See Figure 120)

To replace the timing gear cover, before the screws are tightened insert mandrel thru hub to line cover up with crankshaft. Also use straight edge to line up flange. Then tighten cap screws.

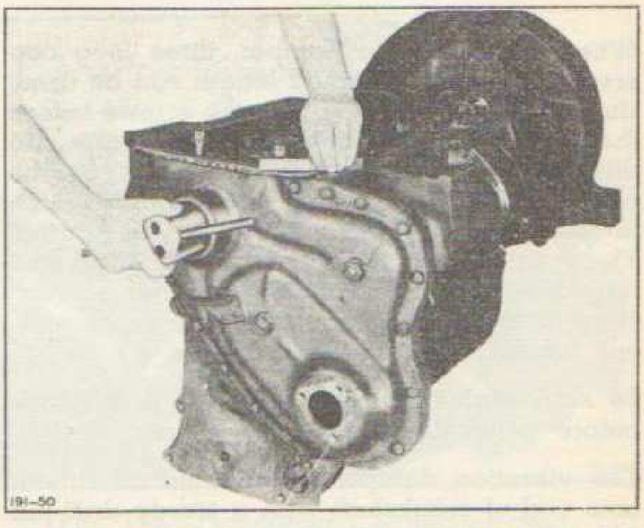


Fig. 120—Aligning Timing Gear Cover
(Tool—Mack Part No. 17-T-273)

Adjustments of Thrust Buttons
(See Figure 121)

Adjustment for accessory shaft should be made before air compressor is re-installed; and should timing gear cover ever be installed when cylinder heads are in place the camshaft should be relieved of all valve-spring load before its thrust adjustment is made.

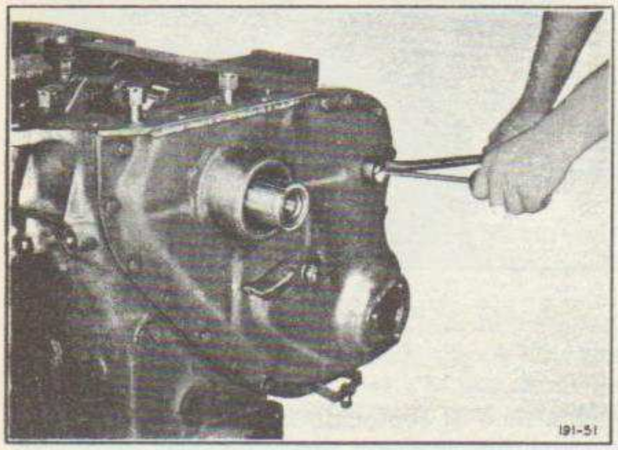


Fig. 121—Accessory Shaft Thrust Adjustment

With timing gear cover firmly secured, make adjustment setting of thrust button screws for camshaft and accessory shaft. The end-play of from .008 to .014 is adjusted by backing off the thrust button screw one quarter turn from finger tight.

Vibration Damper
(See Figure 122)

When assembling a damper, three long cap screws with ample thread length can be used. Nuts should first be runup on the screws before they are screwed into damper. The nuts can then be screwed down thereby pressing the two damper sections together, after which three of the original cap screws can be started. The special screws can then be removed and replaced by the remaining original screws. Wire screw heads using three pieces of wire, one for each two adjacent screws.

Be sure engine front support (1) is in place before re-installing vibration damper.

The vibration damper (2) should be driven onto end of crankshaft with a sturdy drift pin (3) and a driver (4). Driver as illustrated is better than a hammer for this operation. Be certain that key is in line with keyway before driving. Drive damper to a firm seating.

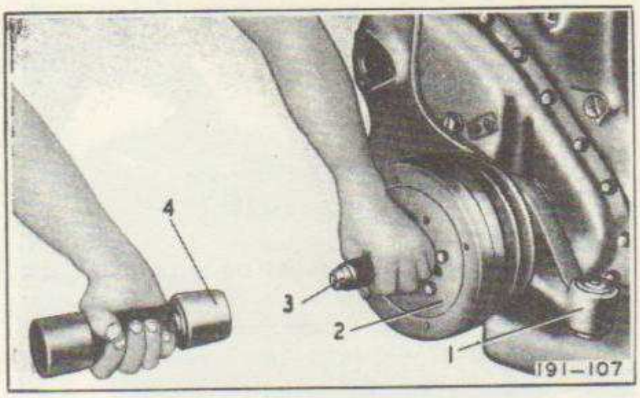


Fig. 122—Driving Vibration Damper Into Place

If the vibration damper had not been disassembled, replace those two capscrews which were removed to accommodate puller tool and wire all screws.

Re-install starting crank jaw making certain that heavy washer is not omitted.

Piston
(See Figures 123 thru 128)

When either used or new piston rings (2) are installed, it is recommended that a ring installer (1), a ring expander with limited motion, be used. Rings may be deformed or broken if such a tool is not used, see Figure 124.

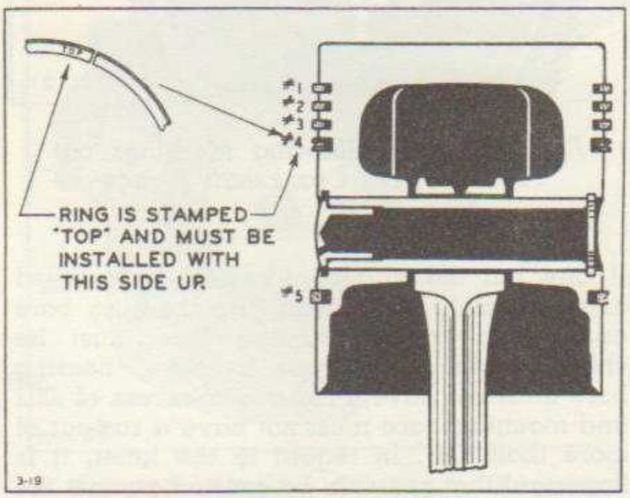


Fig. 123—Sectional View Thru Piston Showing Piston Ring Arrangement

NOTE: L.H. End of Piston Pin shows Plug and R.H. End shows Snap-ring. Engine will have either plugs or snap-rings — not both.

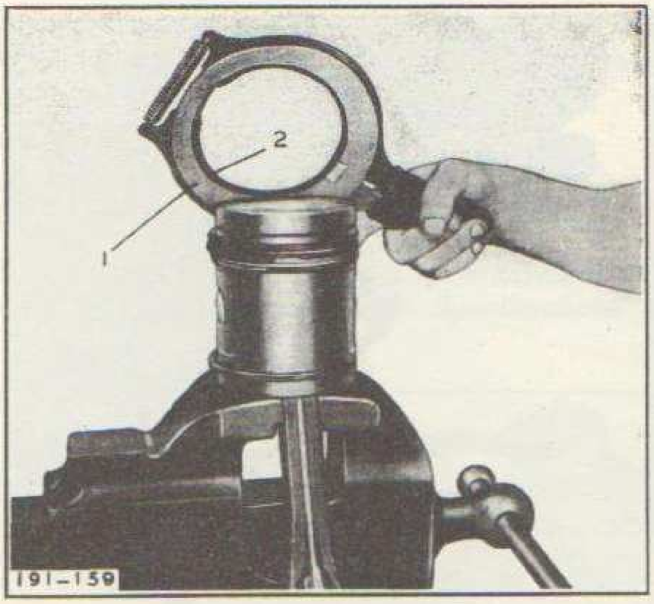


Fig. 124—View Showing Use of Ring Installer Tool
(Tool—Perfect Circle size 5")

All pistons must be installed so that arrows on piston heads point toward front of engine. Connecting rods must be assembled with pistons so that when pistons are placed in block as just instructed, the small oil hole at the lower end of the rod is toward the air compressor side of the engine. This is important.

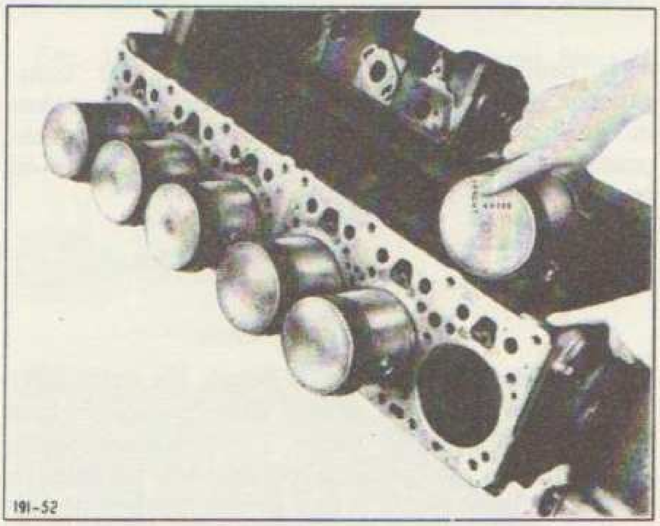


Fig. 125—View Showing Marking on Piston

When installing piston in engine, use a ring compressor to avoid damage to piston rings. Piston may be tapped carefully into bore with the end of a hammer handle.

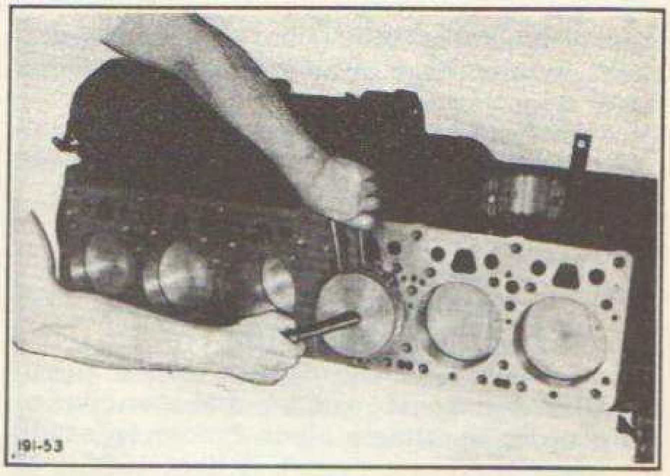


Fig. 126—Inserting Piston in Engine Using Ring Compressor
(Tool—Federal Stock No. 41-C-2550)

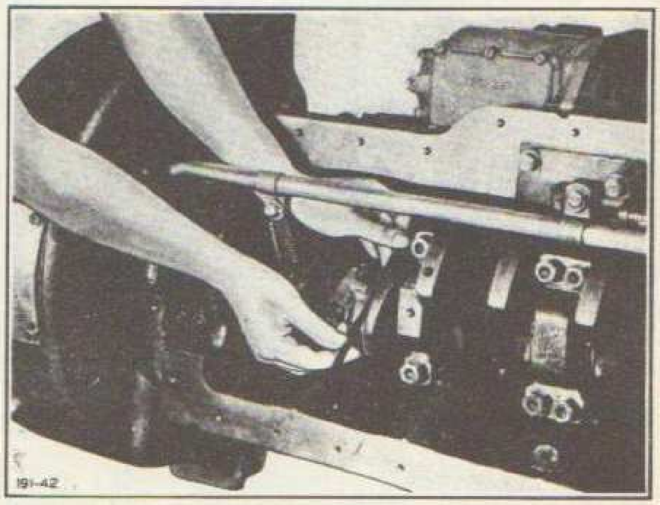


Fig. 127—Checking Side Clearances of Connecting Rod Bearing
(Tool—Federal Stock No. 41-G-400)

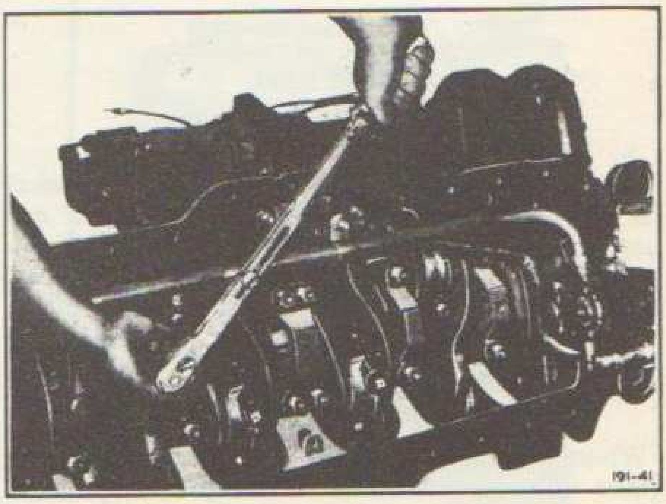


Fig. 128—Tightening Connecting Rod Capscrews
(Tool—J. H. Williams Part No. S-57)

Before tightening connecting rod capscrews, check for clearance at both sides of rod using feeler gage.

Tighten capscrews to the proper tension, see "Section 8: Specifications". Wire heads.

Lower Crankcase

(See Figure 129)

See that crankcase surface and pan flange surface are absolutely clean before re-installing lower crankcase (pan). A light coating of thin shellac may be applied to gasket.

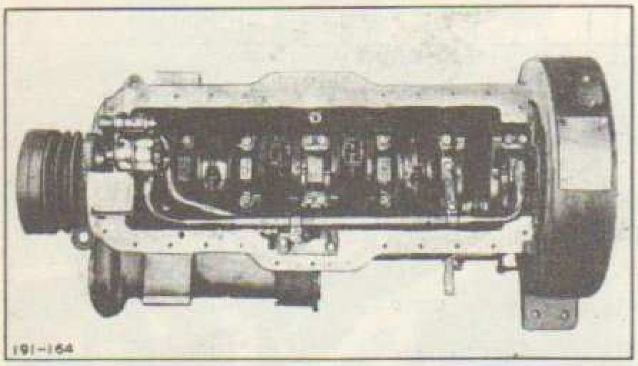


Fig. 129—View into Upper Crankcase When Ready to Re-install Lower Crankcase

After re-installing lower crankcase and setting engine in upright position, install tachometer drive and viscometer unit to safeguard against entrance of anything into the crankcase thru these openings.

Oil Filter

(See Figure 130)

When reinstalling oil filter, be sure that gasket is so placed that all holes in filter pad are open. This is exceedingly important.

Fuel Pump

(See Figure 130)

When installing gasoline pump, make certain that operating lever is in the proper position between guide bosses, and that push rod in crankcase is located correctly on face of lever. It may be necessary to turn flywheel so that

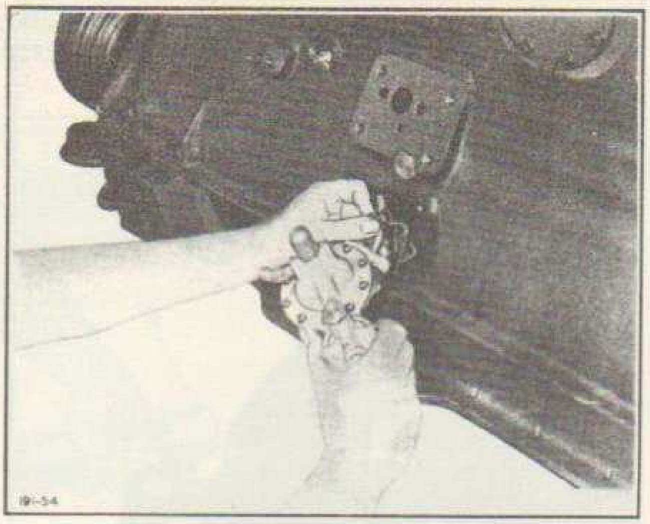


Fig. 130—Installing Fuel Pump

push rod is against the low point of eccentric on camshaft. Pump should go on easily and must not be jammed in place. See that insulating spacer and two gaskets are between pump and crankcase—one gasket to be on each side of spacer.

Air Compressor

(See Figure 20)

It is preferable, when re-installing air compressor, to do so with notch in drive sprocket in line with upper outer bolt hole in compressor flange when first and sixth pistons of engine are at top dead center.

Clutch

(See Figure 29)

Use mandrel tool, Federal Stock No. 41-T-3085 thru clutch cover to center clutch disk so that when it is held in place by pressure plate, hub will be in accurate alignment to receive clutch spline shaft when transmission is installed.

Tighten clutch cover capscrews a little at a time, progressively, keeping the clutch disk accurately centered, the indication of which is when mandrel tool can be withdrawn easily. If the tool becomes bound do not use a hammer to drift it free as this imposes a severe strain upon the disk hub, a strain that may injure its splined bore and permanently deflect the hub in the disk; loosen cover capscrews to eliminate binding of tool and proceed as before. If difficulty persists, remove disk assembly and check it thoroly for bore alignment and disk run-out. A deformed disk assembly (disk and hub) should be replaced with a new one, see "Group 02: Clutch".

Cylinder Heads
(See Figures 130 and 131)

Tighten cylinder head nuts in accordance with specifications, see "Section 8: Specifications".

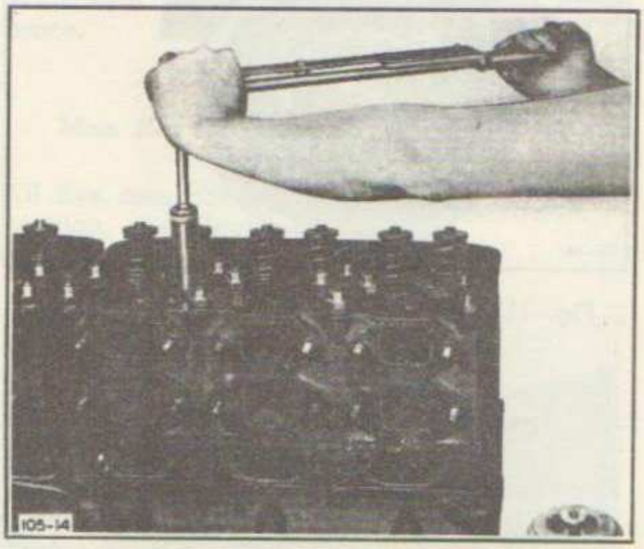


Fig. 130—Tightening Cylinder Head Nuts
(Tool—J. H. Williams Part No. S-57)

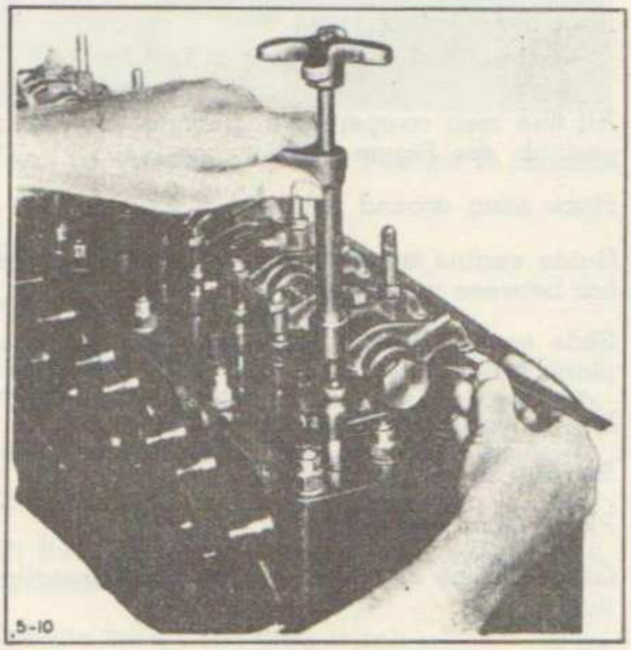


Fig. 131—Adjusting Valve Clearance
(Tool—Federal Stock No. 41-G-400)
(Special wrench is not necessary)

For sequence for tightening head nuts, see "Section 3: Adjustments".

Adjust inlet and exhaust valves to clearances specified, see "Section 3: Adjustments".

Handling Engine
(See Figure 132)

Lifting fittings of the type illustrated provide for convenient handling of complete engines with safety. The front fitting is secured

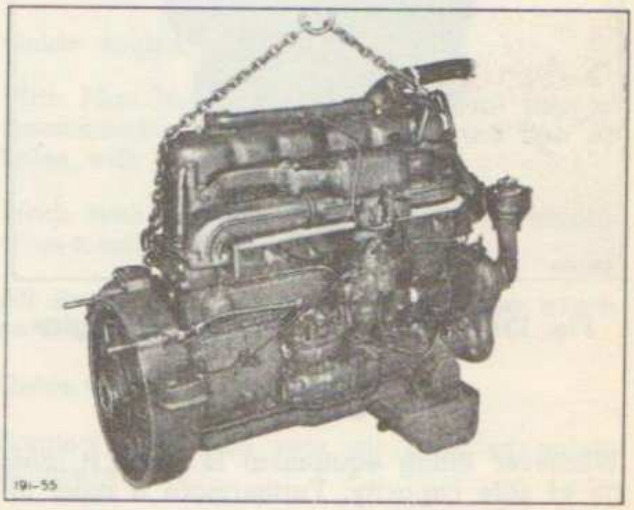


Fig. 132—View Showing Convenient Type of Lifting Fittings
(Tools—Mack Part No's. 17-T-1438 & 17-T-1439)

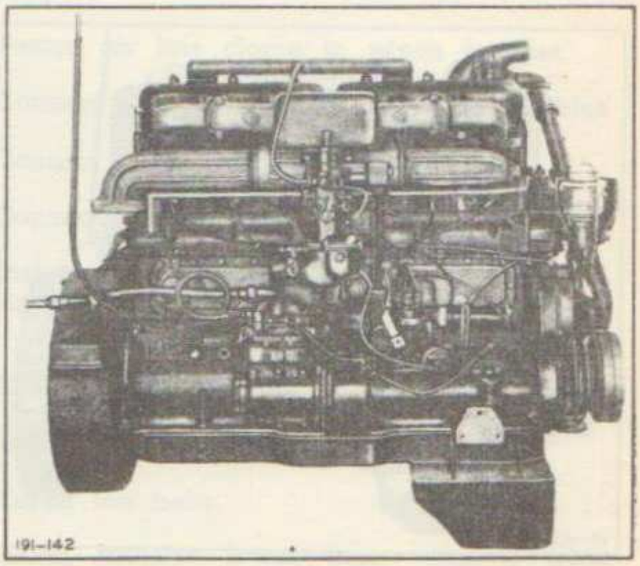


Fig. 133—Engine Complete, Right Side

by two of the front cylinder head nuts. To attach rear fitting detach accelerator cross-shaft assembly and use four capscrews in the holes thus vacated.

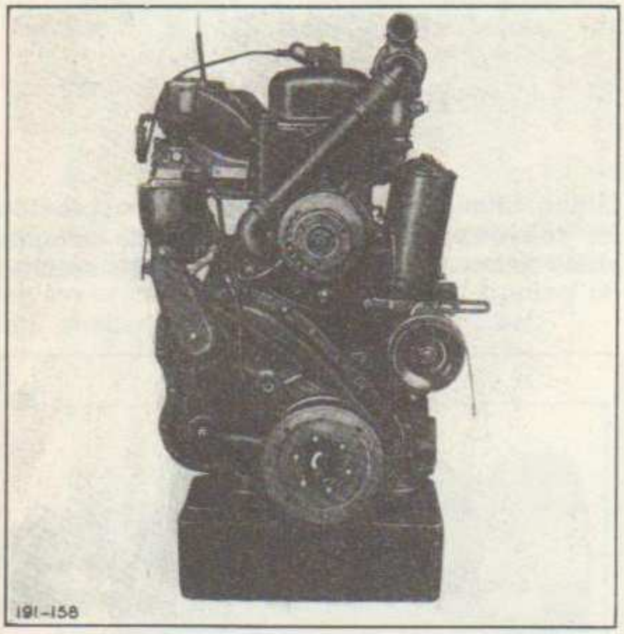


Fig. 134—Front View of Complete Engine

Caution

Whatever lifting equipment is used, it must be of safe capacity. Furthermore it must afford such attachments that accessory parts are not damaged and so handling can always be fully controlled. Inadequate equipment endangers personnel and introduces risk of extensive damage.

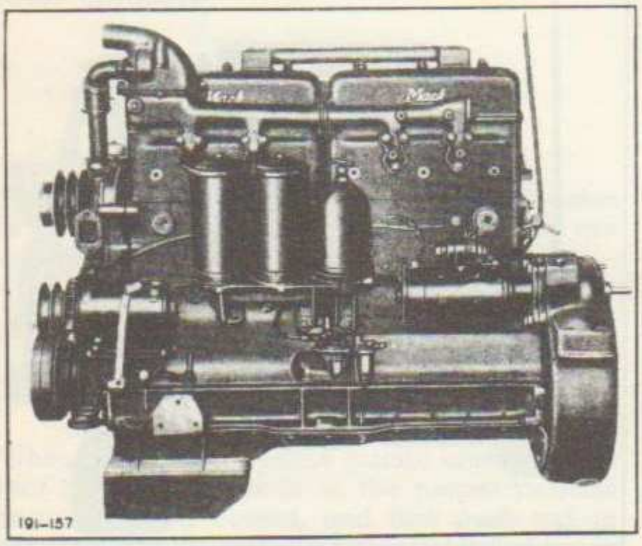


Fig. 135—Engine Complete, Left Side

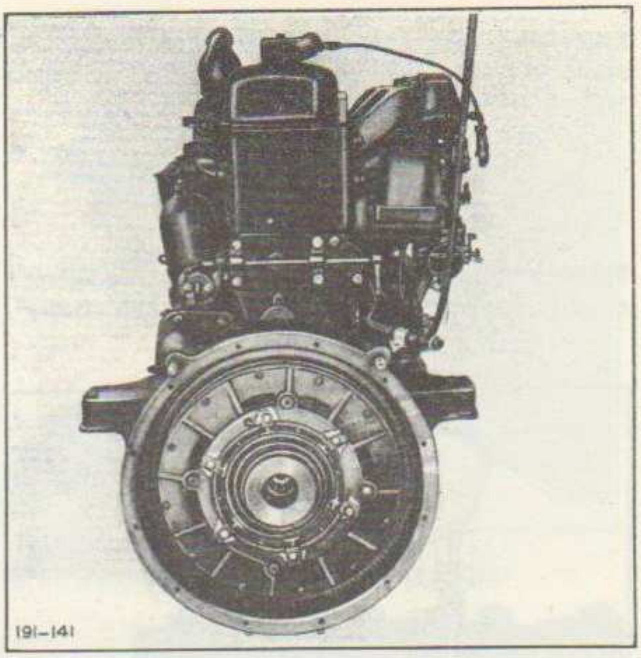


Fig. 117—Rear View of Complete Engine

Installing Engine in Chassis

Five men may be employed to advantage to install the engine in the chassis in a short time. The duties of each man are listed below. Each man is to perform the duties listed for him simultaneously with the others so that all will finish at the same time.

Man No. 1 Working at Left Front

All five men co-operate in placing engine in position, see Figure 137.

Place sling around engine.

Guide engine onto pilot studs with aid of a bar between manifolds.

Slide engine front support cross-member into place.

Insert two engine front support bolts.

Remove sling from engine.

Place sling on winch.

Grease frame channels to ease winch installation.

All five men co-coperate in positioning winch on frame, see Figure 138.

Guide winch at front.

Working with Man No. 2, with use of drift-pins, align winch mounting holes and insert bolts.

Work with Man No. 2 to tighten all winch mounting bolts.

With Man No. 2, install front trailer air line connections.

With Man No. 2, install winch clutch lever.

With Man No. 2, install radiator shell cross brace.

Man No. 2 Working at Right Front

All five men co-operate in placing engine in position, see Figure 137.

Fig. 137—Placing Engine in Position in Chassis

Operate hoist (handling engine).

Place air line in position.

Assist Men Nos. 3 and 4 in inserting and tightening engine front support cross-member bolts.

Slide radiator cross-member into position.

Slide radiator guard into position.

All five men co-operate in positioning winch on frame, see Figure 138.

Operate hoist (handling winch).

Working with Man No. 1, with use of drift pins, align winch mounting holes and insert bolts.

Work with Man No. 1, to tighten all winch mounting bolts.

With Man No. 1, install front trailer air line connections.

With Man No. 1, install winch clutch lever.

With Man No. 1, install radiator shell cross brace.

Man No. 3 Working at Left Side of Engine

All five men co-operate in placing engine in position, see Figure 137.

Guide engine into place.

With Man No. 4, place engine front support cross-member spacers in frame and line up holes with aid of drift pins.

Work with Man No. 4 in tightening engine cross-member bolts.

All five men co-operate in positioning winch on frame, see figure 138.

Guide winch from left side.

Connect front and rear air lines at quick-release valve.

Fasten two air line clamps to frame.

Fasten air line clamp to engine front support.

Fasten headlamp cable clamps to engine support.

Fasten air line clamp to winch bracket.

Connect starter and magnetic switch cables.

Connect viscometer line.

Connect flexible gasoline line.

Install air cleaner.

Install cotter pin in accelerator rod.

Align brake treadle valve.

Install generator and wires.

Adjust fan belts.

Install radiator lower hose — tighten hose clamps.

Place radiator lower hose in position to connect with radiator.

Fasten radiator lower hose to pipe and radiator and install drain cock.

Connect radio bonds from frame to radiator and radiator lower pipe.

Install radiator support nuts, rubbers in engine supports and palnuts.

Install tie rod nut.

Install bolt in radiator lower tie rod.

Fasten tachometer cable clamp to upper tie rod.

Install hood—with Man No. 4.

Install hood radio bond.

With Man No. 4, install front spring rear hanger cross brace.

Man No. 4 Working at Right Side of Engine

All men co-operate in placing engine in position, see Figure 137.

Guide engine into place.

With Man No. 3, place engine front support cross-member spacers in frame and line up holes with aid of drift pins.

Work with Man No. 3 in tightening engine cross-member bolts.

All five men co-operate in positioning winch on frame, see Figure 138.

Fig. 138—Positioning Winch on Chassis Frame

Guide winch from right side.

Fasten radio bond from frame to timing gear cover.

Connect coil wire.

Fasten radio bond from frame to engine governor.

Fasten choke cable to breather pipe and intake manifold.

Connect choke wire to carburetor.

Connect oil gage pressure line.

Connect oil line bracket to rear capscrew in valve push rod cover.

Connect ½" air line to bottom lead in junction block.

Connect main discharge line from air compressor to flexible line.

Connect radio bond from exhaust pipe support bracket to engine.

Move horn into position and fasten.

Connect radio bond between dash and right, rear, head bolt.

Place exhaust pipe in position.

Connect ⅜" air line from air governor to air compressor.

Connect radio bond from dash sheet to exhaust pipe.

Connect exhaust pipe to manifold.

Mount air cleaner pipe between carburetor and top hose connection.

Fasten air cleaner pipe clamp to intake manifold.

Install tachometer cable.

Connect tachometer cable clamp to engine.

Guide radiator into place.

Install fan.

Install radiator top hose.

Install gas throttle retractor spring.

Install radiator tie rods and tighten nut.

Install bolt in radiator lower tie rod.

Fasten tachometer cable clamp to upper tie rod.

Install hood—with Man No. 3.

Install hood radio bond.

With Man No. 3, install front spring rear hanger cross brace.

Man No. 5 Working Principally in Cab

All five men co-operate in placing engine in position, see Figure 137.

Guide engine pilot studs with aid of pinch bar.

Install nuts on pilot studs at bell housing.

Install clamp on speedometer cable.

Install bell housing capscrews.

Remove jack from under transmission.

Place toe and floor boards in position.

All five men co-operate in positioning winch on frame, see Figure 138.

Guide winch from top of engine.

Install and tighten radiator cross-member bolts.

Fasten toe and floor boards.

Install steering post draft plate.

Insert end of exhaust pipe in muffler and fasten.

Fasten accelerator rod to pedal.

Fasten brake treadle valve.

Install winch driveshaft.

Place sling about radiator and lift radiator into position.

Connect batteries.

Install radiator tie rods in cab.

Roll canvas top into place and secure.

Fill crankcase with oil.

Fill radiator with water (and anti-freeze, for cold weather operation).

SECTION 8: SPECIFICATIONS

MAKE	Mack
TYPE	Overhead Valve
MODEL	EY Military
FUEL	Gasoline
No. OF CYLINDERS	6
BORE, INCHES	5
STROKE, INCHES	6
PISTON DISPLACEMENT, CU. IN.	707
HORSEPOWER, A.M.A.	60.0
BRAKE HORSEPOWER, GOVERNED	170
@ SPEED, FULL LOAD	2100
GOVERNED SPEED, NO LOAD	2250
IDLING SPEED	300
MAX. TORQUE, LBS.-FT.	550
@ SPEED	800
FIRING ORDER	1-5-3-6-2-4

Accessory Shaft

TYPE	Drop Forged
NUMBER OF BUSHINGS	2
SHAFT JOURNAL DIAMETERS:	
FRONT	2.061-2.062
REAR	1.998-1.999
END-PLAY	.008-.014
THRUST TAKEN AT	Front

Accessory Shaft Bushings

NUMBER OF BUSHINGS	2
TYPE	High-lead-babbitt lined
FINISHED INSIDE DIA., FRONT	2.0635-2.0640
REAR	2.0005-2.0010

Accessory Shaft Bushing (Cont'd.)

BUSHING TO SHAFT CLEARANCE .0015-.003
HOW FINISHED Prefinished
OUTSIDE DIAMETER, FRONT 2.314-2.315
REAR 2.252-2.253
PRESS FIT IN CASE .002-.004

Camshaft

TYPE Drop Forged
NUMBER OF BUSHINGS 7
SHAFT JOURNAL DIAMETER 2.251-2.252
END-PLAY .008-.014
THRUST TAKEN AT Front

Camshaft Bushings

NUMBER OF BUSHINGS 7
TYPE High-lead-babbitt lined
FINISHED INSIDE DIAMETER 2.2535-2.2540
BUSHING TO SHAFT CLEARANCE .0015-.003
HOW FINISHED Prefinished
OUTSIDE DIAMETER 2.626-2.627
PRESS FIT IN CASE .002-.004

Connecting Rod

MATERIAL Chrome Molybdenum Steel
TYPE "I" Beam
CENTER TO CENTER LENGTH 11.249-11.251
WRIST PIN BUSHING Hard rolled Bronze
WRIST PIN CLEARANCE IN ROD .0003-.0004
Loose @ 250°-300° F., Perceptible Drag @ 70°
ROD AND PISTON REMOVABLE From Top
ROD SIDE-PLAY .006-.012

Connecting Rod Bearings

NUMBER OF BEARINGS 6
MATERIAL Copper-Lead Alloy
TYPE Thin Shell (Removable)
UNDERSIZES AVAILABLE .001, .002, .010, .020, .030, .040 and .050.
BEARING TO SHAFT CLEARANCE Free .0015 Lock .003.
NUT TENSION, LBS.-FT. 145-150
BEARING ADJUSTMENT FOR WEAR Replace

Crankshaft

MATERIAL Drop Forged Steel
TYPE Counterweighted
NUMBER OF MAIN BEARINGS 7
BEARING JOURNAL DIAMETERS:
No. 1, 2, 3, 5, and 6 3.4975-3.4980
No. 4 and 7 3.4965-3.4970
CONNECTING ROD JOURNAL DIA. 2.9975-2.9980
THRUST BEARING AT CENTER Bearing No. 4
CRANKSHAFT END-PLAY .004-.011

Crankshaft Main Bearings

NUMBER OF BEARINGS 7
MATERIAL Copper-Lead Alloy
TYPE Thin Shell (Removable)
UNDERSIZES AVAILABLE .001, .002, .010, .020, .030, .040 and .050.
BEARING TO SHAFT CLEARANCES:
No. 1, 2, 3, 5, and 6 Free .0015 Lock .0035.
No. 4 and 7 Free .0025 Lock .0045.
NUT TENSION, LBS.-FT. 100-105
BEARING ADJUSTMENT FOR WEAR Replace

Cylinder Block

MATERIAL Special Alloy Cast Iron
TYPE Single Block
BORE SIZE 5.0000-5.0005 Honed
MAX. REBORE (OVERSIZE) PERMISSIBLE TO AVOID WEAKENING CYLINDER WALL .060

Cylinder Head

MATERIAL Special Alloy Cast Iron
TYPE Dual-detachable
COMPRESSION RATIO 5.35 to 1
COMPRESSION PRESSURE LBS. PER SQ. IN. @ STARTING SPEED OF 150 RPM 125
MEAN EFFECTIVE PRESSURE 112
STUD NUT TENSION, LBS.-FT. 125-130
GASKET MATERIAL Steel-Copper-Asbestos

Fuel

Engine will operate satisfactorily using gasoline of 68 octane (minimum) A.S.T.M. rating.

Pistons

MATERIAL .... Aluminum LO-EX

TYPE .... Cam-ground, "T" Slot Skirt

AVAILABLE OVERSIZES .... .010, .020, .030, .040, .050 and .060.

DIA. AT TOP RING LAND 4.964-4.968

DIA. AT 1st AND 2nd RING LANDS 4.972-4.976

DIA. AT 3rd RING LAND 4.953-4.957

PISTON CLEARANCE @ TOP OF SKIRT .... .005

PISTON CLEARANCE @ BOTTOM OF SKIRT .... .005

FIT PISTONS WITH A FEELER GAGE OF .0045 AT BOTTOM OF SKIRT AND 90° TO PISTON PIN ON THE THRUST SIDE.

RING GROOVE WIDTHS:

No. 1, 2, and 3 .... .1255-.1265

No. 4 and 5 .... .188-.189

CAM GRINDING USED .... Type H6

Piston Compression Ring

NUMBER PER PISTON (No. 1, 2 and 3 Grooves) 3

WIDTH .... .123-.124

TYPE .... Butted—Straight Gap

GROOVE CLEARANCE .... .0015-.0035

GAP CLEARANCE .... .020-.030

Piston Oil Control Ring

NUMBER PER PISTON (No. 4 Groove) 1

WIDTH .... .1855-.1865

TYPE .... Butted—Straight Gap

GROOVE CLEARANCE .... .0015-.0035

GAP CLEARANCE .... .020-.030

Piston Oiling Ring

NUMBER PER PISTON (No. 5 Groove) 1

WIDTH .... .1855-.1865

TYPE .... Butted—Straight Gap

GROOVE CLEARANCE .... .0015-.0035

GAP CLEARANCE .... .020-.030

Piston Pin

TYPE .... Full Floating

DIAMETER GROUND 1.4369-1.4372

I.D. OF ROD BUSHING 1.4373-1.4376

DIAMETER HOLE IN PISTON 1.4367-1.4370

END FLOAT .... .008-.017

AVAILABLE OVERSIZES .... .003 and .005

FIT OF PIN IN ROD .... .0003-.0004

Loose @ 250°-300°F., Perceptible Drag @ 70° F.

FIT OF PIN IN PISTON .... .0003-.0006

Loose @ 250°-300° F., .0001-.0002 tight @ 70° F.

Push Rods

MATERIAL, INLET .... Steel Tubing

EXHAUST .... Invar Steel Tubing

IDENTIFICATION, INLET .... No. 114A or IN.

EXHAUST .... (Milled Slot) No. 124 or EX.

OUTSIDE DIAMETER 9/16

OVERALL LENGTH .... 18-27/64 to 18-31/64

Rocker Arms

MATERIAL .... Drop Forging

RATIO .... 1.6 to 1

SHAFT DIAMETER 1.1286-1.1291

REAMED DIAMETER OF BUSHINGS 1.1300-1.1305

BUSHING TO SHAFT CLEARANCE .... .0009-.0019

Timing Gears

BACKLASH .... .0005-.0015

CRANKSHAFT GEAR, MATERIAL .... Drop Forging

NO. TEETH 33

CAMSHAFT GEAR, MATERIAL .... Drop Forging

NO. TEETH 66

Valves—Inlet

ADJUSTMENT CLEARANCE:

COLD STATIC	.008-.010
HOT IDLE	.006-.008
SEAT ANGLE	30°
HEAD DIAMETER	2.179-2.189
OVERALL LENGTH	7.866-7.896
STEM DIAMETER	.497-.498
GUIDE, REAM AT ASSEMBLY	.4995-.5000
LOCATION OF END OF GUIDE FROM VALVE SEAT FACE	1-7/16
STEM CLEARANCE IN GUIDE	.0015-.0030
VALVE OPENS	8° BTDC
VALVE CLOSES	43° ALDC
VALVE PERIOD	231°
VALVE SEAT MATERIAL	Cylinder Head
VALVE LIFT	.512

Valves—Exhaust

ADJUSTMENT CLEARANCE:

COLD STATIC	.014-.016
HOT IDLE	.022-.024
SEAT ANGLE	30°
HEAD DIAMETER	1.941-1.951
OVERALL LENGTH	7.897-7.927
STEM DIAMETER	.495-.496
GUIDE, REAM AT ASSEMBLY	.501-.502
LOCATION OF END OF GUIDE FROM VALVE SEAT FACE	1-11/16
STEM CLEARANCE IN GUIDE	.005-.007
VALVE OPENS	40½° BLDC
VALVE CLOSES	5½° ATDC
VALVE PERIOD	226°
VALVE SEAT INSERT MATERIAL	Stellite
VALVE SEAT INSERT PRESS FIT	.0025-.0045
VALVE LIFT	.512

Valve Lifters

AMOUNT OF LIFT, INLET	.325
EXHAUST	.335
ROCKER ARM RATIO	1.6 to 1
STEM DIAMETER	.6855-.6860
GUIDE INSIDE DIAMETER	.6865-.6870
CLEARANCE IN GUIDE	.001-.002
TREATMENT	Ferrox

Valve Springs

SPRING TENSION:

INNER, LBS. @ 2-17/32 LENGTH	31.5-34.5
OUTER, LBS. @ 2-21/32 LENGTH	52.0-57.2
FREE LENGTH, INNER	2-15/16
OUTER	3½
FINISH	Cadmium Plated

Valve Timing

CRANKSHAFT GEAR MARKING .... 1 dotted Tooth

CAMSHAFT GEAR MARKING ..... 2 dotted Teeth

MESH CRANKSHAFT GEAR MARK BETWEEN TWO CAMSHAFT GEAR MARKS.

Vibration Damper

LOCATION ON CAMSHAFT .... Front End

TYPE .... Friction, spring loaded

RIM PULL .... To start turning, 100 lbs.; to keep turning, 60 lbs.

Oil Pump

OIL PRESSURE MAX. @ 2100 R.P.M. .... 45 to 60 lbs.

OIL PRESSURE IDLING @ 300 R.P.M. .... 10 to 20 lbs.

GEAR BACKLASH	.025-.029
GEAR WIDTH	1.214-1.213

DIAMETERS:

HOUSING GEAR BORE	1.995-1.993
HOUSING DRIVE SHAFT BORE	.859-.858
DRIVING SHAFT, LARGE END	.857-.856
IDLER SHAFT, LARGE END	Pressed into Housing
DRIVING SHAFT, SMALL END	.6865-.6860
IDLER SHAFT, SMALL END	.620-.619
DRIVING GEAR O.D.	1.988-1.986
DRIVING GEAR BORE	.687-.686
IDLER GEAR O.D.	1.988-1.986
IDLER GEAR BUSHING BORE	.622-.621

CLEARANCES:

DRIVING SHAFT AND HOUSING	.001-.003
DRIVING GEAR TO SHAFT	.0005-.0025
IDLER GEAR TO SHAFT	.001-.003
GEARS TO HOUSING, RADIAL	.005-.009

Pressure Relief Valve

VALVE SPRING TENSION @ 2¾"	25 lbs.
FREE LENGTH	3⅝"

Lube Oil Filter

PRIMARY UNIT .... Purolator No. 28419

SECONDARY UNITS .... Purolator No. 25788

REPLACEABLE CARTRIDGES, Secondary Purolator No. 25789.

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
S-57	Wrench, Torque Indicating (20 to 200 Lb.-Ft.)	$26.00	J. H. Williams
17-T-169A	Wrench, Extension Torque	2.80	Mack Mfg. Corp.
*41-P-2905-60	Puller, Universal		
17-T-1432	Puller, Flywheel		Mack Mfg. Corp.
17-T-1430	Puller, Main Oil Line Bushing		Mack Mfg. Corp.
5"	Installer, Piston Ring	8.00	Perfect Circle
*41-L-1408	Lifter, Valve, Compression Type		
*40-G-151	Grinder, Cylinder Hone		
*40-M-6	Machine, Cylinder Boring		
*41-R-2275	Reamer, Cylinder Ridge		
*41-G-400	Gage, Thickness		
*41-A-135	Aligner, Connecting Rod		
*41-P-2730	Press, Hydraulic, Conn. Rod		
17-T-1217	Puller & Installer, Camshaft Bearing	46.50	Mack Mfg. Corp.
*40-G-103	Grinder, Piston Pin Hole		
*41-C-2550	Compressor, Piston Ring		
*40-V-505	Valve, Refacer		
*41-R-2310	Reamer, Valve Guide		
*41-T-1608	Tester, Valve Spring		
*41-V-535	Valve Reseating Accessories		
17-T-1436	Extractor, Valve Insert	23.75	Mack Mfg. Corp.
*41-T-3383	Tool, Valve Seat Insert Replacing		
*41-G-124	Gage, Compression Testing		
*41-G-500	Gage, Combination, Vacuum and Pressure		
17-T-273	Aligner, Timing Gear Cover		Mack Mfg. Corp.
*41-T-3085	Tool, Clutch Plate Aligning		
17-T-1438	Bracket, Engine Lifting, Front		Mack Mfg. Corp.
17-T-1439	Bracket, Engine Lifting, Rear		Mack Mfg. Corp.

**Federal Stock No.*

GROUP 02: CLUTCH

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

(See Figure 4 on page 02-3)

A large single plate type of clutch is employed. The driven disk has two facings riveted to it. The facings are of high grade composition, the one engaging the flywheel and the other engaging a pressure plate (13).

A single pressure spring (2) is used and acts on a sleeve (4) which contacts the release bearing (20). Thru this sleeve the spring force is transmitted to twenty hinged levers (7). These levers multiply the pressure of the spring and transmit the increased pressure to the pressure plate (13).

When the clutch is disengaged, the sleeve moves toward the flywheel. In this way, the action on the hinged levers is opposite to the spring pressure on these levers, thus relieving the pressure against the pressure plate and by means of retractor springs (14) preventing its contact with the driven plate. This type of clutch is known as a "pusher" type, which means that it must be pushed to disengage it.

The pilot bearing (19) in the flywheel is of the prepacked sealed type requiring very little lubrication.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Clutch Slips

ADJUSTMENT INCORRECT .... Readjust correctly and evenly. See "Section 3: Adjustments."

CLUTCH DISK LINING WORN OUT—Replace lining with new Mack or Lipe parts.

CLUTCH DISK LINING OF WRONG MATERIAL .... Replace lining with new Mack or Lipe parts.

PRESSURE SPRING CRACKED OR SET .. Renew with genuine part.

PRESSURE PLATE WARPED ... Renew with genuine part.

Noise

SQUEALING (CAUSED BY CLUTCH SLIPPING) ... Readjust clutch.

GRATING OR CLICKING WHEN CLUTCH PEDAL IS DEPRESSED ...... Usually indicates damaged release bearing. Replace with new bearing.

GRATING OR SQUEAKING CAUSED BY DRY PILOT BEARING .... Remove and examine bearing. See "Section 5: Repairs."

SECTION 3: ADJUSTMENTS

NEVER WAIT FOR A CLUTCH TO SLIP BEFORE ADJUSTING IT. Facings "burned" by slippage are short lived.

(See Figure 4)

When the clutch facings wear, the distance (A) increases as the clutch sleeve (4) moves toward the release bearing (20) reducing the clearance (B) between the bearing and the sleeve (clutch engaged). This reduced clearance (B) results in a reduced free travel (the first easy movement) of the clutch pedal. When this free travel of the pedal decreases to about ½" the clutch should be adjusted immediately.

Adjustment for wear is accomplished by removing a shim from each of six packs of shims (11) provided for that purpose. When this clutch is new and correct facings are used on driven disk (25), the distance (A) from sleeve to cover should be 1⅛", and may vary between 1⅛" and $1\frac{3}{16}$". Each shim pack (11) consists of eight shims when the clutch is new. THE NUMBER OF SHIMS IN EACH PACK MUST BE EQUAL.

DO NOT ADJUST PEDAL OR LINKAGE.

To adjust clutch proceed as follows:

Block the clutch pedal in released position. This is necessary to prevent damaging the adjusting shim clamps (9) or their fastenings. Remove the hand hole cover (22) at bottom of case.

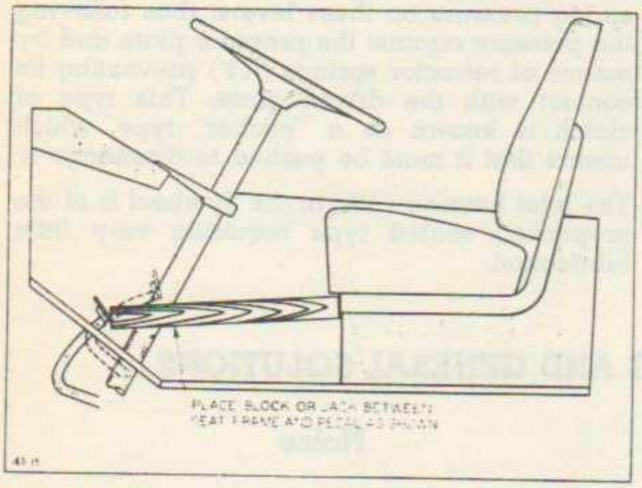


Fig. 1—Blocking Pedal in Disengaged Position

Back off all six adjusting shim clamp nuts (12) five full turns using standard "S"-Wrench.

Engage the clutch by removing the block (or jack) shown in Figure 1. The adjusting shim clamps (9) then back away leaving the adjusting shims (11) free for removal.

Remove ONE shim from under EACH of the adjusting shim clamps with a pair of 8" sharp-nosed pliers, or insert cotter pin puller in small hole of shim. Be sure that no part of the removed shim is left under the clamp. Check all six sets of shims (11) to be sure that all have the same number of shims.

Replace the block as shown above. This clamps the shims back against the clutch cover and the clamp nuts (12) can be tightened. DO NOT ATTEMPT TO TIGHTEN THESE NUTS WITHOUT DISENGAGING THE CLUTCH while so doing. It will result in stripped threads, bent studs, and insecure clamping.

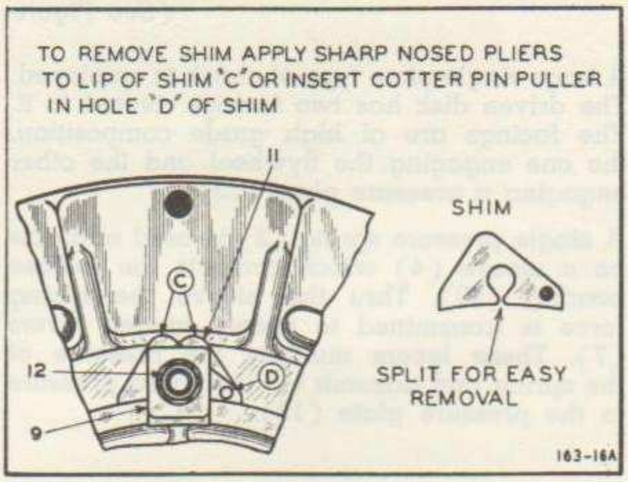


Fig. 2—Removing Shims

With the clutch again engaged, check the dimension (B). It should not be more than 5/32" or less than 1/8" when newly adjusted, also check dimension (A) as shown below. This should be between 1 1/8" and 1-3/16".

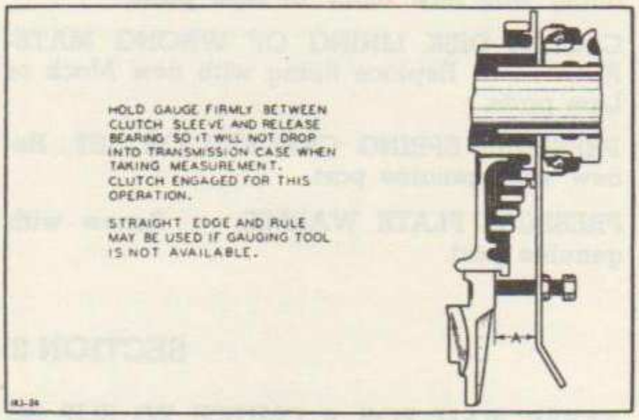


Fig. 3—Measuring Distance from Sleeve to Cover

(Tool—Mack Part No. 17-CQ-16)

(Continued on page 02-4)

1. Adjustor Plate
2. Spring
3. Snap Ring
4. Sleeve
5. Fulcrum Ring
6. Lever Locking Ball
7. Pressure Lever
8. Flywheel Ring
9. Adjusting Strap
10. Flywheel Ring Washer
11. Adjusting Shim
12. Flywheel Ring Nut
13. Pressure Plate
14. Retractor Spring
15. Retractor Spring Washer
16. Retractor Spring Pin
17. Pressure Plate Stud
18. Flywheel Ring Stud
19. Pilot Bearing
20. Release Bearing
21. Facing
22. Inspection Cover
23. Flywheel Screw
24. Flywheel Washer
25. Driven Disk
26. Flywheel Plug
27. Flywheel
28. Starter Ring Gear
29. Flywheel Bolt
30. Flywheel Bolt Nut
31. Flywheel Bolt Cotter
32. Facing Rivet
33. Spring Lug
34. Return Spring
35. Lubricating Tube
36. Lubricating Fitting

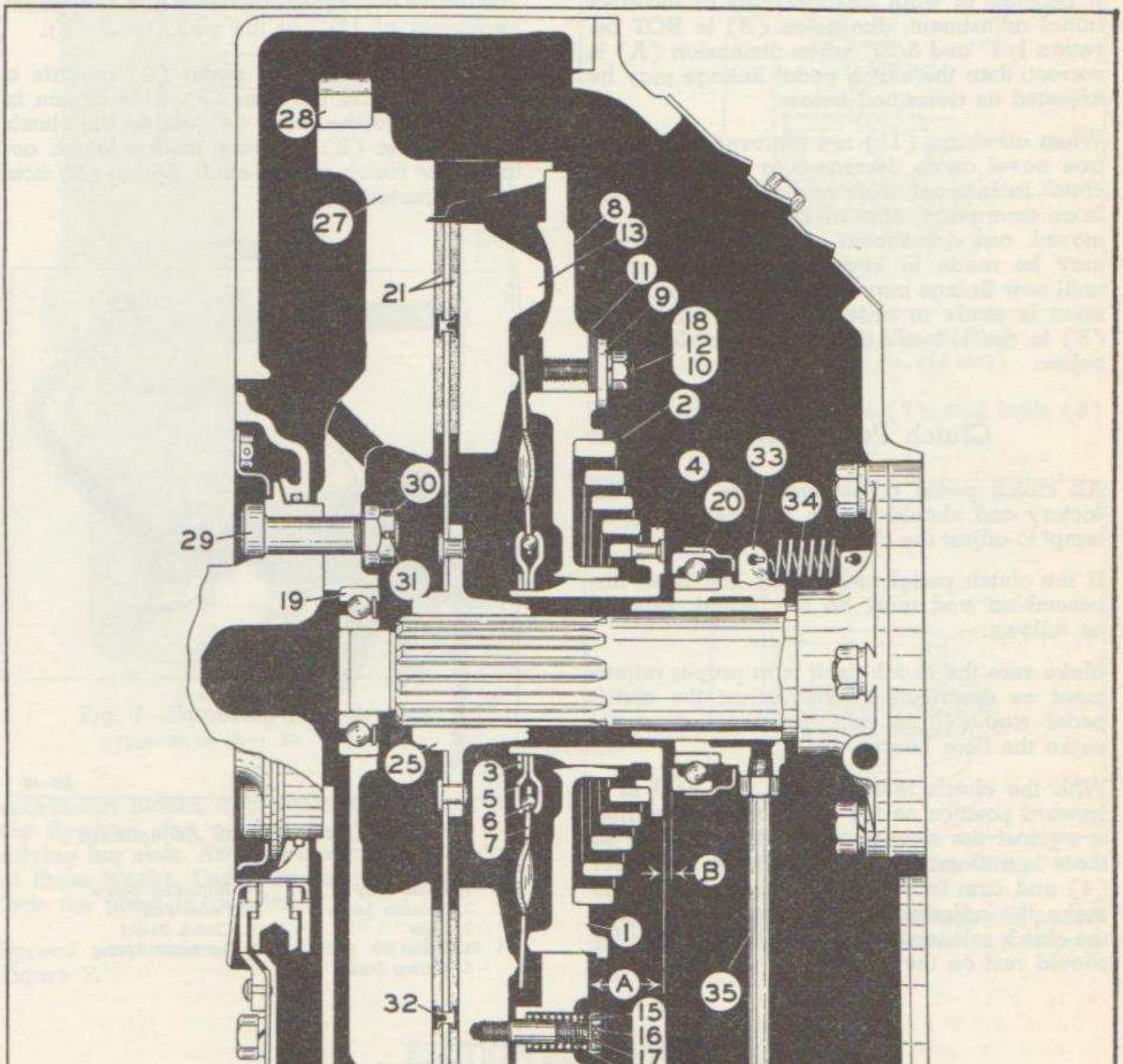


Fig. 4—Sectional View of Clutch

If because of worn linkage parts or incorrect initial adjustment, dimension (B) is NOT between 1/8" and 5/32" when dimension (A) is correct, then the clutch pedal linkage may be adjusted as described below.

When all shims (11) are removed and pedal free travel again decreases to about ½", the clutch facings are worn and must be renewed. In an emergency, after all shims have been removed, one adjustment of the pedal linkage may be made to keep the vehicle running until new linings may be installed. The adjustment is made in order to restore dimension (B) to the ⅛" to 5/32" dimension described below.

Clutch Pedal Setting

All clutch pedal adjustments are set at the factory and should not be changed in an attempt to adjust the clutch.

If the clutch pedal mechanism has been disassembled and must be readjusted, proceed as follows:—

Make sure the clutch itself is in proper adjustment as described above. Adjust the clutch pedal stop (1) so that the pedal does not strike the floor boards.

With the clutch release lever (2) held in a forward position so the clutch release bearing is against the sleeve, adjust the cam (3) so there is a clearance of ¼" between the roller (4) and cam face. Loosen capscrew (5) and make the adjustment with screw (6). When the clutch release lever (2) is freed, the roller should rest on the cam.

The above adjustment amounts to a free pedal movement of 1⅝" at the pedal pad (7).

In operation the clutch pedal (8) imparts a rotary motion to the cam (3). This motion is transferred to the roller (4) giving the clutch release lever (2) a rotary motion which actuates the clutch release-shaft. Spring (9) acts as a retractor spring.

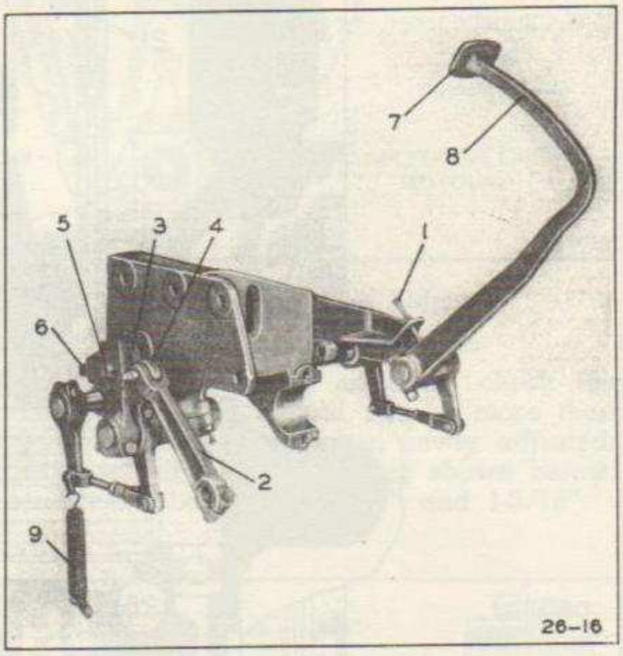


Fig. 5—Clutch Pedal Adjustment

1. Pedal Stop
2. Release Lever
3. Cam
4. Roller
5. Clamp Screw
6. Adjusting Screw
7. Pedal Pad
8. Clutch Pedal
9. Retractor Spring

SECTION 4: DIS-ASSEMBLY

REMOVING CLUTCH FROM CHASSIS

Remove transmission as instructed in "Group 07: Transmission".

Evenly back off the twelve screws (23) which fasten clutch to flywheel, and lift out clutch assembly.

Take out clutch disk (25).

Remove clutch pilot bearing (19) as shown in Figure 6 using puller tool shown.

DIS-ASSEMBLING CLUTCH

To remove pressure plate depress the retaining washers (15) and remove pins (16). The washers and springs will then slip off the four retractor spring studs and the pressure plate can be removed.

To service other parts of the clutch assembly it is necessary to disassemble the clutch. Remove pressure plate as described above. Place the assembly on an arbor or drill press with the assembly resting on clutch sleeve. Place two

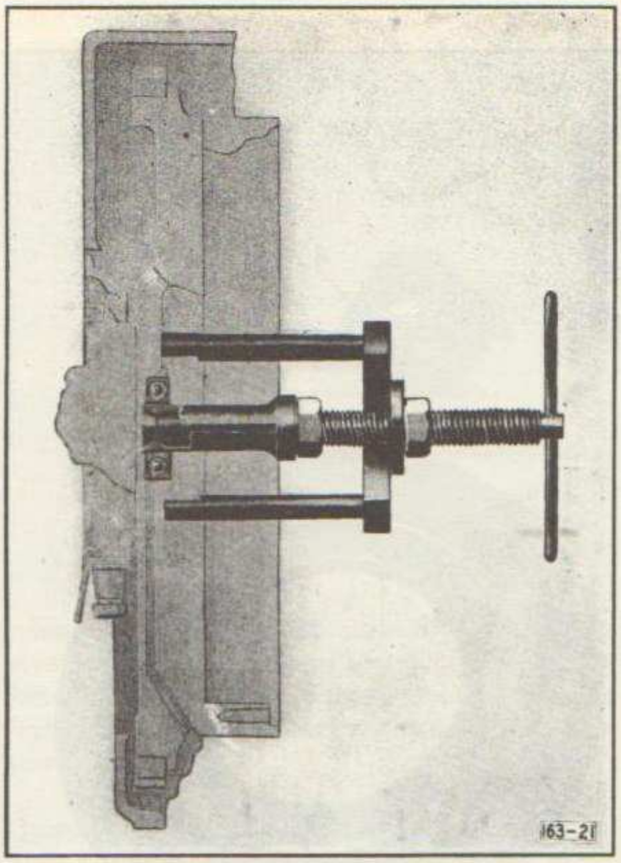


Fig. 6—Removing Pilot Bearing
(Tool—Mack Part No. 17-T-1442)

substantial blocks, approximately 5" long, on the flywheel ring so that they rest over the driving lug slots. Arrange a strong bar on top of these blocks. Compress the assembly and lock the press in position.

Spread and remove snap ring as shown in Figure 7.

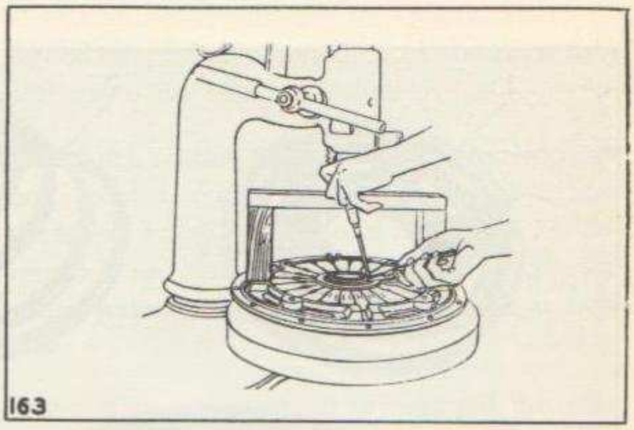


Fig. 7—Removing Snap Ring
(Tool—Federal Stock No. 41-P-1993)

Fulcrum rings (5), levers (7), and balls (6) can now be lifted off.

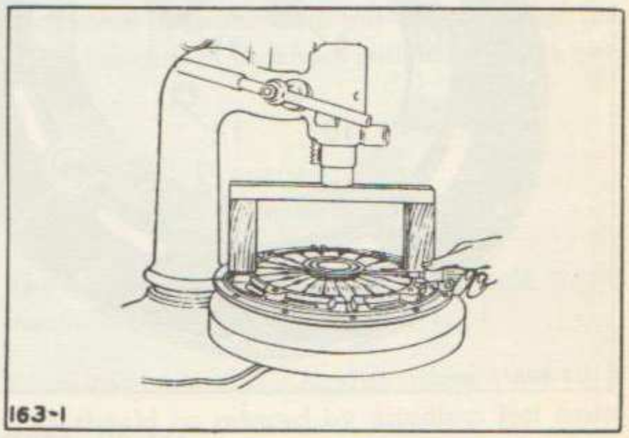


Fig. 8—Removing Fulcrum Ring

Slowly release the assembly which will permit the removal of the spring, sleeve and remaining parts.

SECTION 5: REPAIRS

NOTE: Before re-assembling, all parts should be thoroly cleaned with suitable solvent to remove all traces of dirt and oil, and inspected carefully for cracks or worn surfaces. Parts showing excessive wear should be renewed.

If reinstalling old pressure plate, see that driving lug at "O" mark on edge of plate matches driving slot marked "O" on edge of flywheel ring (8). See Figure 4.

Check spring (2) for load. It should test to 695 lbs. pressure when compressed to 1¼". If less than 630 lbs. replace with new spring.

If flywheel is badly scored or heat checked on the friction surface, it may be removed and refaced.

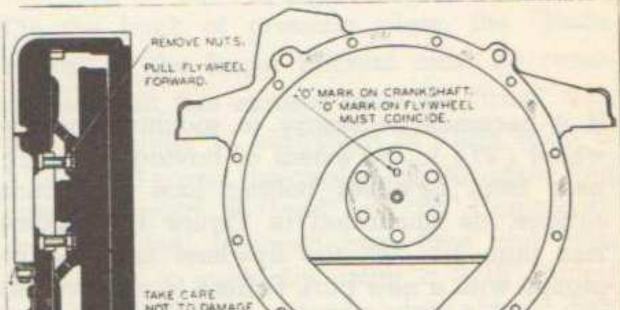


Fig. 9—Removing Flywheel

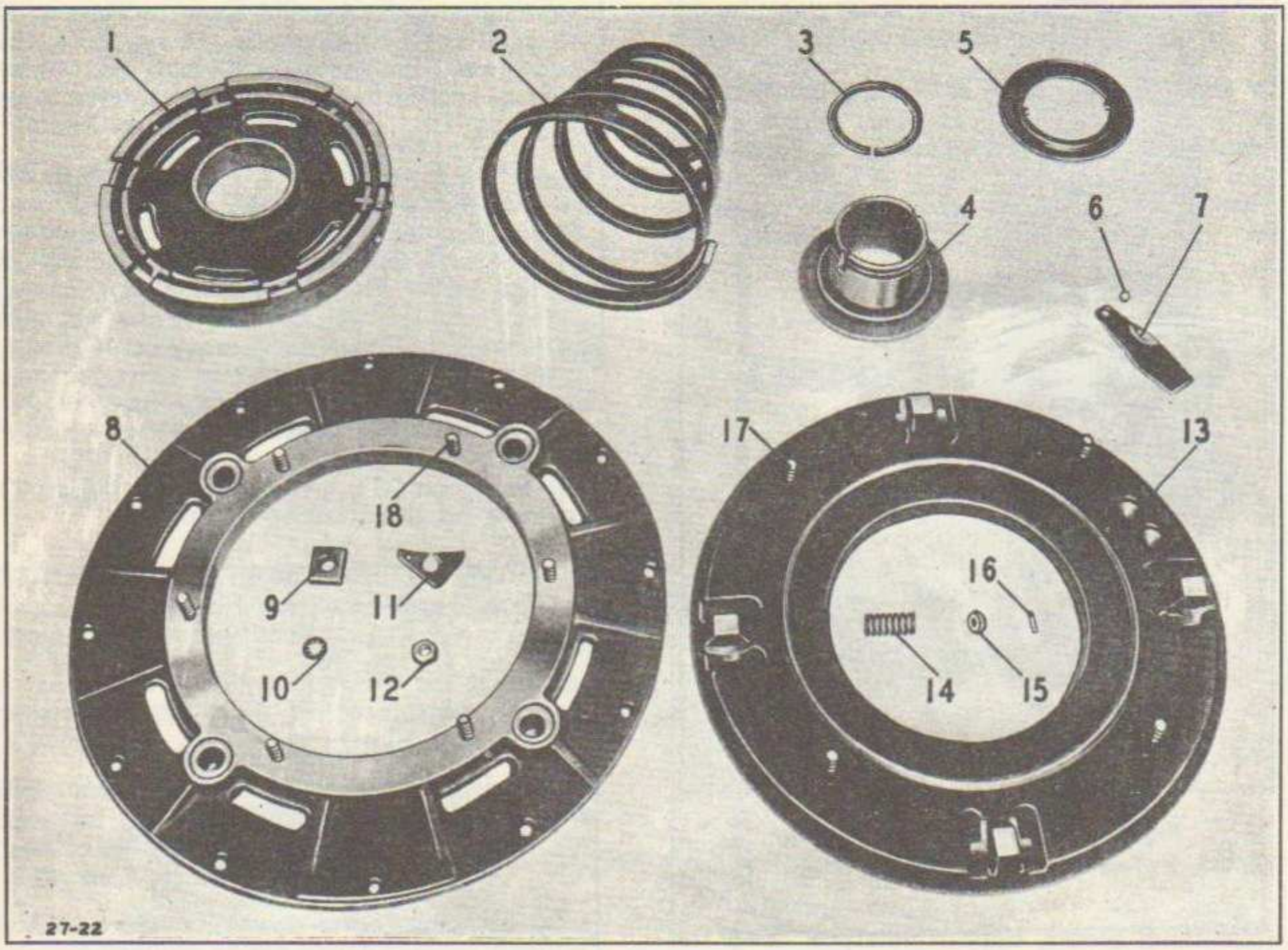


Fig. 10—Exploded View of Clutch

1. Adjustor Plate
2. Spring
3. Snap Ring
4. Sleeve
5. Fulcrum Ring
6. Lever Locking Ball
7. Pressure Lever
8. Flywheel Ring
9. Adjusting Strap
10. Flywheel Ring Washer
11. Adjusting Shim
12. Flywheel Ring Nut
13. Pressure Plate
14. Retractor Spring
15. Retractor Spring Washer
16. Retractor Spring Pin
17. Pressure Plate Stud
18. Flywheel Ring Stud

If it becomes necessary to machine the flywheel (27) to the extent of having the thickness from flywheel bolting face to friction surface, as illustrated in Figure 11, become less than 1-11/16" the flywheel must be replaced with a new part. Failure to observe this precaution will usually result in greatly shortened cluch disk facing (21) life and damage to the clutch pilot bearing (19).

Remove worn facings from clutch disk by punching out the old rivets and replace with new facings and new rivets. This operation is much more securely and uniformly done with special machinery. The clutch disk (25) should be checked for flatness and squareness with the hub. If total out-of-flat or out-of-square is more than 1/32", the clutch will drag. Hub and facing rivets should be checked for loose-

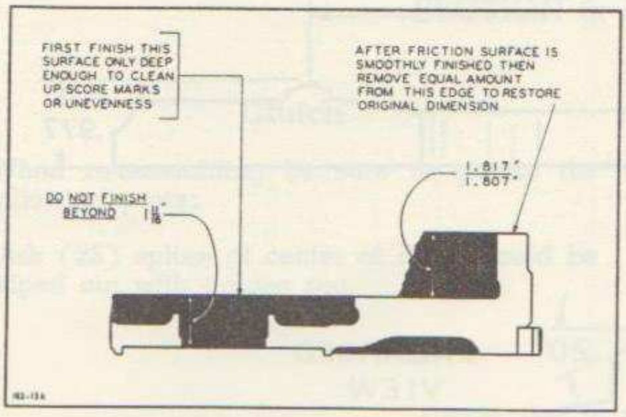


Fig. 11—Resurfacing Flywheel

ness. This can be determined by tapping the rivet heads with a small punch held lightly between the fingers. A loose rivet will give a lighter sound and is best replaced with a new one.

Examine clutch disk hub for wear and if necessary remove any sharp burrs with a file. When hub is slipped over the splined shaft of the transmission it should not stick or jam in place. If hub has to be forced on and off this shaft it may cause "drag" when installed in chassis. Correct clutch facing thickness is between .156" and .161". Total disk and facing thickness after assembly should be between .411" and .423".

If installing a new or reconditioned clutch disk place six new sets of eight shims (11) each under the six adjusting shim clamps (9) as shown in illustration in Figure 2 before proceeding with re-assembly.

Check the fulcrum rings (5) for warpage, or excessive wear. They should show very little warp when placed against a flat plate. The outer edges should not be deeply burred or marked where the locking balls and levers rest.

If using same levers (7), be sure they are straight.

If bent or excessively worn, install new levers. If levers are only slightly worn they may be turned over when reinstalling to present a new surface to the fulcrum points.

The clutch release bearing (20), release collar and related parts should be examined for excessive wear, cleaned and regreased. Do not remove the clutch release bearing from the collar unless it is necessary to install a new one.

When a clutch overhaul is required the pilot bearing should be carefully cleaned and inspected. This bearing is a "loose-ball" type with .002 to .004 total radial clearance between balls and races. Cracked, pitted or scored balls or races are indications of a bad bearing. Looseness is permissible unless excessive. Replace bearing in flywheel with shield side out.

Pressure Plate

(See Figures 12 and 13)

The original thickness of pressure-plate when measured over knife-edge is .977.

Pressure-plates (13) having more than .010 dish should be refaced by grinding. Not more than 1/16" metal should be removed when refacing. Reface only as far as lining contacts pressure plate—to explain this—the center hole in lining is 8" dia., while the hole in pressure plate is 7¼"; thus there is 5/16" all around where lining does not contact, and this 5/16" need not be "cleaned up" when grinding.

On the back of pressure plate, the "knife-edges" of the finger fulcrum must be remachined, and this surface must be "true" with face. Diameter at high-point of knife edge is 9.750 in all cases, the angles are 20° inner and outer and width of "land" is 1/32." Compensation for metal removed from face and from knife-edge is made by using a 3/16" lining instead of 5/32" on pressure plate side of disk when amount removed totals 1/32", and using two 3/16" linings when amount removed totals 1/16" or more.

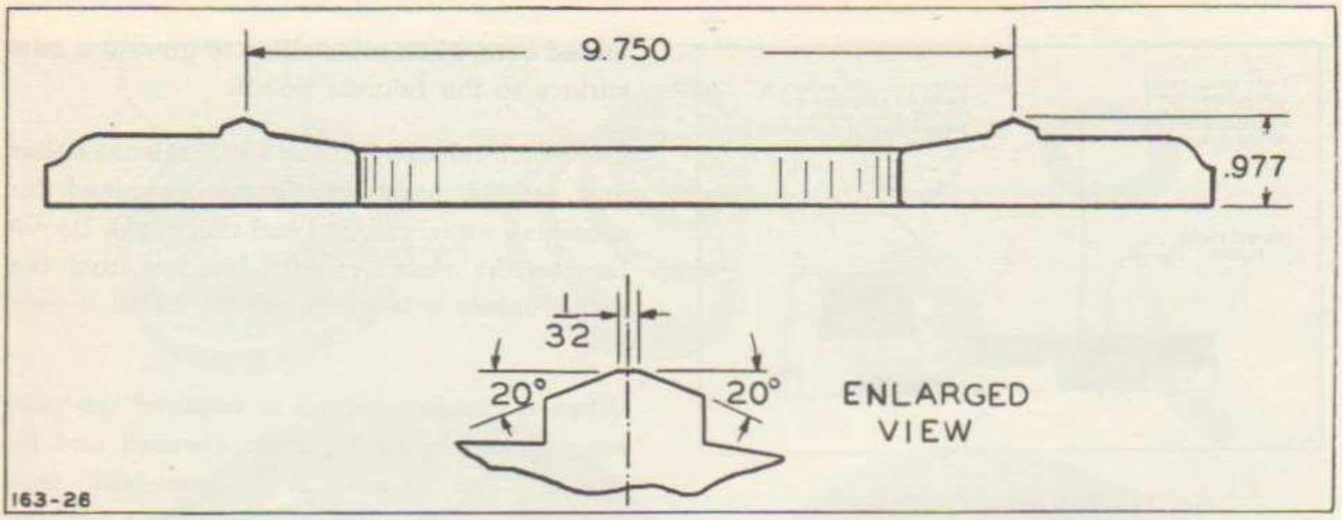


Fig. 12—Pressure Plate Dimensions

Adjusting Plate

Knife-edges on this plate should be resharpened by machining the two 20° angles as described under "Pressure Plate". Illustration above will make this clear. It is *VERY IMPORTANT* to get the correct diameter of knife-edge as shown in illustration below, and that the point of the knife-edge be machined "true" with the flange of adjusting ring.

Compensation for material removed can be made by reducing number of shims. Original thickness of plate is 1.232 from base of slots to top of knife-edges, and one shim can be removed for every .015" that it measures less than 1.232, providing 6 shims remain. If less than 6 shims are left, it will be necessary to machine 1/16" off inside of flange of adjusting ring to permit use of more shims; by machining this flange, the base of slots will no longer be level with flange face and it will be necessary to weld 1/16" strip x 1/8" wide at bottom of each clamp.

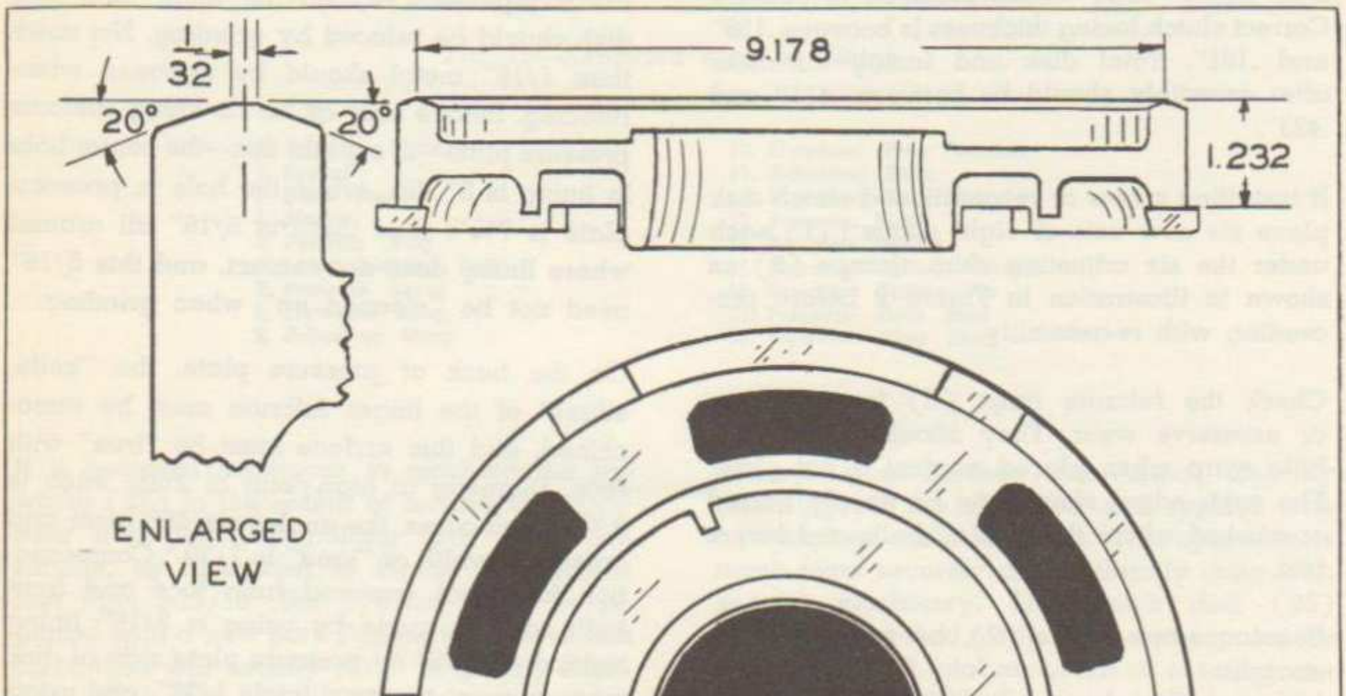


Fig. 13—Adjusting Plate Dimensions

SECTION 6: LUBRICATION

Clutch

When re-assembling be sure to grease the following parts:

Disk (25) spline at center of disk should be wiped out with grease rag.

Repack pilot bearing (19) and release bearing (20).

Fingers (7), fulcrum rings (5), and balls (6) are to be slightly greased.

For other lubricating instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

Place clutch sleeve (4) on table of drill or arbor press and insert coned pilot tool in sleeve to act as a guide in assembling sleeve in adjusting plate (1).

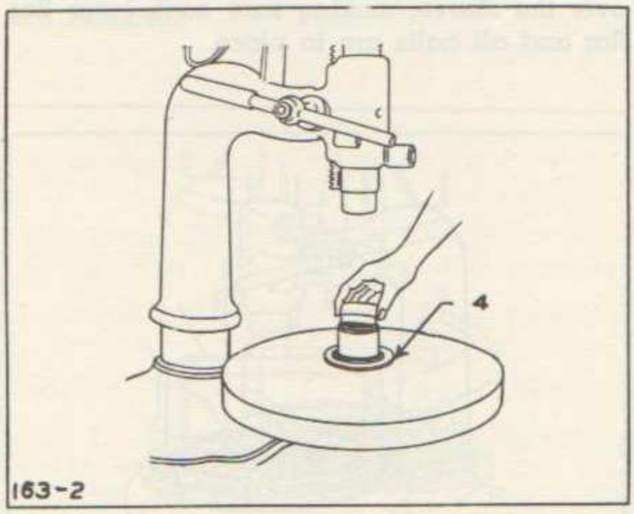


Fig. 14—Assembling Adjusting Plate
(Tool—W. C. Lipe Part No. T-1483)

In assembling spring (2) into adjusting plate (1) be sure that large end of spring butts against boss in adjusting plate. Place adjusting plate and spring over the sleeve with the small end of the spring against the stop in the sleeve.

Arrange blocks and bar as explained under "Section 4: Dis-Assembly" or improvise "U"-shaped tool as shown here. Compress the assembly carefully, lock the press and remove the coned pilot tool.

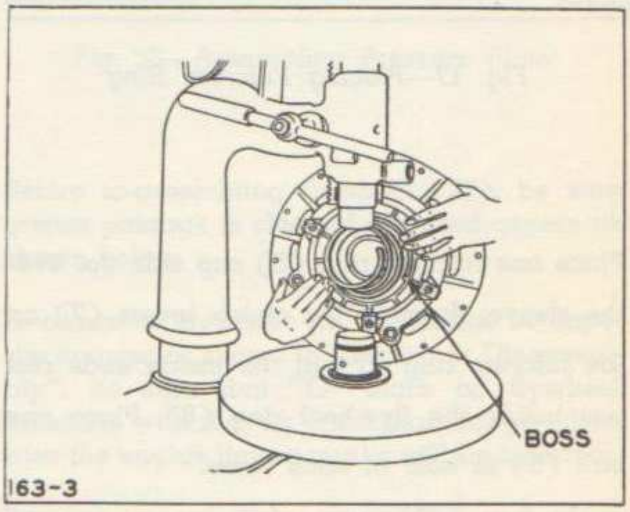


Fig. 15—Assembling Spring and Sleeve

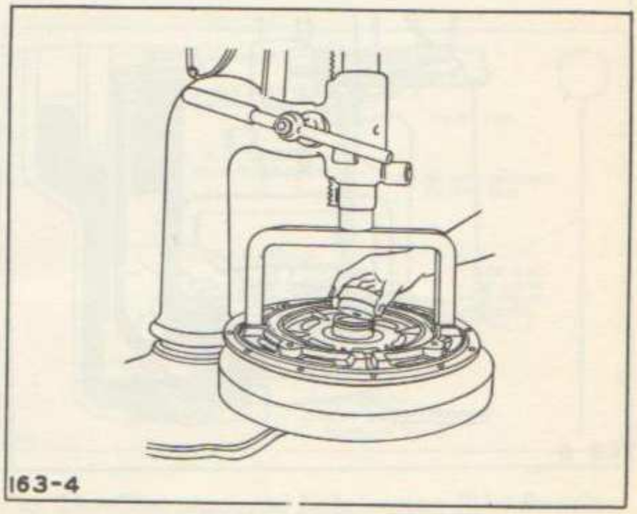
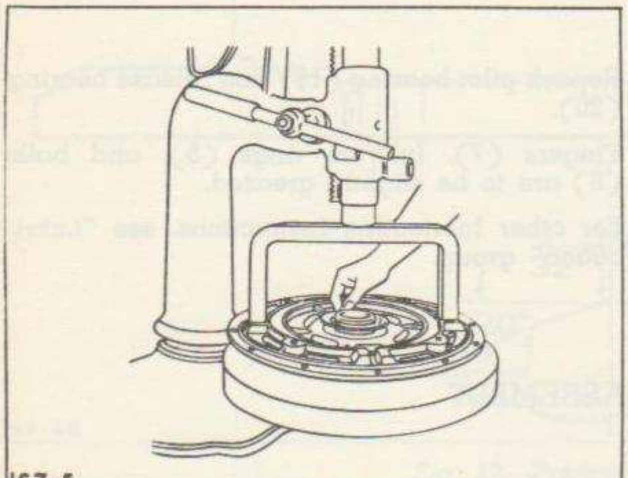


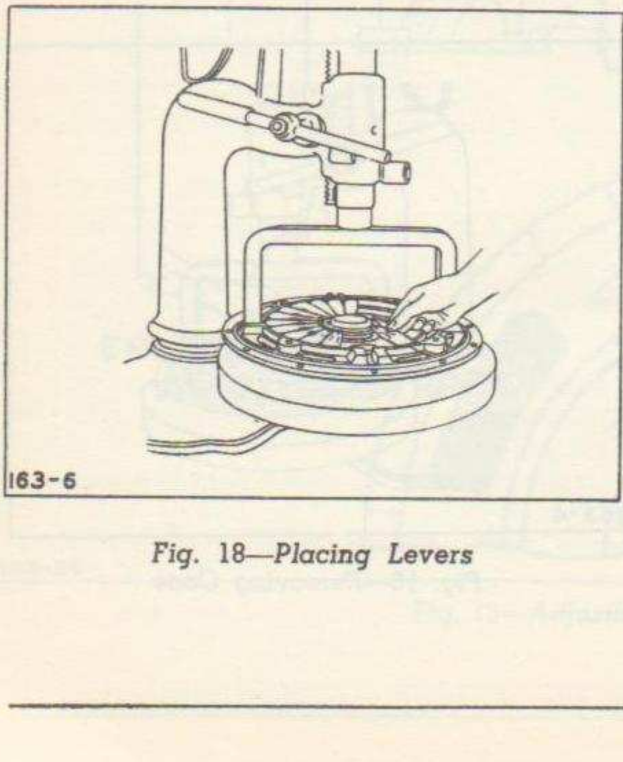
Fig. 16—Removing Cone



163-5

Fig. 17—Placing Fulcrum Ring

Place one fulcrum ring (5) cup side up, over the sleeve. Arrange the clutch levers (7) on the fulcrum ring so that the inside ends rest just inside the flywheel ring (8). Place one ball (6) in hole of each lever.



163-6

Fig. 18—Placing Levers

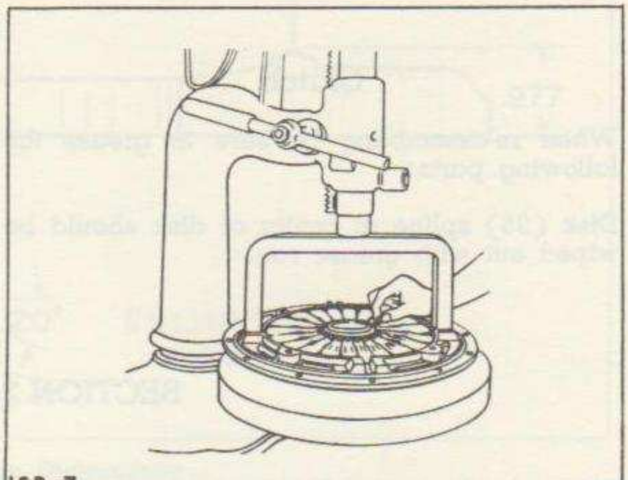


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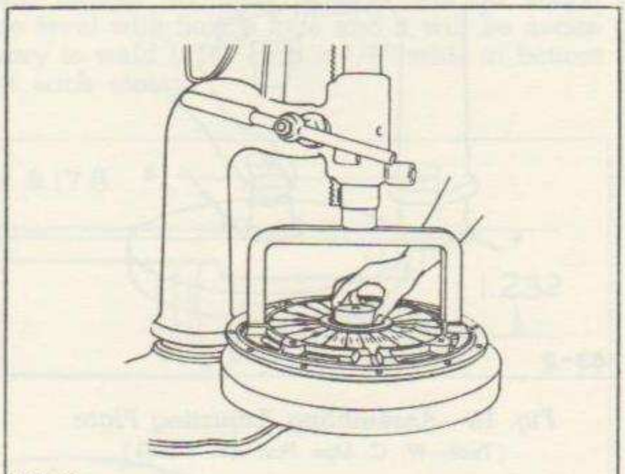
Fig. 19—Placing Balls

Assemble remaining fulcrum ring carefully over the sleeve, making sure each lever lies flat and all balls are in place.



163-8

Fig. 20—Placing Cone
(Tool—W. C. Lipe Part No. T-1483)

Place cone in sleeve, then place snap-ring on cone. See that the snap ring (3) slot is not in line with the keyway of the fulcrum ring.

Then place the cupped part of the tool on snap ring and drive the ring home with a quick blow on the cup top.

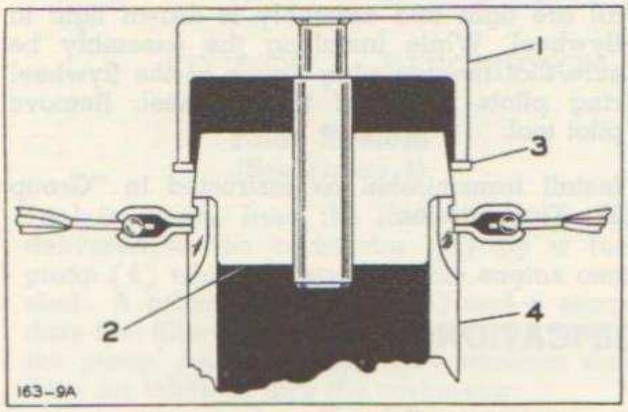


Fig. 21—Installing Snap Ring

1. Cup
2. Cone
3. Snap Ring
4. Sleeve

Remove tools and tap the snap ring snugly into place preferably using staking tool shown. Commence staking at side opposite the slot and work both ways until the ends are reached.

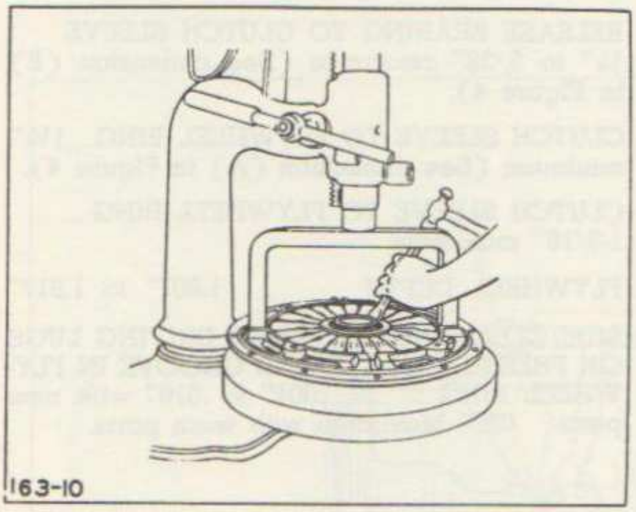


Fig. 22—Staking Snap Ring
(Tool—W. C. Lipe Part No. T-1528)

Test each of the twenty levers to see that they are securely locked in place by a ball. Before assembling pressure plate into clutch cover, be sure that studs (17) are not bent so that retaining washers (15) do not interfere with retractor spring (14) hole. With pressure plate in place, reverse clutch assembly and install springs, washers and pins (16) on pressure plate.

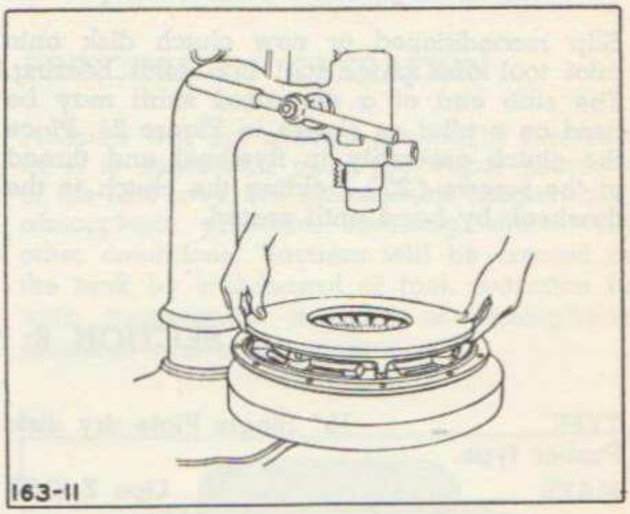


Fig. 23—Assembling Pressure Plate

Before re-assembling flywheel (27), be sure grease passage is cleaned of caked grease as shown below.

Re-assemble flywheel on crankshaft in opposite manner as shown in "Section 4: Dis-assembly". Be sure that "O" mark on flywheel coincides with that on crankshaft flange otherwise the engine timing marks will be incorrect.

Remove grease hole plug (26) and clear grease hole passage of caked grease with a stiff wire.

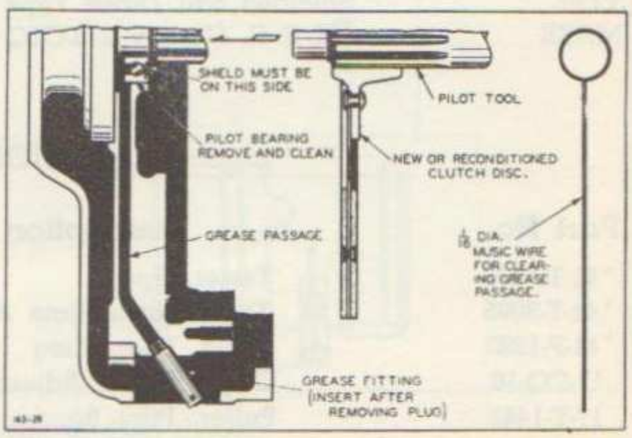


Fig. 24—Cleaning and Lubricating Pilot Bearing
(Pilot Tool—Federal Stock No. 41-T-3085)

Installing Clutch Assembly

Slip reconditioned or new clutch disk onto pilot tool and place tool into pilot bearing. The stub end of a discarded shaft may be used as a pilot as shown in Figure 24. Place the clutch assembly in flywheel and thread in the screws (23), holding the clutch to the flywheel, by hand until seated.

Then gradually tighten every other screw until all are tight and assembly is drawn tight to flywheel. While installing the assembly be sure that the centering flange of the flywheel ring pilots inside of the flywheel. Remove pilot tool.

Install transmission as instructed in "Group 07: Transmission".

SECTION 8: SPECIFICATIONS

TYPE .... 15" Single Plate dry disk, Pusher type.

MAKE .... Lipe Z-40-SX

Friction Facings

TOTAL AREA .... 252.9 sq. in.

OUTSIDE DIAMETER .... 15"

INSIDE DIAMETER .... 8"

THICKNESS (FACING) .... .156 to .161"

TOTAL THICKNESS (ASSEMBLED ON DISK) .... .411" to .423".

Springs

PRESSURE SPRING ... Single tapered coil used 695 lbs. pressure at 1¼" length.

RETRACTOR SPRINGS .... Four helical compression springs 21/32" O.D., 30 lbs. pressure each at 15/16" length.

Release Bearing

TYPE .... Shielded Ball Thrust Type

MAKE .... M. R. C. Gurney 214-CTQ

Pilot Bearing

TYPE .... Shielded loose-ball radial type.

MAKE .... S. K. F. 6305-Z-C-5-.002" Radial clearance.

Adjustment Specifications

CLUTCH PEDAL—WHEN CLUTCH IS PROPERLY ADJUSTED ...... 1¾" maximum free travel. At ½" adjust clutch, not pedal.

RELEASE BEARING TO CLUTCH SLEEVE ⅛" to 5/32" clearance (See dimension (B) in Figure 4).

CLUTCH SLEEVE TO FLYWHEEL RING ..... 1⅛" minimum (See dimension (A) in Figure 4).

CLUTCH SLEEVE TO FLYWHEEL RING .... 1-3/16" maximum.

FLYWHEEL DEPTH .... 1.807" to 1.817"

SIDE CLEARANCE BETWEEN DRIVING LUGS ON PRESSURE PLATE AND GROOVE IN FLYWHEEL RING .... .004" to .010" with new parts. .020" Maximum with worn parts.

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
*41-T-1600	Tester, Spring		
*41-T-3085	Tool, Clutch Plate Aligning		
*41-P-1993	Pliers, Snap Ring		
17-CQ-16	Gage, Clutch Adjustment	$ 1.30	Mack Mfg. Corp.
17-T-1442	Puller, Pilot Bearing	31.75	Mack Mfg. Corp.
T-1483	Tool, Snap Ring Assembly	5.25	W. C. Lipe
T-1528	Staker, Snap Ring	.65	W. C. Lipe

Federal Stock No.

GROUP 03: FUEL

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Fuel System
(See Figure 1)

Fuel is drawn from the fuel tank (1) and delivered to the carburetor (6) by a fuel pump (4) which is driven by the engine camshaft. A primary fuel filter (2) and a secondary fuel filter (3) clean the fuel on the way to the pump. An air cleaner (7) removes dust from air taken in thru the carburetor.

Fuel Tank Pressure Cap
(See Figure la)

Each fuel tank is provided with a pressure cap having spring-loaded valves which function to seal the end of the filler spouts, and only open to relieve excess pressure or vacuum. The pressure relief valve opens between 1½ and 2½ pounds above atmospheric pressure, and the vacuum relief valve opens between 0 and ¼ pound below atmospheric pressure.

Pressure will not always prevail in the tank as it is dependent upon the vapor pressure of the fuel used, the atmospheric temperature, atmospheric pressure, churning effect, and other conditions. Vacuum will be created in the tank by withdrawal of fuel, reduction in tank temperature, increase in atmospheric pressure, and other conditions.

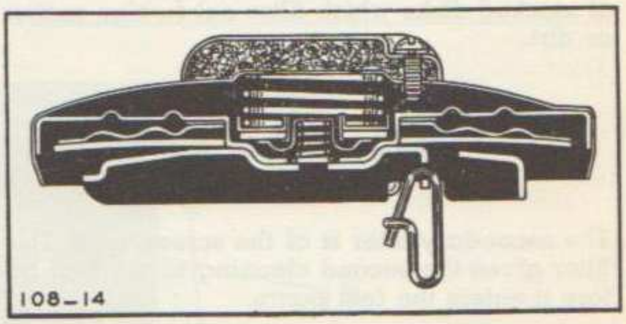


Fig. la—Fuel Tank Pressure Cap

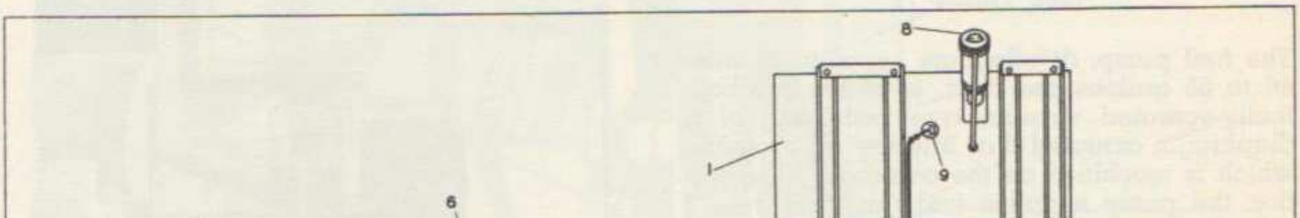


Fig. 1—Schematic Diagram of Fuel System

1. Fuel Tank
2. Primary Fuel Filter
3. Secondary Fuel Filter
4. Fuel Pump
5. Fuel Line
6. Carburetor
7. Air Cleaner
8. Filler Cap (Pressure Type)
9. Fuel Tank Gage Unit
10. Fuel Tank Valve

The advantages of the pressure cap over the conventional vented cap are: It avoids the loss of fuel in either its liquid or vapor states. It prevents the entrance of water, dirt and other foreign matter. By regulating the pressure of the fuel system it reduces the tendency to vapor lock.

Primary Fuel Filter
(See Figure 12)

A metal cased fuel filter (2) cleans the gasoline before it enters the second filter. The filter is of the laminated type consisting of a series of stacked disks which filter out foreign matter or dirt.

Secondary Fuel Filter
(See Item 17 of Figure 7)

The secondary filter is of the screen type. This filter gives the second cleaning to the fuel before it enters the fuel pump.

Fuel Pump
(See Figure 7)

The fuel pump, of adequate capacity of from 40 to 55 gallons per hour, is of the mechanically-operated vacuum type consisting of a diaphragm actuated thru lifter by an eccentric which is machined on the camshaft. In operation the pump supplies fuel (at from 3 to 4 pounds pressure) to the carburetor as required to maintain a predetermined level in the carburetor bowl. As the level diminishes the carburetor float needle valve opens permitting the pump to supply more fuel.

Fuel enters the filter bowl (18) and is screened (17) before passing thru the suction valve (8) on the way to pump chamber. The fuel is then forced thru the pressure valve (12) to the carburetor float chamber. When the carburetor bowl is filled the float chamber shuts its needle valve and pressure is created in the pump chamber which holds the diaphragm downward against the pressure of the spring (39).

Since the rocker arm lever is split, the one half moves without operating the other half until the carburetor bowl valve opens and lever spring pressure is released. The spring (38) keeps the lever lifter in constant contact with the eccentric on camshaft to prevent noise. Air dome (9) maintains an even flow of fuel. All parts are plated to prevent corrosion from condensation. The pump is fitted with a hand priming lever (25). The pump is attached to the engine by two screws. A 1/64" gasket is used each side of a 3/32" composition insulator spacer between the pump and engine. The spacer insulates heat from the pump and therefore must not be omitted.

Carburetor
(See Figures 2, 3, 8 & 13)

The carburetor is of the updraft type employing a compound nozzle system of carburetion, which feature results in a correct air-to-fuel ratio at all speeds. It is fitted with an accelerating pump and economizer for obtaining high performance and low operating costs.

The Venturi (64) measures the volume of air which passes thru the carburetor.

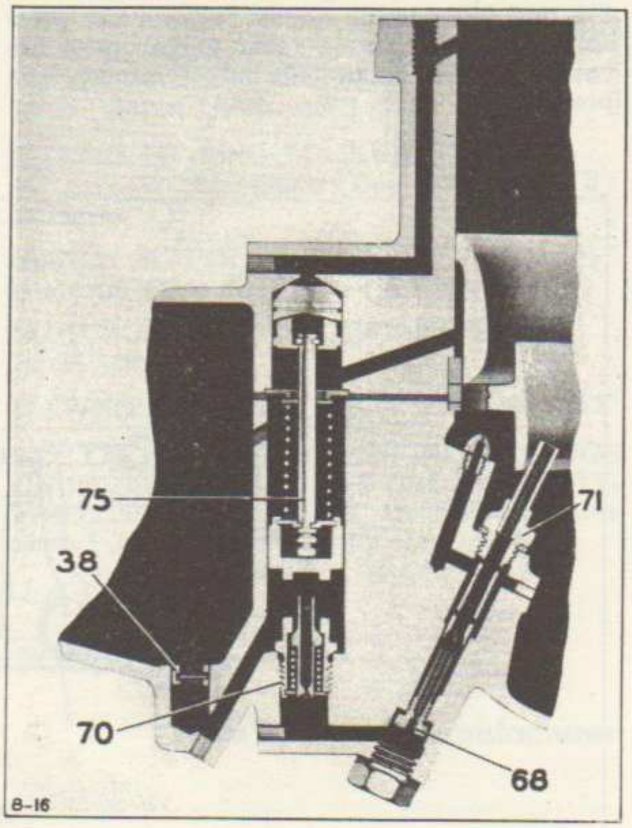


Fig. 2—Showing Vacuum Pump for Power and Acceleration

38. Check Valve Assembly
68. Power Jet Assembly
70. Power Jet Valve Assembly
71. Discharge Jet
75. Vacuum Pump Assembly

Main Jet System
(See Figure 3)

The Main Jet (65), often referred to as the "high speed jet", exerts its principal influence at the higher engine speeds. Fuel from the bowl is metered thru the Main Jet (65) and discharged into the air stream at the point of greatest suction, in the secondary Venturi (64A) thru the Main Discharge Jet (71).

The main jet (65) determines the maximum amount of fuel which may be obtained for high speed operations.

Compensating System
(See Figure 3)

The compensating system consists of the Main Discharge Jet (71) and the Well Vent (73). The flow of fuel from the Main Jet (65) is controlled by the size of the Well Vent (73) and the size of the Main Discharge Jet (71). The mixture delivered thru the Main Discharge Jet may be made richer by either increasing the size of the Main Discharge Jet or by decreasing the Well Vent. Conversely the mixture may be made leaner by either decreasing the size of the Main Discharge Jet or by increasing the size of the Well Vent.

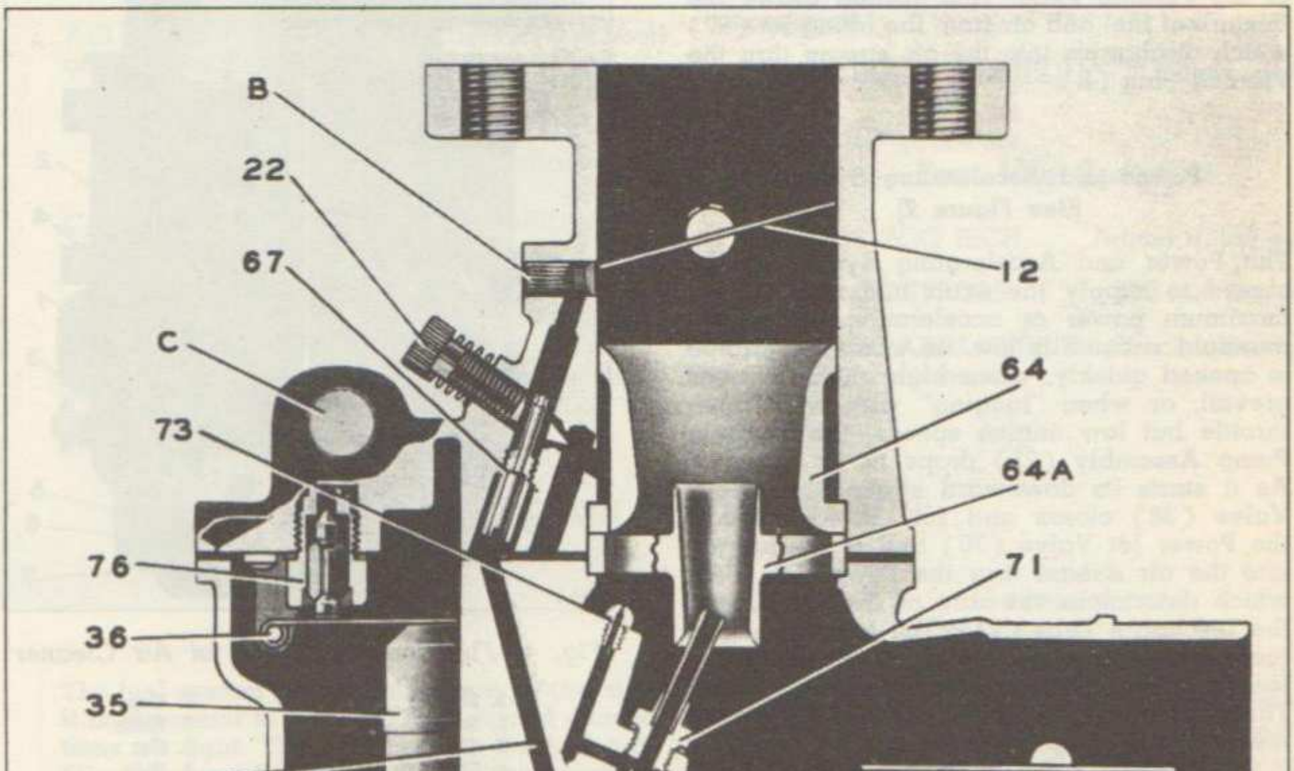


Fig. 3—Sectional View of Carburetor

A. Idling Fuel Channel
B. Priming Plug
C. Inlet Port
12. Throttle Plate
22. Idling Adjusting Needle
35. Float Assembly
36. Axle
64. Primary Venturi
64A. Secondary Venturi
65. Main Jet (High Speed)
67. Idling Jet
68. Power Jet Assembly
71. Main Discharge Jet
73. Main Jet Well Vent
76. Valve and Seat Assembly

Idling System
(See Figure 3)

The Idling System consists of the Idling Jet (67) and the Idle Adjusting Needle (22). The Idling Jet (67) receives its fuel from the Main Jet (65) thru Channel (A). The fuel is metered thru the Idling Jet (67) and is mixed with air which is admitted from behind the Venturi (64). The Idle Adjusting Needle (22) controls the amount of air which is admitted to the Idling System. The Idling System functions only at Idling and Low Speeds. At these speeds, the Throttle Plate (12) is almost closed and there is a very strong suction past the edge of the Throttle Plate. This suction draws the mixture of fuel and air from the Idling Jet (67) which discharges into the air stream thru the Priming Plug (B).

Power and Accelerating System
(See Figure 2)

The Power and Accelerating System is designed to supply the extra fuel required for maximum power or acceleration. When the manifold vacuum is low, as when the throttle is opened quickly, when high engine speeds prevail, or when "lugging" with wide open throttle but low engine speeds, the Vacuum Pump Assembly (75) drops in its cylinder. As it starts its downward stroke, the Check Valve (38) closes and fuel is forced thru the Power Jet Valve (70) and is discharged into the air stream thru the Power Jet (68), which determines the rate of discharge, and the Discharge Tube (71). The amount of this fuel may be regulated by changing the stroke length of the Vacuum Pump Assembly (75). Three notches are provided in the lower part of the Vacuum Pump stem for this adjustment.

Air Cleaner
(See Figure 4)

An air cleaner of the self-washing oil-bath type is mounted on the left side of the engine. The air cleaner removes dust and dirt from the air before it passes thru the carburetor into the engine and the air compressor.

Dusty air enters the cleaner thru holes (9) around the body. The intake holes toward the radiator fan are covered with a shroud (1) to prevent the fan blast blowing air and dirt directly into the cleaner. As indicated by the arrows, the air travels downward around the skirt (4) of the screen assembly (2). The air is then directed upward by the oil in the cup (6) and by cup baffle (7). The air stirs up the oil and carries droplets up to the wire mesh cleaning element (2). The heavy dirt falls into the cup before it reaches the element. The light dirt is caught by the oil on the element and drains into the cup. Air, free of dirt and oil, passes on to carburetor thru the outlet (10) at the top of the cleaner.

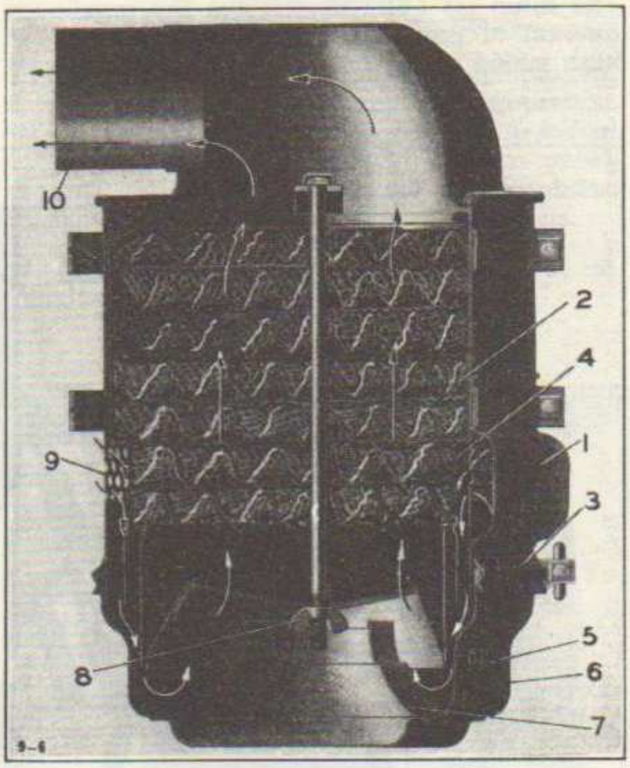


Fig. 4—Functional Diagram of Air Cleaner

1. Shroud	6. Cup
2. Screen	7. Baffle
3. Clamp	8. Nut
4. Skirt	9. Hole
5. Oil Level	10. Outlet

Governor
(See Figures 9, 10 & 11)

A centrifugal governor of the mechanical flyball type is actuated by positive drive thru helical gears from the oil pump shaft. It is sturdily constructed and automatically lubricated from the engine pressure system. Oil enters thru a hole in the mounting flange to the shaft by intermittent feed from which it is sprayed over the top end of the spool shaft. This method gives adequate lubrication at the same time providing an oil wash that prevents corrosion from condensation.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Insufficient Gas Flow

FUEL LINE CLOGGED .... Blow out line and clean vent hole in tank cap.

RUPTURED PUMP DIAPHRAGM .... Renew.

DIRT IN FILTER BOWLS .... Remove and wipe dry. Clean screen in filter bowls.

WORN PUMP LEVER .... Renew.

AIR LEAKS .... Check fuel pump filter bowl gasket and tighten all connections.

STICKY CONTROLS .... Choke or throttle does not return—Clean and oil.

LONG IDLING PERIOD .... Shut engine off when parking.

ENGINE TOO HOT .... Check "Cooling" system, see "Group 05."

DRAGGING BRAKES .... Readjust

TIRE PRESSURE LOW .... Inflate to correct pressure.

OVERLOADED VEHICLE .... Check weight.

Excessive Fuel Consumption

CARBURETOR ADJUSTMENT INCORRECT .... Adjust idling valve, throttle stop or float level.

AIR CLEANER LOADED .... Clean as directed.

FUEL LEAKS .... Tighten all connections.

Fast Idle Speed

MIXTURE TOO RICH .... Adjust idling valve.

STICKY CONTROLS .... Oil moving parts.

IMPROPER ADJUSTMENT .... Check choke valve and throttle lever.

SECTION 3: ADJUSTMENTS

Fuel System
(See Figure 1)

The fuel system is of the suction type therefore it is important to have all fittings and connections air tight. The vent hole in the fuel tank filler cap must be open to permit the breathing of the system.

Primary Fuel Filter

See Figure 12 and instructions on page 03-12.

Secondary Fuel Filter
(See Figure 7)

Dirt and water collecting in the sediment bowl can be drained out by removing the thumb screw at the bottom of the bowl. The filter element should be removed and the sediment washed off in a solvent and cleaned with compressed air.

Governor
(See Figure 11)

There are no adjustments required after governor has once been set for engine speed and sealed. If at any time it is necessary to break the seal, adjusting nut (8) should not be touched. If at any time it is necessary to remove spring (9), remove nut (8) but do not change position of nut (41). Adjusting link (42) should not be changed from its original adjustment.

Carburetor
(See Figure 3)

Adjustment can be made for idling only, mixture at all other speeds is controlled by a "fixed" metering jet which is calibrated at the factory to supply the correct amount of fuel.

Idling Adjustment
(See Figure 3)

When making an idle adjustment, first run engine until thoroly warm, then set the hand throttle until the lowest steady speed is reached. Turn low speed adjustment gradually to right or left until the engine runs steady and as fast as this throttle position will permit. The adjustment operates on air so that screwing IN gives a richer mixture, OUT a leaner one.

If after adjusting, engine idles too fast or too slowly, the desired speed can be obtained by turning the throttle stop screw.

Instructions for Checking Engine Idling and Governed Speed
(See Figure 5)

The photograph shows a typical electrical tachometer connected to indicate engine speed. The needle zero adjustment of the instrument should be checked (if adjustment is provided) before starting the engine. Engine idling speed should be 300 R.P.M. Maximum engine governed speed should be 2250 R.P.M. no load.

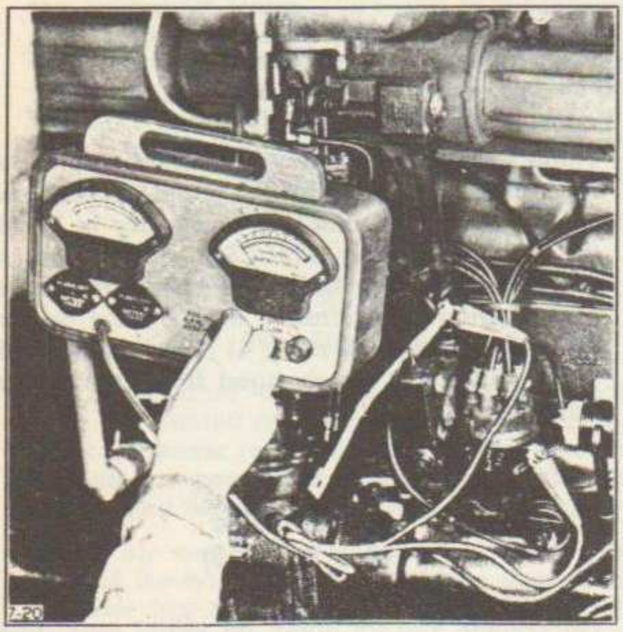


Fig. 5—Checking Idling and Governed Speeds
(Tool—Federal Stock No. 18-T-230)

Combustion Analyzer
(See Figure 6)

A combustion analyzer is used to determine if the correct air-to-fuel ratio is being supplied by the carburetor. If the carburetor reads in error it is due to jets having become worn or during the course of repairs, jets having been knocked slightly out of line. The combustion analyzer has a long sampling hose with clamp fitting (1) which is attached to the end of the exhaust pipe and a smaller hose (2) used to direct the exhaust gases from the instrument and away from the operator.

Over-Speeding

Over-speeding engines is a practice which cannot be condemned too vehemently. Racing idle engines during tune-up, and climbing or descending hills in the wrong "gear" are frequent forms of this abuse. It should be remembered that even tho an engine is equipped with a governor, it very definitely can be run too fast down hill, as the vehicle then drives the engine rendering the governor ineffective. This form of abuse will cause serious damage to engine bearings, pistons and valves.

Fig. 6—Combustion Analyzer
(Tool—Chas. Engelhard, Inc.)

1. Sampling Hose Clamp Fitting
2. Hose for Directing Exhaust Gases away

SECTION 4: DIS-ASSEMBLY

Fuel Pump
(See Figure 7)

After the pump has been removed from the engine proceed to dis-assemble as follows:

Loosen thumb screw (20) by turning to the left. Swing link (21) and bowl seat (19) upward to clear the bowl (18). Remove bowl (18) by twisting slightly to break shellac on gasket (16). Wash out all sediment. Remove gasket (16) by running a knife underneath it to break shellac, taking care not to puncture screen (17). Remove screen (17) and clean.

Remove three fillister head screws (24). Drive sharp instrument under cap (23) to free gasket which has been shellaced in. Remove cap (23) and gasket (22) and two springs (38), and (39) also cap (37). Remove lock wire (33). Drive shaft (32) about ¾ of the way out, enough to free lever (30). Remove lever (30). Remove ten fillister head screws (14) and lockwashers (15). Mark location of upper housing (13) in relation to lower housing (36) so when the pump is re-assembled, the bowl (18) will be in proper relation to operating lever (30). Pull off upper housing (13) being sure not to damage diaphragm

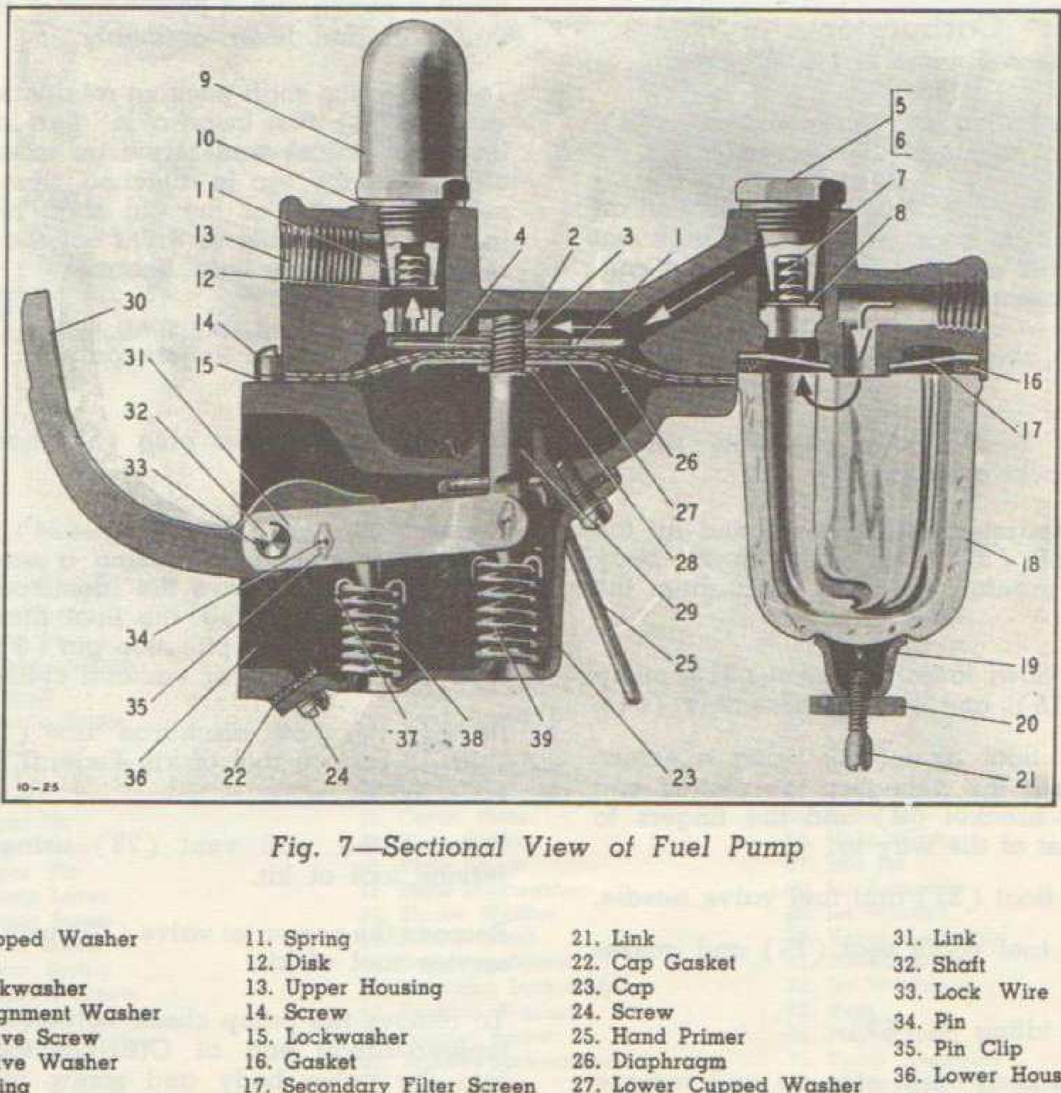


Fig. 7—Sectional View of Fuel Pump

1. Cupped Washer
2. Nut
3. Lockwasher
4. Alignment Washer
5. Valve Screw
6. Valve Washer
7. Spring
8. Disk
9. Pressure Dome
10. Dome Washer
11. Spring
12. Disk
13. Upper Housing
14. Screw
15. Lockwasher
16. Gasket
17. Secondary Filter Screen
18. Bowl
19. Bowl Seat
20. Thumb Screw
21. Link
22. Cap Gasket
23. Cap
24. Screw
25. Hand Primer
26. Diaphragm
27. Lower Cupped Washer
28. Copper Washer
29. Shaft
30. Lever
31. Link
32. Shaft
33. Lock Wire
34. Pin
35. Pin Clip
36. Lower Housing
37. Spring Cap
38. Return Spring
39. Diaphragm Spring

(26) which also acts as a gasket between upper housing (13) and lower housing (36). Remove hex. nut (2) with lockwasher (3) and plain hex. washer (4). Remove upper cupped washer (1) and diaphragm (26). Remove lower cupped washer (27) noting that lower cupped washer (27) is smaller than upper cupped washer (1). Be careful not to lose copper washer (28). Remove shaft (29) which is ready to drop thru bottom of housing (36), which in turn released hand primer (25). Remove valve screw (5) and washer (6). Turn housing (13) upside down and tip out spring (7) and micarta hex. disk (8). Remove high pressure dome (9) and washer (10). Turn housing (13) upside down and tip out spring (11) and micarta hex. disk (12). Note that spring (11) is shorter than spring (7). The pump is now completely dis-assembled.

Carburetor
(See Figures 2, 3 & 8)

Remove Filter Plug (27), union body (24), gaskets (25 & 28) and filter screen (26).

NOTE: As the union body can be installed on either side of the carburetor, mark the correct side with a file or center-punch to avoid confusion at re-assembly.

Remove fuel channel plug (29) and washer (30).

Remove the bowl-to-body assembly screws (32) and lockwashers (33).

Turn the carburetor upside down and lift the bowl assembly (37) clear of the throttle body (1) being careful to avoid damaging the float, etc.

Remove the bowl to body gasket (31), pump assembly (75), and venturi assembly (64).

Remove the float axle (36) using a screwdriver to push the axle thru the slotted end of the float bracket (3) and the fingers to remove it rest of the way to:

Remove the float (35) and fuel valve needle.

Remove the fuel valve seat (76) and gasket (77).

Remove the idling jet (67).

Turn throttle body right side up and remove the pick-up jet (74) located just above the throttle plate.

Before removing the throttle plate (12) unscrew the throttle stop screw (19) far enough to permit complete closing of the throttle plate, then, while holding the throttle in closed position, use a steel scriber to mark the inside of the throttle body close to the throttle plate.

NOTE: This scribed line will be used as a guide at re-assembly. Then file off the riveted ends of the throttle plate retainer screws (10) using a file with a safety edge.

Remove the throttle plate and at the same time note that the edges are machined to fit barrel closely.

Remove the throttle shaft thrust collar taper pin (14) using suitable punch and a light hammer then:

Drive the shaft out of the thrust collar (13) using a punch and a light hammer to remove the shaft and lever assembly.

To remove the shaft packing retainers (9) and washers (8), first insert a ½" fine thread tap into the retainer and screw in, using fingers only, until the tap is attached, then insert a suitable punch (or the old shaft assembly) in the opposite side to drive out the tap with retainer, using a light hammer.

Remove the idling adjusting screw (22) and spring (23) using fingers only or a screwdriver.

Remove the degasser plug (58) and washer (59).

Remove the ⅛" pipe plug (34) and the vacuum channel screw using a screwdriver. NOTE: Do not remove the identification disk (6), the priming plug the float bracket (3), the venturi locating pin, stop pin (5), drive-in type channel plugs or vacuum cylinder liner.

Remove the main discharge tube (71) using C-161-10 service tool of kit, Federal Stock No. 41-T-3365-50.

Remove the well vent (73) using C161-80 service tool of kit.

Remove the power jet valve (70) using C161-81 service tool of kit.

To remove the pump check valve (38), insert tapered-thread end of C161-123 tool of kit into the valve body and screw in counterclockwise until the tool is firmly attached, then, using C161-81 tool as a hammer, strike

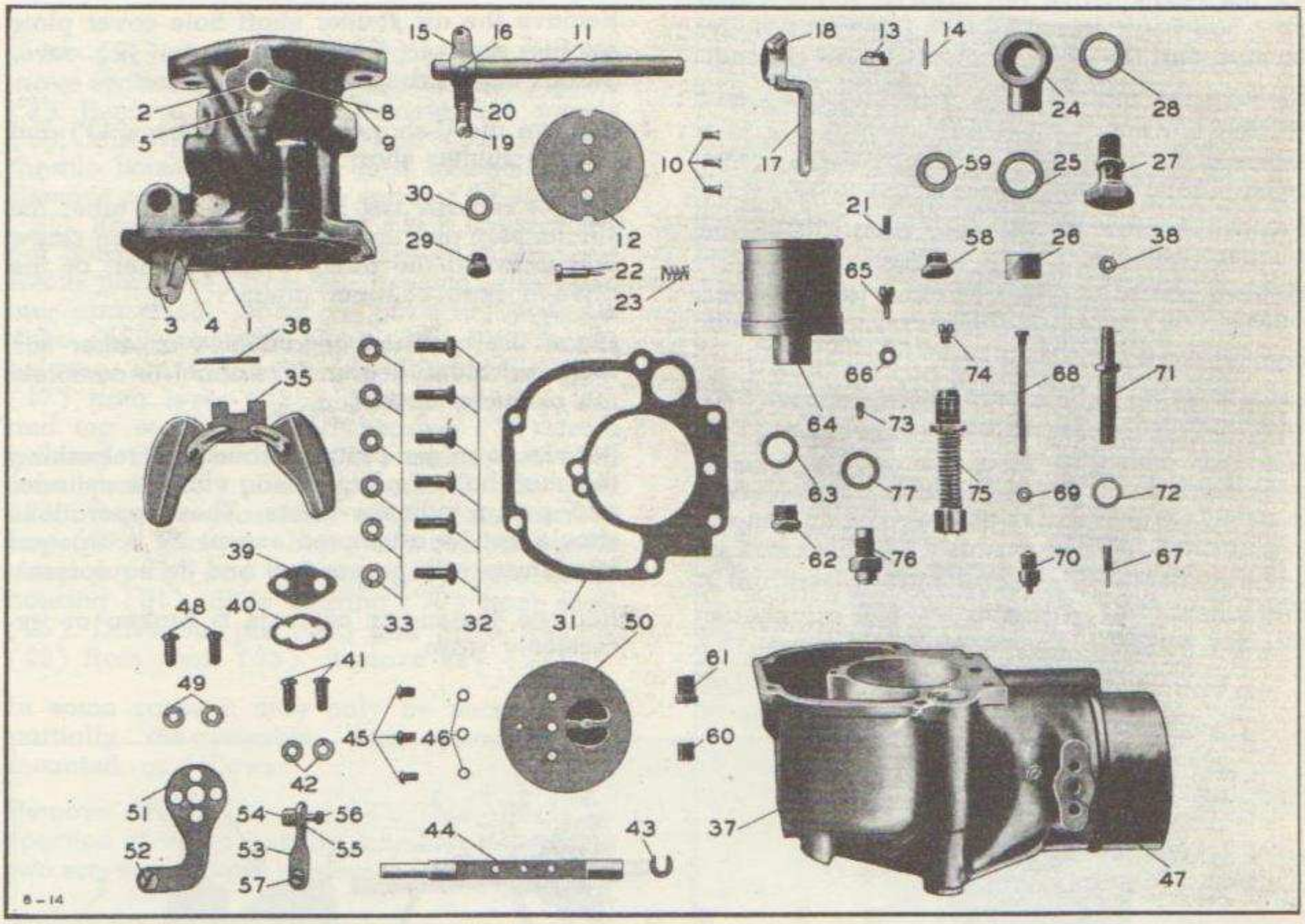


Fig. 8—Exploded View of Carburetor

1. Body Assembly
2. Bushing
3. Float Bracket
4. Float Screw
5. Lever Pin
8. Packing Washer
9. Retainer
10. Throttle Screw
11. Shaft
12. Plate
13. Collar
14. Taper Pin
15. Stop Lever
16. Taper Pin
17. Clamp Lever
18. Clamp Screw
19. Lever Screw
20. Lever Spring
21. Channel Screw
22. Adjusting Screw
23. Adjusting Spring
24. Body
25. Body Washer
26. Screen
27. Filter Plug
28. Plug Washer
29. Connector Plug
30. Plug Washer
31. Body Gasket
32. Body Screw
33. Body Lockwasher
35. Float Assembly
36. Axle
37. Bowl Assembly
38. Valve Assembly
39. Cover Plate
40. Plate Gasket
41. Plate Screw
42. Plate Lockwasher
43. Thrust Washer
44. Shutter Shaft
45. Retaining Screw
46. Retaining Lockwasher
47. Packing Washer
48. Bracket Screw
49. Bracket Lockwasher
50. Shutter Plate
51. Shutter Bracket
52. Clamp Screw
53. Lever Assembly
54. Swivel
55. Swivel Washer
56. Swivel Screw
57. Clamp Screw
58. Lower Plug
60. Bowl Plug
61. Intake Plug
62. Lower Plug
63. Plug Washer
64. Venturi
65. Main Jet
66. Main Washer
67. Idle Jet
68. Jet Assembly
69. Jet Washer
70. Valve Assembly
71. Discharge Jet
72. Jet Washer
73. Vent
74. Pick-up Jet
75. Pump Assembly
76. Valve and Seat Assembly
77. Seat Washer

the puller squarely and sharply a few times to lift the check valve out. NOTE: If the valve disk has been forced out of the valve body, be sure that the disk is not left in the channel.

Remove the main jet channel plug (58) and washer (59).

Remove the main jet (65) and washer (66) using C161-1 service tool of kit.

Remove power jet channel plug (58) and washer (59).

Remove power and accelerating jet (68) and washer (69) using C161-83 service tool of kit.

Remove intake drain plug.

Loosen the air shutter lever clamp screw (57), and remove the lever assembly (53).

Mark, or otherwise note, the correct position and location of the air shutter bracket (51) to avoid confusion at re-assembly, then remove the bracket retainer screws (48), lockwasher (49), bracket (51) and packing washer (47).

File off the riveted ends of the air shutter retainer screws (45) and remove them.

Remove the air shutter (50).

Remove the air shutter shaft hole cover plate retainer screws (41), lockwashers (42), cover plate (39) and gasket (40), then:

Remove the U-shaped thrust washer (43) and the air shutter shaft (44).

Do not remove the bowl vent pitot tube; the shutter stop pin; the air shutter adjusting screw and lock-nut; the pump cylinder liner; or the drive-in type channel plugs.

Clean the castings in kerosene or other solvent and blow thru each channel to complete the cleaning operation.

Repairs to major castings consist of rebushing the shaft holes and installing vacuum cylinder and pump cylinder liners. These operations should not be attempted except by competent machinists with proper tool and jig equipment.

Replace the major castings if broken or excessively worn.

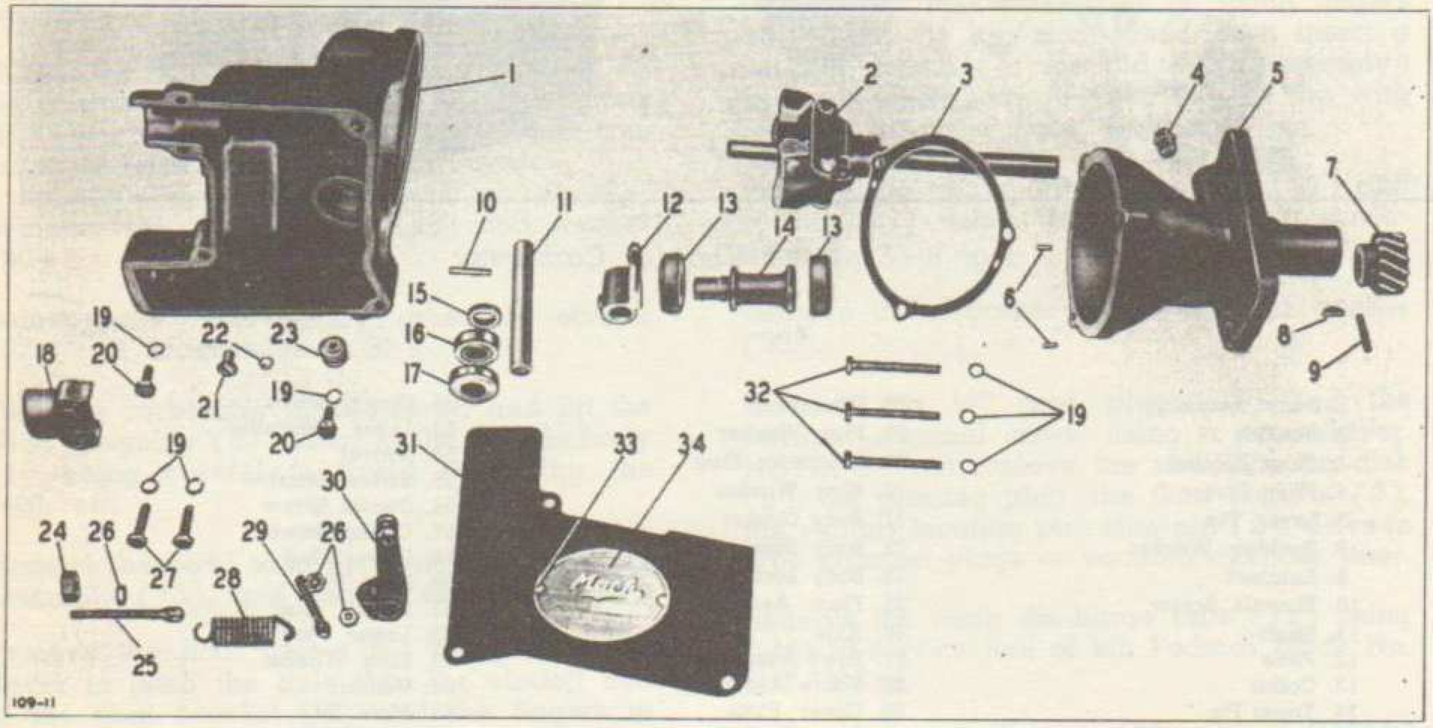


Fig. 9—Exploded View of Governor

1. Body Cap	10. Groove Pin	19. Lockwasher	27. Screw
2. Weight Assembly	11. Rocker Shaft	20. Governor Screw	28. Spring
3. Body Gasket	12. Yoke	21. Governor Screw	29. Screw
4. Pipe Plug	13. Thrust Bearing	22. Welch Plug	30. Throttle Lever
5. Body	14. Thrust Sleeve (Spool)	23. Pipe Plug	31. Spring Cover
6. Dowel Pin	15. Spacer	24. Adjusting Nut	32. Screw
7. Drive Gear	16. Ball Bearing	25. Adjusting Screw	33. Escutcheon Pin
8. Key	17. Oil Seal	26. Jam Nut	34. Name Plate
9. Groove Pin	18. Tube Cover		

Governor

If not previously removed, cut wire and remove seals. Remove three fillister head screws (1). Remove cover (2). Remove five screws (3). Remove covers (4) and (5). Remove throttle housing (6) and tube assembly (7). Remove nut (8). Remove spring (9) and bolt (10). Remove three screws (11). Remove upper housing and paper gasket (13). Remove welch plug (14) from top housing with hammer and chisel. Drive out pin (15). Remove yoke (16) and pull shaft (17) from upper housing. Drive out pin (18) and drive shaft (17) from lever (19). Remove spacer (20) and top seal (21) and bearing (22) from housing. Slide bearing (23) and spool (24) from shaft (25). Drive pin (26) from gear (27). Remove gear (27) with puller. Remove key (28). Remove shaft (25) complete with weights (29) and bearing (30) from lower housing (31). Slide bearing (30) from shaft (25). Drive out pin (32) and drive weights (29) from shaft (25). Remove key (33).

In some cases it may only be necessary to partially dis-assemble, with governor left mounted, as follows:

Remove covers (2) and (4). This affords inspection of valve linkage, namely, to see that two screws (34) are in place and tight; to move

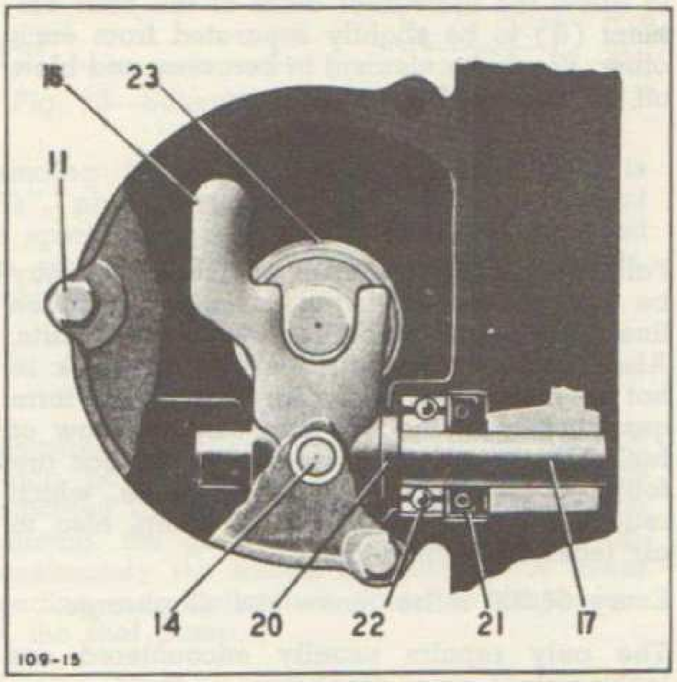


Fig. 10—Governor Section

11. Screw
14. Plug
16. Yoke
17. Shaft
20. Spacer
21. Top Seal
22. Bearing
23. Bearing

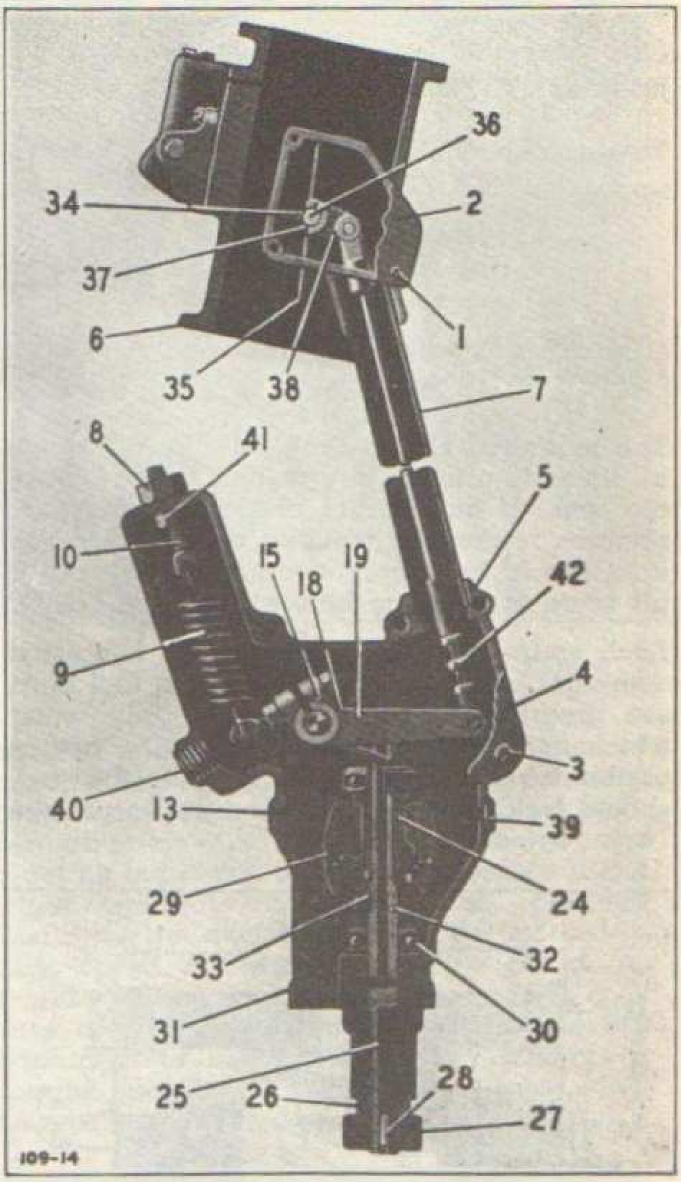


Fig. 11—Sectional View of Governor

1. Housing Screw
2. Housing Cover
3. Cover Screw
4. Cover
5. Cover
6. Throttle Housing
7. Tube Assembly
8. Nut
9. Spring
10. Bolt
13. Housing Gasket
15. Pin
18. Pin
19. Lever
24. Spool
25. Shaft
26. Pin
27. Gear
28. Key
29. Weights
30. Bearing
31. Lower Housing
32. Pin
33. Key
34. Valve Screw
35. Butterfly Valve
36. Butterfly Shaft
37. Pin
38. Lever
39. Dowel Pin
40. Plug
41. Nut
42. Link

lever (19) upward to determine if butterfly valve (35) closes tightly; to inspect spring (9) for initial tension; and to see that adjustment (42) is secure.

To examine action of weights (29), remove upper housing (12) and move weights by hand. They should move freely to their outer limits.

Throttle Housing

Remove two screws (34) from butterfly (35). Remove butterfly (35). Pull shaft (36) from housing (6). Drive pin (37) from lever (38). Remove lever (38).

SECTION 5: REPAIRS

Fuel Tanks
(See Figure 1)

The mounting straps should be kept tight at all times to prevent any chafing movement of the tank. If on account of leakage the tank requires repairs by welding or soldering, the tank should be thoroly steamed out to remove all trace of gasoline before applying heat.

Each spring and fall, after vehicle has stood overnight, remove drain plug of the fuel tank, see diagram Figure 1. Drain off any water which may have accumulated in the bottom of the tank. At least once a year the tank should be drained and flushed out to remove accumulated dirt and water. This should be done especially at the approach of freezing weather.

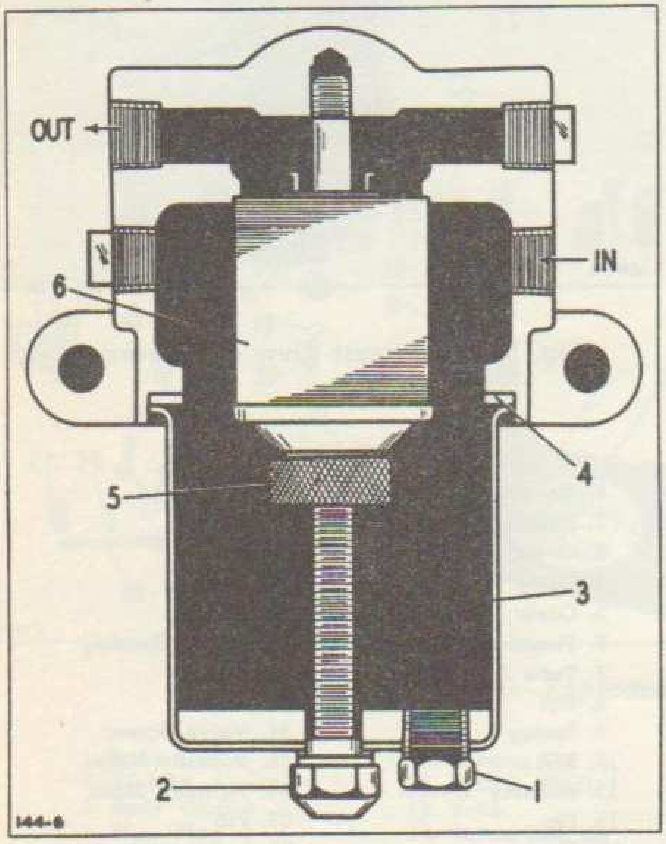


Fig. 12—Sectional View of Primary Fuel Filter

1. Drain plug
2. Bowl Nut
3. Bowl
4. Bowl Gasket
5. Thumb Nut
6. Filter Element

Fuel Tank Pressure Cap
(See Figure 1a)

The pressure cap is not repairable except that the neck gasket may be renewed and the filter cleaned. Remove the three screws, lift off cover, wash filter hair in cleaning fluid and replace.

Primary Fuel Filter
(See Figure 12)

Remove drain plug (1) then unscrew the bowl nut (2). The bowl (3) and gasket (4) can now be cleaned. Care should be taken not to damage the gasket when removing bowl. The thumb nut (5) should be loosened enough to allow the individual disks of the filter element (6) to be slightly separated from each other. Wash the element in kerosene and blow off with moderate air pressure.

Fuel Pump
(See Figure 7)

Failure of pump to deliver sufficient fuel may be due to the following: clogged gasoline line, ruptured diaphragm, or worn lever parts. Also poor grade gasoline may vapor-lock in hot operation; that is, boiling of fuel will form gas pockets in the line and stop the flow of fuel. Many cases of suspected vapor-lock are found to be due to worn lever parts, which reduce the effective stroke of pump, also to air leaks in suction line.

Every 36,000 miles renew the diaphragm.

The only repairs usually encountered are leaky valves, worn diaphragm or leaking gaskets. At the first sign of deterioration of any one part remove and replace the following parts: Diaphragm (26), Inlet valve (8), Outlet valve (12) and Bowl gasket (16). Clean screen (17) and bowl (18). Remount on engine.

Carburetor
(See Figures 2, 3 & 8)

Each spring and fall remove carburetor and clean by blowing out and thru passages with air pressure. Do not insert wire or metal implements in the metered passages, or fuel mixture and operation will be affected.

Float Level
(See Figure 13)

The gasoline level in the float chamber is properly set at the factory and should not be adjusted unless carburetor has been handled roughly, or level has been changed from some other cause.

The correct fuel level is very important. The level is controlled by the setting of the float. If necessary to reset same, it can be done by holding cover assembly upside down and

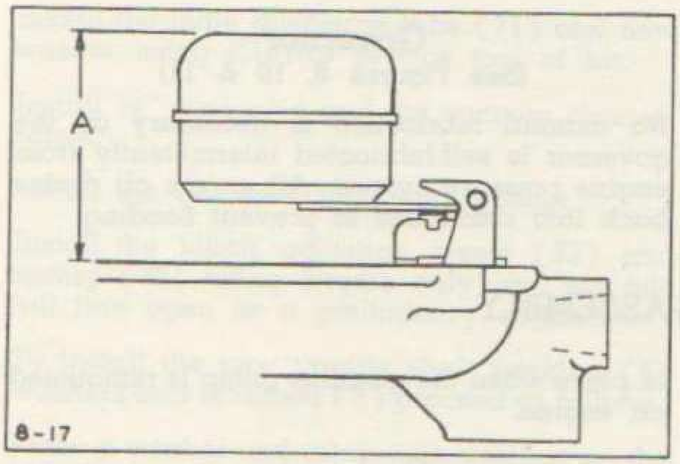


Fig. 13—Schematic View of Float Setting

bending lever arm until distance (A) is 1⅞", plus or minus 3/64". It is important to specify the size number which is stamped on each part, when ordering metering jets, venturi, etc.

Instructions for Checking Fuel Pump Vacuum

Disconnect the flexible gas line from the fuel pump bowl. Connect the vacuum gage as indicated in the illustration. With the engine running, the gage hand should indicate approximately ten inches of mercury. A lower reading may indicate a defective diaphragm in the fuel pump.

Instructions for Checking Fuel Pump Discharge Pressure

Remove the hex. plug from the header on top of the carburetor bowl and connect the pressure gage as indicated in the photograph. The gage should be level with the carburetor bowl

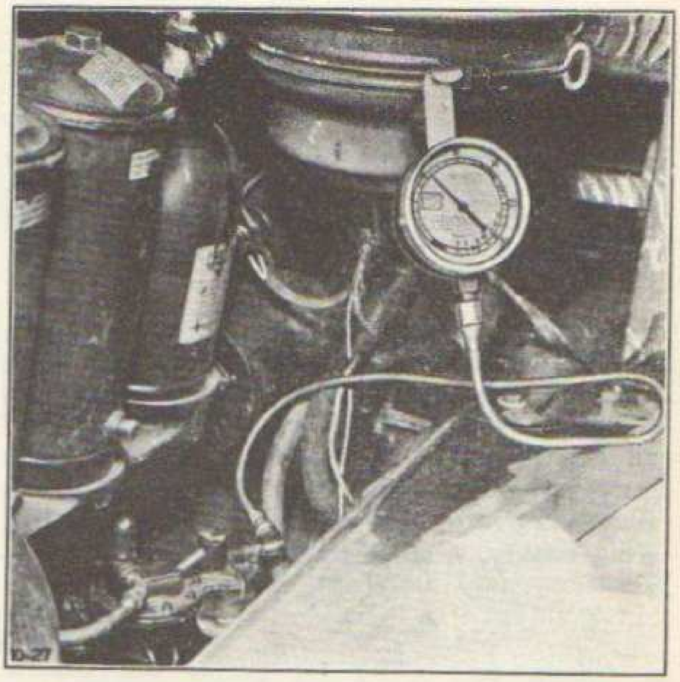


Fig. 14—Checking Fuel Pump Vacuum
(*Tool—Federal Stock No.* 41-G-500)

in order to eliminate the effects of a head of gasoline higher than that normally delivered to the carburetor. The pressure is checked at the carburetor with the engine running in order to get an indication of the fuel pressure under actual operating conditions. Fuel pressure should not be over 3 to 4 lbs. per sq. in., at idling speed, nor less than 1½ lbs. per sq. in. at wider throttle openings. Low pressure indicates fuel pump trouble such as a defective diaphragm or valves, or, it may indicate a clogged fuel line. High pressure may force the needle off its seat and flood the carburetor.

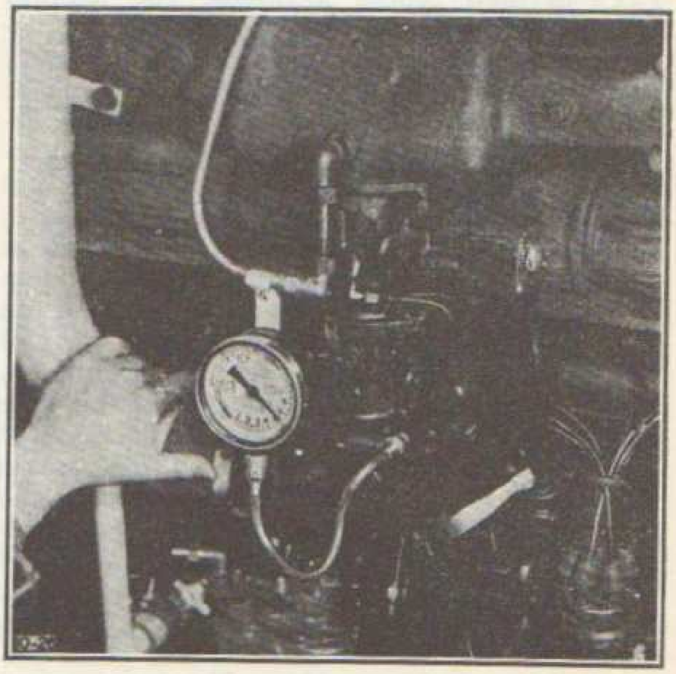


Fig. 15—Checking Fuel Pressure
(*Tool—Federal Stock No.* 41-G-500)

Air Cleaner
(See Figure 4)

The air cleaner cup (6) can be removed by loosening retaining clamp (3). Under severe operating conditions, the cup should be removed daily and cleaned. Fill with oil to level (5) marked on the cup.

Under ordinary operating conditions, and with regular oil change, the cleaner element (2) will be completely self-washing. Under extremely severe conditions, or if the regular oil change is neglected, the cleaner element (2) may become clogged. This element should be removed every 1,000 miles for inspection, and, if necessary, washed in cleaning fluid or kerosene. Allow it to drain and replace. The element is held in place by means of wing nut (8).

Governor
(See Figures 9, 10 & 11)

If any of the functional parts become damaged they should not be salvaged, but replaced by new parts. If spring (9) is to be replaced, proceed as given in "Section 3: Adjustments." To replace bearings (30), (23) or (22), if these are to be replaced for any reason, proceed as given in "Section 4: Dis-assembly". To replace gear (27), remove pin (26) and proceed as given in "Section 7: Re-assembly". At any time of repair when seals have been broken, they should be replaced with new ones, after the trouble has been rectified.

SECTION 6: LUBRICATION

Fuel Pump
(See Figure 7)

The pump is lubricated by means of vapor from the crankcase. Excess condensed vapor drains back into the crankcase. No other lubrication is required.

Governor
(See Figures 9, 10 & 11)

No manual lubrication is necessary as the governor is self-lubricated intermittently from engine pressure system. All excess oil drains back into crankcase to prevent flooding.

SECTION 7: RE-ASSEMBLY

Fuel Pump
(See Figure 7)

To re-assemble the pump, reverse dis-assembly procedure. Be sure to replace springs (7) and (11) in their proper locations. The micarta valves themselves are interchangeable. Replace shaft (29) being sure to replace priming handle (25) first. Note that copper washer (28) is in place before replacing cupped washer (27), with cupped edge down. When replacing cupped washer (1) be sure that cupped edge faces upward. See that holes in diaphragm (26) are lined up with holes in housing (36) before tightening nut (2). When re-installing operating lever (30) be certain that pin (34) and clip (35) which are off center in link (31) are in their lowest position, or the lever motion is restricted. At the time of replacing cover (23) replace the cork gasket if it is damaged in removing. This gasket should be shellaced in. When replacing the bowl (18) be sure that gasket (16) is shellaced in place and that the bowl (18) is seated evenly on gasket (16). It is always best to use a new gasket in place of old at (16) because the slightest air leak at this point prevents the pump from sucking. This is important. Always be sure that insulating spacer and two gaskets, one on each side of spacer, are in place when the gasoline pump is remounted on engine.

Carburetor
(See Figures 2, 3 & 8)

Install air shutter shaft (44) and thrust washer (43).

Hold the cover plate (39) and gasket in place and install retainer screws and lockwashers.

Install the air shutter (50) and when properly centered hold in closed position and install the retainer screws, tightening them securely.

Hold the air shutter bracket (51) in the correct position with new packing washer (47) in place, and install retainer screws and lockwashers.

Install the air shutter lever assembly (53) locating it on the shaft, so that in closed position, the swivel hole lines up with the tube clamp (56) on the bracket.

Recheck operation of the air shutter to make sure that it opens and closes without binding. Tighten the clamp screw securely. The stop screw should be adjusted to stop the air shutter about 1/32" from fully closed position.

Install the intake drain plug.

Install the power and accelerating jet (68) and new fibre washer using C161-83 service tool of kit, Federal Stock No. 41-T-3365-50.

Install the channel plug and new washer.

Install the main jet (65) and new washer using C161-1 service tool of kit.

Install channel plug and new washer.

Install the pump check valve (38), disk side down, using C161--124 tool of kit and a light hammer to drive the valve into place (about 1/32" below the upper edge of the channel).

Install the power jet valve (70) using C161-81 service tool (no gasket is required) of kit.

Install the well vent (73) using C161-80 service tool (no gasket is required) of kit.

Install the main discharge tube (71) and new washer using C161-10 service tool of kit.

Install ⅛" pipe plug and the vacuum channel screw.

Install the degasser plug and washer.

Install the idling adjusting screw (22) and spring (23) using fingers only and set one full turn open as a preliminary adjustment.

To install the new throttle shaft packing (8) washers and retainers (9) proceed as follows:

Place a washer and retainer in position on the old shaft and lever assembly.

Start the shaft into place in the throttle body.

Strike the assembly with a light hammer to drive the packing washer and retainer into place.

Repeat same operations to install packing and retainer in opposite side of the throttle body.

Install new throttle shaft and stop lever assembly (C29-483) and pin the thrust collar to the shaft leaving as little end-play as possible without binding. Be sure the stop screw is "backed" out flush with the stop lever so it will not touch the stop pin.

Using the scribed line (recommended on page 03-8 of "Section 4: Dis-assembly") as a guide, install the throttle plate (13). NOTE: If new plate is used select one that fits very closely to the scribed line, as any variation from this line will change the relation of the throttle plate to the priming plug and affect the idling and part-throttle operation of the carburetor.

Hold the throttle in tightly closed position and install the retainer screws.

Using a suitable mandrel in a vise to support the retainer screw heads, rivet the ends of the screws using a suitable punch and a light hammer, being careful to avoid bending the shaft.

Adjust the throttle stop screw to hold the throttle just slightly open (about 1½ full turns from completely closed position). This preliminary adjustment will be an aid to starting the engine which would not run at all with the throttle completely closed.

Install the pick-up jet (74) (no gasket is required).

Install the idling jet (67) (no gasket is required).

Install a new fuel valve seat (76) and new gasket.

Install a new fuel valve needle and hold the float in position while you:

Install the float axle (36), using the fingers to start it, and the handle end of a screw-driver to force the axle thru the slotted end of the bracket.

NOTE: The float should move freely on its axle and have a very little side-play.

Check position of float assembly for correct measurement to obtain correct fuel level with normal pump pressure. The "A" dimension as shown on page 03-13 should be 1⅞" plus or minus 3/64".

Install venturi assembly (64) making sure that the groove in the side of the main venturi engages the locating pin in the barrel.

Install the vacuum pump assembly (75) and press the spring seat into place in the throttle body using the fingers and the flat side of the screwdriver blade.

Place a new body to bowl gasket in position on the throttle body.

Hold the bowl upside down over the throttle body and start the pump piston into the cylinder being careful to avoid damaging the float assembly.

Install assembly screws (there are six) and lockwashers. Tighten evenly and securely.

Governor
(See Figures 9, 10 & 11)

To re-assemble the governor reverse dis-assembly procedure. Gear (27) is pressed on shaft (25). When remounting the top housing on lower housing (31), be sure to line up dowel pins (39) in lower housing (31) with holes in gasket (13) and the upper housing. It is also necessary to replace small Welsh plug (14) with a new one. To drive pin (18) into lever (19) you must remove plug (40), insert tool in hole and drive in pin (18). Replace plug (40).

To re-assemble the throttle housing, reverse dis-assembly procedure.

SECTION 8: SPECIFICATIONS

Carburetor

MAKE	Zenith
TYPE	Updraft
ZENITH MODEL	63AW16
MACK PART No.	234GB3106
SIZE	2"
VENTURI	42
VENDOR'S PART No.	0-10008
MAIN JET	39
POWER JET REGULATOR	15
PICK-UP JET	15
IDLE JET	15
POWER JET	21
FUEL VALVE SEAT	60

VACUUM TAKE-OFF SPARK ADVANCE DRILL SIZE No. 50 (.040) below edge of butterfly.

Fuel Pump

MAKE	AC
TYPE	D
MACK PART No.	314GC323
HAND PRIMER	Yes
FILTER	In pump
CAPACITY	40-55 G.P.H.
PRESSURE AT CARBURETOR	3-4 lbs.
VENDOR'S PART No.	1538272

Inlet Manifold

VACUUM AT IDLING SPEED OF 300 R.P.M. 19 to 21" mercury (gage tested).

Governor

PART No.	708 GBA 191
MAKE	Pierce
VENDOR'S PART No.	SMA-1303
GROUND STRAP	48RU165
GOVERNOR SPEED SET AT	2100 R.P.M.
GOVERNOR TO ENGINE RATIO	1.176 to 1

Fuel

SATISFACTORY OPERATION ... Using gasoline of 68 octane mm. A.S.T.M. rating.

Fuel Tanks

LOCATION	R.H. & L.H. Frame rails, at rear of cab.
CAPACITY	80 Gallons each

Fuel Tank Pressure Cap

VENDOR	Stant Mfg. Corp.
VENDOR No.	6985-A
NECK GASKET No.	6643

Fuel Filter

MAKE	Zenith
MODEL	F-328
TYPE	Laminated

Air Cleaner

MAKE	Donaldson
MODEL	E-909
TYPE	Oil-bath
OIL USED	In freezing weather, SAE 10 In warm weather, SAE 30 In extremely hot weather, SAE 40

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
*18-T-230	Tachometer, Electric		
*41-G-500	Gage, Combination, Vacuum & Pressure		
*41-T-3365-50	Tool Set, Special Zenith Carburetor		
——	Analyzer, Combustion	$103.50	Chas. Engelhard, Inc.

*Federal Stock Number

GROUP 04: EXHAUST

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

The exhaust system mounted on the right hand side rail consists of a rear outlet exhaust manifold, exhaust pipe, straight-thru muffler, and tail pipe. Ring gaskets are used to seal the exhaust pipe and manifold junction. Friction produced when ring gaskets are compressed between flanges helps hold exhaust pipe in position. The muffler mounting is flexible, due to coil-spring supports so that expansion of exhaust pipe is not restricted. Hot gases from the tail pipe are directed in the air stream on the right hand side of the vehicle.

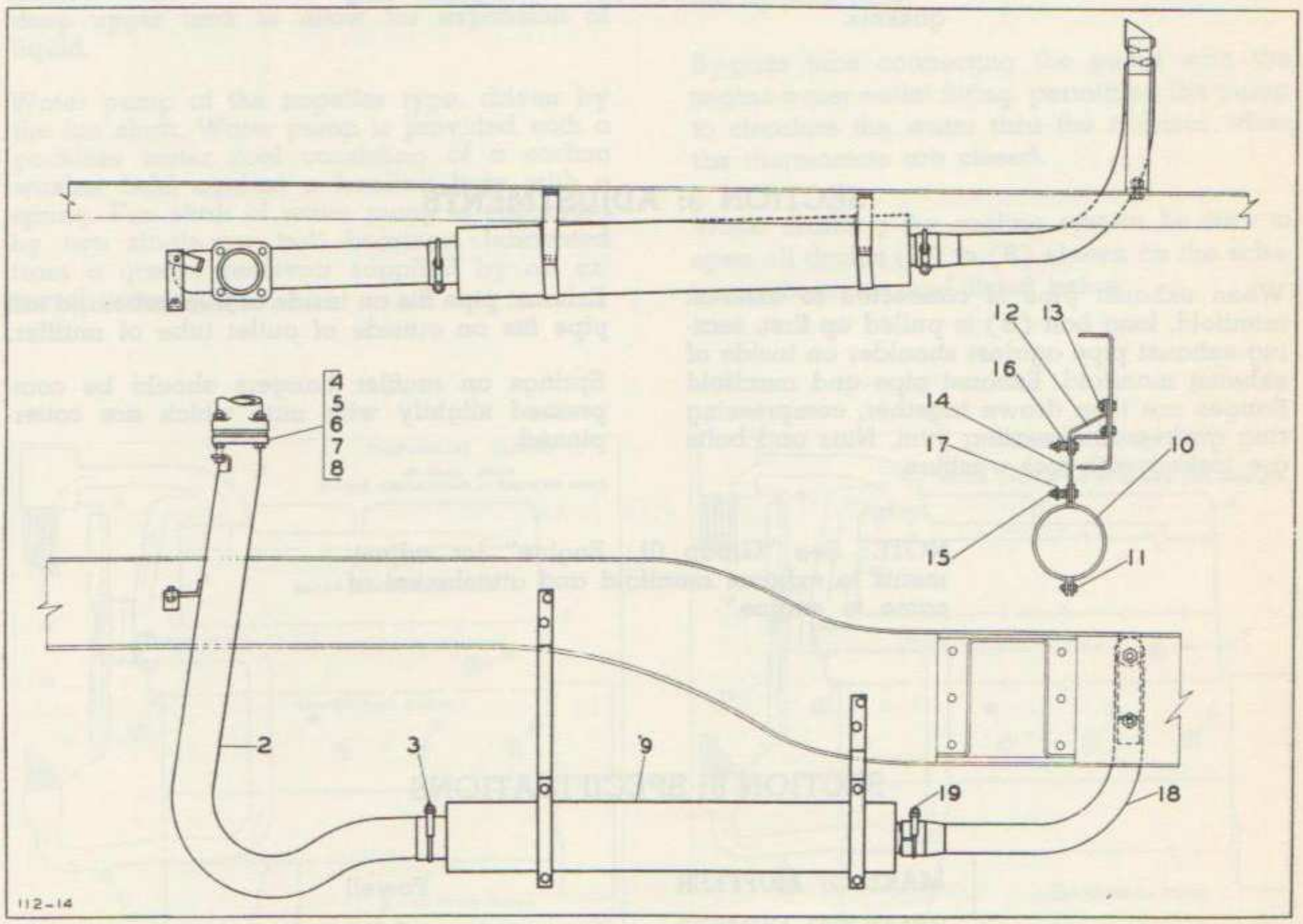


Fig. 1—Top and Side Views of Exhaust System

1. Pipe Arrangement
2. Exhaust Pipe
3. Muffler Clamp
4. Pipe Flange
5. Flange Bolt
6. Flange Bolt
7. Flange Gasket
8. Flange Gasket
9. Muffler
10. Muffler Clamp
11. Clamp Bolt
12. Frame Hanger
13. Hanger Bolt
14. Hanger Link
15. Link Bolt
16. Link Spring
17. Link Washer
18. Tail Pipe
19. Tail Pipe Clamp

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Excessive Noise

BURNED OUT MUFFLER .... Replace.

LEAKY CONNECTIONS .... Tighten

Loss of Power

INCREASED BACK PRESSURE DUE TO MUFFLER TUBE COLLAPSING Replace muffler.

Fumes in Cab

LOOSE GASKETS AT EXHAUST PIPE TO MANIFOLD CONNECTION .... Replace ring gaskets.

SECTION 3: ADJUSTMENTS

When exhaust pipe is connected to exhaust manifold, long bolt (6) is pulled up first, seating exhaust pipe against shoulder on inside of exhaust manifold. Exhaust pipe and manifold flanges are then drawn together, compressing ring gaskets and sealing joint. Nuts and bolts are locked with lock-washers.

Exhaust pipe fits on inside of inlet tube and tail pipe fits on outside of outlet tube of muffler.

Springs on muffler hangers should be compressed slightly with nuts which are cotter-pinned.

NOTE: See "Group 01: Engine" for adjustments to exhaust manifold and attachment of same to engine.

SECTION 8: SPECIFICATIONS

MAKE OF MUFFLER	Powell
VENDOR'S NUMBER	S-216
INLET INSIDE DIAMETER	3½"
OUTLET OUTSIDE DIAMETER	2⅝"
LENGTH	39"
DIAMETER	6"
TYPE	Straight-thru

GROUP 05: COOLING

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

The cooling system employs the exclusive MACK "cold circulation" principle, which maintains the water temperature within efficient operating range. This consists of the customary thermostatic regulator with the addition of a cold-water by-pass from pump to radiator.

The system consists of the following parts:

Radiator with a vertical tube-and-fin core and deep upper tank to allow for expansion of liquid.

Water pump of the impeller type, driven by the fan shaft. Water pump is provided with a packless water seal consisting of a carbon washer held against a housing boss with a spring. Fan shaft of water pump is supported by two single-row ball bearings, lubricated from a grease reservoir supplied by an external grease cup.

Propeller-type fan, driven by double V-belts from the engine crankshaft.

Engine-water manifold and full length water jackets.

Engine-water outlet-fitting housing with two bellows-type thermostats controlling the water circulation either thru the engine block or thru the by-pass tube.

By-pass tube connecting the pump with the engine-water outlet fitting, permitting the pump to circulate the water thru the radiator when the thermostats are closed.

When draining the cooling system be sure to open all drains (1) to (6) shown on the schematic diagrams and listed below.

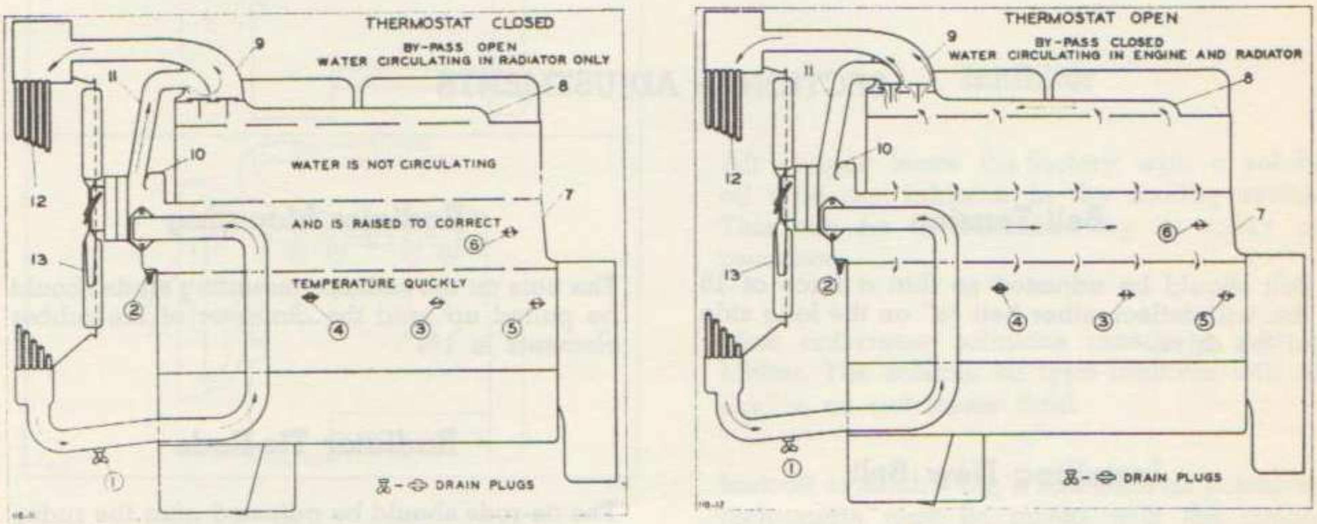


Fig. 1—Schematic Diagrams of Cooling System

1. Radiator drain
2. Water-pump drain
3. Compressor-head drain (R .H. side)
4. Cylinder-block drain (L. H. side)
5. Cylinder-block drain (R. H. side)
6. Water-manifold drain (R. H. side)
7. Water jacket
8. Water manifold
9. Thermostat Housing
10. Water pump
11. By-pass tube
12. Radiator
13. Fan

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Loss of Water

LOOSE HOSE CLAMPS .... Tighten clamps.

DETERIORATED HOSE .... Replace hose.

WATER PUMP LEAKAGE .... Repair pump

LEAKS IN RADIATOR CORE AND TANKS Repair core and tanks.

OVERHEATING .... See "Overheating".

Overheating

WATER LEVEL LOW .... Refill radiator.

FAN BELTS SLIPPING .... Tighten and renew if necessary.

RADIATOR TUBES CLOGGED .... Reverse flush radiator.

THERMOSTAT STICKING .... Clean or renew thermostat.

SUCTION HOSE COLLAPSING .... Renew hose and wire insert.

WATER PUMP FAILURE .... Repair or renew.

Inability to Warm Up

THERMOSTAT WORN OUT .... Renew thermostat.

SECTION 3: ADJUSTMENTS

Belt Tension

Belt should be adjusted so that a force of 15 lbs. will deflect either belt ½" on the long side of the drive.

Installing New Belt

Never stretch belt over pulley flange or use a screw driver or similar tool to force a belt over a pulley flange when renewing belt. Always back up generator pulley to allow belt to slip in place.

Radiator Mounting

The nuts on the radiator mounting studs should be pulled up until the diameter of the rubber elements is 1¾".

Radiator Tie-Rods

The tie rods should be adjusted after the radiator mountings have been tightened according to instructions. The adjustment of the tie rods should not place the radiator in a strained position with respect to the rubber mountings and the engine water outlet to top tank hose.

Cleaning Cooling System

Cooling system should be thoroly cleaned at least twice yearly. After having mixed a reputable radiator cleaning compound or washing soda (½ lb. per gallon) in the cooling system, idle the engine for about 30 minutes with the cooling system as close to boiling as possible. Completely drain system and immediately reverse flush both the radiator and the engine block.

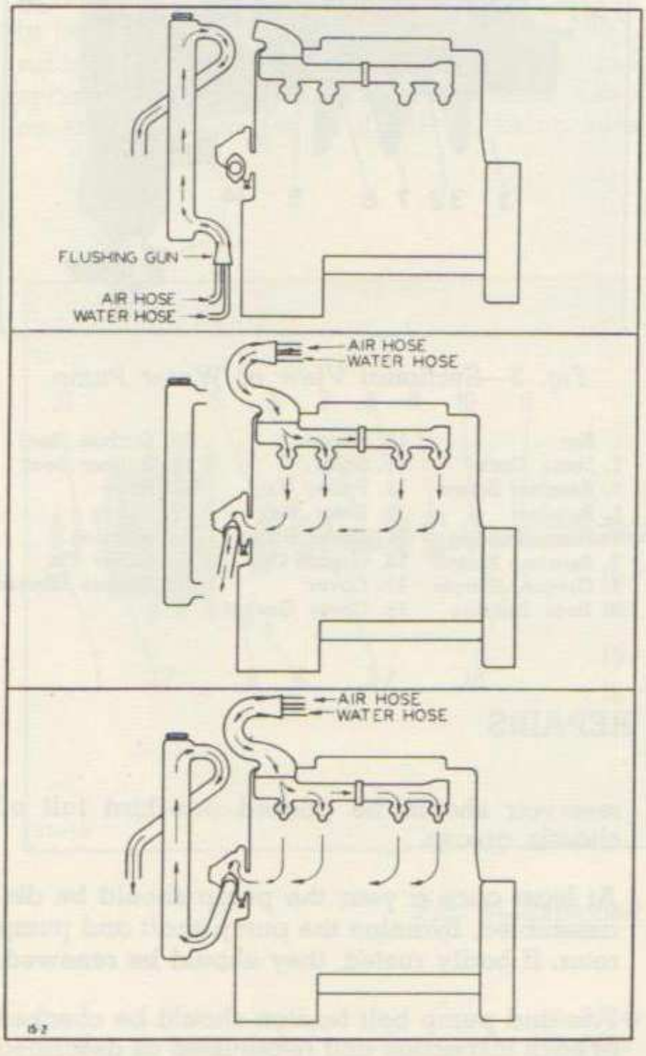


Fig. 2—Reverse Flushing

As shown by the diagram above, the reverse flushing consists of three operations, requiring flushing gun for the water and air-hose connections. After making each of the three connections, the parts being flushed are filled with water, which is blown out with intermittent applications of compressed air, each lasting two or three seconds. Carefully avoid applying the pressure for longer periods because of the damage to radiator core or other parts which may ensue. Repeat the operation until the water is free from rust and scale.

Before flushing the cylinder block, remove the two thermostats from the forward end of the water manifold to avoid damaging their thin metal bellows. Check their operation by dipping them in hot water, which should cause them to expand. As they cool they should contract slowly. If the thermostats are over two years old, or do not operate according to "Section 8: Specifications", replace them with new units.

Clean insects from the radiator core, straighten fins and carefully clean the outside with water or kerosene and air pressure. Check condition of hoses and renew if they show signs of deterioration.

Re-assemble system and fill with water treated with a rust inhibitor for the protection of the iron parts, so that corrosive particles will not form and in circulating clog the narrow passages of the radiator core.

Inhibitor

All chassis leave the factory with a soluble oil type rust inhibitor in the cooling system. This can be distinguished by its milky appearance.

Most anti-freeze solutions contain a rust inhibitor. The soluble oil type inhibitor will not oxidize an anti-freeze fluid.

Instead of soluble oil, a salt such as potassium dichromate may be mixed with the cooling water to reduce corrosive action in the system. Use ¾ ounce by dry weight to the gallon of water. Its presence may be detected by its yellowish color. Since this inhibitor would oxidize an anti-freeze, the cooling system including heaters should first be completely drained and preferably flushed before adding anti-freeze.

SECTION 4: DIS-ASSEMBLY

To dis-assemble the water pump, loosen generator adjusting arm, remove two belts.

Drain pump thru drain plug (2).

Remove cap screws (14).

Remove cover (17) and gasket (18).

Pull rotor (24) off shaft (11).

Remove rubber seal (20).

Remove cotter pin (31) and nut (1).

Remove pulley (27).

Remove bearing retainer screws (3).

Remove bearing retainer (5).

Pull shaft (11) from cover (17) complete with bearings (6) and (9), slingers (32), (8) and (10), and spacer (7).

Wash all grease from grease reservoir.

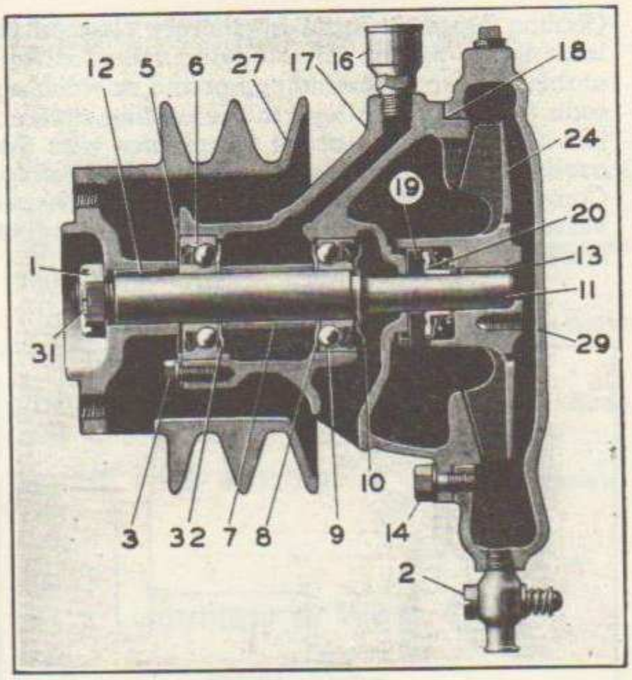


Fig. 3—Sectional View of Water Pump

1. Nut
2. Drain Cock
3. Retainer Screw
5. Retainer
6. Front Bearing
7. Bearing Spacer
8. Grease Slinger
9. Rear Bearing
10. Slinger
11. Shaft
12. Pulley Key
13. Rotor Key
14. Cover Screw
16. Grease Cup
17. Cover
18. Cover Gasket
19. Carbon Seal
20. Rubber Seal
24. Rotor
27. Pulley
29. Housing
31. Cotter Pin
32. Grease Slinger

SECTION 5: REPAIRS

When the water pump is dis-assembled as given in "Section 4: Dis-assembly," all worn or badly rusted parts should be renewed.

After considerable usage the carbon washer and other parts may require renewal, especially if water is seen leaking from the housing drain.

Whenever repairs are made the ball bearing reservoir should be packed one-third full of chassis grease.

At least once a year the pump should be dis-assembled. Examine the pump shaft and pump rotor. If badly rusted, they should be renewed.

Fan and pump belt tension should be checked at each inspection and re-adjusted as described in "Section 3: Adjustments."

SECTION 6: LUBRICATION

After every repair job the ball bearing reservoir should be flushed out and repacked one-third full of chassis grease.

The housing should not be filled, or leakage will result. This is very important.

SECTION 7: RE-ASSEMBLY

To re-assemble water pump, replace grease slinger (10) and bearing (9) on shaft (11), and insert shaft (11) in cover (17) pressing bearing (9) into place. Then replace grease slinger (8), spacer (7), grease slinger (32) and front bearing (6) on shaft (11) and bolt retainer (5) in place on cover (17). Replace fan pulley (27) and secure with nut (1) and cotter pin (31) being sure that key (12) is in keyway. Replace carbon seal washer (19), rubber seal (20), ring (21), guide (22), and spring (23) on shaft (11). Press rotor (24) on shaft (11) as far as it will go being sure to locate key (13) in keyway. Attach cover (17) to housing (29) and secure with cap screws (14).

Refill grease reservoir with grease recommended in "Lubrication" group.

Close drain cock (2).

Replace fan belts as described in "Section 3: Adjustments".

Refill water system and check for leaks.

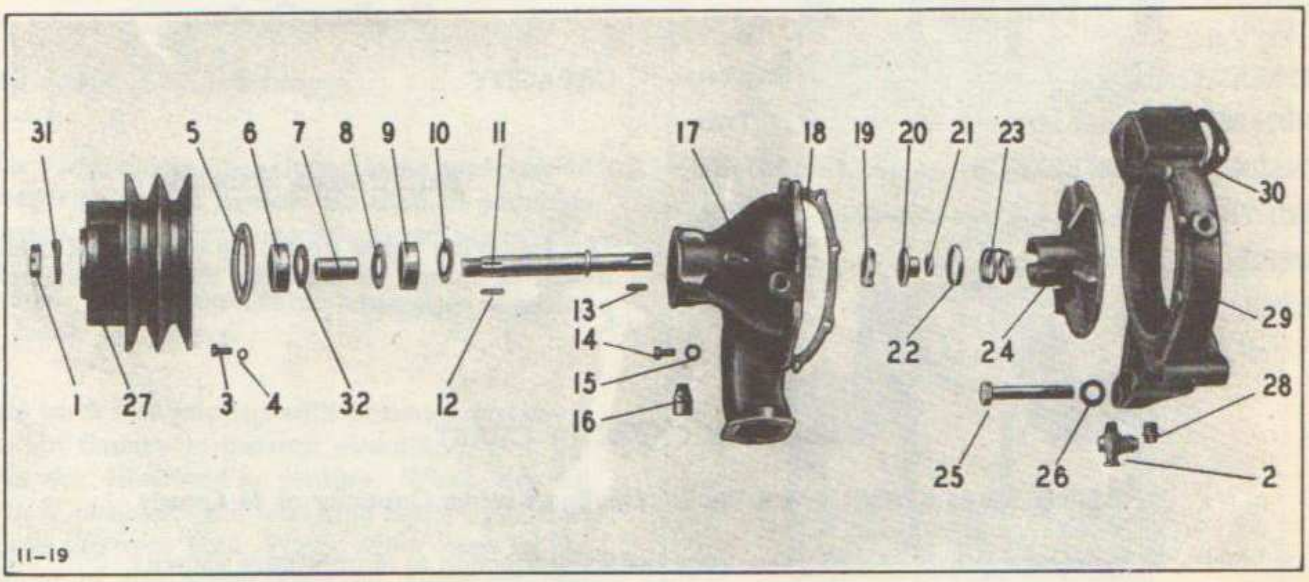


Fig. 4—Exploded View of Water Pump

1. Nut
2. Drain Cock
3. Retainer Screw
4. Lockwasher
5. Retainer
6. Front Bearing
7. Bearing Spacer
8. Rear Grease Slinger
9. Rear Bearing
10. Grease Slinger
11. Shaft
12. Pulley Key
13. Rotor Key
14. Cover Screw
15. Cover Washer
16. Grease Cup
17. Cover
18. Cover Gasket
19. Carbon Seal Washer
20. Rubber Seal
21. Ring
22. Guide
23. Spring
24. Rotor
25. Cylinder Screw
26. Cylinder Washer
27. Pulley
28. Plug
29. Housing
30. Cylinder Gasket
31. Cotter Pin
32. Front Grease Slinger

SECTION 8: SPECIFICATIONS

Radiator

MAKE	Modine
MODEL	AD3844
FRONTAL AREA	736 sq. in.
CORE DEPTH	3¾"

Fan

MAKE	Service Products
DIAMETER	24"
No. OF BLADES	6

Fan Belt

MAKE	Dayton
NUMBER	Two
INSIDE CIRCUMFERENCE	59-17/64
WIDTH	1-5/64
DEPTH	19/32
ANGLE	40°

Water Pump

TYPE	Centrifugal impeller
LOCATION	Front of engine block
CLEARANCE	Between rotor and housing —0.025 to 0.043.

Thermostat

MAKE	Fulton Sylphon
NUMBER	Two
FULLY OPEN	175°
FULLY CLOSED	155°

Cooling System

CAPACITY	Qts. 54

Anti-freeze Solution

The following table gives the amount of anti-freeze in quarts needed for the various temperatures expected.

ANTI-FREEZE CAPACITY CHART

For MACK Models NO-2, 3 & 6 Trucks, Cooling System Capacity of 54 Quarts

Table shows quarts of anti-freeze required for protection to temperature shown.

LOWEST AMBIENT TEMPERATURE EXPECTED								
Fahrenheit °F.	+25	+20	+10	0	—10	—20	—30	—40
Centigrade °C.	—4	—7	—12	—18	—23	—29	—34	—40
Alcohol	6	9	15	20	23	26	28	29
Distilled Glycerine	9	11	17	21	25	28	32	37
Ethylene Glycol	6	10	14	18	22	25	28	30

GROUP 06: ELECTRICAL

The electrical system is of the battery type consisting essentially of the Ignition, Starting and Lighting units. A complete schematic wiring diagram is given in Figure 2.

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Ignition System

The ignition system utilizes a Battery, an Ignition Switch, a high tension Coil, a Distributor with which is combined a Condenser, and the Spark Plugs. An ignition circuit wiring diagram is shown in Figure 4.

Battery

The battery acts as a dependable reservoir of electricity with a twofold function. It provides current for the lighting system and other electrical accessories, and secondly, even under extreme temperature, furnishes ample capacity to crank the engine.

This truck is equipped with batteries having a built-in feature to prevent overfilling. See figures for No-Over-Flo feature. When the fill plug is removed, the lead ring seats over, and closes the vent hole. When water rises to the bottom of the filling tube no more air can escape thru the filling tube, hence no more water can be added. Any excess water rises in the filling tube only.

Screwing the vent plug into position unseats the lead ring by tilting it to a horizontal position, thus opening the vent hole. Ample space remains for electrolyte expansion and rise of level. Consequently, no electrolyte is later forced thru the vent opening to cause any damage.

The two 6-volt batteries have the positive terminal grounded.

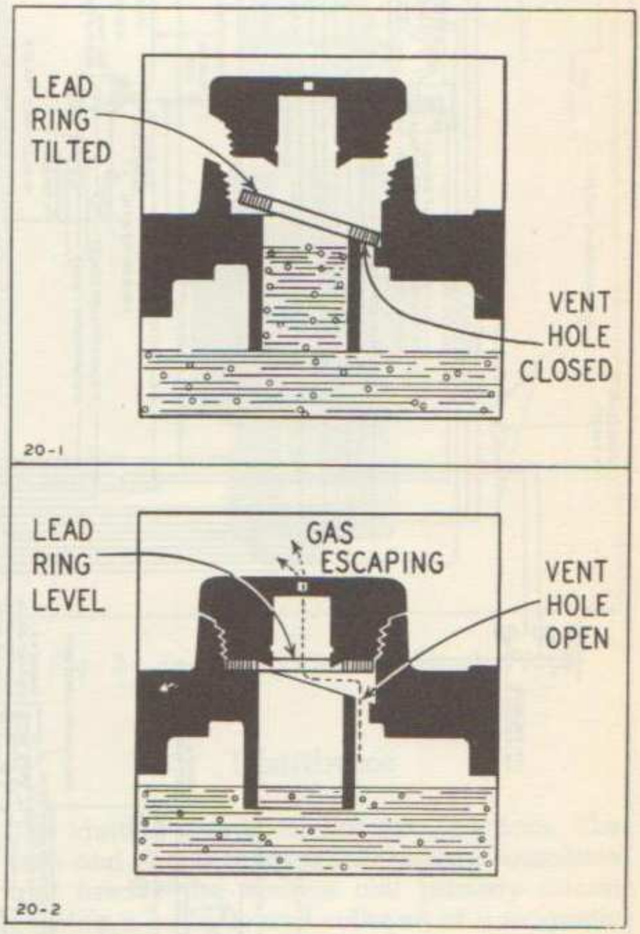


Fig. 1—Sectional View of Battery No-Over-Flo

Coil

The purpose of the ignition coil is to transform energy from the low voltage source, generator or battery, into energy at sufficiently high voltage to jump the gap at the spark plug. The coil is required to fire the engine under cold weather starting, normal operating, and high speed conditions, when the engine and other parts of the ignition system are normal.

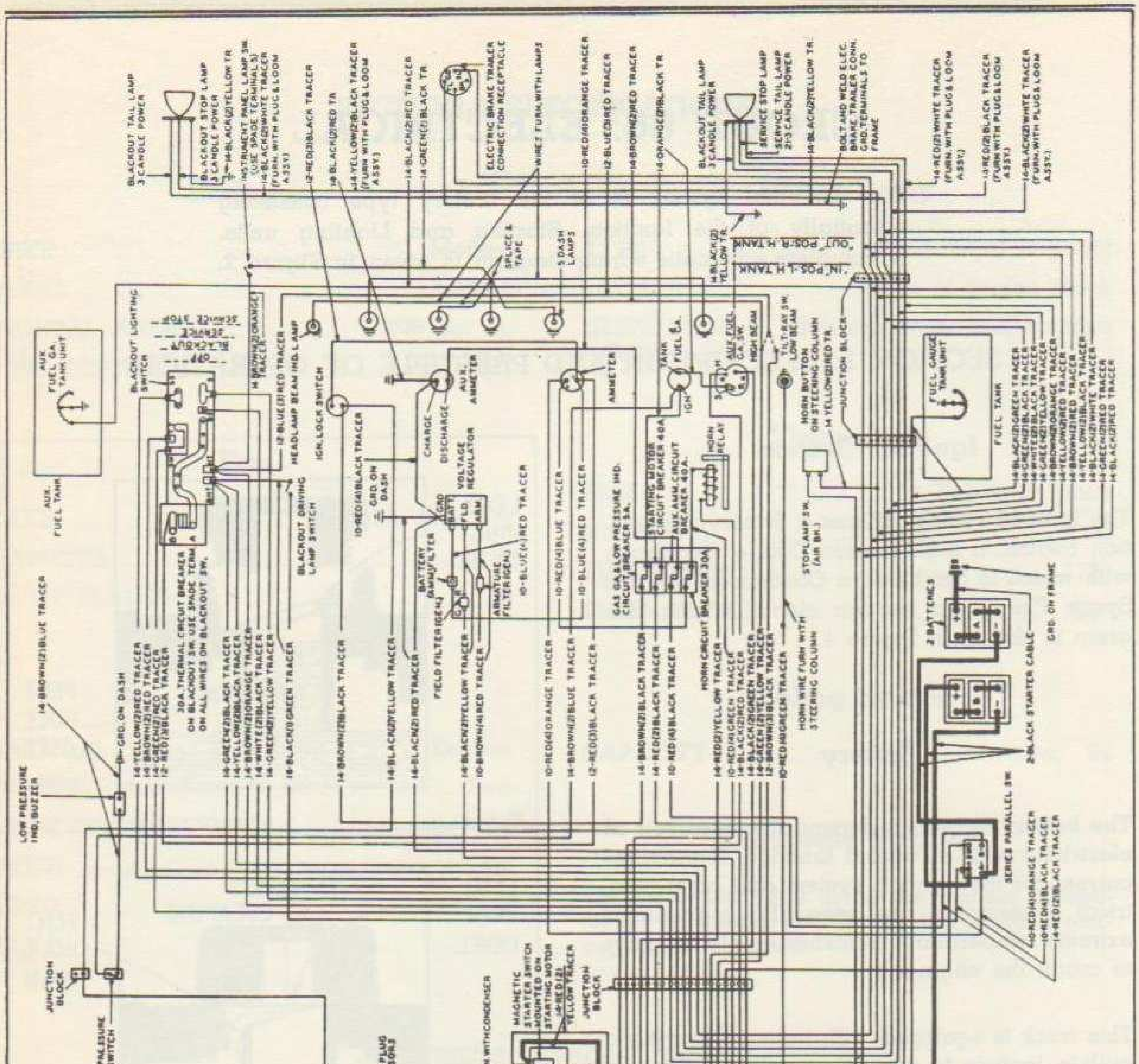


Fig. 2—Complete Wiring Diagram

There are two electrical circuits within the coil, namely, the primary and the secondary. The primary is wound with comparatively few turns of heavy wire on the outside of the secondary. Each end of the primary winding is connected to a low-tension terminal. The secondary is wound with many layers of fine wire around the iron cone with each layer insulated from each other. One end of the secondary winding is connected to the primary and the other to the high-tension terminal.

Current from the battery or generator flows thru the primary circuit creating a magnetic field about the winding and cone. This current does not instantly reach its highest value due to the inductive effect of the magnetic field.

Since there are 60 to 100 times as many turns in the secondary as there are in the primary, the induced voltage in the secondary will be 60 to 100 times that of the primary. A secondary voltage of from 4,000 to 15,000 volts is required to produce the spark at the plug. This variation is due to engine compression, engine speed, plug temperature, condition of plug electrodes and width of the spark gap.

Spark Plugs

The purpose of a spark plug is to create a spark between the electrodes to ignite the fuel in the combustion chamber.

Spark plugs are constructed to insure efficient operation over an exceptionally wide temperature variation. From a cold start, a spark plug must operate under extremely high temperatures with repeated explosion pressures in a few seconds. Each type of spark plug is so varied in shape and design as to be suitable for the heat range required for the particular engine.

The correct plug for an engine is one which will "soot" slightly, rather than become too hot and cause pre-ignition with resulting crackage of cylinders and cylinder heads.

The spark plugs furnished with the engine in this truck are Champion, Model J-10. This spark plug is known as a "cold" plug and is required with a hot running engine. A "cold" plug has a low insulator seat which quickly carries the heat away from the core.

A cool running engine requires a "hot" plug or one with a high insulator seat which is capable of retaining the heat longer.

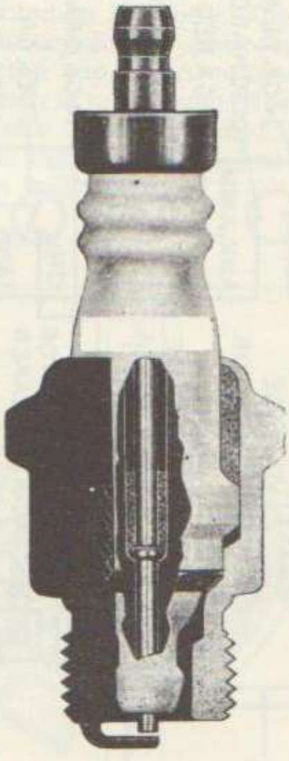


Fig. 3—Sectional View of Spark Plugs

Distributor

The ignition distributor has two functions. The cam and circuit breaker mechanism completes and breaks the ignition coil primary circuit causing a build-up and collapse of a magnetic field in the ignition coil. This build-up and collapse, aided by the condenser action, induces in the secondary winding of the ignition coil a high voltage. The second function of the distributor is to distribute this high voltage to the correct spark plug by means of the distributor rotor and cap, and the high tension wiring.

The distributor shaft is gear driven at one-half engine speed. A weight plate, supporting the two sets of weights, is integral with the shaft. At the upper end of the shaft is mounted the breaker cam which is free, upon action of

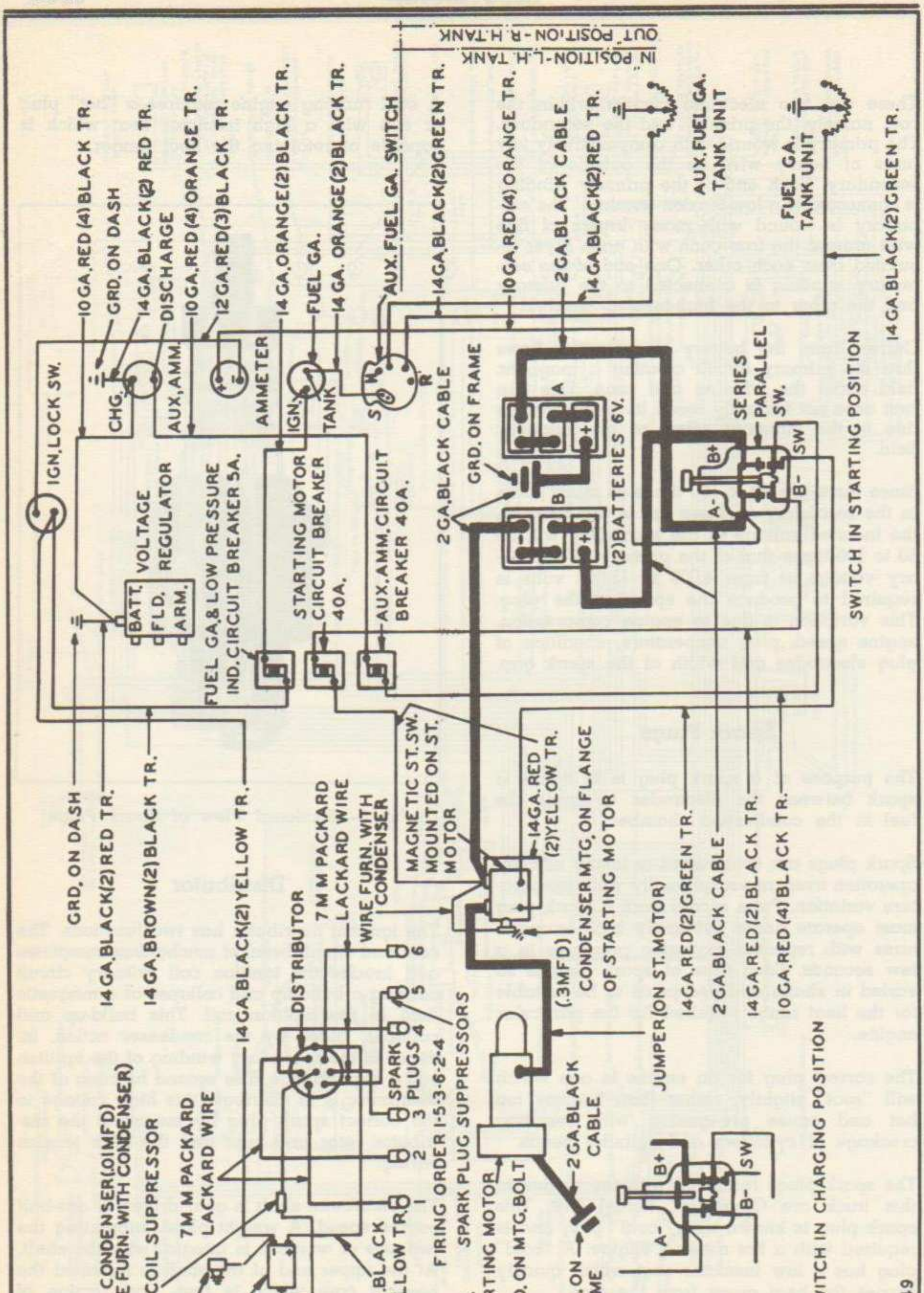


Fig. 4—Ignition Circuit Wiring Diagram

the weights, to rotate as much as 9.5 degrees with respect to the shaft. Finally on top of the breaker cam, and keyed to it, is the rotor. A breaker lever, which rubs against the cam and follows the contour of the cam, carries a contact point which makes and breaks contact with another stationary point six times each shaft revolution. A condenser is connected electrically across, or in parallel, with these points and greatly reduces arcing which might occur when the points separate. Also this condenser plays an important part in securing the high secondary voltage needed to fire the spark plugs.

The breaker lever points carry primary or 6 volt current only, interrupting this current six times per shaft revolution. When the primary circuit is opened a high voltage is induced in the secondary winding of the ignition coil. The "hot" or high tension lead is carried to the center of the distributor cap, where it is electrically connected to the rotor. The high voltage jumps the small gap between the rotor segment and the cap insert connected to the spark plug which is to fire next. Now the spark jumps the spark plug gap and ignites the mixture of gas and air which has been compressed in the cylinder.

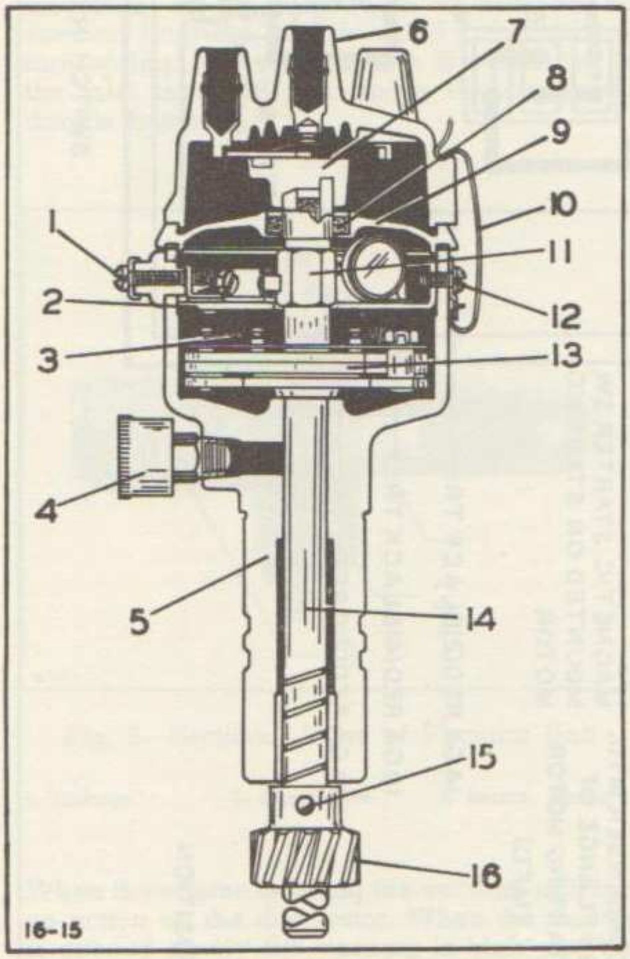


Fig. 5—Sectional View of Distributor

1. Terminal Screw
2. Breaker Plate
3. Weight Spring
4. Grease Cup
5. Housing
6. Cap
7. Rotor
8. Cover Felt Seal
9. Housing Cover
10. Cap Spring
11. Cam Assembly
12. Spring Support Screw
13. Weight
14. Main Shaft
15. Gear Pin
16. Gear

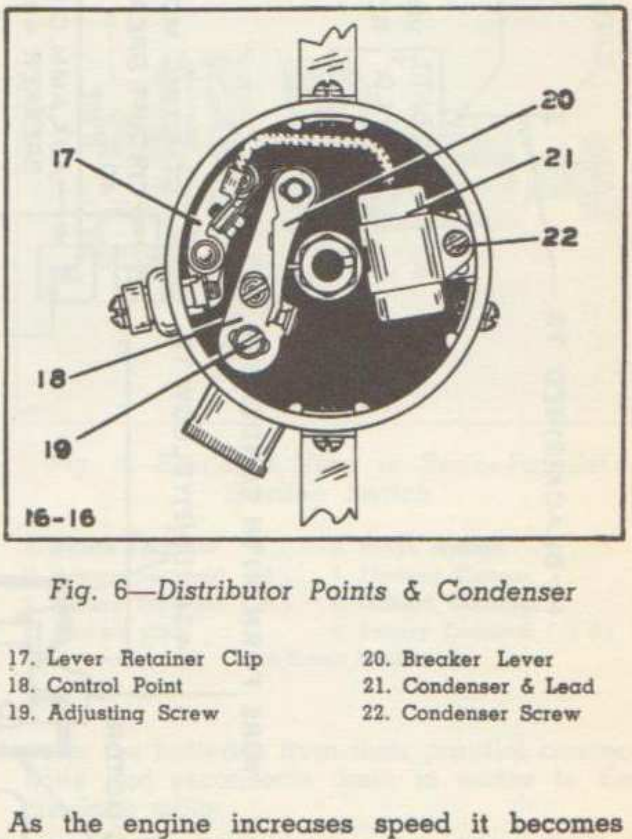


Fig. 6—Distributor Points & Condenser

17. Lever Retainer Clip
18. Control Point
19. Adjusting Screw
20. Breaker Lever
21. Condenser & Lead
22. Condenser Screw

As the engine increases speed it becomes necessary to obtain a spark earlier in the engine cycle, or to "advance" the spark. This is automatically taken care of in the centrifugal advance mechanism. At higher speeds, the weights are thrown out, against spring tension, by the increased centrifugal force. This movement of the weights is transmitted to the breaker cam and rotates it relative to the main shaft. This rotation is in the same direction as shaft rotation. Thus at high speeds, the breaker points open about 9.5 degrees earlier than at low speeds, and the spark plug fires about 18.5 degrees earlier in the engine cycle.

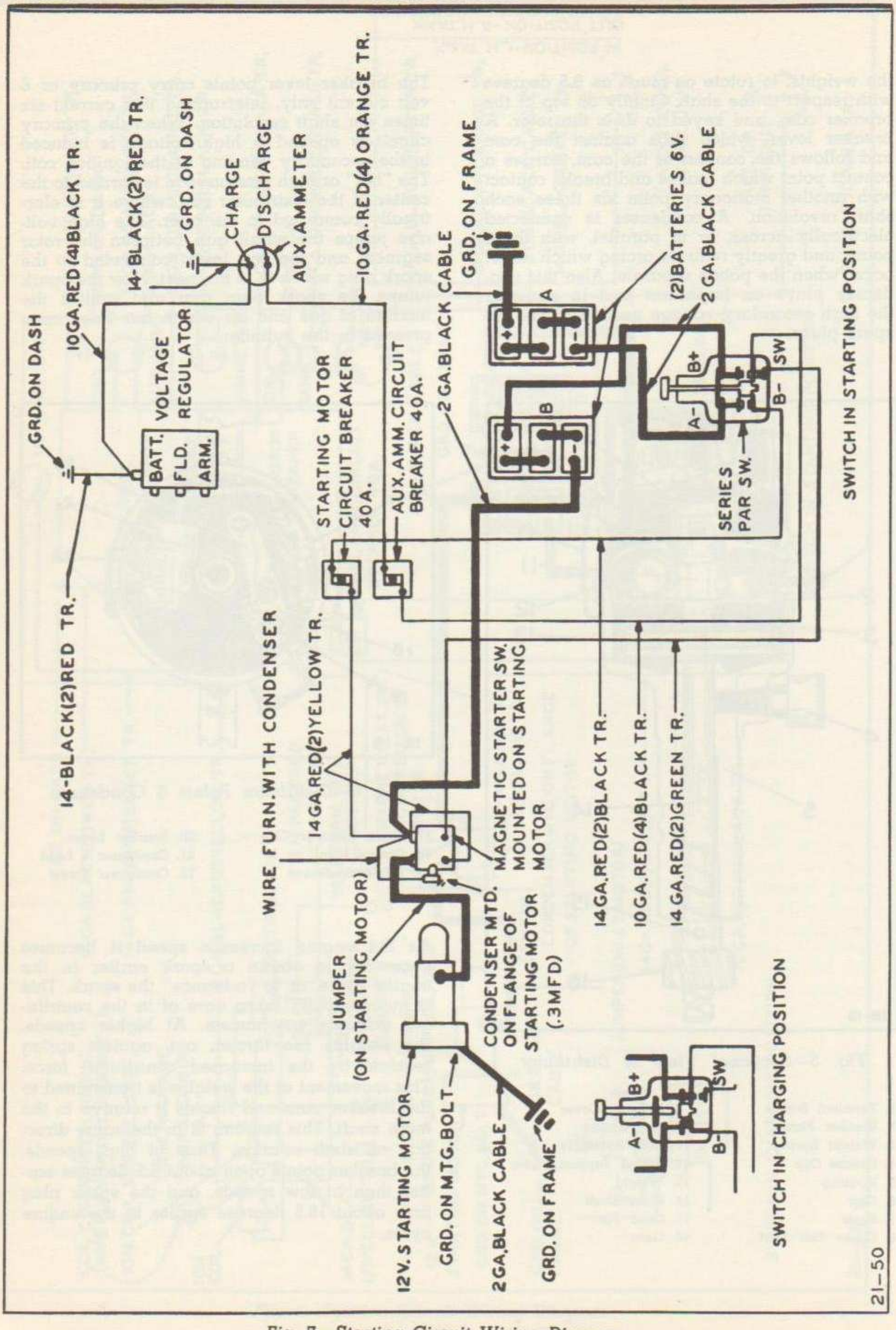


Fig. 7—Starting Circuit Wiring Diagram

A complete set of events happening from the time the breaker points close until they close again is called a "cycle". Since there are six lobes on the cam, the breaker points open and close six times each distributor revolution and we have six ignition cycles. At high engine speeds, (2000 to 3000 r.p.m.) the distributor shaft rotates at 1000 to 1500 r.p.m. and consequently there are from 6000 to 9000 ignition cycles per minute.

The distributor is of the vacuum-automatic control type, incorporating a vacuum unit in addition to the centrifugal action.

With the vacuum control, whether linked to the breaker plate, or to the advance arm, movement of the diaphragm is actuated by vacuum from the engine and a calibrated return spring. The vacuum line is connected to the inlet manifold just above the carburetor throttle butterfly.

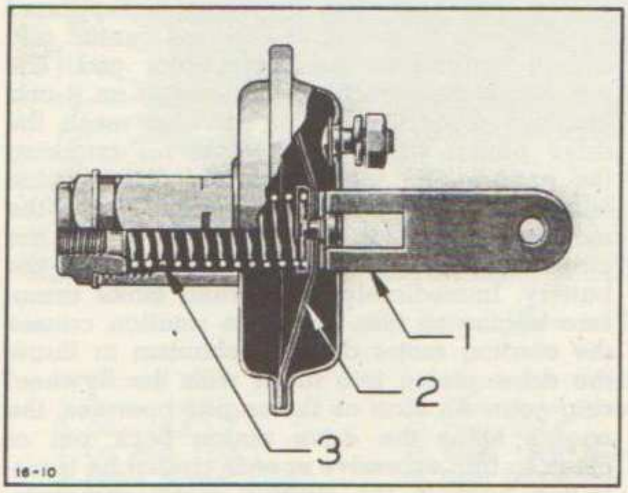


Fig. 8—Sectional View of Vacuum Unit

1. Linkage 2. Diaphragm 3. Return Spring

When the engine is idling the vacuum unit has no action on the distributor. When the throttle is opened slowly the vacuum is high and the spark will be given additional advance to that of the centrifugal advance. On full load, wide open throttle when the vacuum is low or at high speed, the vacuum unit will not advance the spark. Under these low vacuum conditions spark advance depends upon the centrifugal mechanism in the distributor.

This results in greater economy and improved engine performance.

Series-Parallel Starting Switch

The series-parallel system is designed to provide a means of connecting two 6-volt batteries in series to provide increased voltage for cranking, and reconnecting the two batteries in parallel for normal operation of the other electrical equipment after starting of the engine has been accomplished. In this particular application, two 6-volt batteries are employed, producing 12 volts when connected in series and 6 volts when connected in parallel. The series-parallel system makes use of a series-parallel switch which, when operated, disconnects the batteries from their parallel connections and reconnects them in series to the cranking motor.

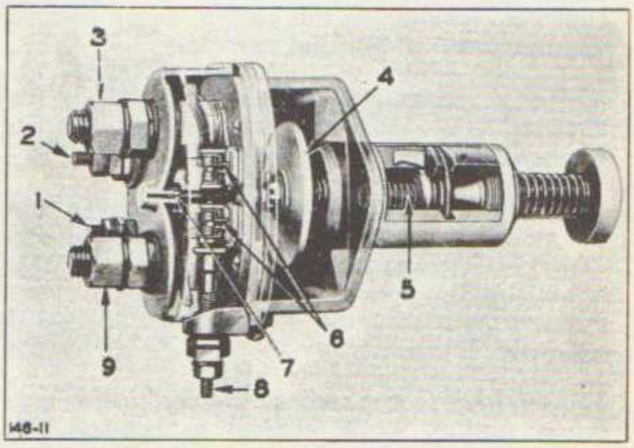


Fig. 9—Sectional View of Series-Parallel Starting Switch

1. Switch Terminal	6. Hinge Springs
2. Battery Terminal (-B)	7. Floating Plunger
3. Battery Terminal (-A)	8. Ground Terminal
4. Contact Disk	9. Battery Terminal (+B)

5. Quick-Break Mechanism

Assume the engine to be stopped, then the two 6-volt batteries are connected in parallel thru two sets of contacts inside the switch and they both deliver current to any lamps which may be switched on.

When the engine is to be started the ignition switch is first turned on, then the Series-Parallel switch knob is depressed. The first part of this movement opens the two sets of contacts thus breaking the parallel connection of the batteries. Further movement closes the heavy contacts inside the switch thus connecting the batteries in series. The final portion of the plunger movement closes a set of contacts which allow current to flow thru the coil of a magnetic switch. This reacts on a plunger inside the magnetic switch and its contacts close, completing the circuit from the batteries to the starting motor which begins to crank the engine. Cranking will continue as long as the knob of the Series-Parallel switch is depressed. As soon as the engine fires, pressure on the switch should be released allowing the switch to return to its normal position. When the switch returns to normal, first the circuit to the magnetic switch coil is opened, thus allowing the contacts to open the starting circuit. Next the series connection between the batteries is opened and finally the two sets of contacts close inside the switch, again placing the batteries in parallel for charging.

As noted above, the two 6-volt batteries are charged in parallel thru two sets of contacts in the Series-Parallel switch.

All of the generator current, after passing thru the regulator is carried to the main ammeter where a circuit is taken off to supply the lights, ignition, etc. The current to both batteries passes thru the main ammeter and is indicated thereon.

Battery (A) is connected directly to the generator output, while current to battery (B) must pass thru the contacts in the Series-Parallel switch and thru the auxiliary ammeter. The purpose of the auxiliary ammeter is to indicate that battery (B) is receiving a charge. Two 40 ampere quick-break circuit breakers are provided in the circuit of battery (B). These are normally closed and serve to protect the contacts in the Series-Parallel switch, thru which battery (B) is charged, from damage in case batteries (A) and (B) are incorrectly connected up.

Magnetic Switch

The magnetic switch mounted on top of the cranking motor is a definite part of the cranking motor assembly. It is a 12 volt, heavy duty, plunger type solenoid switch making contact thru the contact disk, when in operation, with the two heavy copper lead terminals to the switch.

When the series-parallel switch is operated for cranking, the two six-volt batteries are connected in series, making twelve volts available for cranking purposes. This voltage is also impressed on the coil within the magnetic switch. When the coil is energized, a strong magnetic field is induced in the center of the coil. A steel solenoid boot or plunger which is pinned to the contact disk shaft, is pulled into this strong magnetic field with a quick positive action, thrusting the contact disk securely against the two heavy copper terminal studs. The contact disk itself is electrically insulated from the shaft on which it is mounted. As soon as this contact is made, the cranking motor circuit is complete and cranking begins. When the engine fires, and the foot pedal is released, the circuit is broken at the series-parallel switch. The cranking motor no longer receives battery current and the switch closing the circuit to the magnetic switch coil is also opened. A spring mounted on the contact disk shaft thrusts the solenoid boot back to "non-operating" position.

Starting Motor

This starting motor is a six brush, six pole, heavy duty unit. The armature is supported by bushings at the drive end and center, and a ball bearing at the commutator end. The unit has a magnetic switch mounted on it and employs a starting motor drive to mesh the drive pinion with the flywheel for cranking the engine and to demesh the drive pinion when the engine begins to operate. When the magnetic switch is in operation, it closes the circuit between the starting motor and the battery. Immediately the starting motor armature begins to turn, and this rotation causes the starting motor drive mechanism to throw the drive pinion into mesh with the flywheel ring gear. As soon as the engine operates, the engine spins the drive pinion back out of mesh so that excessive speeds cannot be transmitted back to the starting motor armature.

The starting motor is a device for converting electrical energy into the mechanical energy necessary to crank the engine. Current from the vehicle batteries is utilized to operate the starting motor. This current is subsequently replaced in the batteries by operation of the vehicle's generator.

The starting motor produces cranking torque by utilizing the principle that force is exerted on an electrical conductor held in a magnetic field when current is passed thru the conductor. A number of such conductors or armature windings are assembled in the starting motor armature. The field coils are wound about iron pole shoes which are firmly fastened to the field frame of the cranking motor. As current from the battery passes thru the field coils, a powerful magnetic flux is set up in the iron pole shoes. The armature windings and the field coils are connected electrically in series; that is, all the current which passes thru the armature windings must also pass thru the armature and field windings. This rotational movement is transmitted by the starting motor drive pinion to the engine flywheel, so that the engine is cranked.

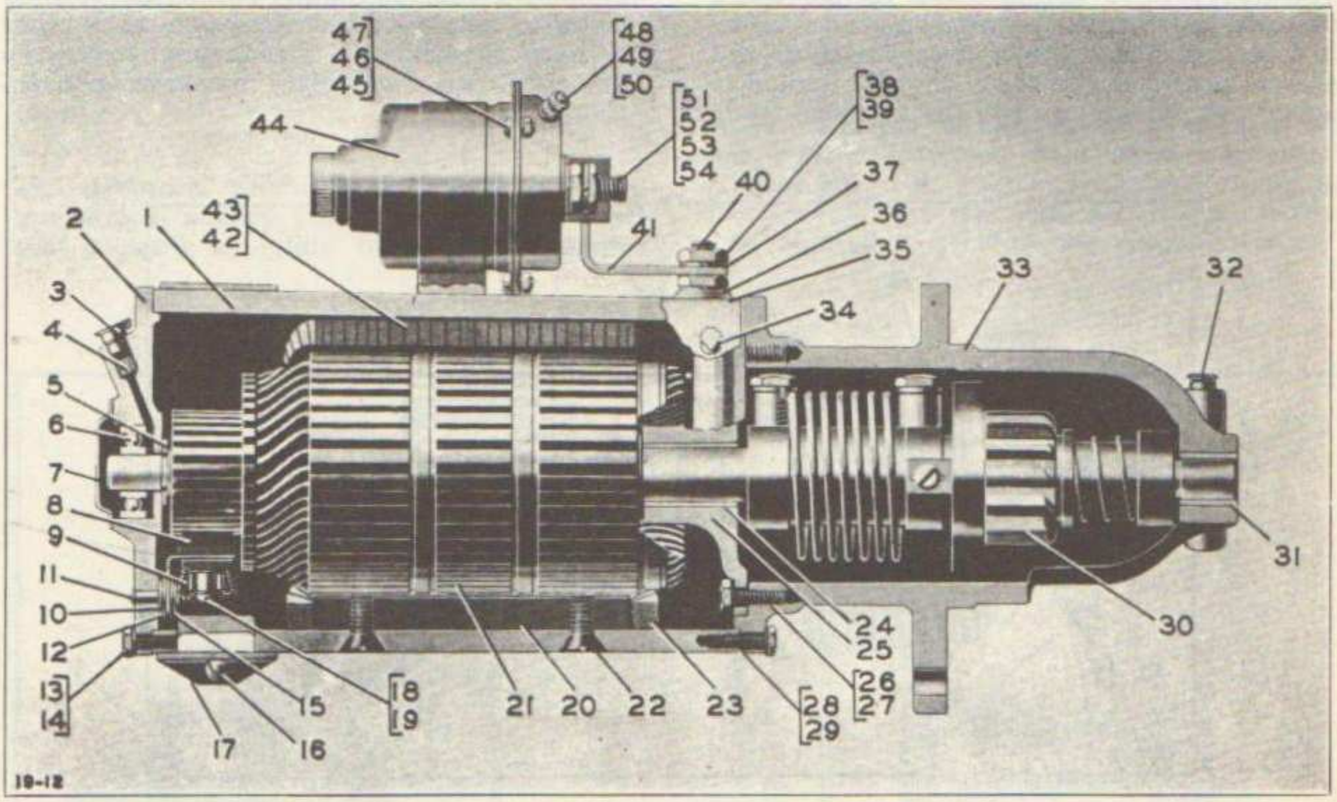


Fig. 10—Sectional View of Starting Motor and Magnetic Switch

1. Starting Motor
2. Frame (C.E.)
3. Oiler (C.E.)
4. Oil Wick (C.E.)
5. Space Washer (C.E.)
6. Bearing (C.E.)
7. End Plate (C.E.)
8. Brush
9. Brush Spring
10. Bushing Washer
11. Brush Holder Rivet
12. Rivet Washer
13. Frame Screw (C.E.)
14. Frame Lockwasher (C.E.)
15. Rivet Plain Washer
16. Cover Band Screw
17. Cover Band
18. Brush Lead Screw
19. Lead Lockwasher
20. Pole Shoe
21. Armature
22. Pole Shoe Screw
23. Field Coil (Lower)
24. Bearing Bushing
25. Bearing Plate
26. Bearing Screw
27. Bearing Lockwasher
28. Drive Housing Screw

C.E. = Commutator End.

29. Housing Lockwasher
30. Motor Drive
31. Bushing (D.E.)
32. Oiler (D.E.)
33. Drive Housing
34. Oiler (Field Frame)
35. Insulation Washer
36. Plain Washer
37. Terminal Lockwasher
38. Terminal Nut (Thin)
39. Terminal Nut (Thick)
40. Terminal Stud
41. Connector Strap
42. Field Coil (R.H.)

D.E. = Drive End.

43. Field Coil (L.H.)
44. Magnetic Switch
45. Switch Cover Screw
46. Switch Cover Nut
47. Cover Lockwasher
48. Coil Lead Stud
49. Coil Lead Nut
50. Stud Lockwasher
51. Terminal Stud
52. Stud Nut (Thin)
53. Stud Nut (Thick)
54. Stud Lockwasher

thru the field coils. Current flowing thru the armature windings, in the presence of the intense magnetic field set up in the pole shoes, causes a strong force to be exerted on the armature windings. Since these windings are securely attached to the armature, they cause the armature to rotate on its shaft. The resultant force with which the armature rotates, then, is dependent upon the amount of current flowing

Starting Motor Drive

The starting motor drive consists of a drive head keyed to the armature shaft, drive spring, hollow sleeve, and pinion. The pinion has a thread cut in its inner face which matches threads on the hollow sleeves. When the armature begins to rotate, the starting motor drive assembly, except for the pinion, picks up speed with it. The pinion, being unbalanced, does not pick up speed as rapidly as the sleeve, with the result that the sleeve turns within the pinion, and the threads force the pinion endwise along the shaft and into mesh with the flywheel teeth. The heavy drive spring takes up the shock of meshing. When the engine begins to operate, it spins the pinion faster than the shaft and sleeve turn, with the result that the pinion is spun back out of mesh with the flywheel teeth.

operated in a loose or jerky manner because the contacts of the series-parallel and magnetic switch may be caused to flutter until they are damaged by electric arcing while starting current is passing thru these contacts.

Prolonged cranking may cause the starting motor to become overheated enough to char or burn its windings. Switches may also be damaged and the battery unnecessarily discharged.

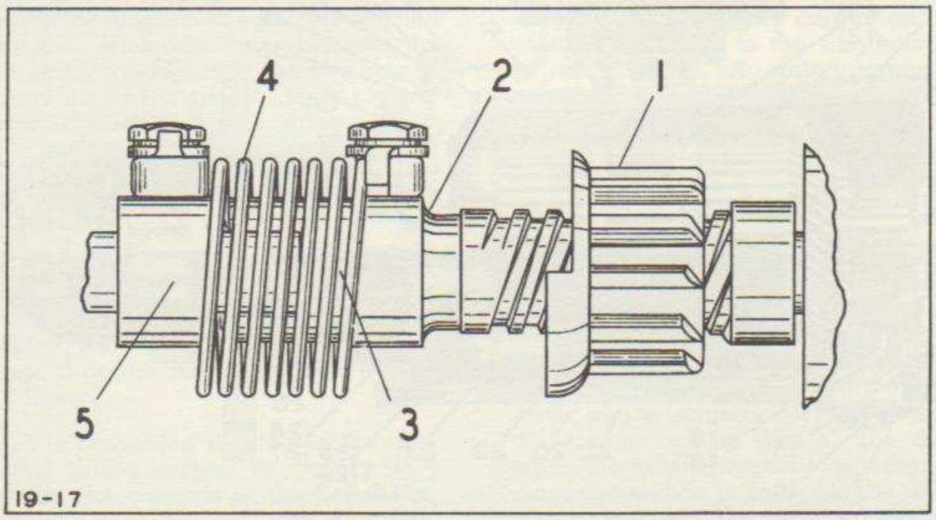


Fig. 11—View of Starting Motor Drive

1. Gear Assembly 2. Back Stop 3. Service Sleeve 4. Spring 5. Head

Starting Engine

Important: To avoid damage and to provide longest life to motor brushes, commutator, switch contacts and battery, operate starting switches as follows:

A. Operate hand operated button switch with quick full movement so as to hold in firm contact during cranking.

B. Release button switch quickly and completely at instant engine starts.

C. Release hand operated button switch if engine fails to start in about thirty seconds.

D. Wait at least two minutes before operating switches a second time. This permits cooling of all electrical starting units.

The hand operated button switch must not be

Do not use the starting system to "inch over" the engine. Use hand crank instead. Never operate starting switches while engine is running.

Generator

The generator is a machine for converting mechanical energy into electrical energy. This generator is a hinge mounted, two brush, two pole, 6-volt, 25 ampere unit, with sealed ball bearings in both the drive end and commutator end, supporting the armature. The armature is belt driven by means of a pulley on the armature shaft. A fan on the pulley provides for the ventilation of the generator when the generator is operated. The generator output is controlled in accordance wih load requirements and battery state of charge by means of a current and voltage regulator.

The function of the generator is twofold. It restores to the battery the current withdrawn during cranking, thus maintaining the battery in a charged condition. Second, it carries the connected electrical load up to the capacity of the generator, when the generator is operating at speeds at which substantial or maximum generator output can be obtained, thus preventing undue or prolonged draining of the battery.

The generator produces electricity by using mechanical energy (thru the drive belt from the engine) to rotate a series of conductors, assembled in the generator armature, in a magnetic field. This causes a flow of current in the conductors, which is lead thru the armature commutator, generator brushes, and leads, to the battery and other electrical accessories. The magnetic field is created by field windings which are assembled in the field frame around field pole shoes.

Current (from the conductors in the armature) is passed thru the field windings and induces the magnetic field. Only a small part of the total current induced in the armature is required to produce the magnetic field.

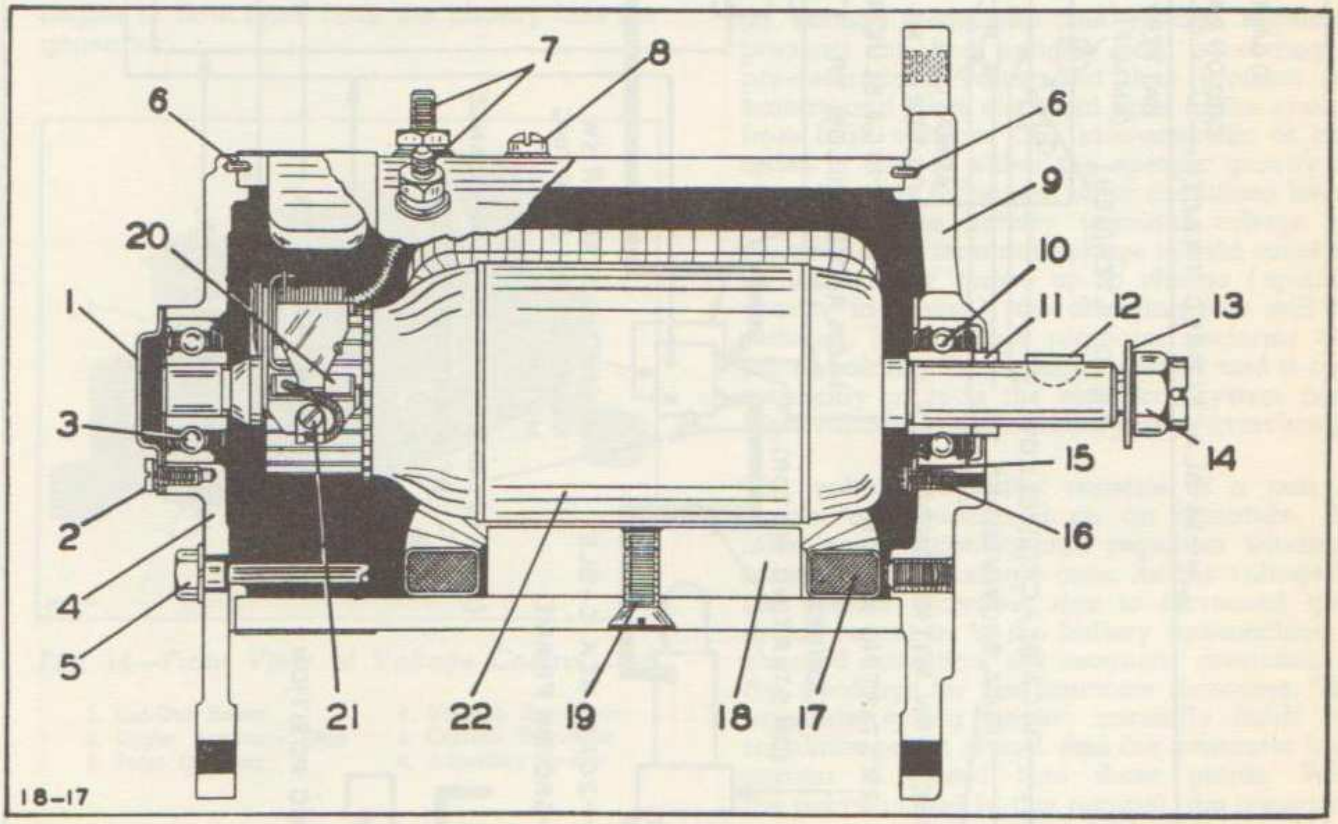


Fig. 12—Sectional View of Generator

1. End Cover Plate
2. Cover Plate Screw
3. Ball Bearing (C.E.)
4. Frame (C.E.)
5. Thru Bolt
6. Dowel Pin
7. Terminal
8. Field Frame Screw
9. Frame (D.E.)
10. Ball Bearing (D.E.)
11. Spacer Collar
12. Woodruff Key
13. Shaft Nut Washer
14. Shaft Nut
15. Retainer Plate
16. Retainer Screw
17. Field Coil
18. Pole Shoe
19. Pole Shoe Screw
20. Brush
21. Brush Lead Screw
22. Armature

C.E. = Commutator End. D.E. = Drive End.

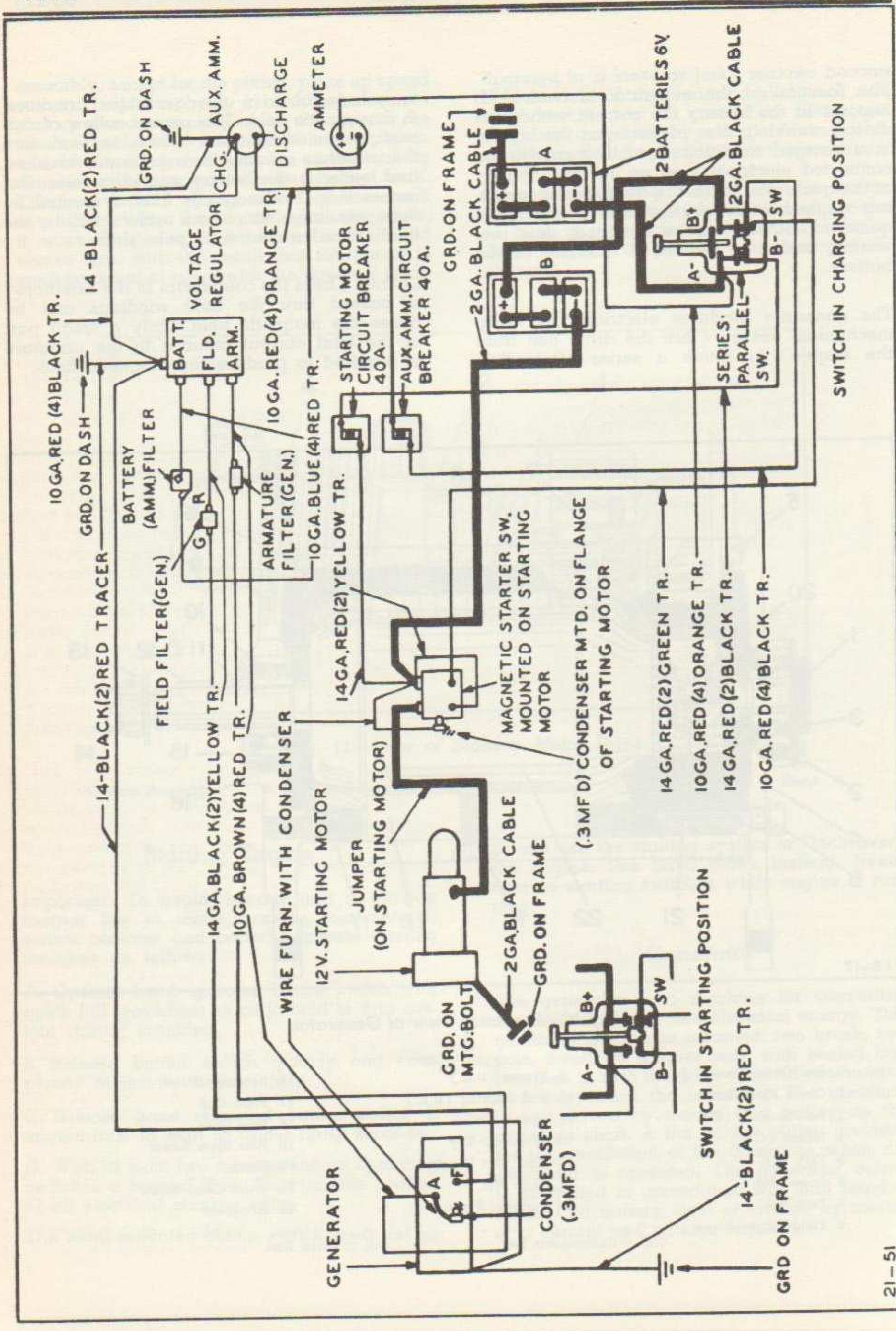


Fig. 13—Generating Circuit Wiring Diagram

Voltage Control Unit

The generator-regulator is an electromagnetic device for controlling the generator output to meet all conditions of operation, load, and battery. There are three separate units in the regulator, the cut-out relay, the voltage regulator, and the current regulator.

The functions of the three units in the regulator are as follows:

(1) Cut-out relay: The cut-out relay closes the circuit between the generator and the battery when the generator voltage has built up to a value sufficient to force a charge into the battery. The cut-out relay opens the circuit when the generator slows or stops and current begins to flow back from the battery into the generator.

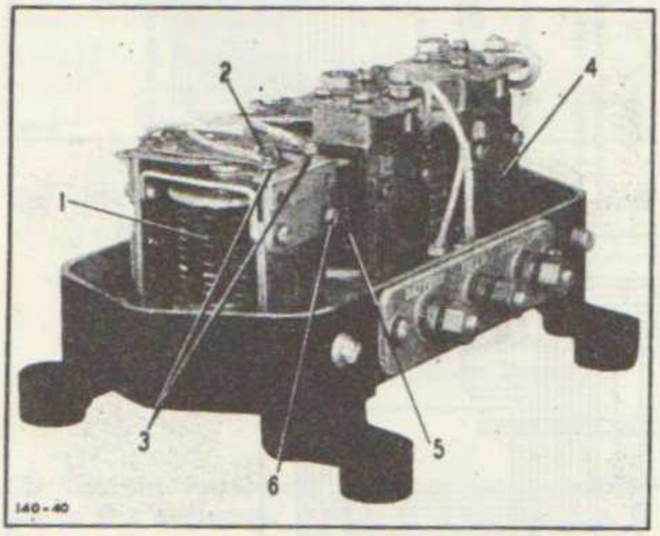


Fig. 14—Front View of Voltage Control Unit

1. Cut-Out Relay
2. Upper Armature Stop
3. Point Opening
4. Voltage Regulator
5. Current Regulator
6. Adjusting Screws

The cut-out relay consists of two windings, a shunt winding and a series winding, assembled on a single core, above which is positioned an armature. The shunt windings consists of many turns of fine wire, and is connected across the generator. The series winding consists of a few turns of heavy wire designed to carry full generator output, and it is connected into the charging circuit. The armature carries points which are positioned above matching stationary points. When the generator is not operating, the armature is held away from the winding core by spring tension and the points are separated. As soon as the generator begins to operate at a speed sufficient to produce enough voltage to charge the battery, this voltage, which is impressed on the relay windings, creates enough magnetism to overcome the armature spring tension and closes the points. So long as the generator charges the battery, the points are held closed. But when the generator slows or stops so that current flows from the battery to the generator, the points open. They open because the series winding magnetic field reverses as the current in it reverses so that the two windings no longer help each other, but their magnetic fields buck, causing such a reduction of the total magnetic field that the armature spring tension can pull the armature away from the winding core and separate the points.

(2) Voltage Regulator: The voltage regulator prevents the line voltage from exceeding a pre-determined value and thus protects the battery and other electrical units in the system from high voltage. One characteristic of batteries is that as either the specific gravity or charging rate increases, other conditions being the same, the battery terminal voltage increases. If the terminal voltage is held constant as the battery comes up to charge (specific gravity increases), the charging rate will be reduced. The voltage regulator performs this job of holding the voltage constant and it consequently protects the electrical system from high voltage and the battery from overcharge.

The voltage regulator consists of a pair of points, one positioned on an armature, the other semi-stationary and regulator windings assembled on a single core. As the voltage in the system increases due to increased generator output or to the battery approaching a charged condition, the magnetic attraction of the windings for the armature increases. The armature spring tension normally holds the regulator points closed, and the generator field current is closed thru these points. With the points closed in this manner, the generator output can increase to a high value, and can cause, under the above mentioned conditions, a high voltage. When the voltage reaches a pre-determined value, the magnetic attraction on the regulator armature is sufficient to overcome the armature spring tension and pull the armature toward the winding core. This opens the points, causing a resistance to be inserted into the generator field circuit. Resistance in the generator field circuit immediately causes a reduction of the generator output, with a consequent reduction of voltage. Reducing the voltage, however, reduces the magnetic pull on the armature, so that almost at once the

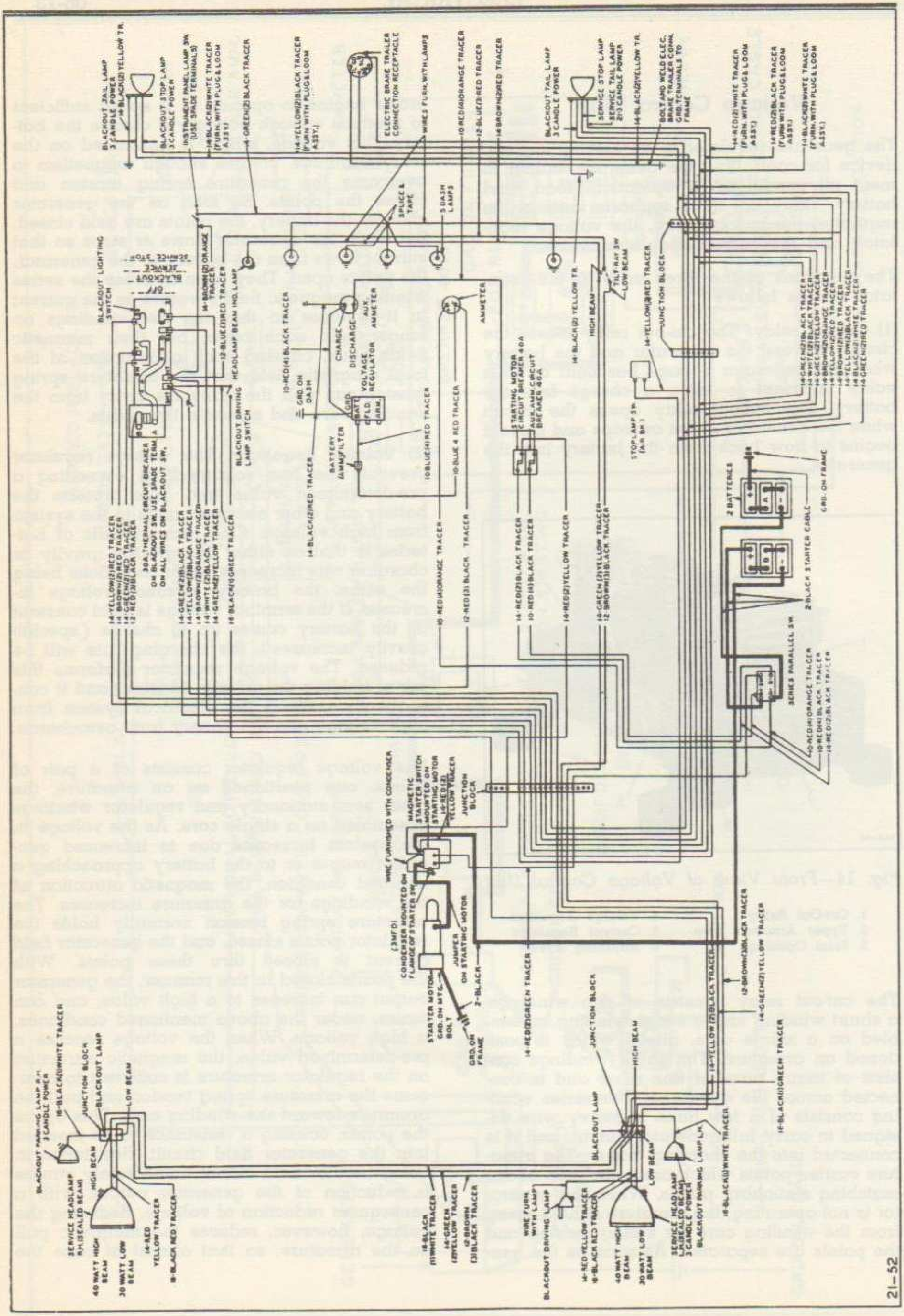


Fig. 15—Lighting Circuit Diagram

armature is released and the spring tension closes the regulator points. This permits an increased output and voltage, so that the points are again opened. This cycle is repeated very rapidly so that the voltage is held to a constant value and the output is reduced to just what is required by the connected electrical load and the condition of charge of the battery.

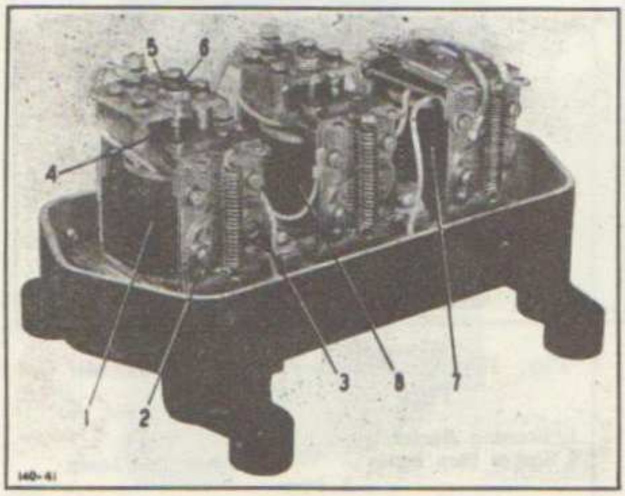


Fig. 16—Rear View of Voltage Control Unit

1. Voltage Regulator
2. Lock Screws
3. Eccentric Screws
4. Point Opening
5. Lock Nut
6. Contact Screw
7. Cut-Out-Relay
8. Current Regulator

(3) Current regulator: The current regulator limits the generator output to a safe value. It is, in effect, a current limiting device which operates when the generator output has increased to its safe maximum and prevents the generator from exceeding this value.

The current regulator consists of a pair of points, one positioned on an armature, the other semi-stationary, and regulator windings assembled on a single core. As the current output of the generator reaches the value for which the current regulator is adjusted (the maximum specified output of the generator), the magnetic strength of the current windings is sufficient to overcome the spring tension holding the regulator points closed. They open, and cause a resistance to be inserted into the generator field circuit. This causes a reduction of the generator ouput. However, as soon as the output falls below the value for which the current regulator is set, the magnetism becomes insufficient to hold the points open, they close, and permit the generator output to increase again. This cycle is repeated very rapidly (from 50 to 300 times per second), preventing the generator output from exceeding its specified maximum.

Note: Either the current regulator or the voltage regulator may operate at any one time, but both never can operate at the same time. When the battery is low and the load requirements are high (many accessories turned on) the current regulator operates to prevent the generator from exceeding its specified maximum and the voltage regulator does not operate because the voltage does not reach a value sufficient to cause it to operate. When the battery begins to come up to charge, and electrical accessories are turned off, the voltage begins to increase and reaches a value at which the voltage regulator begins to operate. The generator output consequently begins to taper off so that output is below a value at which the current regulator would operate. Consequently, only the voltage regulator operates under this condition.

Lighting Equipment

Lighting Switches

Lighting units are controlled by switches within easy reach of the operator. Switches are illustrated in lighting circuit wiring diagram on page 06-14 in relative position.

The size and color of the wires used in this circuit are also indicated in this diagram.

Lamp Bulbs

The lamp bulb specifications are shown in "Section 8: Specifications."

Instrument Panel Lamp Switch

This is a push-pull type switch located in the center of the instrument board. It is used to put the instrument board lights on if the blackout switch is in position 3 or 4 (Main lights in full out position).

Main Light and Blackout Switch

This switch shown below is located on the right of the group of instruments, near the center of instrument board. It controls the headlamp, stop and tail lamps and blackout equipment. It has one "off" and three "on" positions.

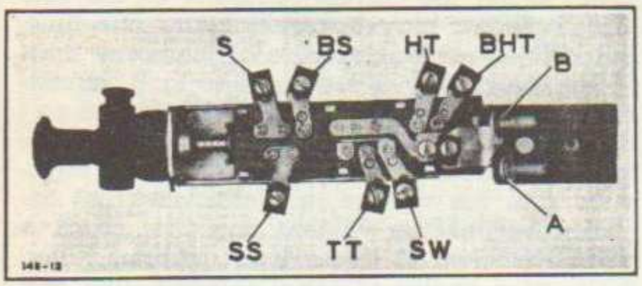


Fig. 17—View of Blackout Switch

- A Auxiliary Feed
- B Battery
- BHT Blackout Parking, Blackout Driving and Blackout Tail Lamp
- BS Blackout Stop Lamp
- HT Headlamp, Instrument Panel Lamps and Service Tail Lamp
- S Service Stop Lamp
- SS Stop Lamp Switch and "SL" Contact on Trailer Connection
- SW Feed to Stop Lamp Switch
- TT To "TL" Contact on Trailer Connection

With the control knob all the way in, all lights are off.

Pulling the knob out to the first "on" position lights the blackout tail, blackout driving, blackout parking lamps and energizes the wire to stop light switch and "TL" contact in trailer receptacle. When the stop light switch operates, the B.O. stop lamp lights and contact "SL" in the trailer receptacle is energized.

Pulling the switch to the second "on" position, which can be done only after the switch lock button is pressed, lights the headlamps, service tail lamp and instrument lights and energizes the wires to stop lamp switch and "TL" contact in trailer receptacle. When the stop light switch operates, the service stop lamp lights, and contact "SL" in the trailer receptacle is energized.

Pulling the switch to the third and last "on" position energizes the wire to stop light switch, so service stop light will light when switch is closed. Contact "SL" in trailer receptacle is also energized.

Blackout Tail and Stop Lamp

This lamp is at the rear on the right hand side of the frame and is controlled by the blackout lighting switch on the instrument board.

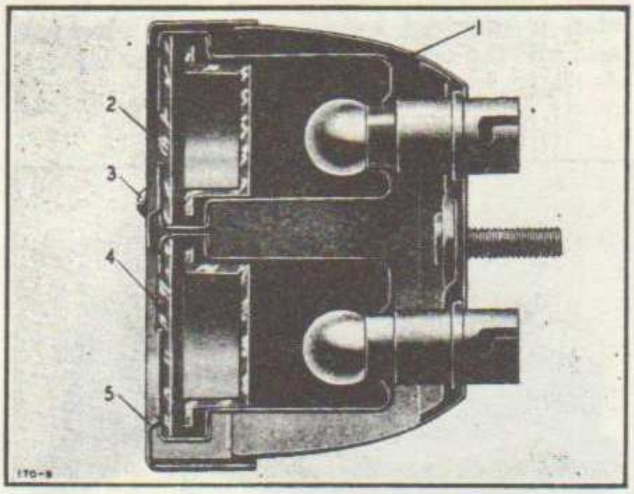


Fig. 18—Sectional View of Blackout Tail and Stop Light

1. Housing Assembly
2. Upper Stop Lamp
3. Door Screw
4. Lower Tail Lamp
5. Door

Each bulb is 3 C.P. 6 volt and is built into a dust and moisture proof assembly which must be replaced as a unit.

Blackout Fender Lamps

A blackout fender lamp is mounted on each fender and controlled by the blackout lighting switch. The lamps are equipped with 6 volt 3 C.P. single contact bulbs replaceable by removing the lens rim.

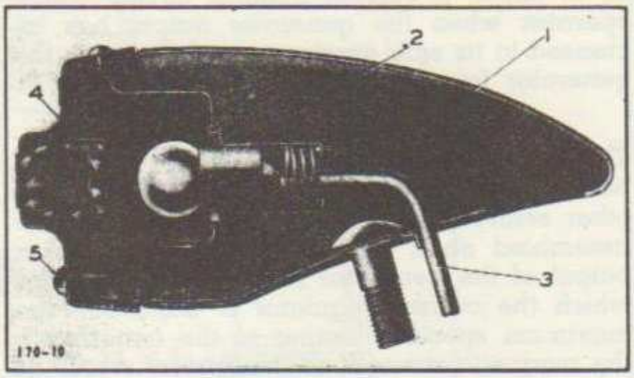


Fig. 19—Sectional View of Blackout Fender Lamp

1. Housing Assembly
2. Socket
3. Wire
4. Door Assembly
5. Door Screw

Service Tail & Stop & Blackout Tail Lamp

This lamp is mounted at the rear of the frame on the left hand side. The service tail light operates with the headlights for ordinary night driving.

The service stop lamp operates normally in day or night driving.

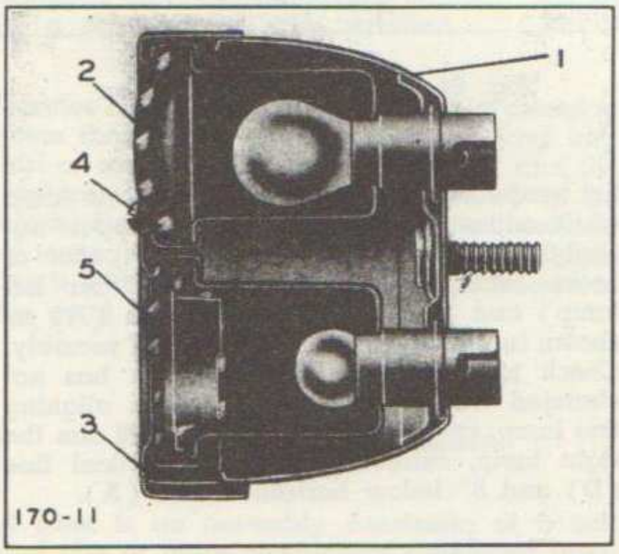


Fig. 20—Sectional View of Service Tail & Stop and Blackout Tail Lamp

1. Housing Assembly
2. Upper Service Unit
3. Door
4. Door Screw
5. Lower Blackout Tail Lamp Unit

The blackout tail lamp operates with the other blackout lights. All are controlled by the blackout lighting switch on the instrument board.

Blackout Driving Lamp

This lamp is mounted above the left headlamp and is controlled by the blackout driving light switch on the instrument board when blackout switch is in first "on" position. It is equipped with a 6 volt, single filament, hooded, sealed beam unit.

As indicated by its name, it is used for driving in a blackout, since its light cannot be seen from any point higher than the lower edge of the hood.

The complete sealed unit is replaced in case of a burn out.

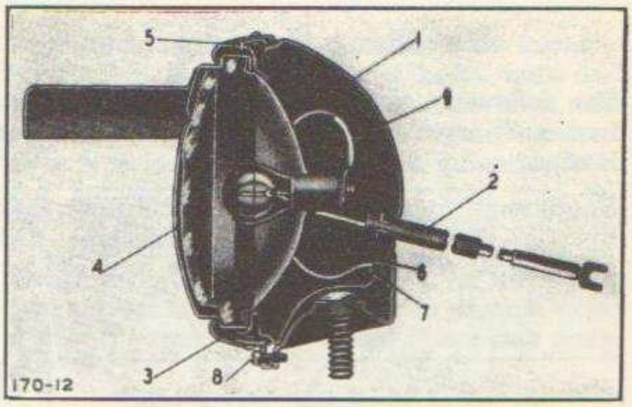


Fig. 21—Sectional View of Blackout Driving Lamp

1. Housing Assembly
2. Lead Wire
3. Door
4. Blackout Unit
5. Unit Mounting Ring
6. Ground Screw
7. Lockwasher
8. Door Screw
9. Ground Wire

Head Lamp

This model is equipped with two 6 volt sealed beam headlamps.

They are serviced by replacing complete sealed beam unit should the lamp burn out or the reflector become dulled.

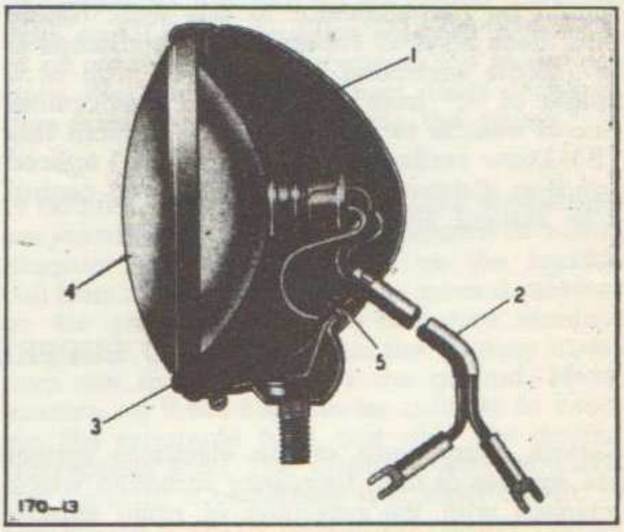


Fig. 22—Sectional View of Headlamp

1. Housing Assembly
2. Lead Wire
3. Door Assembly
4. Sealed Beam Unit
5. Ground Screw

Its two beams are controlled by the blackout lighting switch on the instrument board.

A spherical mounting on the lamp permits it to be aimed as desired.

Headlamp Adjustment

The following procedure for "Headlamp Adjustment" applies only when vehicle is not loaded.

Headlamps may be adjusted accurately and quickly with a commercial headlamp test machine. If same is not available, proceed as follows:

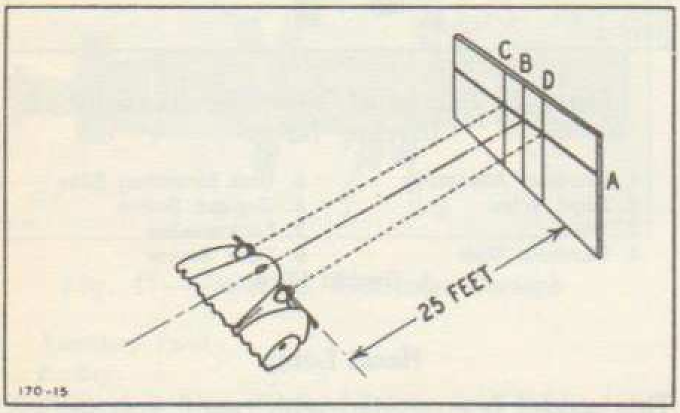


Fig. 23—Aiming Headlamps

Place vehicle on level floor so that lamps are 25 feet from a vertical surface such as a wall of a building. The centerline of vehicle should be perpendicular to this wall. Height from floor level to centerline of headlamps is 69". Draw horizontal line (A) on wall at a height of 60" from floor level. Project center line of vehicle to wall and draw vertical line (B). Draw vertical lines (C) and (D) spaced equal to distance between lamps and central with vertical line (B).

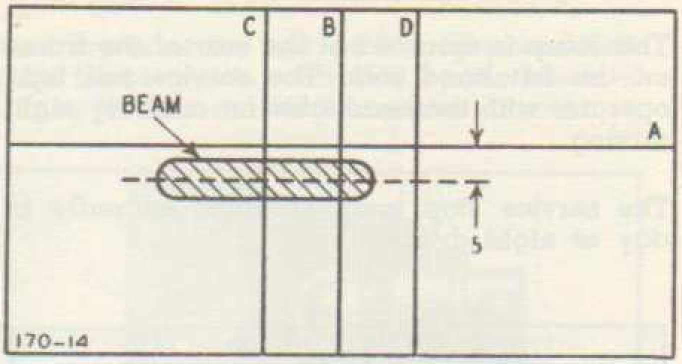


Fig. 24—Headlamp Beam Chart

Set lamps using high beams. Cover one lamp while adjusting the other. Loosen support nut slightly and aim lamp so that hot spot of beam centers on vertical line (C for left lamp) and 5" below horizontal line (A) as shown in the figure. Then tighten nut securely. Check to make sure beam pattern has not changed while tightening nut. After aligning this lamp, cover same and proceed to aim the right lamp, centering beam on vertical line (D) and 5" below horizontal line (A).

Blackout Driving Lamp Adjustment

This lamp shall be so aimed that the visual cutoff of the top of the beam, on a vertical screen 10 ft. in front of the lamp, is at least 2" and not more than 3" below the bottom of horizontal slot in lamp shield, with the vehicle loaded and standing on a level surface.

RADIO SUPPRESSION EQUIPMENT

Certain components of the electrical system are sources of high frequency radiation which interfere with the reception of radio signals when a radio receiver is mounted in the vehicle itself or even if it is mounted in some adjacent vehicle. The principal sources of this interference are the ignition system, the generator, and the voltage regulator.

Radio interference resulting from these sources is minimized or suppressed by the installation of suppressors, filters, or bonds. The location and purpose of these various devices are explained as follows:

Suppressors

Suppressors are high resistance elements enclosed in an insulated housing, having suitable electrical connections at each end for insertion in series with the high tension wires of the ignition system. Seven suppressors are installed in the ignition circuit, six in series with the spark plug wires at the spark plugs and one in series with the high tension wire from the coil to the center terminal on the distributor cap. These suppressors have a nominal direct current resistance of 10,000 ohms.

The suppressors are assembled at the high tension wire by screwing them on to the wire. Care must be taken when installing a suppressor to completely screw the suppressor on to the wire rather than merely push them together, so that a good solid connection between suppressor and wire is insured.

The spark plug end of the suppressor is snapped on to the spark plug terminal, similar to a conventional wire terminal.

Service on the suppressors consists of cleaning them thoroughly with a cloth to remove any dirt or moisture that may be present and the replacement of any which is found to be cracked or scorched. One of the best methods of testing a suspected suppressor is by replacing it with a new one or one that is known to be good.

Filters and Condensers

A filter is an assembly consisting of a coil and one or more condensers connected internally in a metal can, and mounted in such a manner that the can is well grounded to the vehicle.

Three filters are incorporated in the generator-regulator circuit, as indicated on wiring diagram, page 06-12. These filters are mounted on the left side of the dash toward the engine, directly below the voltage regulator. One of these filters is connected in series with the armature terminal of the regulator, another in series with the field terminal of the regulator, and the third in series with the battery terminal of the regulator.

It should be noted that each filter has a particular function and a particular rating, and that if it is replaced for any reason, it is imperative that it be replaced with the same type of filter. The part number stamped on the filter must be used as a guide for this replacement, since several of the filters are identical in external appearance.

The filter housings are mounted in direct contact with the dash and are fastened with zinc plated bolts, nuts, and internal-external tooth type lock washers. If for any reason one of these filters is removed, care must be taken to insure that the same type of bolts, nuts and lock washers are used to replace it. It will be noted that there are three internal-external tooth type lock washers on each mounting bolt, one between the head of the bolt and the filter mounting bracket, one between the filter mounting bracket and the dash, and one between the nut and the dash. It is necessary that all of these be present to insure good electrical contact between the filters and dash.

Maintenance on the filters consists of:

Keeping the terminal connections and wiring tight.

Keeping the mounting bolts with their respective washers drawn tight.

Mounting surfaces, tops and bottoms of all filters and their placement positions on the vehicle to be kept clean and free from paint and accumulated dirt.

The principal troubles that can occur in a filter are an open circuit or a short circuit. These can be detected by the proper electrical tests, and if either condition exists, it is possible in an emergency to disconnect the two wires from the filters and connect them together, thus removing the filter from the circuit.

In addition to the three filters, three condensers are installed in the vehicle, as shown in wiring diagram on page 06-2, one on the ignition coil from the switch terminal to ground, another on the generator from the armature terminal to ground, and the third on the starting motor from the live terminal to the ground. Maintenance on these condensers consists in keeping the terminals tight and also the ground connections tight. The principal trouble which can occur in a condenser is a short circuit, in which case it will be possible to run the vehicle in an emergency by disconnecting the condenser entirely.

Bonds

A bond is an electrical contact of extremely low resistance between two or more metal parts. Bonds may be either of the flexible braid

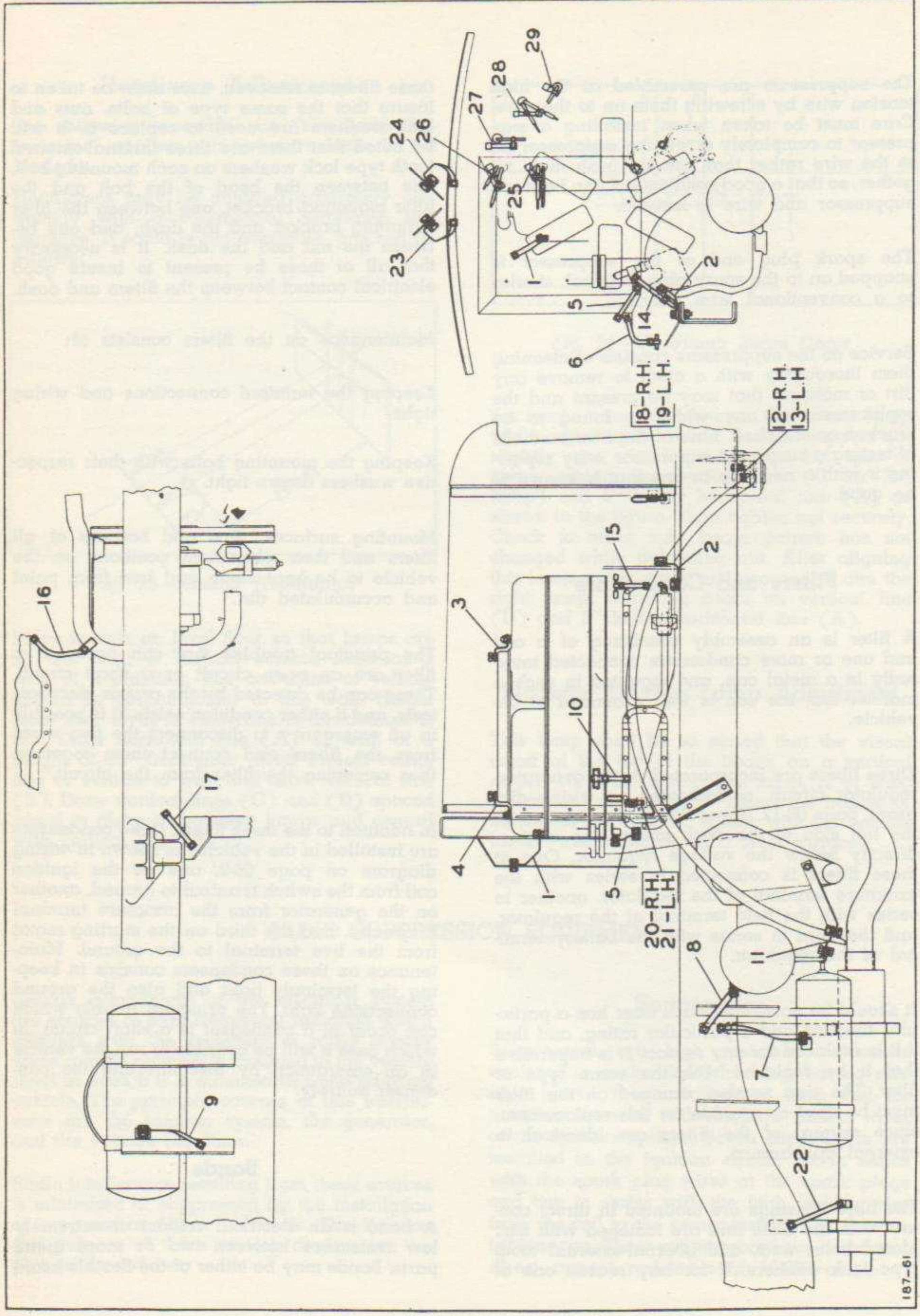


Fig. 25—Bonding Points

type or the contact type. A third type of bond consists merely in the use of internal-external tooth type lock washers between two normally contacting metal surfaces to provide a low electrical resistance connection between them. All these types are used on this vehicle.

All bonds must be thoroly checked for mechanical tightness. It will be noted that the bonds are mounted with zinc plated bolts, nuts, and internal-external tooth type lock washers. Replacement must be made with the same kind and arrangement of hardware. Broken and frayed bonds should be replaced.

There are four contact type bonds on this vehicle. Two of these are at the front (5) and the rear (3) of the lower hood corner on the right and left sides. These bonds consist of Phosphor-Bronze springs which contact tinned spots on the hood when the hood is in the closed position. The Phosphor-Bronze springs are mounted to the spring mounting brackets with zinc plated bolts, nuts, and internal-external tooth type lock washers. Care should be taken to keep these connections tight to insure low electrical resistance. In case of replacement, the same type of hardware must be used.

The tinned spots on the hood must be kept clean. Please note that vigorous sanding will remove the tinning from the surface, resulting in a poor connection. In case the tinning becomes worn off, these spots should be re-tinned.

Internal-external tooth type lock washers are used under the bolts and nuts employed in mounting the fenders, radiator, pintle hook spring, headlamp, and dust pan. Care should be taken to insure that these bolts are tight to provide low electrical resistance between these elements, and whenever any of these pieces is removed or replaced, the internal-external tooth type lock washers must be installed at the same time.

General

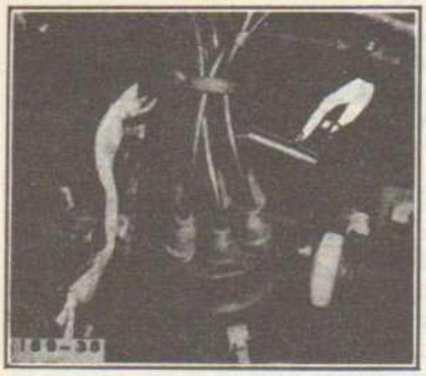
If all of the radio suppression equipment is found to be in good condition, as described in the above paragraphs, and radio interference still persists, the following items should be checked, as they vitally affect the emission of the radio interference:

Dirty distributor cap.
Incorrect spark plug gaps.
Burned or pitted breaker contact points.
Broken or oil soaked wires.
Loose electrical connections.
Poor battery connections

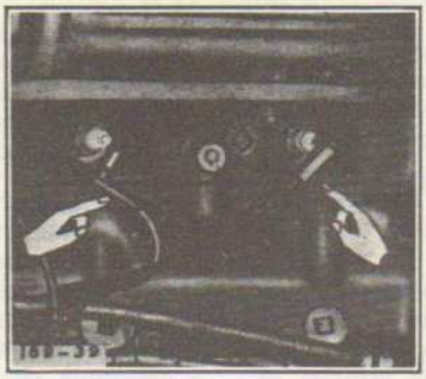
Bonding Points

1. R.H. Rear Engine Head Stud to Fire Wall
2. Timing Case Cover to Frame at Front of Engine
3. Valve Cover Breather to Valve Cover Front
4. Valve Cover Breather to Valve Cover Rear
5. Exhaust Pipe to Fire Wall
6. Air Line to Fire Wall at Lower Right Corner
7. R.H. Air Storage Tank to Frame (parallel to gas tank)
8. R.H. Air Storge Tank to Frame (in front of gas tank)
9. L.H. Air Storage Tank to Frame
10. Air Line From Compressor to Engine Block
11. Air Line to Front Fender Rear Support, Which is Parallel to R.H. gas tank.
12. Lower Radiator Tank to Frame Right Side
13. Lower Radiator Tank to Frame Left Side
14. Governor Shaft to Frame
15. Gas Line to Engine Block
16. Lower Water Return Line to Crankcase
17. Frame to Left Front Cowl Brace
18. Contact Spring from Lower Front Corner of Hood to Radiator Shell Right Side
19. Contact Spring from Lower Front Corner of Hood to Radiator Shell Left Side
20. Contact Spring from Lower Rear Corner of Hood to Cowl Right Side
21. Contact Spring from Lower Rear Corner of Hood to Cowl Left Side
22. Muffler to Frame
23. Upper Hood Panel to Cowl Right Side
24. Upper Hood Panel to Cowl Left Side
25. Fire Wall to Oil Viscosity and Water Temperature Lines
26. Fire Wall to Windshield Wiper Tube and Air Pressure Tube
27. Fire Wall to Speedometer Cable
28. Fire Wall to Choke and Throttle Controls
29. Fire Wall to Tachometer Cable

Suppressors

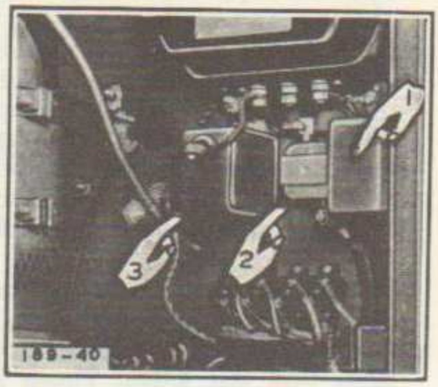


Suppressor in series with high tension wire from coil to distributor cap center terminal.



Suppressors in series with spark plug wires at spark plug.

Filters



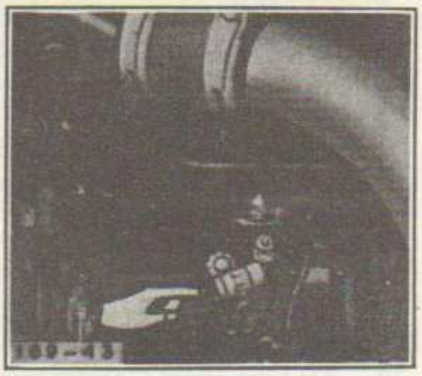
Filters in the generator-regulator circuit:

1. Armature Filter.
2. Field Circuit Filter
3. Battery Filter.

Condensers

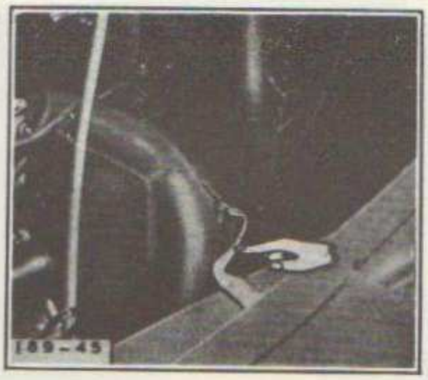
Condenser on the starting motor from the live terminal to the ground.

Condenser on the ignition coil from the switch terminal to the ground.

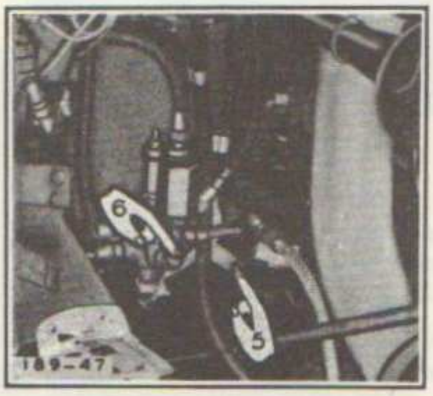


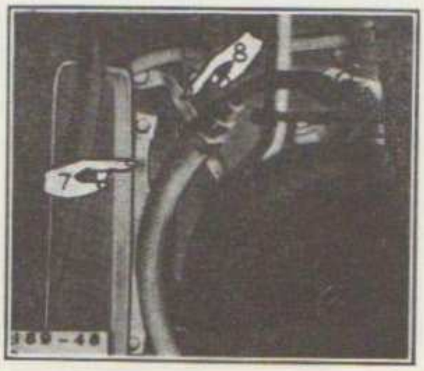
Condenser on generator.

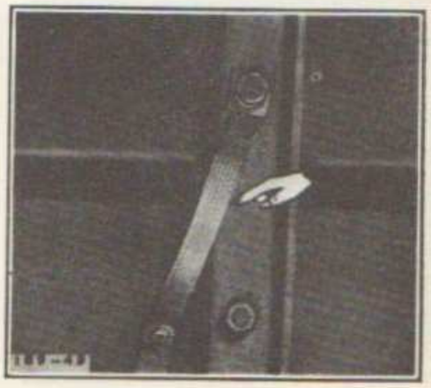
Bonding Points



1. R.H. Rear Motor Head Stud to Fire Wall
2. Timing Case Cover to Frame at Front of Engine
3. Valve Cover Breather to Valve Cover Front
4. Valve Cover Breather to Valve Cover Rear

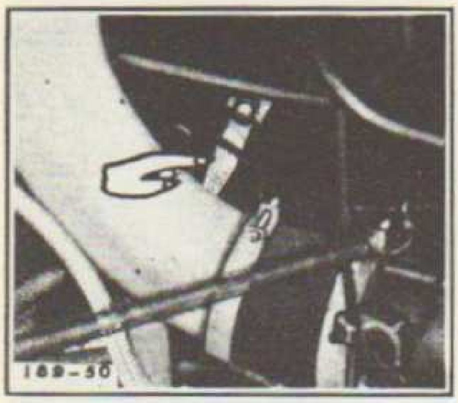






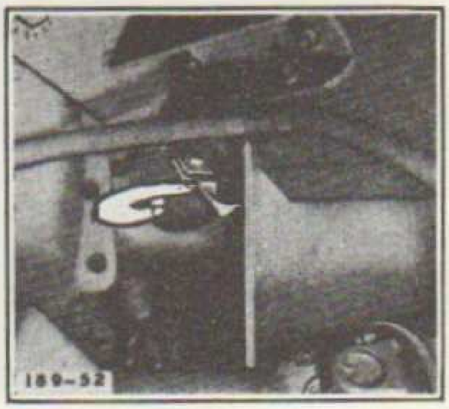
5. Exhaust Pipe to Fire Wall
6. Air Line to Fire Wall at Lower Right Corner
7. R.H. Air Storage Tank to Frame (parallel to gas tank)
8. R.H. Air Storage Tank to Frame (in front of gas tank)
9. L.H. Air Storage Tank to Frame

Bonding Points



10. Air Line From Compressor to Motor Block

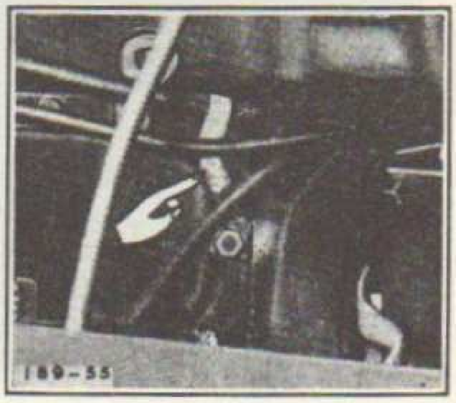
11. Air Line to Front Fender Rear Support, Which is Parallel to R.H. gas tank



12. Lower Radiator Tank to Frame Right Side

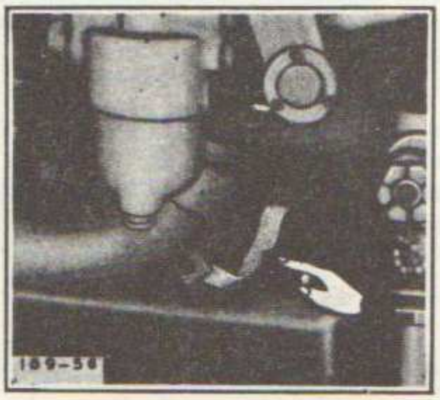
13. Lower Radiator Tank to Frame Left Side

14. Governor Shaft to Frame

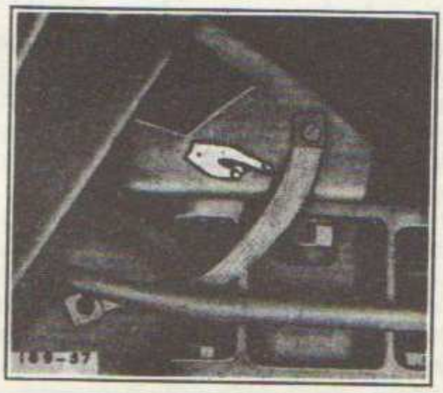


15. Gas Line to Motor Block

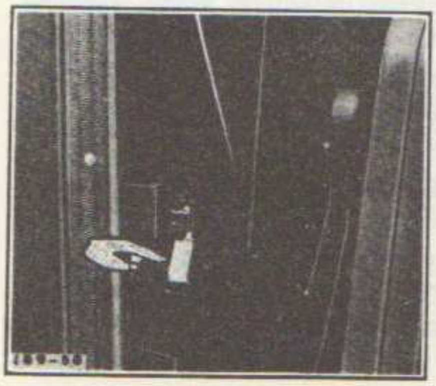
Bonding Points

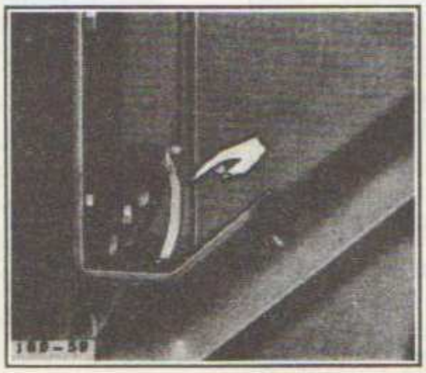


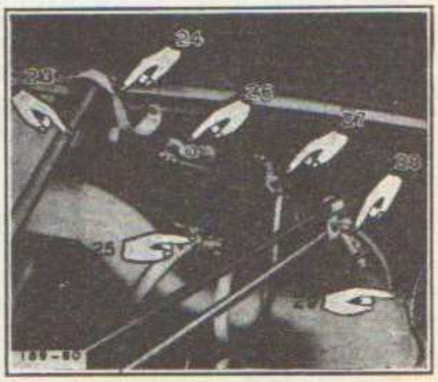
16. Lower Water Return Line to Crankcase



17. Frame to Left Front Cowl Brace







18. Contact Spring from Lower Front Corner of Hood to Radiator Shell Right Side
19. Contact Spring from Lower Front Corner of Hood to Radiator Shell Left Side
20. Contact Spring from Lower Rear Corner of Hood to Cowl Right Side
21. Contact Spring from Lower Rear Corner of Hood to Cowl Left Side
22. Muffler to Frame
23. Upper Hood Panel to Cowl Right Side
24. Upper Hood Panel to Cowl Left Side
25. Fire Wall to Oil Viscosity and Water Temperature Lines
26. Fire Wall to Windshield Wiper Tube and Air Pressure Tube
27. Fire Wall to Speedometer Cable
28. Fire Wall to Choke and Throttle Controls
29. Fire Wall to Tachometer Cable

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Ignition System

Note: To locate trouble in the ignition system, a systematic checking procedure should be used. It should be remembered that many other components in the engine enter into engine operation and that it will be often necessary to perform a complete engine tune-up if trouble is experienced, so that not only ignition, but all other components, will be checked. It sometimes happens, however, that there is neither time nor instruments available to make a complete analysis of the equipment and under these conditions it may be desirable to attempt a quick check in an effort to locate the trouble so that temporary corrections can be made. Turn on ignition switch and use starting motor in an attempt to start engine.

If starting motor cranks the engine slowly or not at all, then the trouble is probably due to a rundown battery, defective cables or connections, defective starting motor, or some engine condition which prevents the development of normal cranking speed.

If starting motor cranks the engine at normal speed, but engine does not start, remove high tension lead from one spark plug and hold lead terminal about 3/16" from engine block. A good spark should occur when the engine is cranked.

If spark does occur, the ignition primary and secondary circuit are probably all right and the trouble is possibly due to an out of time condition or to some other trouble in the engine such as carburetion, etc.

If a spark does not occur, check dash ammeter while cranking.

If the ammeter shows a small reading which fluctuates during cranking the primary circuit is probably all right and the secondary circuit should be considered as not delivering the spark due to a defective coil, wiring, condenser, cap or rotor.

If there is no ammeter reading, the coil may be open or loose connections, defective wiring, bad switch, dirty contact points, etc., may be present.

If ammeter shows a reading which does not fluctuate at all during cranking, the contact points are so out of adjustment that they do not open, or the primary circuit is grounded either in the coil or the wiring.

Battery

LOW SPEED OF STARTER ...... Not sufficiently charged. Check with hydrometer to learn condition.

Coil

ENGINE MISSING ...... Tighten loose connections.

Spark Plugs

POOR ENGINE PERFORMANCE ...... Clean plugs; inspect for cracked porcelain, and readjust points to the correct gap.

Distributor

Loss of Energy in the Primary Circuit

RESISTANCE IN CIRCUIT ...... Tighten all loose connections; replace defective leads; replace burned contact points, replace coil or switch.

DEFECTIVE CONDENSER ...... Test on condenser tester and if faulty replace, do not attempt to repair.

DISCHARGED BATTERY ...... Recharge or replace.

GROUNDED CIRCUIT IN COIL WIRING, OR DISTRIBUTOR TERMINALS ...... Replace coil, check wiring and terminal.

Loss of Energy in the Secondary Circuit

DEFECTIVE HIGH TENSION WIRING ...... Replace as necessary—do not repair.

DEFECTIVE CONNECTIONS IN HIGH TENSION CIRCUIT ...... Tighten connections and check for opens and grounds.

FOULED, CRACKED, OUT OF ADJUSTMENT PLUGS ...... Repair or replace as conditions warrant.

HIGH TENSION LEAKAGE ACROSS COIL HEAD, DISTRIBUTOR CAP OR ROTOR ...... Clean parts with a rag dampened in carbon tetrachloride. If leakage still occurs, replace necessary part.

DEFECTIVE IGNITION COIL ...... Replace coil.

Out of Time

WRONG TIMING .... Retime Engine.

DISTRIBUTOR BEARING WORN .... Replace part and if a bent shaft has caused this condition, replace shaft.

Magnetic Switch

GROUNDED COIL .... Using a test lamp and prod, place one prod on one of the insulated coil terminals and the other on the switch case. If light lights, the coil is grounded. Do not attempt to repair faulty coils, replace the coil or install new switch.

Starting Motor

Note: Usually there is no exact procedure for positively determining on the vehicle whether or not the starting motor is at fault when the starting motor cranks the engine slowly or not at all. Yet some idea of the location of trouble may be obtained by watching the operation of the equipment with the headlights turned on. It must be remembered that failure of the starting motor to crank the engine normally may be due to a low battery, bad connections, defective cables, defective starting motor, low temperature, or to faulty conditions within the engine itself. A quick check may be made to find the approximate location of trouble by turning on the lights and operating the starting motor. One of three things will happen. The lights will go out, the lights will dim, or the lights will stay bright with no cranking action.

Lights Go Out

DEFECTIVE CONNECTION IN THE CIRCUIT BETWEEN THE STARTING MOTOR AND BATTERY .... Clean and tighten the connections and replace any defective cable. Note: In an emergency starting may sometimes be accomplished by wiggling the battery connections so a better connection is temporarily established.

Lights Dim

ADDED BURDEN OF CRANKING ON THE BATTERY CAUSES VOLTAGE TO DROP OFF .... Check battery and then investigate for excessive current drain such as: heavy oil, tight bearings, pistons, etc., in engine; frozen or tight bearings or loose screws which allow armature in starter to drag.

Lights Stay Bright

OPEN CIRCUIT BETWEEN THE STARTING MOTOR AND BATTERY .... Examine circuit and magnetic switch for opens and repair.

OPEN CIRCUIT WITHIN STARTING MOTOR .... Tighten brush leads. Replace worn brushes. Turn down in a lathe or undercut the mica of a dirty, gummy, burned or high mica commutator. In an emergency, it may be possible to get started provided the trouble is due to a dirty or gummy commutator, by sanding the commutator with a piece of No. 00 sandpaper.

If the starting motor still does not operate, tests must be made for open windings in the field or armature. Place one test lamp prod on the insulated field winding lead and the other on ground. If the test lamp lights, the field windings are all right, at least as far as open windings are concerned. Should the lamp not light, insolate the trouble to a particular field coil by testing across each winding separately. Replace the faulty coil. Test the armature for open windings with a test lamp or on a growler. Repair winding or replace armature as necessary.

Note: Never operate starting motor more than 30 seconds at a time without a pause of several minutes to allow the unit to cool off.

If the starting motor is considered to be defective and the trouble (brushes, commutator, or connections) is not readily apparent, the starting motor should be removed from the vehicle for the no load and torque tests.

No load test.—Connect the starting motor in series with a battery of the specified voltage and an ammeter capable of reading several hundred amperes. If an r.p.m. indicator is available, read the armature r.p.m. as well as the current draw with the unit running free speed or no load.

Torque test.—Torque testing equipment is required for conducting a stall torque test of the starting motor. The torque developed, current draw, and voltage are checked together.

Interpretation of No Load and Torque Tests

LOW FREE SPEED AND HIGH CURRENT DRAW WITH LOW DEVELOPED TORQUE .... Check for following: (1) Armature drag caused by tight, dirty, worn bearings or loose field poles. (2) Grounded armature or field. (3) Shorted armature.

FAILURE TO OPERATE WITH HIGH CURRENT DRAW.............Direct ground in switch, at terminal or brushes or frozen shaft bearings which prevent armature turning.

FAILURE TO OPERATE WITH NO CURRENT DRAW.............Check for following: (1) Open field circuit. (2) Open armature coil. (3) Broken or weakened brush springs, worn brushes, high commutator mica or other condition which would prevent good contact between brushes and commutator.

LOW NO-LOAD SPEED WITH LOW TORQUE AND LOW CURRENT DRAW.............Check for following: (1) Open field. (2) High internal resistance due to worn brushes, dirty commutator, weak or worn brush springs, and other causes of poor contact between brushes and commutator. (3) Defective leads or connections.

HIGH FREE SPEED WITH LOW DEVELOPED TORQUE AND HIGH CURRENT DRAW............. Shorted fields. It is difficult to detect shorted fields with ordinary testings instruments, since the field resistance is originally low. If shorted fields are suspected, install new fields and check for improvement in performance.

Generator

Note: If abnormal operation of the generator-regulator system is noted, it is first necessary to determine whether it is the generator, the regulator, or some other component of the electrical system which is at fault. The procedure for making this determination is covered in the section on regulators. If the generator is at fault, further attention should be given it, as outlined in following paragraphs.

No Generator Output

STICKING BRUSHES.............Clean brush holders and brush arms; replace arms if bent. Replace brushes and brush springs if required.

GUMMED COMMUTATOR.............Wipe with clean cloth slightly dampened with carbon tetrachloride or similar solution.

BURNED COMMUTATOR.............Turn down and under-cut mica.

Note: Test points connected in series with test lamp and a source of electricity are required for following checks:

GROUNDED ARMATURE CIRCUIT.............Raise and insulate grounded brush from commutator and check with test points from the armature terminal to frame. If the lamp lights, indicating ground, raise other brush and check commutator and terminal separately to locate ground.

GROUNDED FIELD CIRCUIT.............Disconnect field lead from field frame (removing screw and lockwasher) and test with test points from the field terminal to frame. If test light lights, indicating field is grounded, correction must be made not only on the generator but also regulator.

OPEN FIELD CIRCUIT.............Check with test points from the field terminal to the disconnected lead clip. If light does not light, field circuit is open. Leads which have broken or connections which have become loose to produce this condition may be resoldered (rosin flux). If open circuit is caused by conditions inside a field winding, replace field.

SHORTED FIELD CIRCUIT.............Connect battery and ammeter in series with the field circuit to determine how much current the field draws. Normal field draw with a 6-volt battery is 1.7 - 1.9 amperes. If a shorted field is found, replace the field and check the regulator contact points.

OPEN ARMATURE CIRCUIT.............If commutator bars are not too badly burned; resolder leads in riser bars (rosin flux), turn commutator down and undercut mica.

SHORT ARMATURE CIRCUIT.............Discard and install new armature.

Excessive Generator Output

Usually results from a grounded generator field, either internally or in regulator. Opening field circuit by disconnecting lead from field terminal of regulator or generator with the generator operating at a medium speed will determine which unit is at fault. If output drops off, regulator is causing condition. If output remains high, field is grounded either at pole shoes, leads, or field terminal.

Unsteady or Low Generator Output

LOOSE DRIVE BELT.............Tighten.
STICKING BRUSHES.............Clean.
LOW BRUSH SPRING TENSION.............Adjust.
DIRTY COMMUTATOR.............Turn down and undercut mica.

Noisy Generator

LOOSE MOUNTING .... Tighten.
DRIVE PULLEY .... Adjust.
WORN BEARINGS .... Replace.
IMPROPERLY SEATED BRUSHES .... Reseat by using brush seating stone.
BENT BRUSH HOLDER .... Replace.

Voltage Control Unit

Determining Whether Trouble Exists .... The dash ammeter should show a fairly high reading immediately after starting until some minutes of operation, after which the ammeter reading should begin to drop to a lower value if the battery is in a charged condition. If the ammeter shows little or no charge to the battery altho the battery is known to be in a low state of charge (as shown by slow cranking motor operation, dim lights, or weak operation of other electrical equipment) then further checking to locate the trouble is required. Likewise, if the ammeter continues to read high even tho the battery is known to be in a charged condition (as shown by snappy, fast cranking motor operation or normally bright lights) then further checking to locate the trouble is required. The most accurate way to determine the state of charge of the battery is to use a hydrometer.

Low Battery With Low Charging Rate

DEFECTIVE WIRING OR LOOSE CONNECTIONS .... Replace defective wiring and tighten loose connections between the generator and regulator and between the regulator and battery. Note particularly the tightness of the connections at the ammeter and battery. This condition causes excessive resistance in the charging circuit which in turn cause regulator to operate as tho the battery were fully charged even tho it may be in a discharged condition.

GENERATOR NOT PRODUCING FULL OUTPUT .... Eliminate regulator from the system by momentarily connecting a jumper lead from regulator armature to field terminals with all electrical accessories turned off. If generator output comes up then regulator may be considered as source of trouble. Install new regulator and improvement in performance noted. Caution: Under the above conditions a good generator can produce a very high output, consequently, extreme care must be taken to avoid operating the generator for more than a second or two—just long enough to see if it can produce a high output.

GENERATOR NOT PRODUCING ANY OUTPUT .... Check cut-out relay points as to whether or not they are closing. They may not be closing due to high closing voltage setting or to a defective winding.

Charged Battery With High Charging Rate

HIGH VOLTAGE REGULATOR SETTING .... If instruments are not available to make further checks, replace regulator and check for improvement in performance (reduction of generator output as battery comes up to charge).

Note: In tropical climates where high temperatures exist, it may sometimes be found that a normal voltage regulator setting may cause high charging rate to the battery. This is due to a battery characteristic whereby the battery resistance or counter-voltage suffers some reduction with high temperatures. Under such conditions, the voltage regulator setting may be reduced to as low as 7.1 volts altho this should not be done unless it is considered absolutely necessary to relieve battery overcharging. The cut-out relay setting must also be reduced so that it is still below the voltage regulator setting. Reduce cut-out relay closing voltage to 6.5 volts when the voltage regulator setting is reduced as low as 7.1 volts. If the cut-out relay setting is not reduced, the voltage setting may be lower than the cut-out relay, with the result that the voltage regulator would operate before the cut-out relay, and prevent the voltage from increasing to a value sufficient to close the cut-out relay.

Do not make these reductions in voltage settings in localities where cold weather is experienced, since this would cause the battery to be undercharged.

Caution: In any checking of the regulator, care must be taken to avoid closing the cut-out relay contact points by hand with the battery connected. Closing the cut-out relay points by hand would allow a heavy current to flow from the battery to the generator. This current might weld the points together, and cause the generator to be seriously damaged before leads could be disconnected.

Low Voltage Circuit Tester, High Tension Ignition Circuit Tester and Universal Battery Tester Tools

(See Figures 26, 27 and 28)

Complete, accurate and rapid checks of the electrical units require special testing equipment. This special testing equipment, itself, must be properly cared for and checked periodically for accuracy or its precision units will fail to accurately test the electrical unit being serviced.

Fig. 26—Low Voltage Circuit Tester
(Tool—Federal Stock No. 17-T-5575)

To assist in locating the causes of the electrical trouble and to arrive at the solution, the Low Voltage Circuit Tester and the High Tension Ignition Circuit Tester have proven to be the most satisfactory aid.

If there still is doubt after making the Battery Test on Low Voltage Circuit Tester, as to whether or not the battery is the cause of the electrical trouble, the Universal Battery Tester should be used.

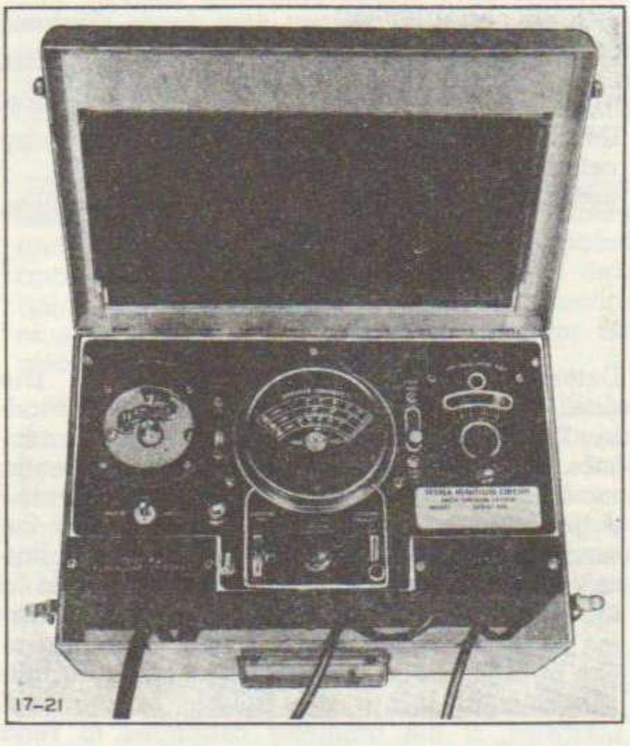


Fig. 27—High Tension Ignition Circuit Tester
(Tool—Federal Stock No. 17-T-5520)

Fig. 28—Universal Battery Tester
(Tool—Federal Stock No. 17-T-5505)

Low Voltage Circuit Tester

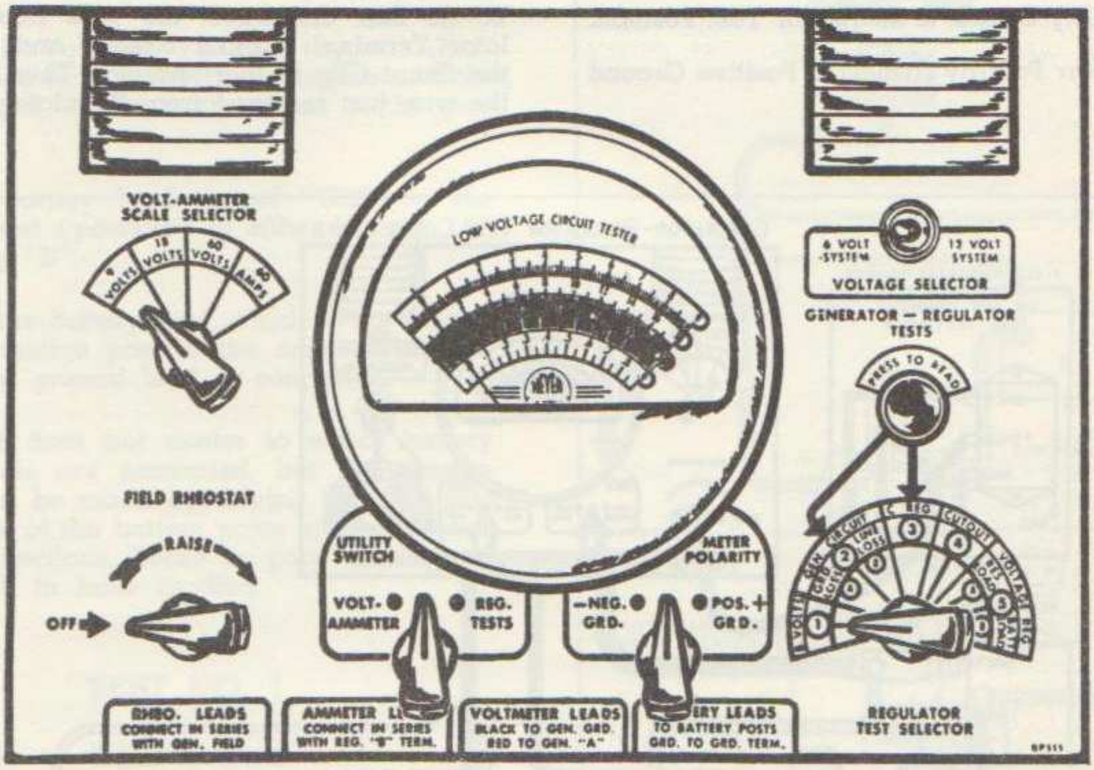


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Fig. 29—View of Low Voltage Circuit Tester
(Tool—Federal Stock No. 15-T-5575)

The Low Voltage Circuit Tester is a self-contained trouble-shooting device for making a complete and rapid check of the generator-battery circuit, including any current and voltage regulators which may be used. Battery voltage, regulator and cut-out settings, and generator performance can all be easily determined.

The Tester is so constructed that all the connections must be made before any tests are attempted. Then by moving the selectors and switches in the order specified on the Operating Instruction Plate, the condition of the whole generator-battery circuit is readily observed.

If any meter readings for a particular test are unusual or are not within the range specified on the Operating Instruction Plate, then refer to the discussion concerning that test which is contained in this section. Here in this section the ranges specified on the instruction plate are given in more detail. Suggestions are also given as to what may be causing the trouble and how it can be corrected.

Generator-Regulator Test Connections

The Low Voltage Circuit Tester should be connected as shown in Figure 30 before any tests are attempted.

This diagram is special for this vehicle because two batteries and a Series-Parallel Starting Switch are used to crank the engine at 12 volts. Make all connections shown except those for the Field Rheostat, which is used for Test No. 4 only.

IMPORTANT: In order to make accurate tests of generator output and battery voltage, the units should be run long enough to establish normal operating temperatures (about 145°F.) especially in cold climates, because all test specifications given in this manual are based on normal operating temperatures.

Test Connections

Place knob of Voltage Selector Switch at 6 volts.

Turn Utility Switch to Regulator Test Position.

Turn meter Polarity Switch to Positive Ground Position.

Place Regulator Test Selector Switch in No. 1 position.

Connect the Ammeter Test leads in series with Regulator Battery Terminal.

To do this, disconnect the wire from Regulator Terminal marked Battery and connect the Shunt Clip to that terminal. Then connect the wire just removed from Regulator Battery

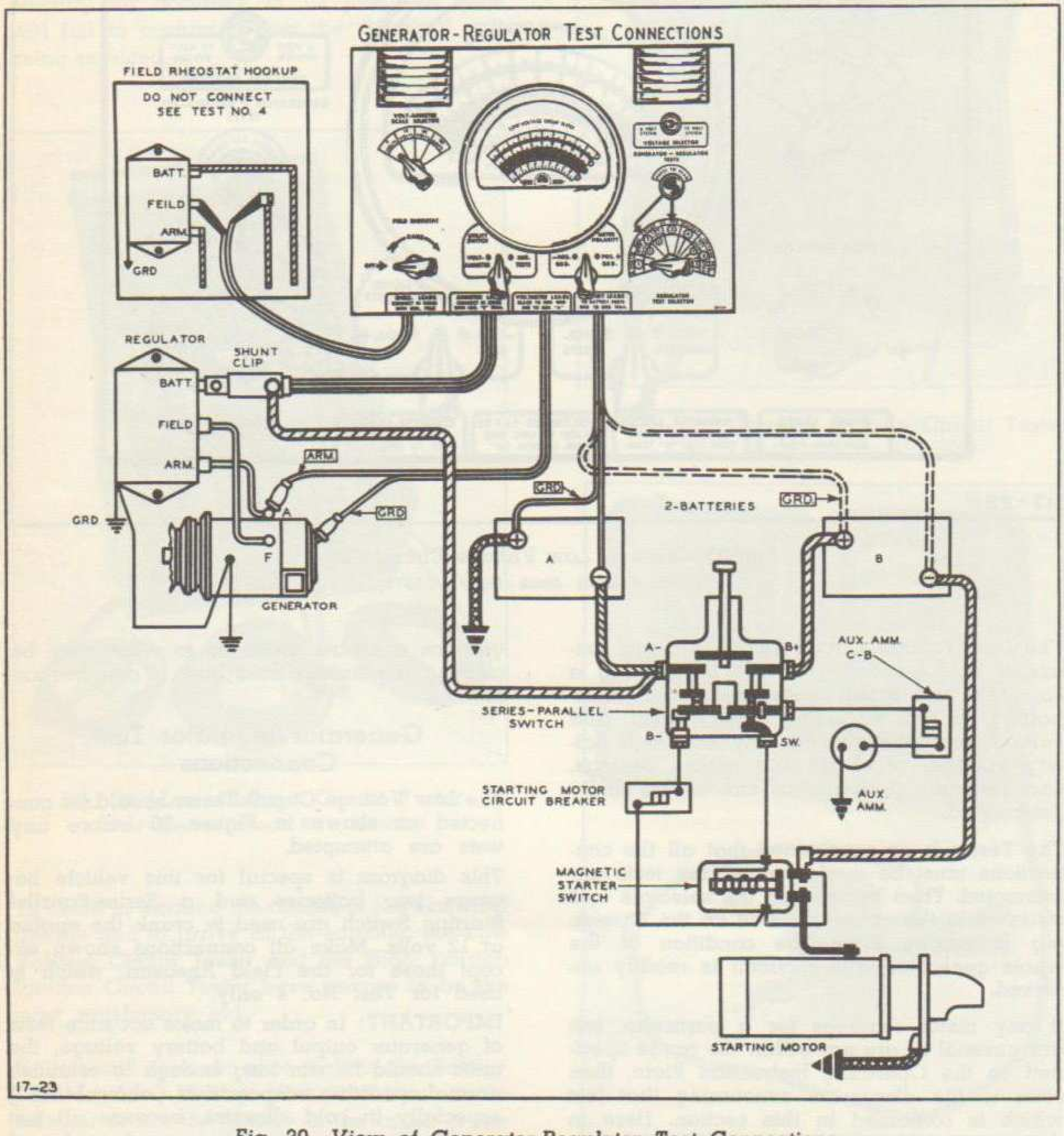

Fig. 30—View of Generator-Regulator Test Connections

Terminal to the end of the Shunt Clip. This is important because the Shunt Clip must be in series with the circuit to be tested. This Clip contains a built-in meter shunt to which the tester is calibrated.

Connect the Voltmeter Test lead tagged "ARM" to armature terminal of the generator and the lead tagged "GRD" to the frame of the generator.

Connect Battery lead tagged "GRD" to the ground post (positive) of either battery "A" or battery "B".

Connect the Battery lead, which is not tagged to the negative post of the same battery to which the ground lead is connected.

NOTE: It does not matter to which battery these leads are connected, but the connections must be made by driving the pins into the center of the battery posts to assure good tight connections. Loose or poor connections will result in false reading.

TEST NO. 1

Battery Test
(See Figure 31)

This test is a check on the condition of the batteries using the starting motor as a load.

See that Regulator Test Selector Switch is in No. 1 position.

With the ignition switch in the "off" position, operate the starting motor by pressing on the knob of the Series-Parallel Sarting Switch which is located at the driver's left on the floor of the cab. With the starting motor cranking the engine, the Voltage should not drop below 5.25 volts on the yellow scale.

If the voltage drops below 5.25 volts, check the specific gravity of each cell as well as the temperature of one or more cells.

The electrolyte should be 60°F. or higher.

A variation of more than 20 points between cells indicates a defective battery. If the gravity of all cells is alike, but below 1.270 (1.245 in tropical climates), a partially charged battery is indicated.

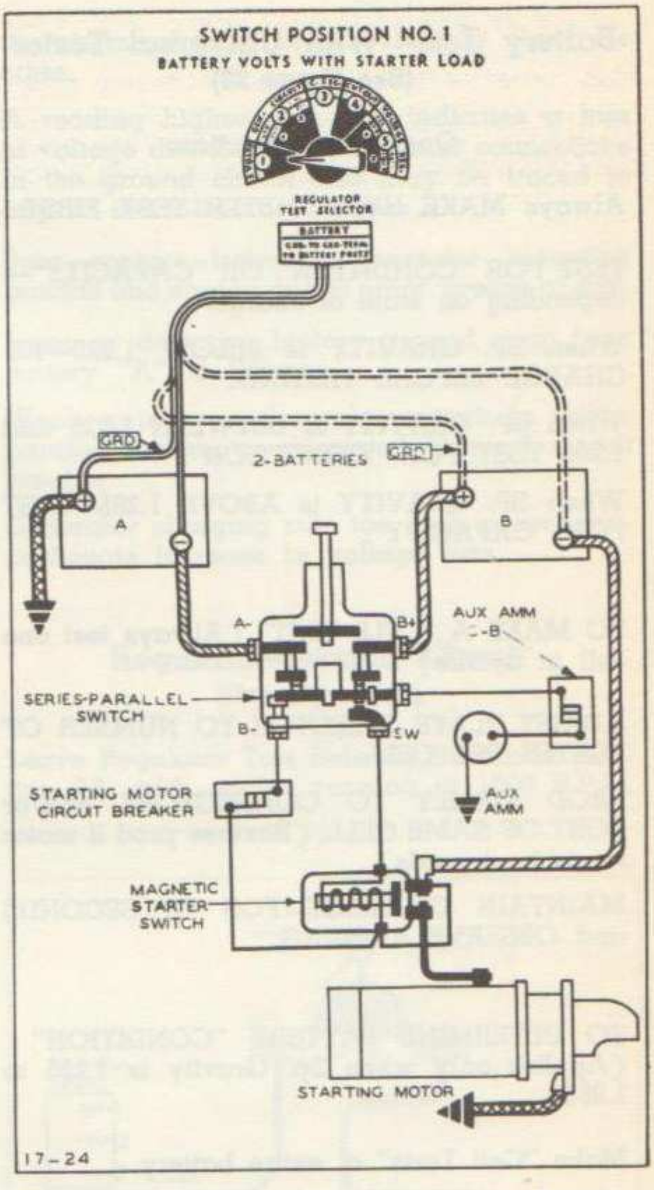

Fig. 31—Battery Test Connections

The battery leads should be shifted to the second battery and a voltage reading taken as before.

Battery condition affects generator system operation. An old battery, one partially charged or one whose temperature is fairly high, say 75° to 100°F., will accept a higher charge from the generator than will one fully charged or with hard or sulphated plates. If there is any doubt about the condition of the batteries, test each one as outlined with the Universal Battery Tester.

Battery Test—With Universal Tester
(See Figure 28)

Operating Instructions

Always MAKE HYDROMETER TEST FIRST.

TEST FOR "CONDITION" OR "CAPACITY"—depending on state of charge.

When SP. GRAVITY is BELOW 1.225—RECHARGE BEFORE TESTING.

When SP. GRAVITY is BETWEEN 1.225 and 1.265 TEST FOR "CONDITION".

When SP. GRAVITY is ABOVE 1.265—TEST FOR "CAPACITY".

TO MAKE A "CELL TEST" (Always test one cell at a time)

ADJUST PLATE SELECTOR TO NUMBER OF PLATES PER CELL.

PROD FIRMLY TO CONNECTORS and/or POST OF SAME CELL. (Reverse prod if motor reads backwards)

MAINTAIN CONTACT FOR 15 SECONDS and OBSERVE READING.

TO DETERMINE BATTERY "CONDITION" (Applies only when Sp. Gravity is 1.225 to 1.265)

Make "Cell Tests" of entire battery.

Record readings obtained ON PERCENT SCALE.

Note DIFFERENCE in cell readings. CELL DIFFERENCES OF 30% OR GREATER—DEFECTIVE—REPLACE.

TO DETERMINE BATTERY "CAPACITY" (Applies only when battery is above 1.265 and has been idle at least 6 hours)

Make "Cell Tests" of entire battery.

Record readings obtained on COLOR SCALE.

ALL GREEN—BATTERY CAPACITY O.K.
ALL YELLOW—UNSAFE—REPLACE.
ALL RED—WORN OUT—REPLACE.

VARIABLE—One or more—Yellow or Red—DEFECTIVE—REPLACE.

Temperature Correction

The motor is automatically compensated for temperature, no correction being necessary as long as temperature of tester and battery are equal. To correct hydrometer readings, add one point for each 3° above 80°F. and subtract one point for each 3° below 80°F.

If the above test shows the batteries to be in good condition, use them for the tests which follow, otherwise, replace them with batteries known to be in good condition.

A voltage reading below 4.5 volts on either 6 volt battery with the starter cranking the engine usually indicates a discharged or defective battery. A discharged battery may be caused by:

Improper adjustment of either voltage or current regulator units, which will be determined by tests which follow.

Generator not charging due to faults within the generator itself. These causes are covered elsewhere in this manual.

Broken or loose generator—fan drive belt.

Battery in such a condition it will not take its full charge.

Excessive use of starter, lights, heater, etc.

Grounds or high resistance in the charging circuits.

Bad charging contacts in the series-parallel switch on defective thermal circuit breakers.

Ignition switch left on with engine not running.

If the battery is in good condition and fully charged, the starting motor may be the cause of excessive voltage drop thru low speed caused by.

Engine oil too heavy. In cold weather heavy oil will lower the cranking speed, increase the current draw and thereby cause greater voltage drop. Likewise a cold engine with proper grade of oil will increase the voltage drop.

Dirty or burned commutator or brushes.

Undue friction in starting motor bearings, or bearings worn so armature drags on pole pieces.

Loose or corroded battery terminals.

TEST NO. 2

Voltage Loss In Generator and Battery Ground Circuit

(See Figure 32)

Place Regulator Test Selector Switch in position 2A.

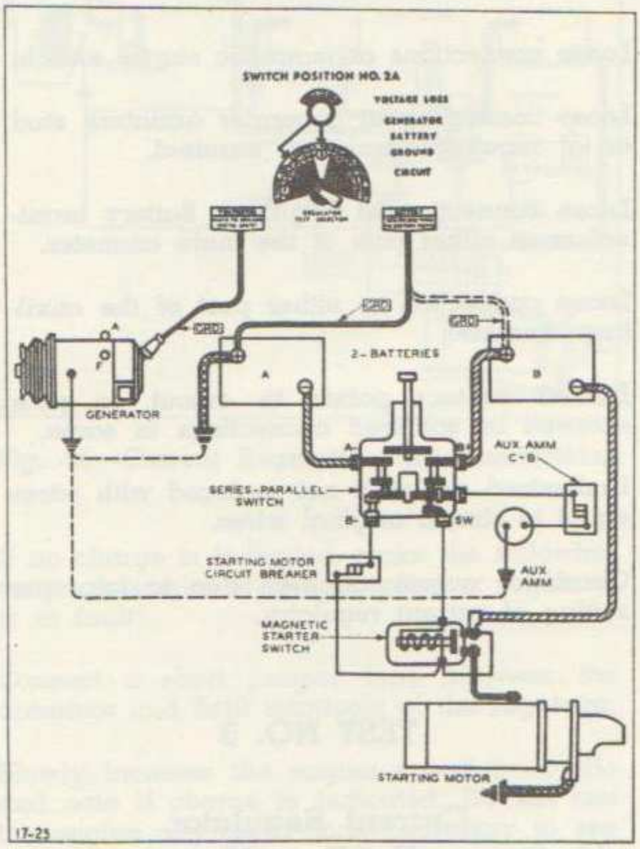

Fig. 32—Generator-Battery Ground Circuit Test Connections

Run engine at about 1000 R.P.M., then press black push button marked "Press to Read".

The meter reading should not exceed .05 volt (one division) on the green scale if the ground circuit is in good condition.

These tests should be made with the battery ground lead properly connected to the positive terminal post of one battery then the other.

A reading higher than this indicates a loss of voltage due to poor contacts or connections in the ground circuit and may be traced to any of the following causes:

Poor contact between generator mounting bracket and engine due to paint, grease or rust.

Loose or defective battery ground strap from Battery "A" to Frame.

Weak springs on charging contacts in series-parallel switch or damaged thermal circuit breaker.

Generator charging rate too high causes proportionate increase in voltage loss.

Regulator-Ground Circuit

(See Figure 33)

Leave Regulator Test Selector Switch in position 2A, with engine running at 1000 R.P.M.

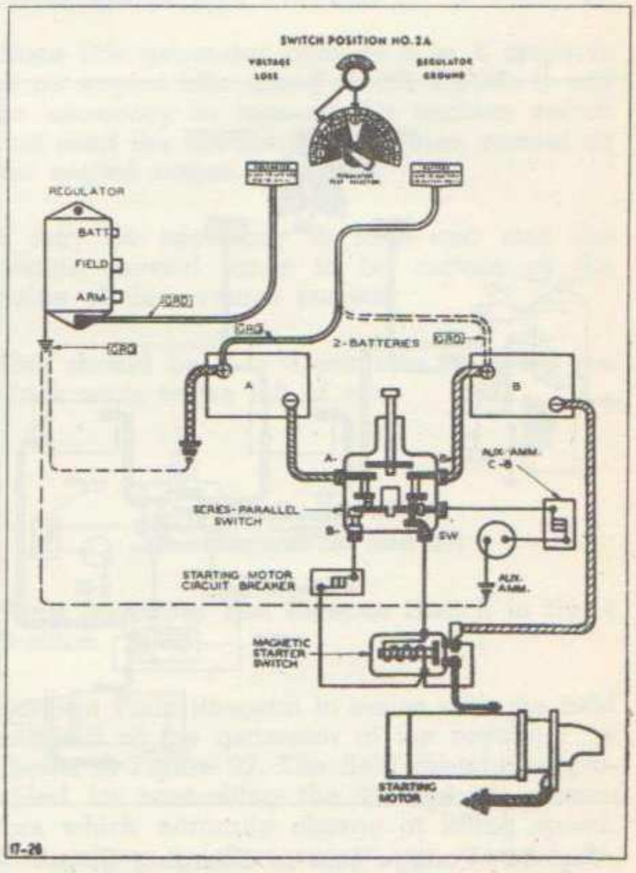

Fig. 33—Regulator-Ground Test Connections

Disconnect the voltmeter "GRD" test cable which is connected to the generator frame and connect it to the regulator base and again press the black button. Reading should not exceed .05 volt (1 division) on the green scale. A higher reading indicates voltage loss in the regulator ground circuit.

Voltage losses in this circuit are caused by a poor ground at the regulator base. Check for loose mounting screws and rust, paint or grease under base. Also make sure the regulator ground wire is securely attached to the regulator.

After completing this test leave the "GRD" cable in this position for all the following tests.

Voltage Loss in Charging Circuit

(See Figure 34)

Place Regulator Test Selector Switch in No. 2B position with the engine running.

Press the black button and note the voltage loss on the yellow scale. Next switch the battery cable to the negative post of the other

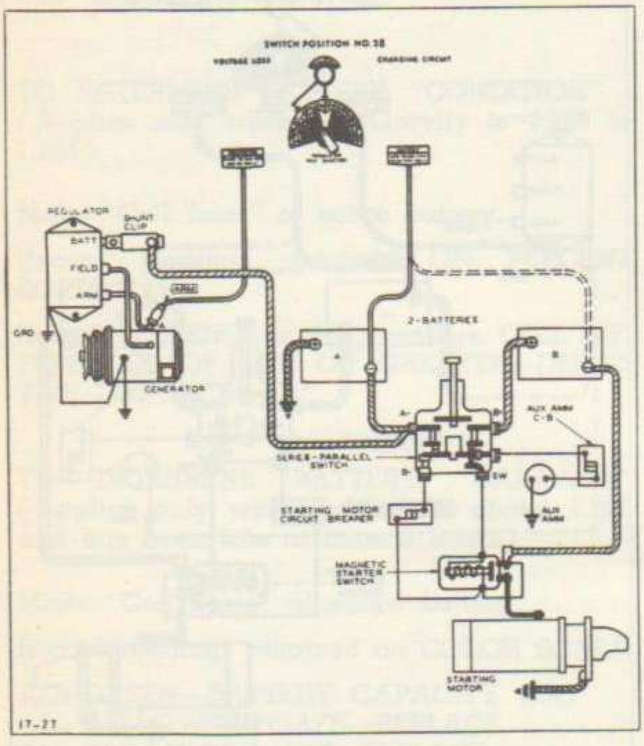

Fig. 34—Voltage Loss in Charging Circuit Test Connections

battery and press button and take reading. Since the two batteries are connected in parallel while charging, the current output of the generator divides approximately equally between them.

For either battery the voltage loss reading should not exceed .35 volt for 10 amperes flowing in the circuit. Excessive voltage drop in the charging circuit may be caused by any of the following:

Corroded battery cable terminals or loose ground connection at battery "A".

Loose connections at series-parallel switch, at positive and negative posts of battery "B", defective thermal circuit breakers.

Loose connections at magnetic starter switch.

Loose connection at generator armature stud or at regulator armature terminal.

Loose connection at Regulator Battery terminal or at either post of the main ammeter.

Loose connection at either post of the auxiliary ammeter.

Burned contact points in cutout or poor screwed or soldered connections in same.

Undersized cables if not replaced with wires equal in size to original wires.

Generator output too high due to improper setting of current regulator.

TEST NO. 3

Current Regulator

(See Figure 35)

Set Regulator Test Selector Switch to No. 3 position.

Run engine at about 1000 R.P.M. and press the black push button. Note the charging rate in amperes on the black scale.

Charging current should approximate the generator's rated output of 25 amperes.

If charging current is higher than 27 amperes or lower than 21 amperes, the current regulator should be adjusted as outlined under Current Regulator Setting.

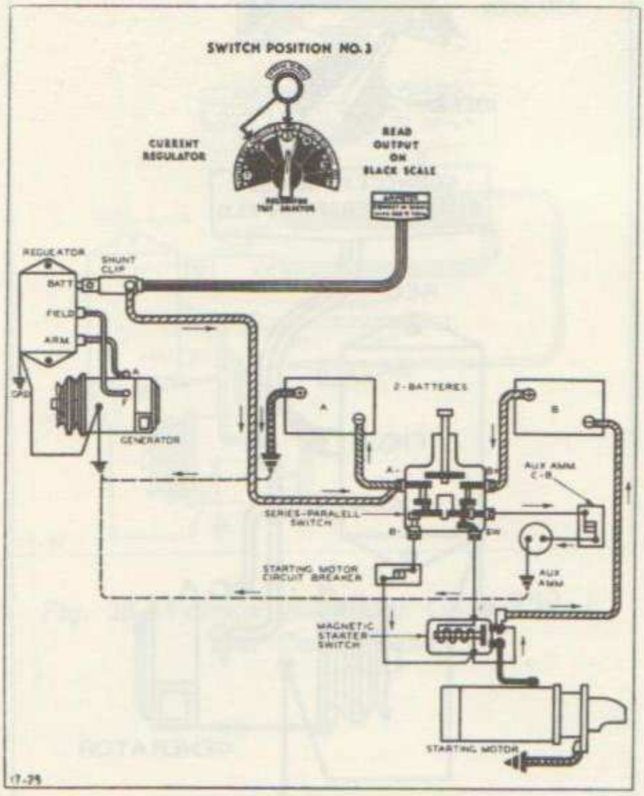

Fig. 35—Current Regulator Test Connections

If no charge is indicated, make the following test to determine if the generator or regulator is at fault:

Connect a short jumper lead between the armature and field terminals of the regulator.

Slowly increase the engine speed from idle and note if charge is indicated. Do not run the engine any faster than necessary to see if generator is charging. To do so with this jumper in place may quickly damage the generator armature or fields, or the cutout winding.

If the ammeter shows no current flowing in the circuit, it will be necessary to take a voltage reading to determine if the generator or the regulator is at fault.

To take a voltage reading, place the Utility Switch in the volt-ammeter position. Turn the volt-ammeter scale selector to "60 volt" range.

Slowly increase the engine speed and note if the voltmeter shows any voltage.

If the voltage increases to between 6.4 and 8 volts, the generator is functioning properly and the fault is in the regulator.

If no voltage is shown when the engine speed has reached 1000 R.P.M. or the voltage is under 6.4 at this speed, the generator is at fault.

Slow down the engine to idle and remove the test jumper between regulator armature and field terminals for all succeeding tests.

TEST NO. 4

Cut-out Relay

Circuit Breaker—Reverse Current
(See Figure 36)

Leave Regulator Test Selector Switch in position No. 3.

Since this generator charges 2 to 4 amperes at an engine idle speed of 300 R.P.M., it will be necessary to turn off the ignition switch and read the discharge or reverse current as the engine comes to a stop.

It may be necessary to start and stop the engine several times to be certain of the value of this reverse current.

This should be 0 to 3 amperes, read on the black scale to the left of zero.

Closing Voltage

(See Figures 36 and 37)

Place Regulator Test Selector Switch in No. 4 position.

Connect Field Rheostat in series with the field terminal of the generator at the regulator as shown in Figure 37. The field rheostat is provided for controlling the voltage of generators which normally charge at idling speed. The voltage to close cutout can then be determined.

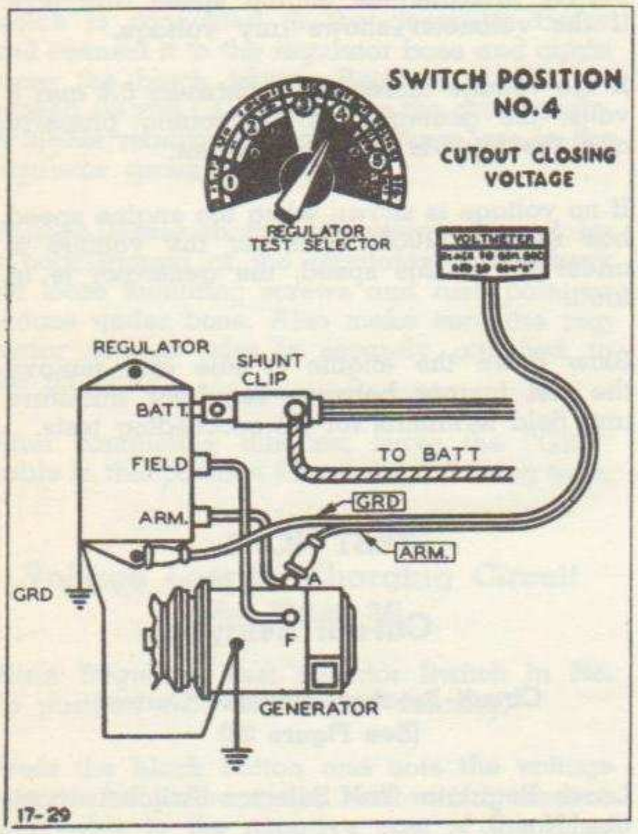

Fig. 36—Closing Voltage Test Connections

With the rheostat in the field circuit the generator will not charge at idle speed. Increase the engine speed slightly and maintain this speed. Then slowly turn rheostat knob which will allow the generator voltage to increase and watch voltmeter. When the pointer kicks back, the cutout closing voltage is reached. This should be 6.5 to 6.9 for this unit.

The closing voltage must be higher than the battery voltage but lower than the regulator open circuit voltage.

Closing voltage of cutout is adjusted as noted under Cutout Relay Closing Voltage.

TEST NO. 5

Voltage Regulator Open Circuit Setting

(See Figure 38)

This regulator must be tested on open circuit.

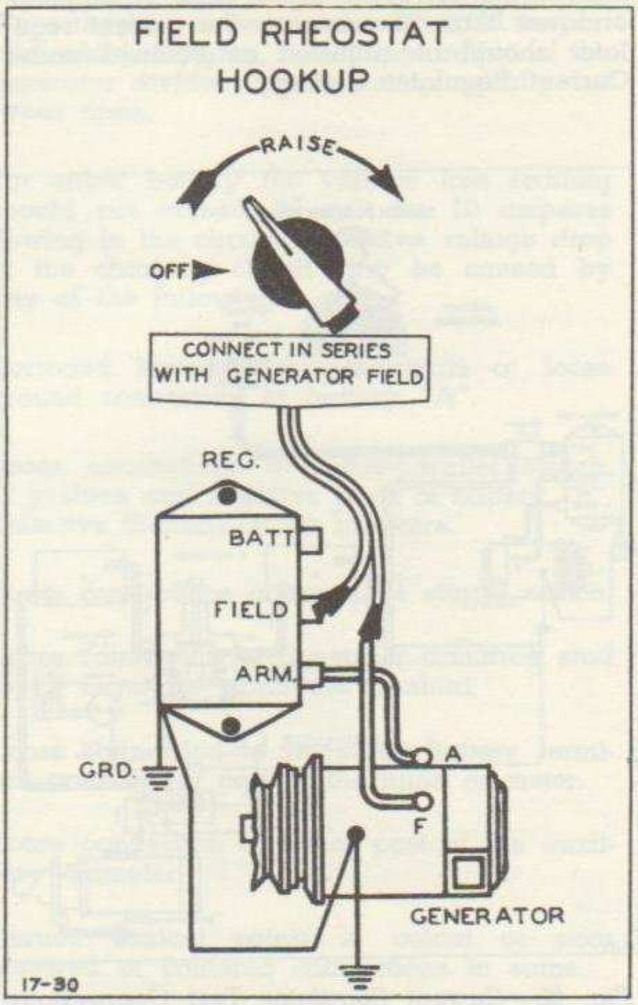

Fig. 37—Field Rheostat Test Connections

Disconnect the Field Rheostat used in previous test and reconnect the generator field wire to field terminal on regulator.

Set Regulator Test Selector Switch to position 5B.

Disconnect battery lead from regulator and place where it will not touch any object.

Run engine at about 1000 R.P.M. for five minutes to permit the voltage to stabilize.

Next note the generator voltage on the voltmeter. It should be 7.5 volts. If not, adjust as indicated under Voltage Regulator Setting.

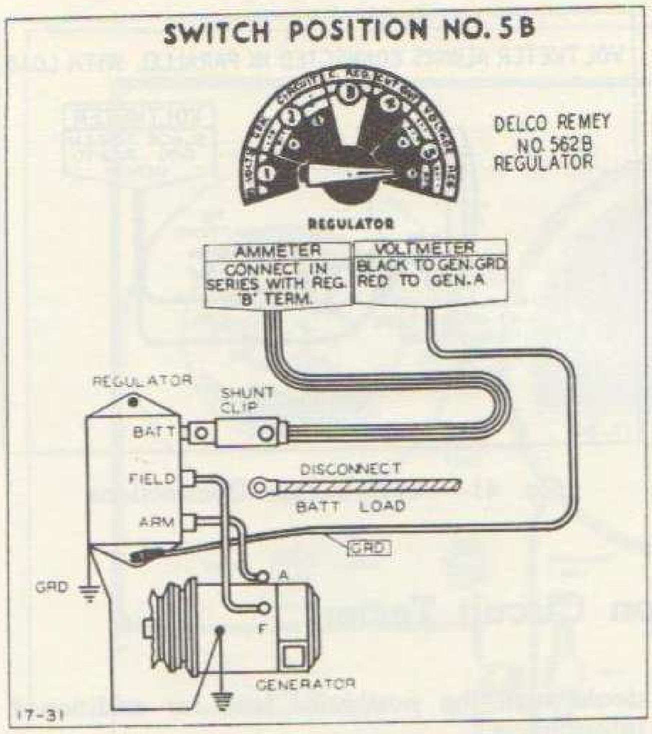

Fig. 38—Voltage Regulator Open Circuit Test Connections

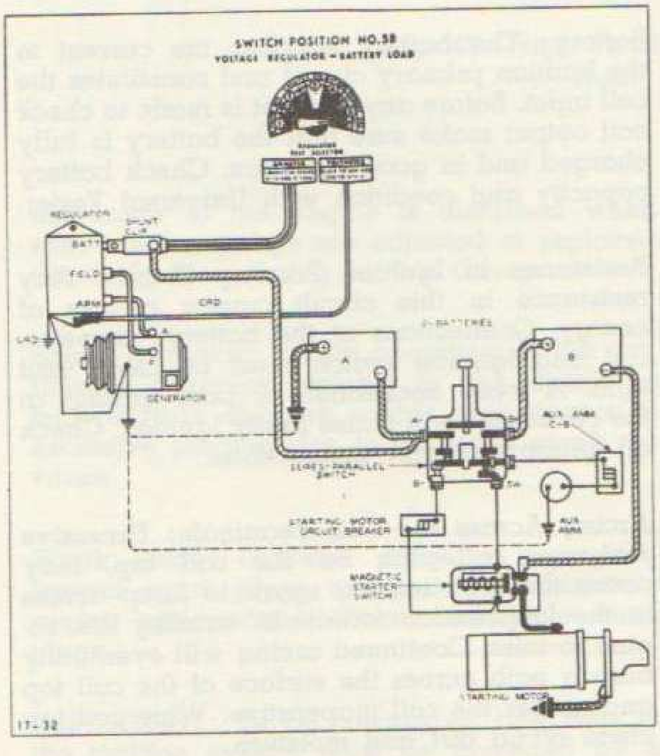

Fig. 39—Voltage Regulator—Battery Load Test Connections

Voltage Regulator Test—Battery Load

(See Figure 39)

Have Regulator Test Selector Switch in No. 5B position.

Reconnect battery lead to end of terminal shunt clip.

Run engine at 1000 R.P.M. for five minutes, then note the voltmeter reading. It should be between 6.5 and 7.2 volts with a nearly fully charged battery.

This is the final test on the regulator operating in the electrical system with battery and vehicle wiring in the circuit. No further adjustments should be attempted.

The charging current will vary due to changing characteristics of the electrical system and the voltage will vary between the limits given above.

This completes the tests and all test leads should be disconnected and all wires securely tightened on the terminals.

Volt-Ammeter Tests

Place Voltage Selector to suit voltage—6 volts on this vehicle.

Place Utility Switch at Volt-Ammeter position.

Place meter polarity switch to suit polarity—positive ground on this vehicle.

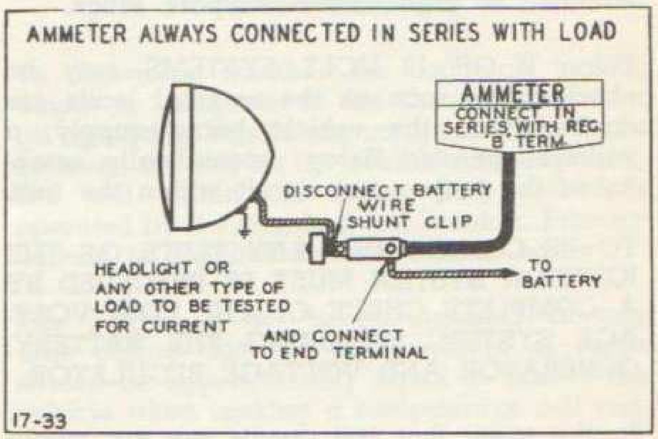

Fig. 40—Current Test Connections

Place volt-ammeter scale selector at desired meter range.

Use ammeter leads to measure current (amperes) placing the shunt clip in series with the circuit to be tested (not to exceed 60 amperes). See Figure 40.

Use voltmeter leads to measure voltage making connections always parallel to or across the circuit to be tested. Volt-ammeter is now available for other low voltage system tests within the range of the meter. See figure 41.

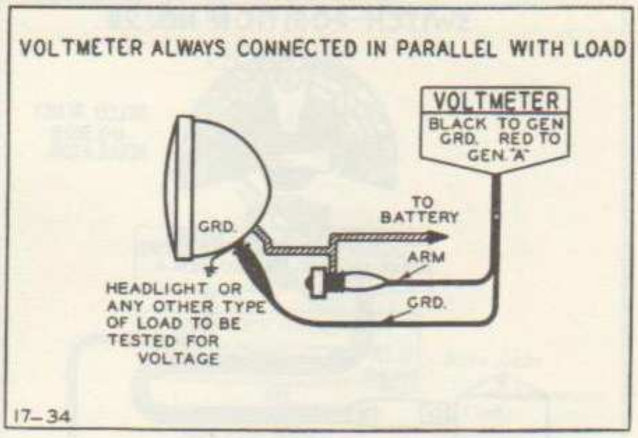

Fig. 41—Voltage Test Connections

High Tension Ignition Circuit Tester

(See Figure 42)

The High Tension Ignition Circuit Tester is a self-contained trouble-shooting device for making a complete and rapid check of the Primary and Secondary Ignition Circuits including the Coil, Condenser, Breaker, Spark Plugs and High Tension Cables.

It is equipped with a Standard Breaker, Test Coil and Test Condenser. By following the simplified hook-up and test procedure specified on the OPERATING INSTRUCTIONS plate, comparative tests are made between the Vehicle Coil or Condenser, and the Standard Coil, or Condenser. A Variable Spark Gap is provided to measure the High Tension output at the Coil and at other points in the High Tension Circuit. It is also used to detect short-circuited or high-resistance Spark Plugs.

Either 6 OR 12 VOLT SYSTEMS may be checked. As soon as the external leads are connected to the vehicle battery-supply, a voltage operated Relay automatically establishes the proper test circuit within the unit.

TO BE CONCLUSIVE, ANY TESTS OF THE IGNITION SYSTEM MUST BE PRECEDED BY A COMPLETE CHECK OF THE LOW VOLTAGE SYSTEM, INCLUDING THE BATTERY, GENERATOR AND VOLTAGE REGULATOR.

In the event that test results are not within the limits specified on the OPERATING INSTRUCTIONS plate, refer to that section, which deals with the particular test, for additional information.

When making an ignition check with the High Tension Ignition Circuit Tester (Fig. 42) for the purpose of locating the cause of faulty performance or engine failure, the following must also be considered:

Battery: The battery supplies the current to the ignition primary circuit and constitutes the coil input. Before any attempt is made to check coil output make sure that the battery is fully charged and in good condition. Check battery capacity and condition with Universal Tester.

Resistance in Ignition Primary Circuit: Any resistance in this circuit causes a loss of energy. Connections at the battery, ammeter, coil and ignition switch must be clean and tight. A loose connection or poor ground at the condenser will cause faulty ignition. Check all primary circuit connections.

Arcing Across the Coil Terminals: Excessive moisture, collecting on the coil top, may cause the high tension spark to jump across to the low tension terminals, causing the engine to miss. Continued arcing will eventually burn a path across the surface of the coil top and render the coil inoperative. Wipe coil top clean of all dirt and moisture.

Ignition Timing: Ignition timing will affect performance materially. The timing of the

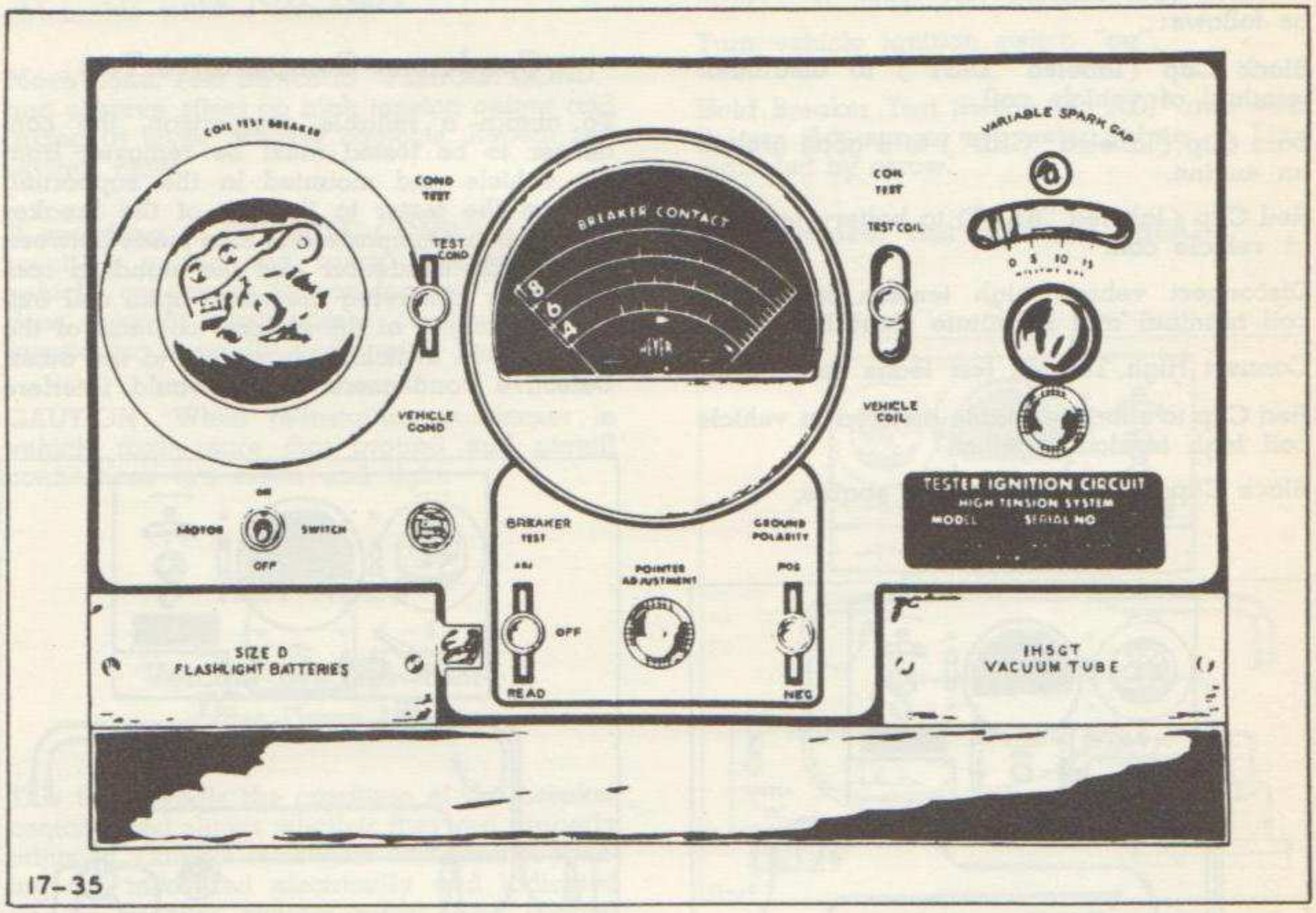

Fig. 42—High Tension Ignition Circuit Tester
(Tool—Federal Stock No. 17-T-5520)

distributor to the engine is disturbed whenever breaker points are adjusted or replaced. Check ignition timing in this Group.

Spark Advance: Faulty operation of the centrifugal governor weights in the distributor will result in sluggish engine performance or excessive pinging due to improper spark advance.

Spark Plugs: Cracked, dirty or improperly spaced spark plugs will prevent satisfactory engine performance. Clean and space spark plugs.

IMPORTANT: To be conclusive, any tests of the ignition system must be preceded by a complete check of the low voltage system, including the battery, generator and regulator as outlined in this Group.

TEST NO. 1

Ignition Coil Comparative Test

(See Figure 43)

To determine whether the coil high tension output is adequate to fire the engine under all operating conditions, comparison is made between the coil on the vehicle and the standard coil within the tester. Both coils are operated by the standard test breaker. Primary current is supplied by the vehicle battery.

The Engine is not to be operated at any time during this test. Temperature of tester should be approximately equal to that of the vehicle when making a comparative coil test.

Disconnect "Coil to Distributor" low tension lead at coil.

Connect Low Tension test leads to vehicle as follows:

Black Clip (labeled "DIST") to distributor terminal of vehicle coil.

Bare Clip (labeled "GRD") to a good ground on engine.

Red Clip (labeled "BAT") to battery terminal of vehicle coil.

Disconnect vehicle high tension lead from coil terminal and substitute short test cable.

Connect High Tension test leads as follows:

Red Clip to short test cable inserted in vehicle coil high tension terminal.

Black Clip to good ground on engine.

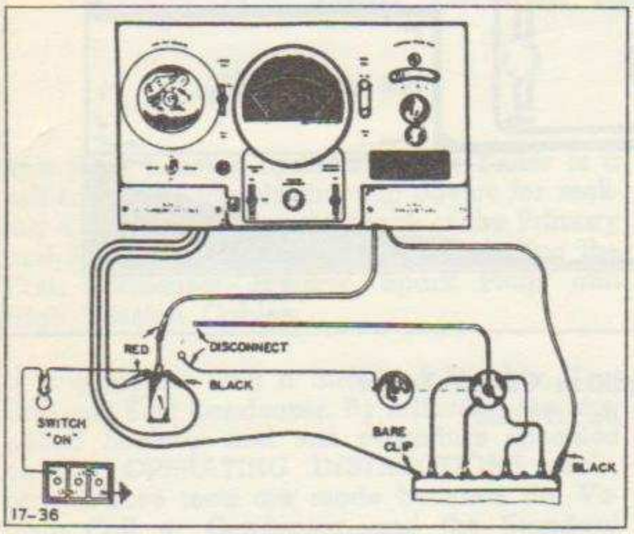

Fig. 43—Ignition Coil Test Connection

Turn vehicle ignition switch "on".

Place Coil Test Switch at "TEST COIL".

Turn Motor Switch "on".

Adjust Variable Spark Gap to highest setting obtainable without missing.

Move Coil Test Switch to "VEHICLE COIL" and observe continuity of spark as well as maximum millimeter reading obtained with Variable Spark Gap. If no missing occurs, vehicle coil is satisfactory.

If spark misses, although Standard Test Coil fires steadily, the vehicle coil should be replaced. After making this test, re-connect the high and low tension wire at coil.

TEST NO. 2

Condenser Comparative Test

To obtain a reliable comparison, the condenser to be tested must be removed from the vehicle and mounted in the supporting clip on the tester to the left of the Breaker Test Switch. Comparison is then made between the vehicle condenser and the standard condenser by observing the effect upon coil output and arcing at the breaker contacts of the tester, when switching from one to the other. Defective condensers which would interfere

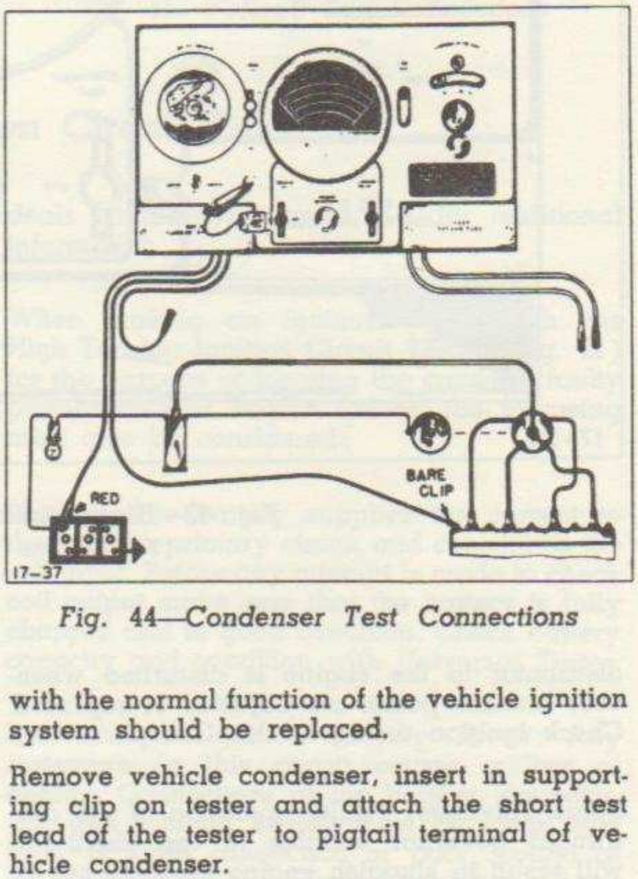

Fig. 44—Condenser Test Connections

with the normal function of the vehicle ignition system should be replaced.

Remove vehicle condenser, insert in supporting clip on tester and attach the short test lead of the tester to pigtail terminal of vehicle condenser.

Connect Low Tension test leads to vehicle as follows:

Bare Clip (labeled "GRD") to good ground on engine.

Red Clip (labeled "BAT") to battery or starter switch.

Place the High Tension test leads in a position where they will not ground on vehicle.

Place Coil Test Switch at "TEST COIL".

Turn Motor Switch "on".

Adjust Variable Spark Gap to highest setting obtainable without missing.

Move Cond. Test Switch to "VEHICLE COND." and observe effect on high tension output and arcing at tester breaker contacts. Repeat test several times.

If switching to "VEHICLE COND." does not result in arcing and spark does not miss, vehicle condenser is satisfactory. If arcing does occur or spark misses, condenser is not functioning normally and should be replaced.

CAUTION: When re-installing condenser in vehicle make sure that ground and pigtail connections are clean and tight.

TEST NO. 3

Vehicle Breaker Test

(See Figure 45)

This test reveals the condition of the breaker contacts and shows whether they are properly adjusted. Contact resistance and contact spacing are measured electrically and indicated on the breaker contact meter. The shaded section at the right of the meter scale represents the permissible tolerance of contact resistance. Contact spacing is indicated in degrees of cam angle (angle of rotation thru which the breaker contacts remain closed). Insufficient contact opening causes a high reading, excessive contact opening a low reading. Faulty operation of the breaker mechanism causes the meter pointer to fluctuate and, when aggravated by high speed operation, a reduction in cam angle reading.

The coil test switch must remain in the "TEST COIL" position thruout this test.

Connect Low Tension test leads to vehicle as follows:

Black Clip (labeled "DIST") to primary terminal of distributor.

Bare Clip (labeled "GRD") to good ground on engine.

Set Ground Polarity Switch to Positive ground.

Have vehicle breaker contacts fully closed.

Turn vehicle ignition switch "on".

Hold Breaker Test Switch at "ADJ" and with Pointer Adjustment set meter pointer to Line indicated by arrow.

Move Breaker Test Switch to "READ".

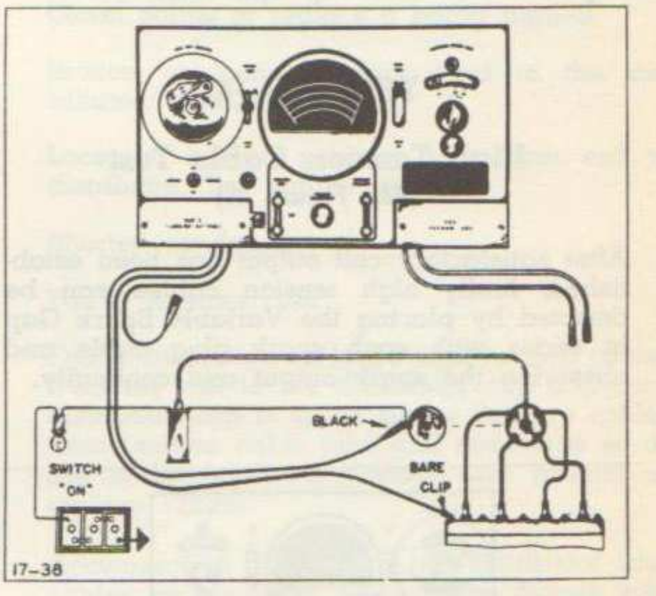

Fig. 45—Breaker Test Connections

Pointer should remain within shaded section. If below this, contact resistance is excessive. Clean or replace the breaker points before proceeding with breaker test:

Operate engine at "fast idle" (500 R.P.M.)

Hold Breaker Test Switch at "ADJ" and with Pointer Adjustment set meter pointer to line indicated by arrow.

Hold Breaker Test Switch at "READ" and observe cam angle of breaker contacts. The cam angle (point dwell) reading should be 35°.

Raise engine speed to approximately 2100 R.P.M. and note any reduction in cam angle.

High speed reading should be within 10% of that obtained at "fast idle".

Breaker Point Adjustment:

Remove vehicle distributor cap and rotor.

Turn vehicle ignition switch "on".

Hold Breaker Test Switch at "READ" and, while cranking engine with starting motor, adjust breaker contacts until the correct cam angle (point dwell) reading of 35° is obtained.

Replace distributor cap and rotor.

TEST NO. 4

High Tension Cable Test

(See Figure 46)

After satisfactory coil output has been established, faulty high tension cables can be detected by placing the Variable Spark Gap in series with each spark plug cable and observing the spark output and continuity.

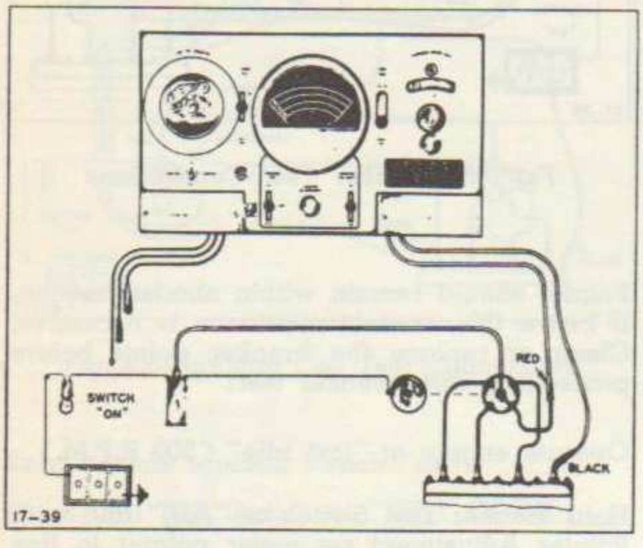

Fig. 46—Cable Test Connections

The Coil Test Switch must remain in "VEHICLE COIL" position during the remainder of tests:

Disconnect spark plug cable and connect High Tension test lead with Red Clip to the end of the cable.

Connect High Tension test lead with Black Clip to top of spark plug.

Operate engine at "fast idle" and place Variable Spark Gap at maximum setting obtainable without missing.

Spark length should be within 2 mm. of that obtained in "Ignition Coil Comparative Test".

If maximum setting obtainable without missing is less than this, connect the Red Clip directly to corresponding distributor cap terminal.

If satisfactory spark is now obtained, the cable is at fault. If spark still misses, the fault lies with the distributor cap or rotor.

TEST NO. 5

Spark Plug Test

(See Figure 47)

Do Not disconnect Vehicle High Tension Cables during Spark Plug tests.

Short Circuit Test:

Connect HIGH TENSION test lead with BLACK Clip to engine Ground.

Connect HIGH TENSION test lead with RED

Clip to Spark Plug Terminal.

Open VARIABLE SPARK GAP to 15 mm.

Operate engine at "fast idle" (500 R.P.M.) and observe neon tube flashes.

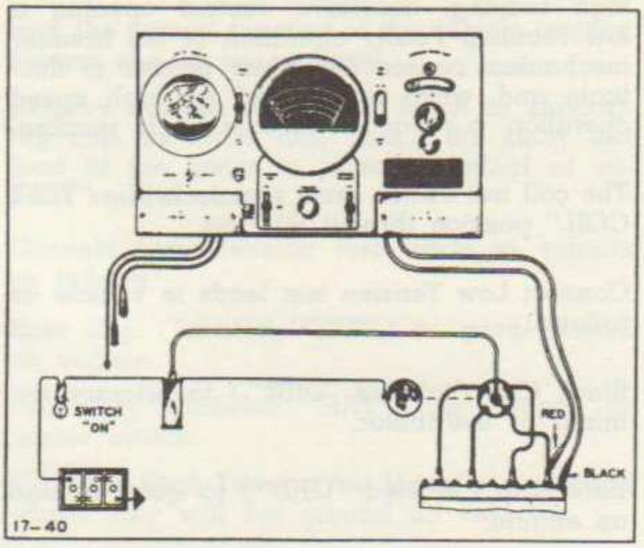

Fig. 47—Spark Plug Test Connections

Regular flashes indicate Spark Plug firing correctly. Weak or irregular flashes indicate leak between Vehicle High Tension Cables or faulty Distributor Cap.

No flashes indicate a shorted Spark Plug or that no High Tension current reaches the Spark Plug.

Resistance Test:

Spark Plugs must be cleaned and gapped before test is made.

With VARIABLE SPARK GAP closed, connect HIGH TENSION test lead with BLACK Clip to engine Ground.

Connect HIGH TENSION test lead with RED Clip to Spark Plug terminal.

With engine at "fast idle" (500 R.P.M.) gradually open VARIABLE SPARK GAP and note at what setting (in millimeters) the spark ceases to jump the gap.

Spark Plug Resistance is proportionate to this gap setting.

Settings in excess of those normally obtained on the same type of vehicle (plugs properly spaced and in good condition) indicate High Resistance. Spark Plug is apt to miss when subjected to maximum compression.

Checking Ignition System

If the engine fails to start, and it has been determined that fuel is being delivered to the cylinders, (See Group 01—Engine), a quick check of the ignition system without the aid of special testing equipment may be made as follows:

Check the intensity of spark by disconnecting a wire from a spark plug and holding it about ¼ inch from the cylinder head while the engine is being cranked. If the spark jumps ¼ to ⅜ inch to the cylinder head, it should be adequate to start the engine.

If the intensity of the spark is adequate and the engine will not start, remove the spark plugs; clean, space and test or replace them.

If no spark is being delivered to spark plugs, the difficulty may be due to:

No contact at ignition switch. Place jumper wire across switch. If engine starts, switch should be replaced.

Broken distributor drive shaft or gear. Distributor rotor will not turn when engine is cranked and broken parts should be replaced.

Burned or dirty distributor breaker points. Clean points or replace if badly burned.

Broken or loose primary lead in the distributor. Install new lead.

Loose or broken primary wire from coil to distributor. Try jumper wire.

Shorted condenser.

Faulty Ignition coil.

Faulty insulation on large high tension cables from the coil to the distributor cap and from distributor cap to spark plugs. Remove cables from ignition cable tube and rearrange so as not to be in direct contact with ground or replace cables.

Accumulation of moisture on distributor cap, cables, coil or spark plugs. Wipe thoroly with dry cloth.

Cracked distributor cap or rotor. Replace with new parts.

Checking Procedure:

When the engine is being cranked with the ignition switch on and all other electrical equipment off, a slight intermittent discharge should show on the vehicle ammeter. If such a discharge does not show, look for difficulties covered by first four items above. If a continuous discharge shows and the distributor points are breaking, then the condenser may be shorted and should be replaced. If the intermittent discharge shows, 7th and 8th items can be checked by pulling the large wire, running from the coil to the distributor out of the distributor cap and holding the end of the wire about ¼ inch from the cylinder block while the engine is being cranked. If the spark does not jump the gap pull wire out of the ignition cable tube and try again. A spark then would indicate a satisfactory coil and faulty insulation on wire. No spark would indicate a faulty coil.

Care and Maintenance

Tester Breaker

The Tester Breaker is equipped with a single-lobe cam giving approximately 2000 breaks per minute. The contact spacing is equal to 35° cam angle on a 6 lobe cam.

For the purpose of a periodic check of the Breaker, the Tester should be connected to a vehicle and tests made in the following manner:

Contact Resistance:

Have COIL TEST Switch in "VEHICLE COIL" position.

Disconnect "Coil to Distributor" Low Tension lead on vehicle.

Connect LOW TENSION test leads to vehicle as follows:

BLACK CLIP (labeled "DIST".) to Distributor terminal of Vehicle Coil.

BARE Clip (labeled "GRD") to good Ground on engine.

*RED Clip (labeled "BAT") to Battery terminal of Vehicle Coil.

*On vehicles with lock-type Coil, to Battery or Starter Switch.

Set GROUND POLARITY Switch to match ground polarity of vehicle system.

Have Tester Breaker Contacts fully closed.

Turn Vehicle Ignition Switch "on".

Hold BREAKER TEST Switch at "ADJ" and with POINTER ADJUSTMENT set meter pointer to LINE indicated by arrow.

Move BREAKER TEST Switch to "READ". Pointer should remain within the shaded section. If below this, contact resistance is excessive and Breaker Contacts should be replaced. (Replace with Delco Remy Breaker Arm No. 813238 and Breaker Contact No. 1845785.)

Turn Motor Switch "on".

Hold BREAKER TEST Switch at "ADJ" and with POINTER ADJUSTMENT set meter pointer to LINE indicated by arrow.

Move BREAKER TEST Switch to "READ" and observe CAM ANGLE of Tester Breaker on meter scale labeled "6 LOBE CAM".

Cam angle of Tester Breaker should be 34° to 36°; if not within these limits adjust contact spacing until a steady reading of 35° is obtained.

Contact Spring Tension:

Contact Spring tension should be 17 to 21 ounces, measured with a suitable spring tension scale.

Lubrication

When adjustment or replacement of Breaker Contacts becomes necessary, apply a slight amount of petrolatum to the Breaker Cam.

Make sure that the Breaker Arm Bushing does not bind.

AVOID EXCESSIVE LUBRICATION. DO NOT HANDLE BREAKER CONTACTS WITH GREASY FINGERS.

The Breaker Motor does not require lubrication. Its bearings are packed with sufficient lubricant to last during its life.

The Breaker Contact Meter

A periodic check of the Breaker Contact Meter should include the following:

Make sure that the meter pointer comes to rest on the zero line at the left of the scale. An adjusting screw is provided on the face of the meter to bring this about.

Check meter movement for friction by moving BREAKER TEST Switch to "ADJ" several times.

Pointer should swing freely across the scale. If pointer sticks, this may be due to accumulation of a "Static" charge on the meter face. This is easily dissipated by breathing onto the meter face or wiping it with a damp cloth. If this does not correct sticking of the pointer, friction exists in the meter movement and the meter should be replaced.

When replacing a meter, note marking on back of meter case and connect RED Lead to POS. and BLACK Lead to NEG.

Flashlight Batteries

Three (3) Standard (Size D) Flashlight Batteries are used to operate the Breaker Circuit Meter. In normal use they should last from six months to one year.

When the meter pointer can no longer be adjusted to the line (indicated by arrow on meter scale) batteries have become discharged and must be replaced with Size D Flashlight Batteries.

ALWAYS REPLACE ALL THREE BATTERIES.

To Replace:

Removing the cover at the lower left of the Tester panel exposes a screw which holds the contact plate on top of the batteries. Upon removing this, the batteries can be readily extracted.

Vacuum Tube

The No. 1H5GT Radio Tube is part of the Breaker Contact Meter circuit. If for any reason the Tube becomes inoperative, this will be revealed by the fact that no meter reading results when placing the BREAKER TEST SWITCH at either "ADJ" or "READ".

To Replace:

Remove cover at the lower right of the Tester panel.

Detach Grid Cap Lead.

Remove Tube and Tube Shield.

Insert Replacement Tube (Note Keyway in socket).

Attach Tube Shield and Grid Cap Lead

Coil

The Standard Coil used for the purpose of comparison with the Vehicle Coil is an oil-sealed Delco-Remy Coil (No. 1115149). In the event that replacement becomes necessary, an identical Coil should be used.

Condenser

The Standard Condenser used for comparison with the Vehicle Condenser is a Delco-Remy Condenser (No. 1869704, Capacity .18 to .26 MFD.) In the event that replacement becomes necessary, an identical Condenser should be used.

Relay

A voltage operated Relay is provided within the unit for the purpose of automatically adapting the tester to either 6 or 12 volt systems. When the LOW TENSION test leads are connected to a vehicle with 6 volt system, the relay remains closed. When connected to a vehicle with 12 volt system, the relay opens; thereby introducing suitable resistance in the motor and coil circuits so that they can be operated on the 12 volt supply.

To check the Relay, remove the tester chassis from the carrying case, connect LOW TENSION test leads labeled "GRD" and "BAT" to a 6 and 12 volt battery respectively and observe the action of the Relay. Relay should remain closed at 6 volts and open at 12 volts.

SECTION 3: ADJUSTMENTS

Ignition Timing

The ignition can be timed from the front of the engine as shown below.

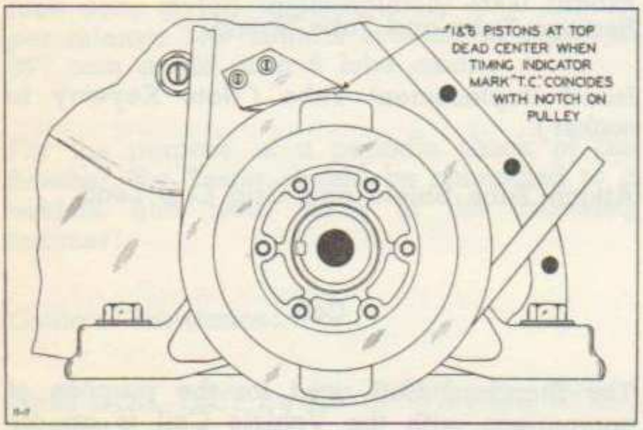

Fig. 48—View of Fan Pulley Showing Timing Indicator

For front timing, when the notch coincides with the pointer, No. 1 and No. 6 pistons are at top dead center. From this position the engine should be rotated in a counter-clockwise direction 10°, at this point the breaker points should just start to open. Spark plug gap should be .030.

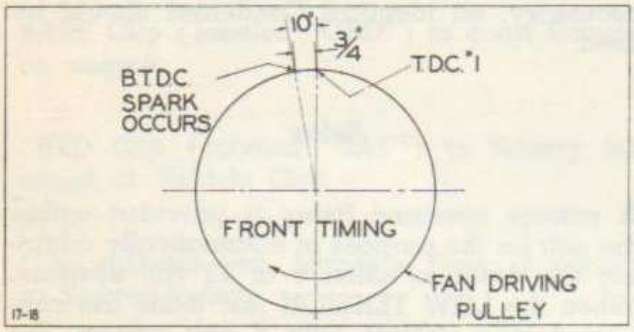

Fig. 49—Front Timing Diagram

The ignition may also be timed from the rear of the engine at the flywheel.

For rear timing, when the top dead center mark coincides with the notches in the flywheel housing, the No. 1 and No. 6 pistons are at top dead center. From this position the engine should be rotated in a counter-clockwise direction 10° or 1-1/2" or 4-1/4 teeth on the starter ring gear. At this point the breaker points should just start to open.

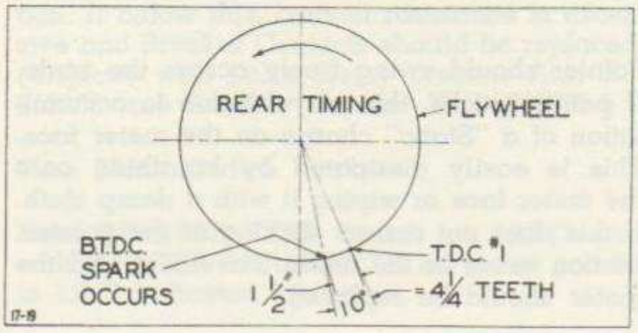

Fig. 50—Rear Timing Diagram

A power light, as shown below, will determine promptly and accurately whether the engine is in time.

Connect test leads as shown and hold the power light in line with the flywheel housing or pulley marking.

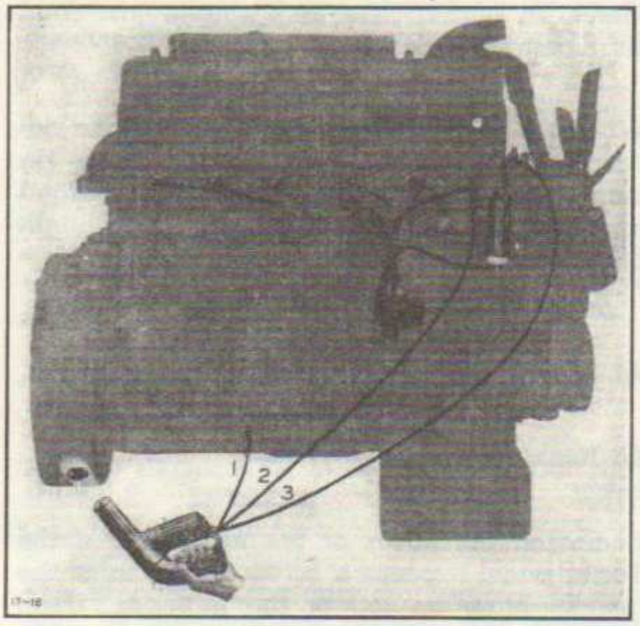

Fig. 51—Testing With Power Light
(Tool—Federal Stock No. 41-L-1440)

1. To Ground Connection
2. To No. 1 Spark Plug
3. To Positive Battery Lead

Set engine at idling speed of approximately 500 R.P.M. and if the ignition timing is correct, the indicator pointer will be in line opposite the notch on the flywheel or fan pulley. If timing is not correct adjust distributor housing accordingly.

Ignition Tune-Up

A periodic check-up should be made to insure a perfect running engine.

It has been a common practice for years for a mechanic to make a guess as to what might be wrong with an engine, which oft times proves to be incorrect.

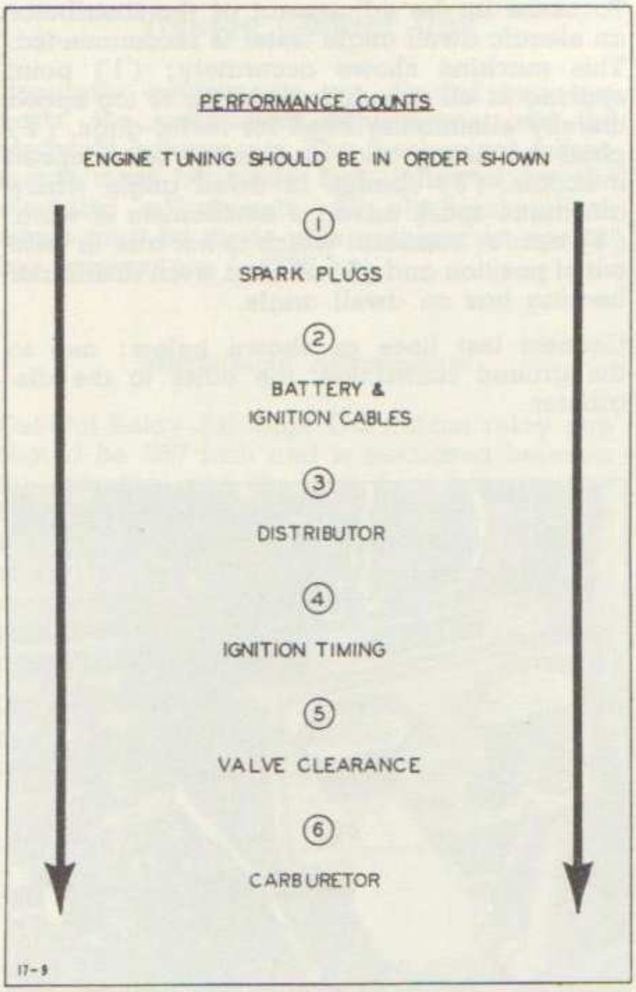

Fig. 52—Engine Tune-Up Chart

In the figure above will be found a systematic method of checking an engine which removes all guess work and tends to reduce operating cost to a minimum.

1. Spark Plugs

Care should be used to select the proper type of plug for this engine when renewing as called for in "Section 8: Specifications."

Cleaning the plugs with an abrasive cleaner should always be the first step in a general tune-up.

After cleaning plugs inspect for cracked porcelains, renew when required.

Readjust points to the correct gap as given in "Section 8: Specifications," using a feeler gage. When setting gap never bend the center electrode.

When replacing plugs be sure they are screwed tightly in place and that the gaskets are not damaged.

2. Battery and Ignition Cables

Be sure that the battery ground strap is tight and both ends have clean contacts.

Then check the cable from battery to starting motor, be sure that both ends have clean, tight contacts.

Check all ignition wires for any signs of breaks in the insulation. If breaks are found, wire should be replaced. Connections on both ends should be reasonably tight.

3. Distributor

Distributor points should be free of pits. If filing or grinding will not recondition the points they should be replaced.

Adjust point gap to clearance given in "Section 8: Specifications," whenever points have been removed and check on a general tune-up.

Examine distributor cap for cracks and burned electrodes. Renew if condition is bad.

Rotor spring to center cap point should have spring contact. Rotor electrode should not show excessive burning.

Condenser connections are to have clean contacts. Test condenser for breakdown when hot.

4. Ignition Timing

Check timing of the ignition of No. 1 Cylinder by the flywheel markings, or from timing indicator, as shown in figures and described on preceding pages.

5. Valve Clearance

With the engine cold readjust the valve tappet clearance.

Check for cracked spring coils.

6. Carburetor

Remove and clean the air cleaner as directed in "Group 03: Fuel."

Check carburetor attaching screws and gasket for leaks.

See that carburetor float level is as given in "Group 03: Fuel."

Start up engine and thoroly warm, then adjust the carburetor idling screw until the engine runs evenly and the mixture is as lean as possible.

Spark Plugs

If the engine is not firing regularly the plugs can be tested while the engine is running by using a Neon tube. Touch tester to each plug. A normally bright flash indicates a good plug. A very bright flash indicates that the gap is too great. A weak flash indicates a weak spark or poor plug. No flash at all indicates that the plug is not getting its supply of current or more likely a shorted or fouled plug.

The proper gap is .030. When adjusting, bend only the outer point, as the plug must be compression tight around the center electrode. Bending inner point may start a leak or crack the porcelain.

Distributor

There are few adjustments necessary on the distributor but they are of tremendous importance. The "dwell angle" or "cam angle" may be defined as "the number of degrees of cam rotation during which the breaker points are closed." This dwell angle is important as it determines the period for which primary current is available. The maximum opening between the contact points is the measure of this dwell angle; the closer the points are together, the greater the dwell angle. The greater the point gap, the smaller the dwell angle. When the points are dirty or oxidized they must be cleaned as outlined in "Section 5: Repairs." They may be set with a feeler gage to maximum opening of .024 inch and a minimum opening of .018 inch. This setting will give the correct dwell angle for the distributor and will give normal operation.

In order that the breaker lever will "follow" the cam it is necessary to have the spring tension great enough to prevent "bouncing" at high speed. However, if the tension is too great, the rubbing block on the breaker will wear out prematurely due to the extra pressure. Hence, with a spring gage, adjust the spring tension to between 17 and 21 ounces.

To assist in the adjustment of the distributor an electric dwell angle tester is recommended. This machine shows accurately: (1) point spacing at all speeds from idling to top speed thereby eliminating need for feeler gage, (2) point bouncing and at exactly what speed it occurs, (3) change in dwell angle where automatic spark advance mechanism is worn, (4) cam or camshaft which is not true or bent out of position and (5) effect a worn distributor bearing has on dwell angle.

Connect test lines as shown below: one to the ground connection, the other to the distributor.

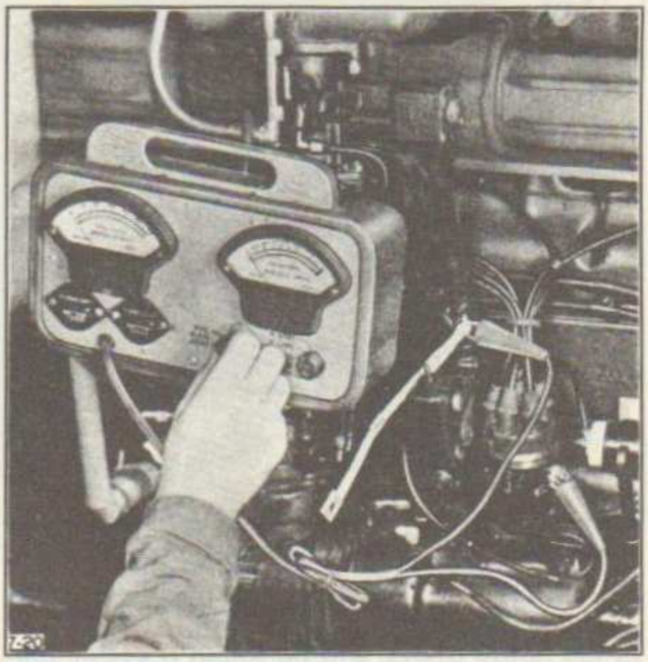

Fig. 53—View of Dwell Angle Tester
(Tool—Federal Stock No. 17-T-5520)

1. Lead to Ground Connection
2. Lead to Distributor

When reading on 900 R.P.M. scale turn switch to 900 position and when reading on 4500 R.P.M. scale turn switch to 4500 position.

Turn switch to proper lobe position, corresponding with number of lobes on the distributor.

With engine idling at 500 R.P.M. check the dwell angle for 35°. Note: Should the meter read to the left instead of on the scale, reverse the clips on the distributor and ground.

With engine running at 2000 R.P.M the. degree of dwell should read the same as at idling speed.

Voltage Control Unit

Regulator adjustments are divided into two parts, the mechanical adjustments, and the electrical adjustments. The mechanical adjustments must be made first, followed by the electrical adjustments. All electrical adjustments must be made with regulator at operating temperature (145°F.)

Mechanical Adjustments

Cut-Out Relay Air Gap. The cut-out relay gap should be .057 inch and is measured between the armature and the core (not between the brass pin in the armature and the core) with the points just touching. It is adjusted by loosening the two adjusting screws and raising or lowering the bracket as required. Be sure points are lined up, and tighten screws after adjustment.

Cut-Out Relay Point Opening.—The cut-out relay point opening should be .020 inch and is adjusted by bending the upper armature stop.

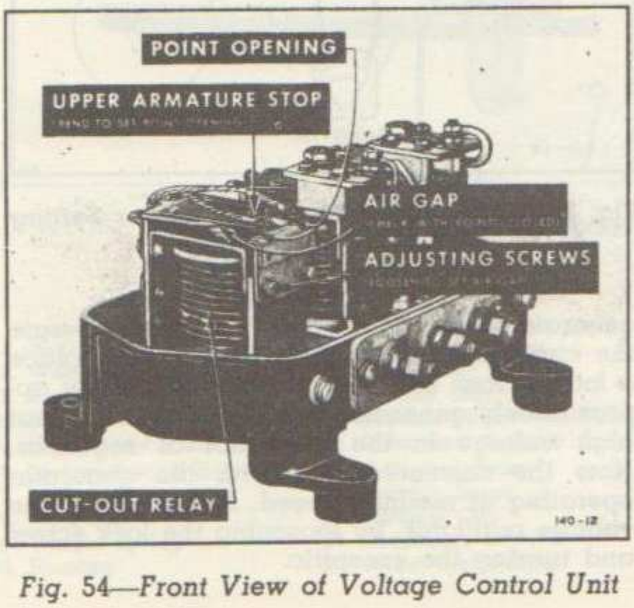

Fig. 54—Front View of Voltage Control Unit

If the points do not close at the same instant, the contact bracket should be slightly realigned (and air gap reset) and the spring fingers only slightly bent.

Voltage Regulator Point Opening. The voltage regulator point opening should be .015 inch and is checked with the armature held down against the winding core. It is adjusted by loosening the lock nut and turning the contact screw. Care must be taken to avoid distorting the contact spring. The correct procedure is to place the screw-driver into the screw slot, and hold the screw stationary while the lock nut is loosened. The spring should rise slightly above the fibre insulator when the points come together. This provides a wiping action between the points which maintains better contact. After the correct adjustment is made, tighten the lock nut by holding the screw stationary with the screw-driver and tightening lock nut with wrench.

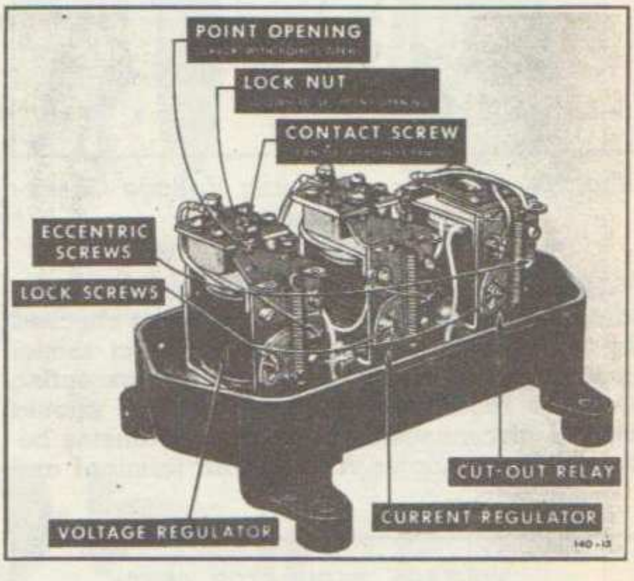

Fig. 55—Rear View of Voltage Control Unit

The Current Regulator Point Opening. The current regulator point opening should be .015 inch and is checked and adjusted as for the voltage regulator.

Electrical Adjustments

Cut-Out Relay Closing Voltage. The cut-out relay closing voltage should be 6.5 to 6.9 volts and is checked by connecting the regulator in the normal manner to the correct model generator and a 6-volt battery, with a voltmeter connected between the regulator ARMATURE terminal and the regulator base. Slowly increase generator speed and note the voltage at which the cut-out relay points close. Adjust by loosening the locking screw and turning the eccentric screw. Increasing spring tension increases closing voltage. After each adjustment, slow generator and bring back to speed, to check adjustment. Relay closing voltage must be below voltage regulator setting; otherwise voltage regulator will operate and hold voltage below the value required to close cut-out relay.

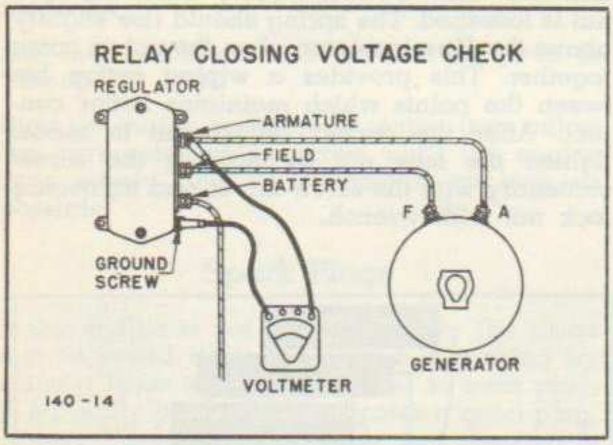

Fig. 56—Drawing of Closing Voltage Check Arrangement

Voltage Regulator Setting. The voltage regulator setting should be 7.5 volts and is checked by connecting the unit to the correct model generator in the normal manner excepting that the regulator BATTERY terminal should be left disconnected. Connect a voltmeter between the regulator ARMATURE terminal and the regulator base. Operate generator at medium speed and note voltage setting. Regulator must be hot—at operating temperature (145°F.). Either heat regulator in an oven to this temperature (avoid excessive baking or heat) or operate the regulator for about 45 minutes with the cover in place, to obtain this temperature. Adjust by loosening lock screw and turning eccentric screw. Increasing spring tension increases voltage setting, while reducing tension lowers voltage setting. After tightening lock screw, check setting by slowing generator until cut-out relay points open, then bring generator back to speed. Voltage regulator setting must always be above cut-out relay setting; otherwise voltage regulator would operate and prevent voltage from reaching a value sufficient to cause cut-out relay to operate.

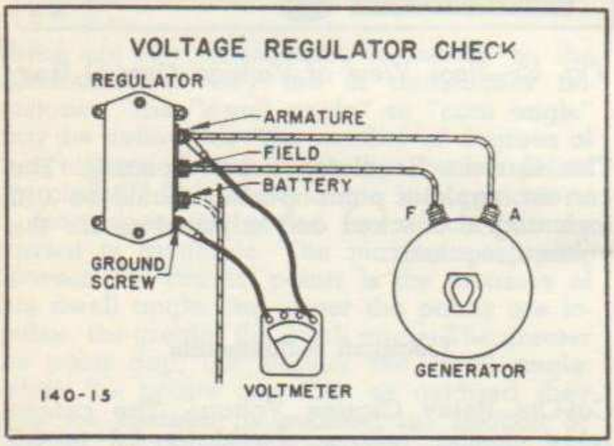

Fig. 57—Drawing of Voltage Regulator Setting Check Arrangement

Current Regulator Setting. The current regulator setting should be 25 amperes and is checked by connecting the unit to the proper model generator and a 6-volt battery in the normal manner, with an ammeter connected into the circuit at the regulator BATTERY terminal so that all output can be measured. A jumper lead must be placed across the voltage regulator contact points to prevent the voltage regulator from operating and reducing the generator output to a value too low to operate the current regulator. It is desirable to place a load across the battery which will draw approximately generator output and thus prevent high voltage in the generator or regulator. Note the current setting with the generator operating at medium speed. Adjust as for the voltage regulator, by loosening the lock screw and turning the eccentric.

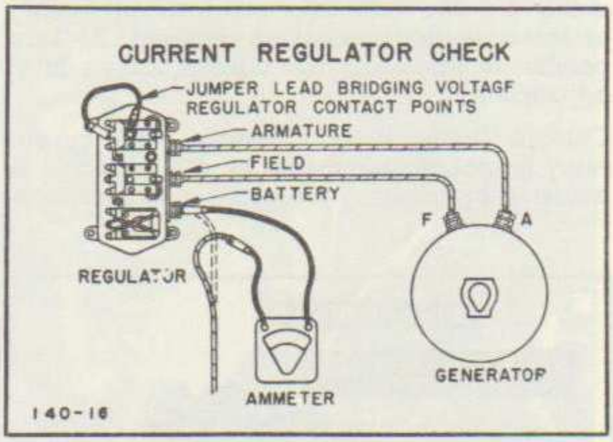

Fig. 58—Drawing of Current Regulator Setting Check Arrangement

SECTION 4: DIS-ASSEMBLY

Distributor

Unsnap cap springs (27) and remove distributor cap (39). Lift off rotor assembly (38), housing cover felt seal (37) and housing cover (36). Note housing cover gasket is glued into slot in housing cover.

Unscrew terminal screw (35) and take off terminal screw lockwasher (34), terminal clamp (33) and insulating bushing (32).

Unscrew two cap spring screws (31) and lockwashers (30). Remove cap springs (27) and cap spring supports (28) and (29). Unscrew screw (26) and lockwasher (25). Lift out breaker plate assembly on which is mounted breaker points and condenser.

Unscrew condenser lead screw (24) and washer (23). Unscrew condenser attaching screw (21) and lockwasher (20). Remove condenser (19). Slip out breaker lever retainer

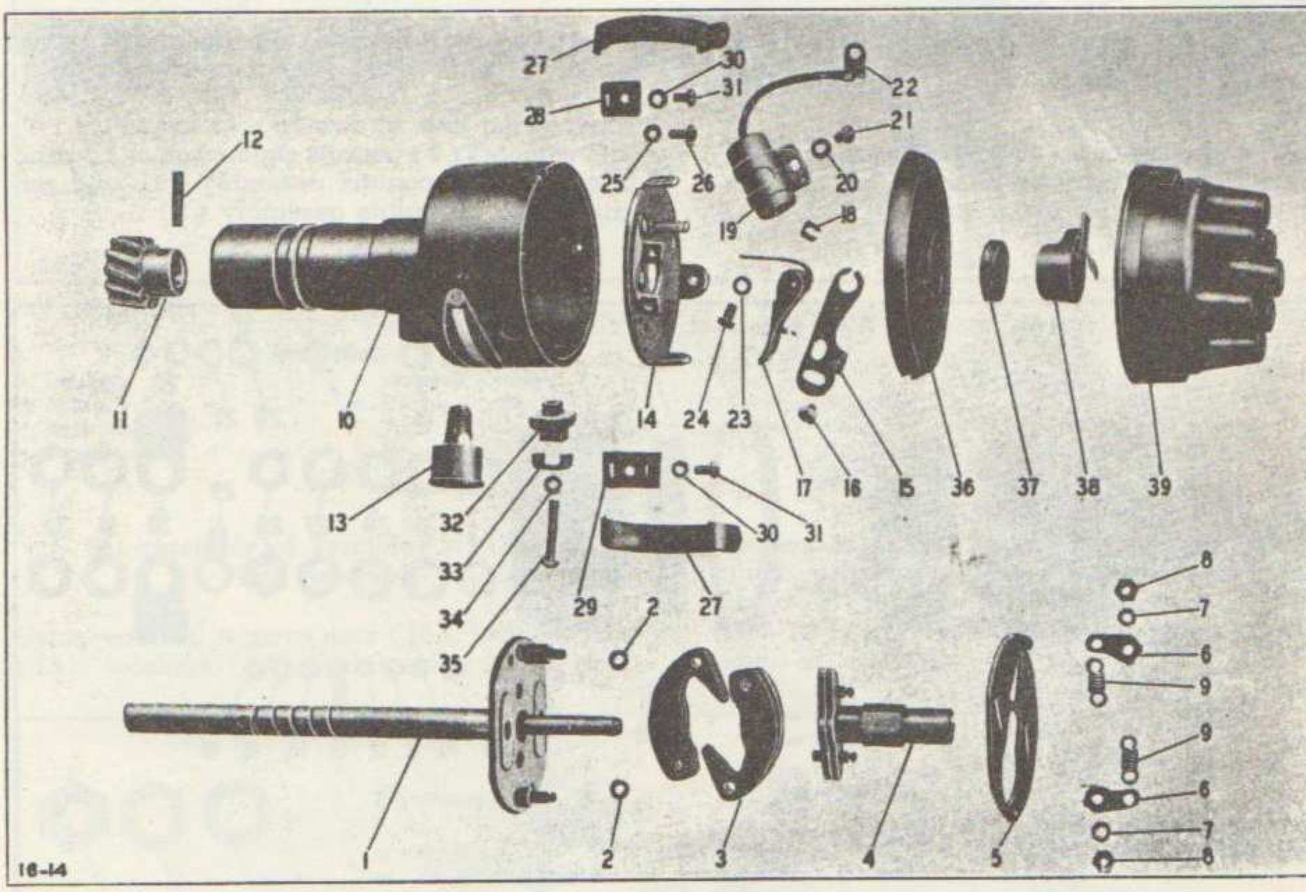

Fig. 59—Exploded View of Distributor

1. Main Shaft
2. Weight Washer
3. Weight
4. Cam
5. Hold Down Plate
6. Lockwasher, 2 Hole
7. Lockwasher
8. Plate Nut
9. Weight Spring
10. Housing
11. Gear
12. Gear Pin
13. Grease Cup
14. Breaker Plate
15. Point and Support
16. Adjusting Screw
17. Breaker Lever
18. Retainer Clip
19. Condenser
20. Screw Lockwasher
21. Condenser Screw
22. Lead
23. Lead Screw Lockwasher
24. Lead Screw
25. Support Lockwasher
26. Support Screw
27. Cap Spring
28. Spring Support
29. Cover Locater
30. Support Lockwasher
31. Support Screw
32. Screw Bushing
33. Terminal Clamp
34. Terminal Lockwasher
35. Terminal Screw
36. Housing Cover
37. Cover Felt Seal
38. Rotor
39. Cap

clip (18). Lift out breaker lever (17). Unscrew contact adjusting screw (16) and lift out contact point and support (15). Remaining part is breaker plate assembly (14).

Punch out gear pin (12), remove gear (11) and shaft (1) and cam (4) with attached centrifugal advance assembly from distributor housing (10).

Pry tongs of 2 hole lockwashers (6) away from nuts (8) and unscrew nuts (8), removing lockwashers (7). Pry springs (9) off spring posts and take off 2 hole lockwashers (6). Weight hold down plate (5) may be lifted off.

Remove four weights (3) from posts and take off weight washers (2). Cam assembly (4) may be taken off shaft (1). Felt wick in cam (4) may be taken out of hole in top of cam shaft.

Remove grease cup (13) from housing (10). Bronze bearings may be punched out of housing shaft hole with arbor press.

Series-Parallel Starting Switch

Using wrench, remove two nuts (32), lockwashers (31), terminal connector straps (30), terminal clip (29), nuts (28), lockwashers (27), plain washers (26), insulating washers (25) and insulating washer bushings (24).

Unscrew nuts (23) and remove lockwashers (22), washers (21), clips (20), terminal assemblies (19), lockwashers (18) and plain washers (17).

Remove nut (16), lockwasher (15), washer (14), clip (13), nut (12), lockwasher (11), washer (10) and insulating bushing (9).

Cover (8) may be lifted off along with cover gasket (6) and insulating piece (7).

Unscrewing four screws (5), lockwashers (4) and washers (3) permits separation of housing push rod and contact assembly (1) and terminal stud and plate assembly (2).

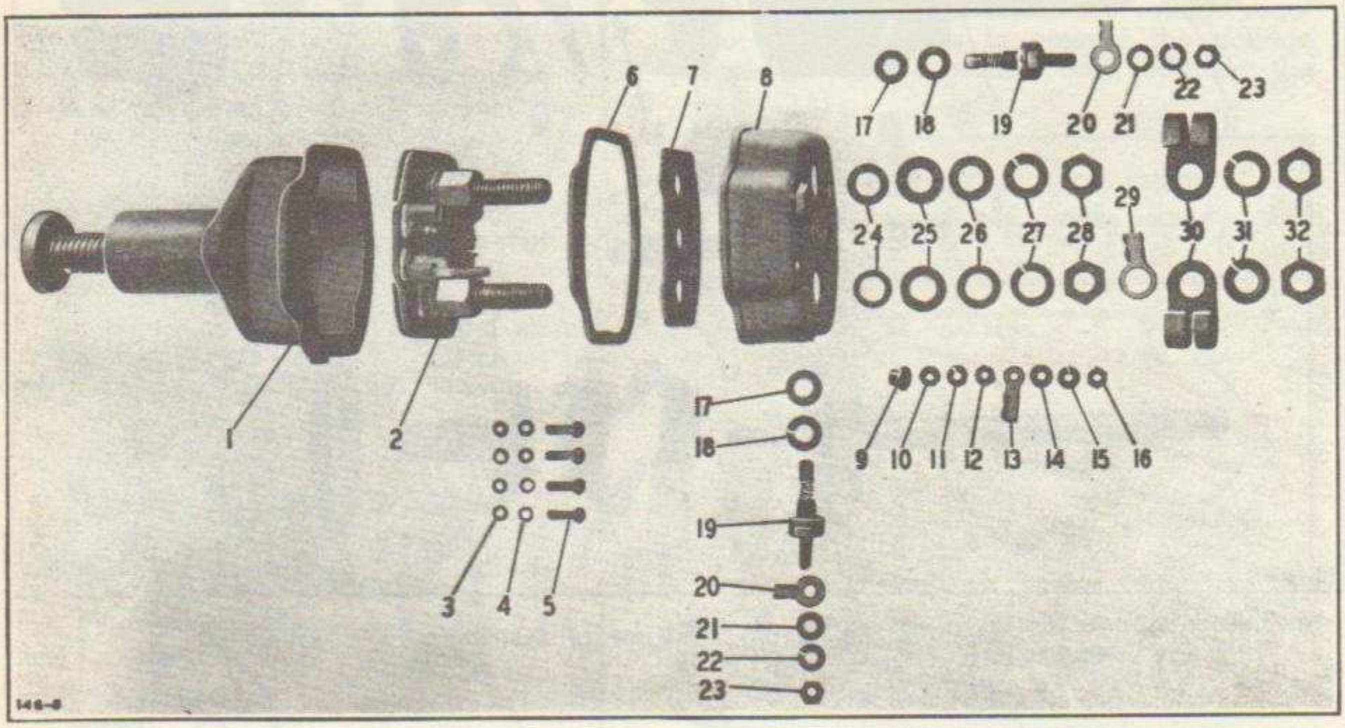

Fig. 60—Exploded View of Series-Parallel Starting Switch

1. Housing Assembly	9. Insulating Bushing	17. Plain Washer	25. Insulating Washer
2. Plate & Contact	10. Plain Washer	18. Terminal Lockwasher	26. Plain Washer
3. Screw Washer	11. Stud Lockwasher	19. Terminal Stud	27. Stud Lockwasher
4. Screw Lockwasher	12. Terminal Nut	20. Terminal Clip	28. Terminal Nut
5. Plate Screw	13. Terminal Clip	21. Terminal Washer	29. Terminal Clip
6. Cover Gasket	14. Plain Washer	22. Terminal Lockwasher	30. Straps
7. Cover Insulator	15. Terminal Lockwasher	23. Terminal Nut	31. Clip Lockwasher
8. Switch Cover	16. Terminal Nut	24. Insulating Bushing	32. Clip Nut

Dis-assembly of Housing, Push Rod and Contact Assembly

Using pliers, remove cotter pin (14) from hole. When re-assembling use new cotter pin and assemble on nut (13) so as not to interfere with maximum travel of the push rod. Remove nut (13), contact disk (12), washers (10) and contact disk spring (11).

A 1¼ inch wrench is needed to unscrew plunger assembly (9). Parts shown in figure are a part of this assembly and are not serviceable items.

Sleeve retainer washer (8) and housing sleeve (5) may be removed as may push rod assembly (7) and spring (6).

Spring (4) and pins (3) may be removed, after which release arm (2) may be shaken from housing (1).

Grounding screw (16) and lockwasher (15) may be unscrewed if necessary.

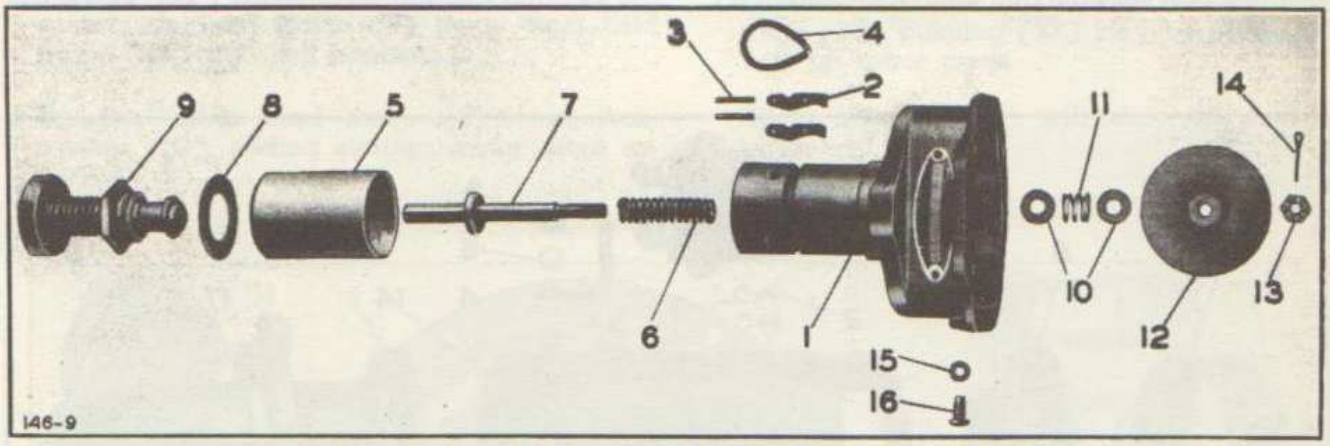

Fig. 61—Exploded View of Parallel Switch Housing, Push Rod and Contact Assembly

1. Housing
2. Release Arm
3. Arm Pin
4. Arm Spring
5. Housing Sleeve
6. Return Spring
7. Push Rod
8. Retainer Washer
9. Push Button
10. Retainer Washer
11. Contact Spring
12. Contact Disc
13. Contact Nut
14. Cotter Pin
15. Screw Lockwasher
16. Ground Screw

Dis-assembly of Terminal Stud and Plate Assembly

Using wrench, remove nuts (16), lockwashers (15), washers (14) and washer (13) from terminal studs (5). Terminal studs (5) may be pulled out from other side of the assembly. Insulation plate (4), insulating washer bushings (3) and terminal plate (2) may be removed.

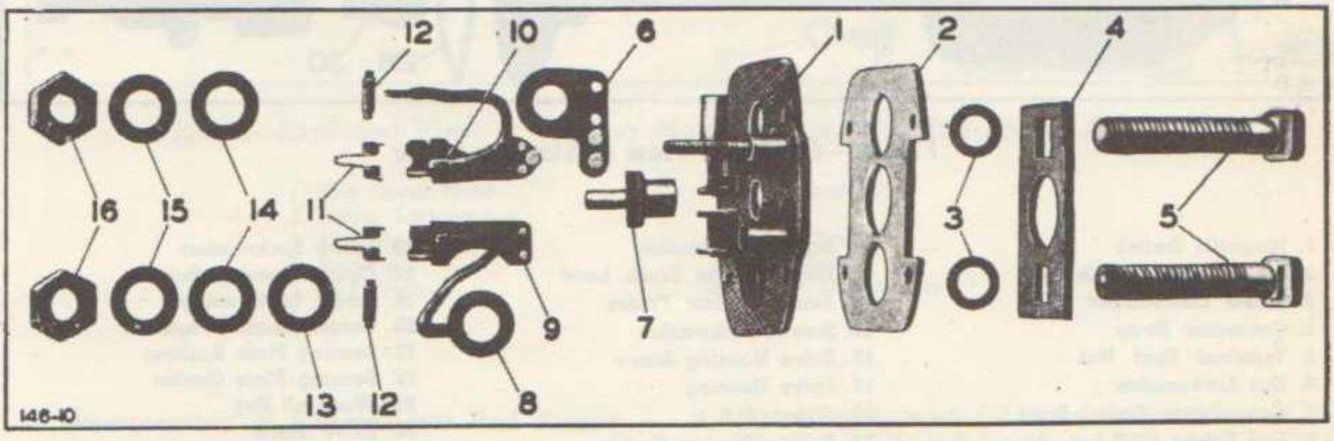

Fig. 62—Exploded View of Parallel Switch Terminal Stud and Plate Assembly

1. Contact Switch
2. Terminal Plate
3. Insulating Washer
4. Insulating Plate
5. Terminal Stud
6. Contact & Support
7. Contact Plunger
8. Clip Ring
9. 2 Point Blade
10. 3 Point Blade
11. Tension Spring
12. Hinge Pin
13. Plain Washer
14. Plain Washer
15. Stud Lockwasher
16. Stud Nut

Removing pins (12) and springs (11) permits removal of contact blades (9) and (10). Contact and support (6) is free for removal as is plunger (7).

Starting Motor

Detach magnetic switch (1) by removing two attaching screws (2) and lockwashers (3) and terminal stud nut (5) and lockwasher (6).

Detach drive housing assembly (17). Mark drive housing assembly (17) and field frame (14) to establish relationship. Remove six screws (16) and lockwashers (15). Tap housing (17) away from field frame (14) with a soft hammer.

Remove armature (21) with center bearing plate (26) from drive housing (17) by cutting safety wire and removing three hex head (24) and one flat head screw (22), lockwash-

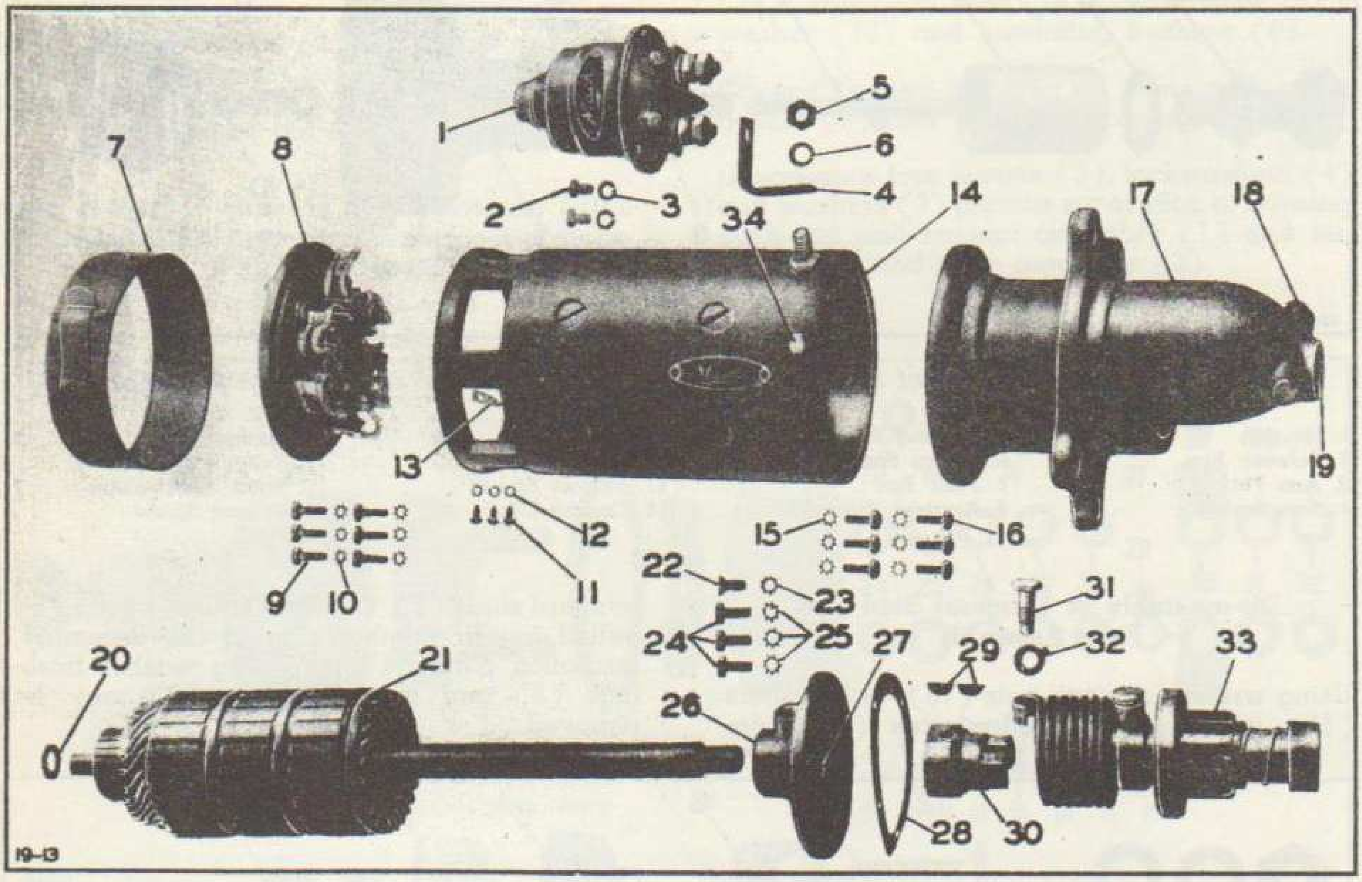

Fig. 63—Exploded View of Starting Motor

1. Magnetic Switch
2. Switch Mounting Screw
3. Screw Lockwasher
4. Connector Strap
5. Terminal Stud Nut
6. Nut Lockwasher
7. Commutator Cover Band
8. End Frame (C.E.)
9. End Frame Screw (C.E.)
10. Screw Lockwasher (C.E.)
11. Brush Lead Screw
12. Screw Lockwasher
13. Field Coil to Brush Lead
14. Starting Motor Frame
15. Screw Lockwasher
16. Drive Housing Screw
17. Drive Housing
18. Oiler (D.E.)
19. Drive Housing Bushing
20. Space Washer (C.E.)
21. Armature
22. Center Bearing Screw
23. Screw Lockwasher
24. Center Bearing Screw
25. Screw Lockwasher
26. Center Bearing Plate
27. Bearing Plate Bushing
28. Bearing Plate Gasket
29. Woodruff Key
30. Drive Head
31. Head Spring Screw
32. Screw Lockwasher
33. Drive Assembly
34. Bearing Plate Oiler

C.E. = Commutator End D.E. = Drive End

ers (25) and (23). Pull armature (21), with center bearing plate (26) and starting motor drive (33) from drive housing (17).

Mark commutator end frame (8) and field frame (14) so relationship is established. Remove cover band (7) and note relationship of leads and brushes. Disconnect three field leads from brush holders by removing three screws (11) and lockwashers (12). Remove six screws (9) and lockwashers (10) and tap commutator end frame (8) away from field frame (14) with soft hammer.

Unscrew drive head screw (31) and lockwasher (32), sliding starting motor drive assembly from shaft. Drive head (30) will slide off armature shaft, permitting removal with pliers of two Woodruff keys (29). Center bearing plate (26) and gasket (28) may now be removed.

Drive housing bushing (19) may be removed on an arbor press. Oiler and oil wick (18) may also be removed.

Remove oil wick (34) from center bearing plate (26). Bushing (27) may be pressed out with an arbor press.

Space washer (20) will slide off armature (21).

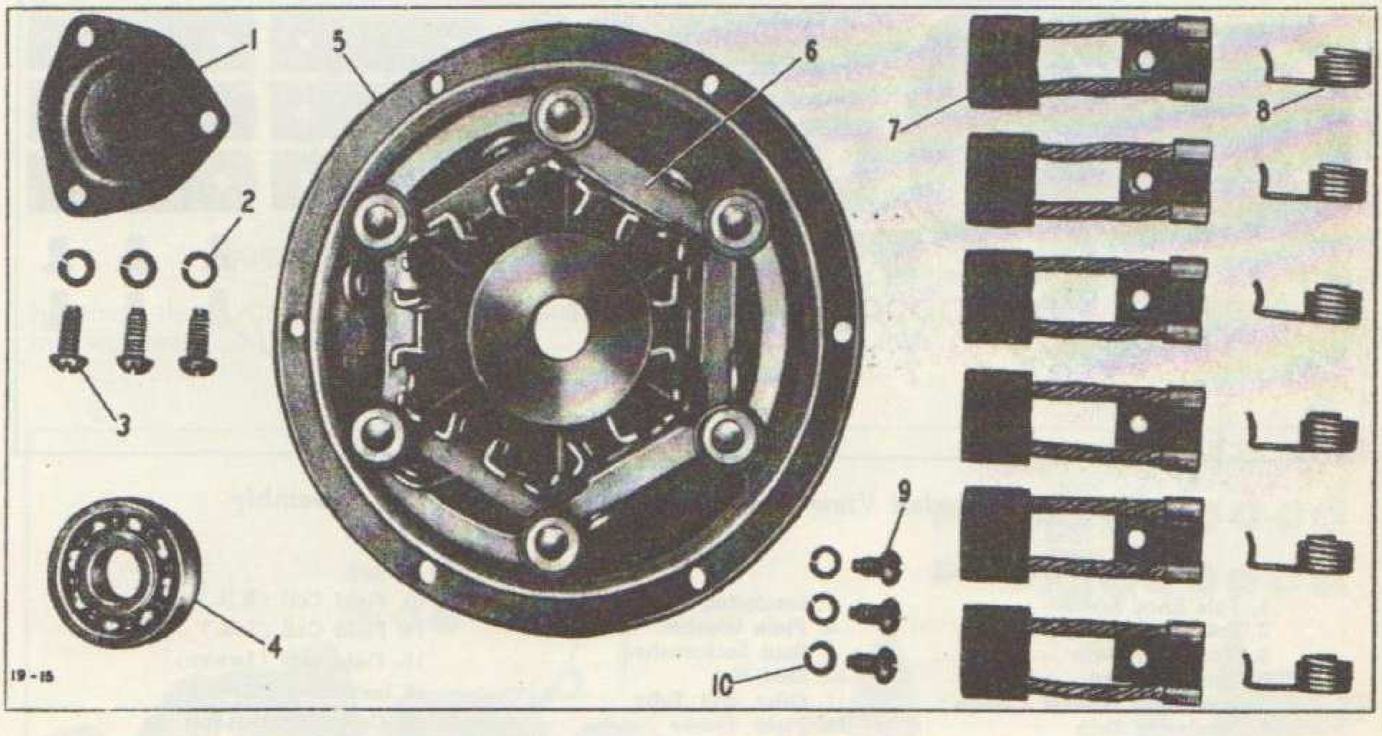

Fig. 64—Exploded View of Starting Motor Commutator End Frame Assembly

1. End Cover Plate
2. Screw Lockwasher
3. Plate Screw
4. Bearing
5. End Frame
6. Oiler and Wick
7. Brush
8. Brush Spring
9. Lead Screw
10. Screw Lockwasher

Dis-assembly of Commutator End Frame

Take out three screws (3), lockwashers (2) and lift off plate (1). Ball bearing (4) may be pulled out. Remove remaining three brush lead attaching screws (9) and lockwashers (10). Brushes (7) and brush springs (8) may be lifted out of the brush holders.

Oiler and Oil wick (6) may be removed from commutator end frame (5).

Dis-assembly of Field Frame Assembly

Using wrench, loosen and remove nut (10), lockwasher (9), washer (8), insulating washer (5), three insulating small washers (7), insulating strip (6), insulating washer (5) and terminal stud (4).

Using pole shoe screwbit and brace, remove twelve pole shoe screws (1) and lift out six pole shoes (2). Coil windings (15), (14) and (13) may be removed thru either end of field frame (12) along with insulation strip (3) and two insulation pieces (16).

Oiler and oiler tube (11) may be removed from field frame (12).

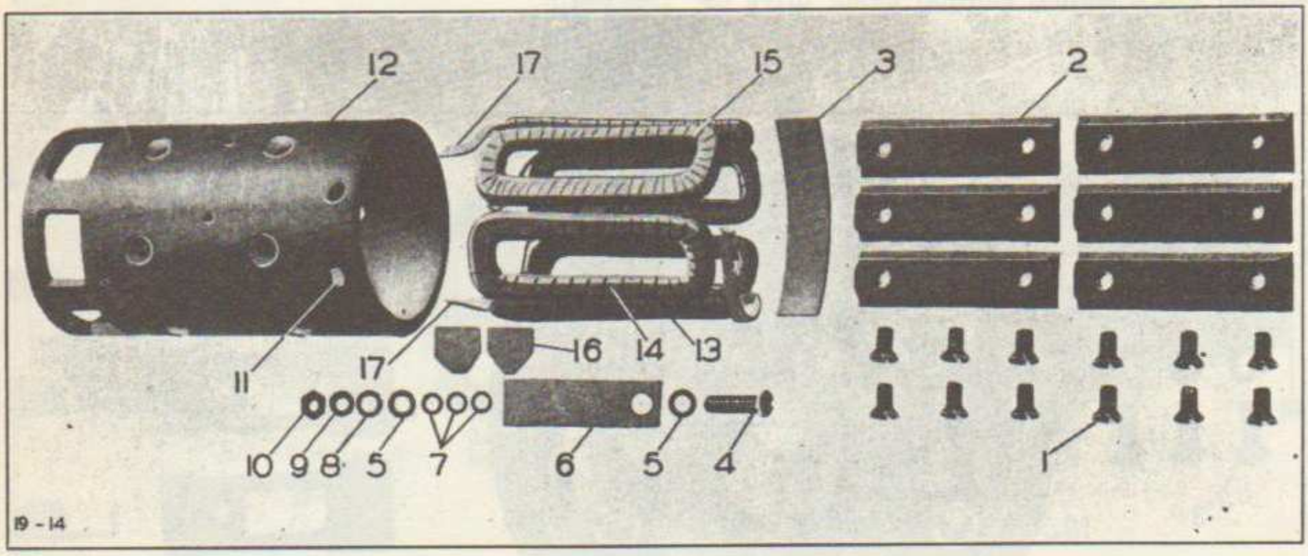

Fig. 65—Exploded View of Starting Motor Field Frame Assembly

1. Pole Shoe Screw
2. Pole Shoe
3. Insulating Strip
4. Terminal Stud
5. Insulating Washer (Large)
6. Insulating Strip
7. Insulating Washer (Small)
8. Plain Washer
9. Stud Lockwasher
10. Stud Nut
11. Oiler and Tube
12. Field Frame
13. Field Coil (R.H.)
14. Field Coil (L.H.)
15. Field Coil (Lower)
16 Insulating Strips
17. Coil to Brush Lead

Starting Motor Drive

Bend down tangs on lockwasher (9) and unscrew screw (8). This permits removal of drive head (10). Spring (5) may be removed after screw (7) has been unscrewed and tangs on lockwasher (6) bent down.

Back stop screw (3) may be unscrewed permitting removal of back stop (2).

Remainder of assembly is ordinarily serviced as unit.

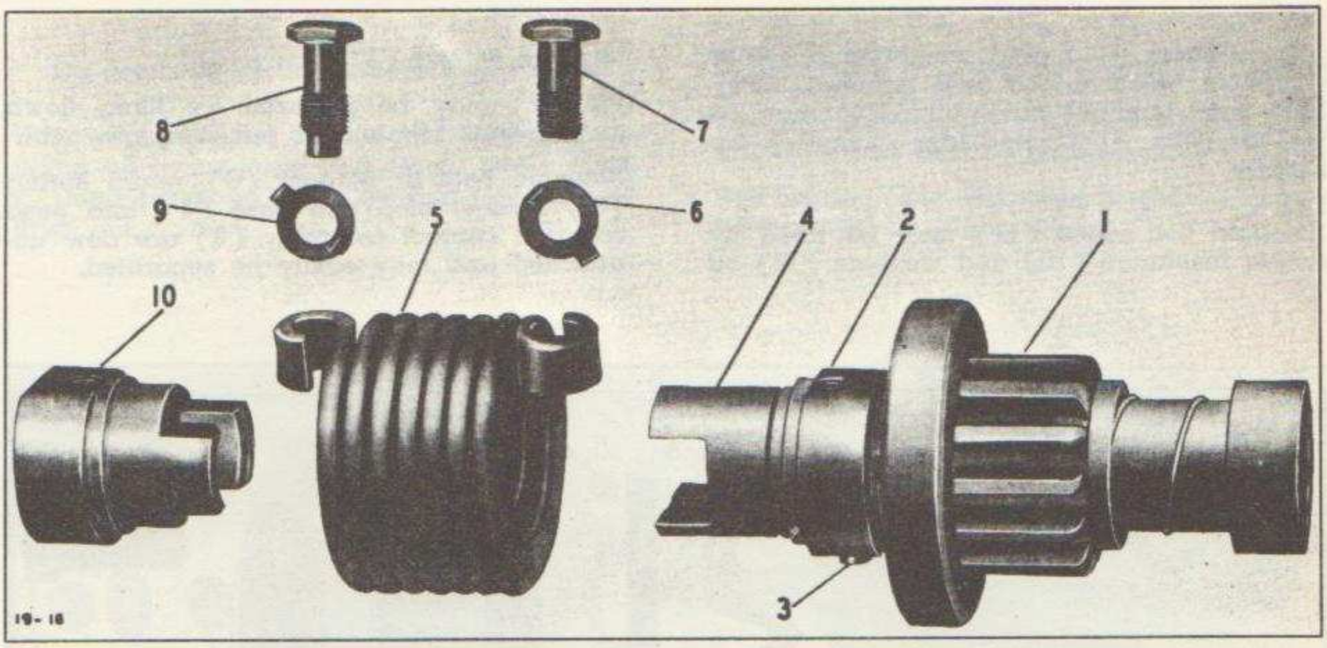

Fig. 66—Exploded View of Starting Motor Drive Assembly

1. Gear Assembly
2. Back Stop
3. Stop Screw
4. Service Sleeve
5. Spring
6. Screw Lockwasher
7. Shaft Screw
8. Head Screw
9. Screw Lockwasher
10. Head

Magnetic Switch

Remove three Case attaching screws (19), lockwasher (20), and nuts (21).

Pull Case (1) away from rest of switch assembly. Plug (2) may be unscrewed if necessary.

Remove nuts (18 & 16), lockwashers (17 &

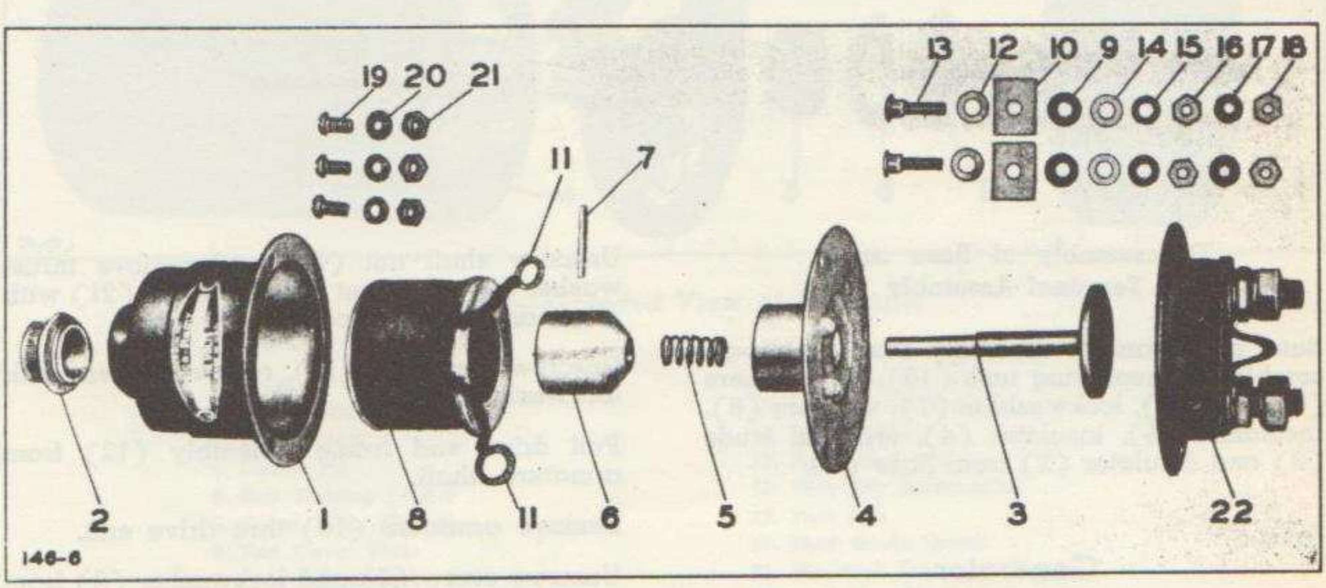

Fig. 67—Exploded View of Magnetic Switch

1. Case & Bracket
2. Cover Plug
3. Push Rod
4. Plunger Stop
5. Return Spring
6. Plunger
7. Push Rod Pin
8. Solenoid Coil
9. Insulating Bushing
10. Insulating Washer
11. Coil Leads
12. Plain Washer
13. Coil Lead Stud
14. Stud Washer
15. Stud Lockwasher
16. Stud Nut
17. Stud Lockwasher
18. Stud Nut
19. Base Screw
20. Screw Lockwasher
21. Screw Nut
22. Base & Terminal

15), washers (14), and insulating bushings (9) from solenoid coil lead terminals (13). Base and terminal assembly (22) may be pulled away from remainder of switch assembly.

Solenoid coil leads (11) may be freed by taking insulators (10) and washers (12) off terminal screws (13).

Pin (7) may be removed by filing down staked ends of pin and punching pin out.

Solenoid boot or plunger (6), return spring (5), plunger stop and base (4), and push rod and contact assembly (3) are now unattached and may easily be separated.

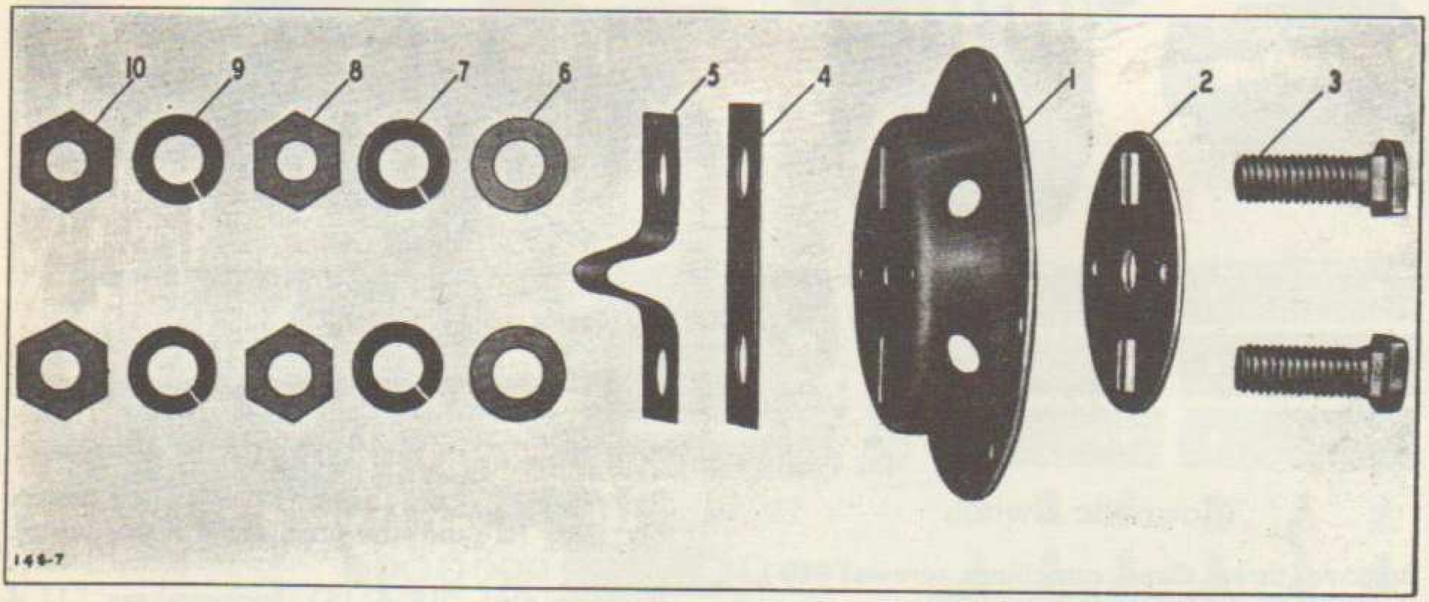

Fig. 68—Exploded View of Magnetic Switch Base and Terminal Assembly

1. Base
2. Base Insulation
3. Terminal Stud
4. Insulating Strip
5. Insulating Strip
6. Plain Washer
7. Stud Lockwasher
8. Stud Nut
9. Stud Lockwasher
10. Stud Nut

Dis-assembly of Base and Terminal Assembly

Base and terminal assembly may be dis-assembled by removing nuts (10), lockwashers (9), nuts (8), lockwashers (7), washers (6), insulation (5), insulator (4), terminal studs (3) and insulator (2) from Base (1).

Generator

Dis-assembly into Main Sub-Assemblies

Twist cotter pin (24) from shaft nut (23) with pliers, replacing cotter pin upon reassembly if it is at all damaged.

Unscrew shaft nut (23) and remove thrust washer (22). Pull out Woodruff key (21) with pliers and remove space collar (20).

Unscrew thru bolts (19), removing them with lockwashers (18).

Pull drive end frame assembly (12) from armature shaft.

Remove armature (10) thru drive end.

Unscrew screw (3) and lockwasher (2) from brush, thus freeing armature terminal to brush lead (1).

Lift off commutator end frame (25).

Remove cover band (11) by prying under snap spring.

Dis-assembly of Commutator End Frame

Unscrew 3 screws (9) and lockwashers (8), lifting off commutator end frame cover plate (7) and gasket (6). Ball bearing (5) may be lifted out.

Dis-assembly of Drive End Frame Assembly

Unscrew 3 screws (17) and lockwashers (16), lifting off ball bearing retainer plate (15).

Ball bearing (14) and space washer (13) may be removed by lifting out.

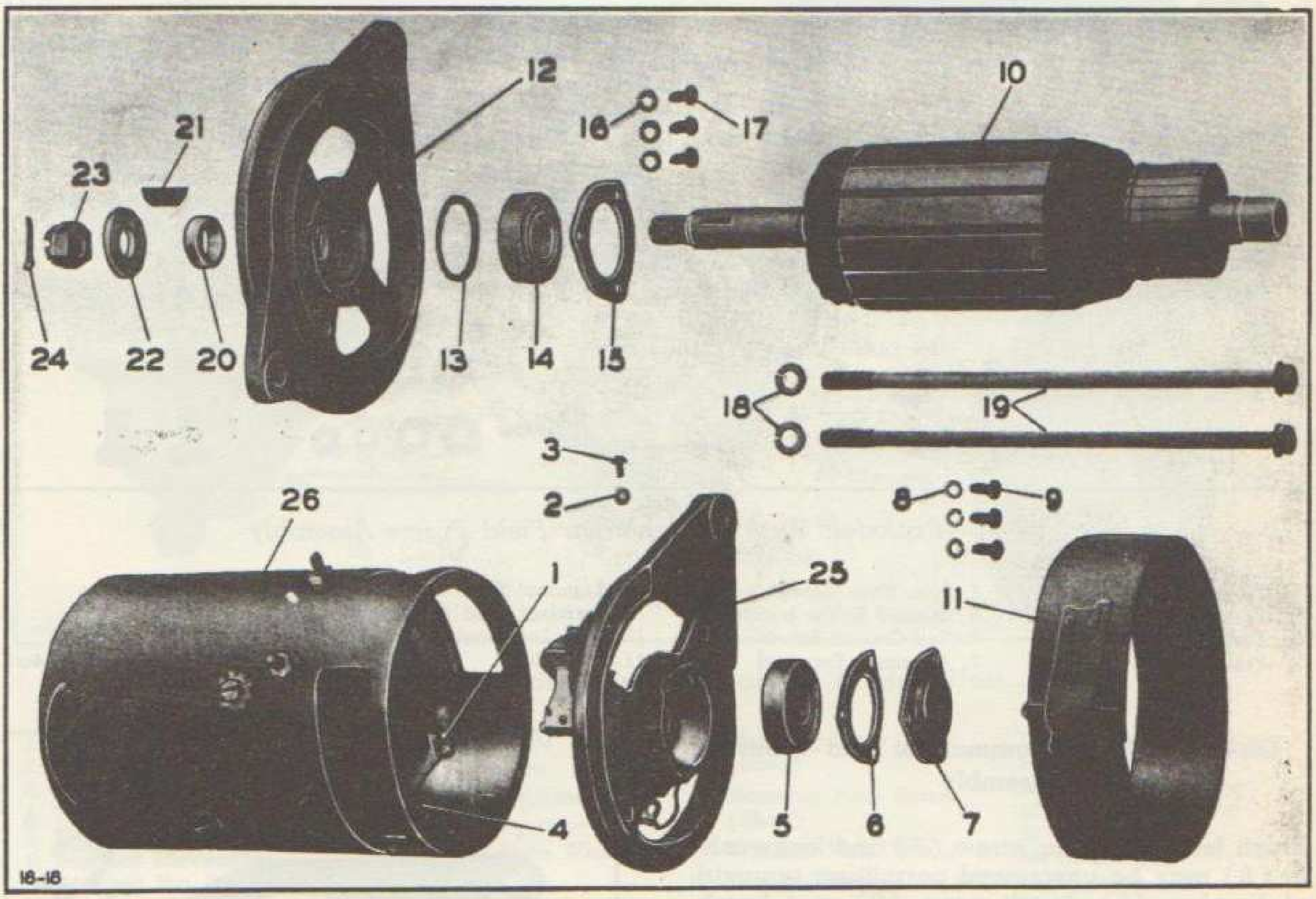

Fig. 69—Exploded View of Generator

1. Terminal to Brush Lead
2. Lockwasher
3. Lead Screw
4. Dowel Pin
5. Ball Bearing (C.E.)
6. Cover Plate Gasket
7. End Cover Plate
8. Screw Lockwasher
9. Cover Plate Screw
10. Armature
11. Cover Band
12. Drive End Frame
13. Bearing Space Washer
14. Ball Bearing (D.E.)
15. Retainer Plate (D.E.)
16. Lockwasher
17. Retainer Screw
18. Thru Bolt Lockwasher
19. Thru Bolt
20. Shaft Space Collar
21. Woodruff Key
22. Shaft Nut Washer
23. Shaft Nut
24. Cotter Pin
25. Frame (C.E.)
26. Field Frame

C.E. = Commutator End D.E. = Drive End

Dis-assembly of Field Frame Assembly

Using wrench, remove two nuts (11), lockwashers (10), washers (9) and insulators (8) from terminals studs (7) and (14). Terminal (7) may be removed from inside of field frame (1).

Unscrew screw (6) and lockwasher (5), freeing field coil lead to ground (15).

Use pole shoe screw screwbit and brace, remove pole shoe screws (4). Pole shoes (3) and field coils (2 & 2A) may be pulled out either end of field frame (1).

Grounding screw (13) and lockwasher (12) may be removed if necessary from field frame (1).

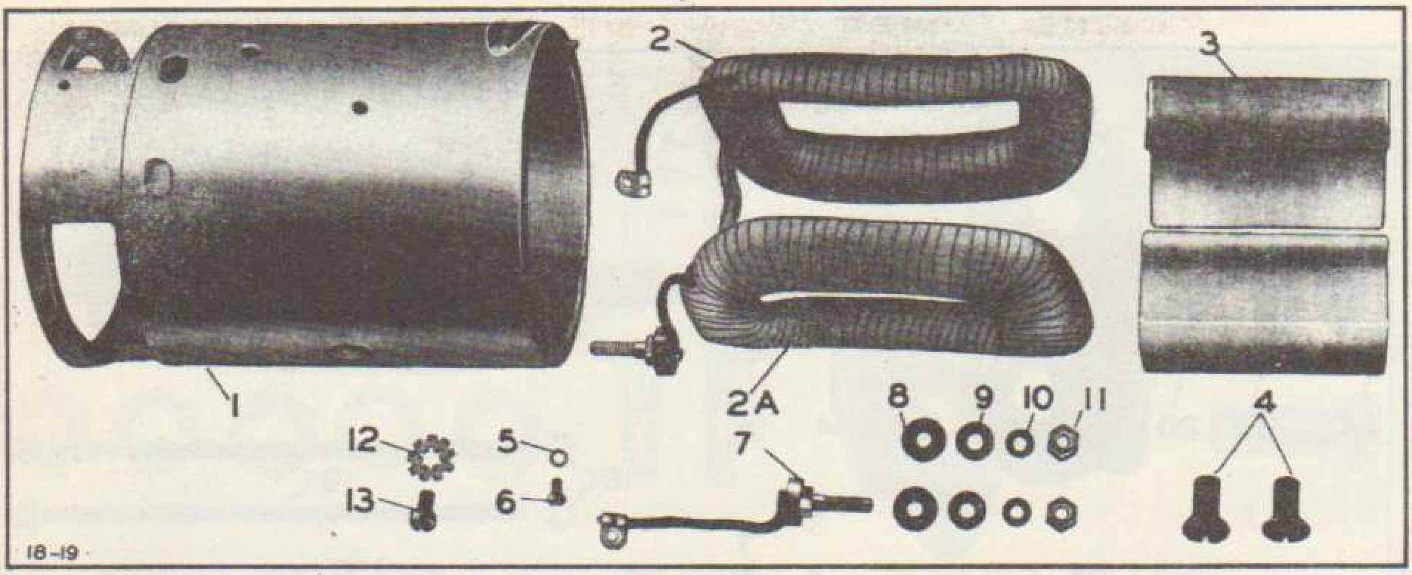

Fig. 70—Exploded View of Generator Field Frame Assembly

1. Field Frame
2. Field Coil (L.H.)
2a. Field Coil (R.H.)
3. Pole Shoe
4. Pole Shoe Screw
5. Ground Screw Lockwasher
6. Coil Ground Screw
7. Armature Terminal
8. Terminal Stud Insulator
9. Terminal Stud Washer
10. Stud Lockwasher
11. Stud Nut
12. Screw Lockwasher
13. Grounding Screw
14. Field Coil Terminal
15. Field Coil to Ground Lead

Dis-assembly of Commutator End Frame Assembly

Brush lead attaching screw (7) and lockwasher (6) may be unscrewed permitting removal of brushes (5), brush arms (3) and brush arm tension springs (4). Space washers (2) may also be removed.

Brush pin and holder assembly (8) is riveted to commutator end frame (1) and cannot be serviced separately from end frame (1).

1. Commutator End Frame
2. Brush Arm Space Washer
3. Brush Arm
4. Brush Arm Springs
5. Brush
6. Brush Lead Screw Lockwasher
7. Brush Lead Screw
8. Brush Pin and Holder

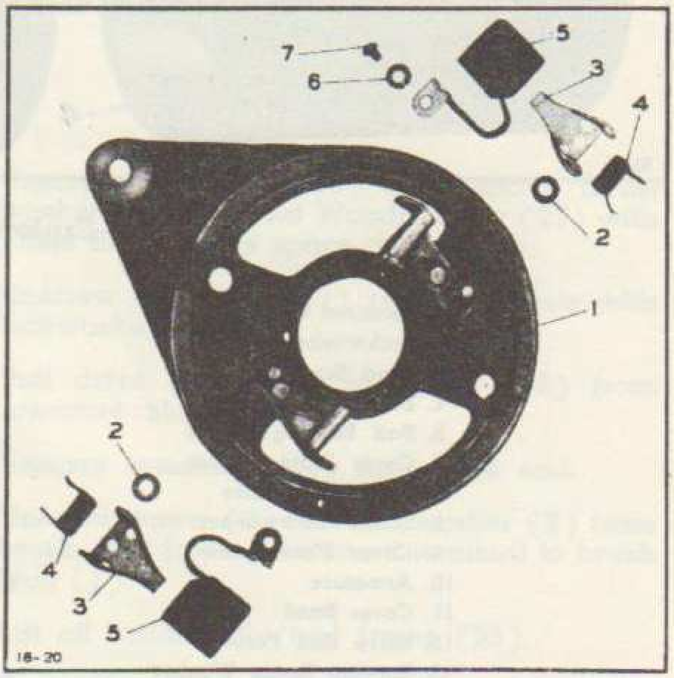

Fig. 71—Exploded View of Generator Commutator End Frame

Voltage Control Unit

Dis-assembly into Main Sub-assemblies

Remove cover (25) by unscrewing two cover nuts and lifting cover off.

Unscrew seven mounting plate screws (15 & 16), washers (13) and lockwasher (14) and lift mounting plate (9) with regulator assemblies from base (26).

see illustration page 06-4] and current regulator lead [6, see illustration page 06-48]. Use soldering iron to melt solder being careful not to heat clamping base excessively, as this will cause it to become loose in the mounting plate. Remove the lead clamping screw (18), lockwasher (17) and flat washer (16), which clamps the two leads together. If further application of heat is required to unsolder leads from clamping base, be sure to allow enough time for clamping base to cool before using soldering iron again. Remove leads and small washer (15) in bottom of clamp.

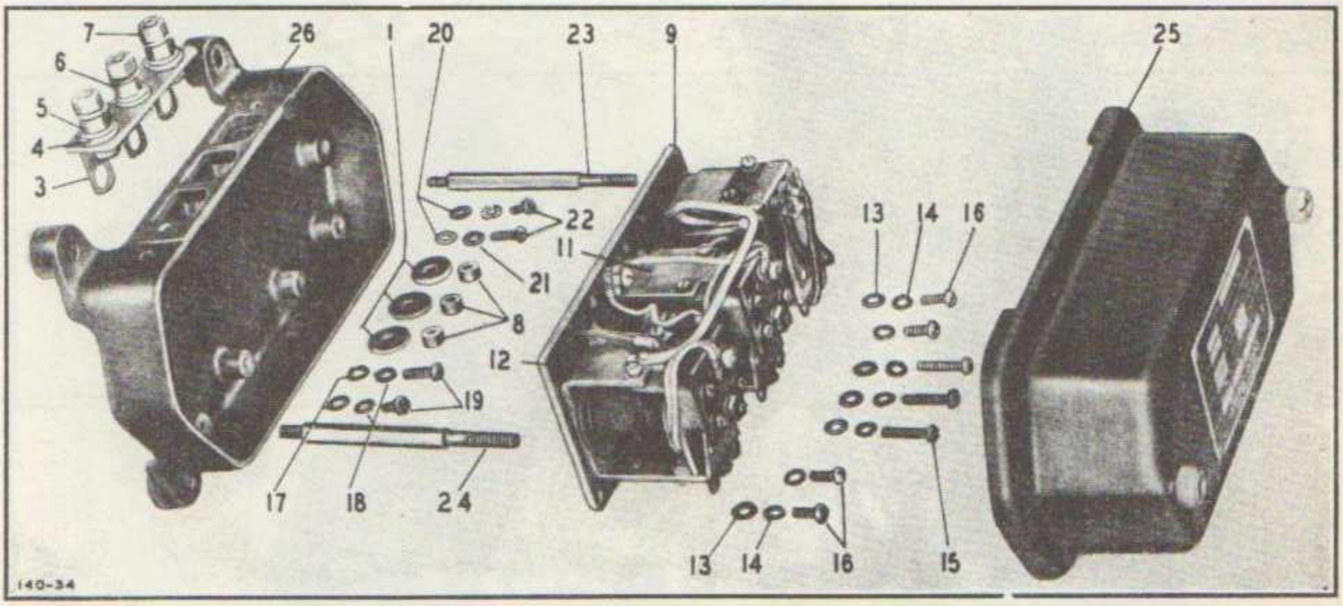

Fig. 72—Exploded View of Voltage Control Unit

1. Insulating Washer
2. Terminal Plate
3. Connector Strap
4. Terminal Stud Washer
5. Terminal Nut (Inner)
6. Terminal Lockwasher
7. Terminal Nut (Outer)
8. Insulating Bushing
9. Mounting Plate
10. Cut-Out Relay
11. Current Regulator
12. Voltage Regulator
13. Mounting Plate Washer
14. Mounting Plate Lockwasher
15. Mounting Plate Screw (Long)
16. Mounting Plate Screw (Short)
17. Terminal Plate Washer
18. Terminal Plate Lockwasher
19. Terminal Plate Screw
20. Screw Washer
21. Screw Lockwasher
22. Grounding Screw
23. Cover Stud
24. Cover Stud
25. Cover
26. Base

Remove terminal stud and plate assembly (2) by unscrewing terminal plate attaching screws (19), washers (17) and lockwashers (18). Insulating washers (1) and insulating washers or bushings (8) may be left in place in base (26) for reassembly.

Remove two ground screws (22), lockwashers (21) and washers (20) from front face of base (26).

Remove two cover studs (23 & 24) from base (26) by unscrewing with wrench.

Dis-assembly of Mounting Plate

Disconnect heavy voltage regulator lead [26,

Disconnect heavy current regulator lead [6, see illustration page 06-48] and cut-out relay lead [18, see illustration page 06-48]. Repeat preceding operation in removing these leads from the clamping base.

Disconnect leads [6 & 18, see illustration page 06-48], from relay contact bracket [10, see illustration page 06-48], holding leads with pliers to avoid burning fingers, unsolder cut-out relay series winding lead and shunt winding lead from cut-out relay bracket.

Disconnect voltage regulator frame lead (19). Remove screw (22) and lockwasher (23).

Disconnect voltage regulator lead [26, see illustration page 06-47] from current regulator frame by removing screw and lockwasher [20 & 21 see illustration page 06-48] which fasten that lead to frame.

Disconnect current regulator shunt winding lead (24) and resistance lead (1) by removing screw (14) and lockwasher (13) from tapped collar in mounting plate.

Disconnect relay frame lead (20). Remove screw and lockwasher [16 & 17 see illustration page 06-48] which fasten that lead to frame.

Dis-assembly of unit into component sub-assemblies is now complete and these sub-assemblies may now be handled independently.

Dis-assembly of Voltage Regulator

Remove spring (25) by unclosing and lifting off.

Disconnect lead (11) from contact bracket (21) by removing nut (10) and lockwasher (9).

Remove contact bracket assembly by removing four screws (24), lockwashers (23) and washers (22).

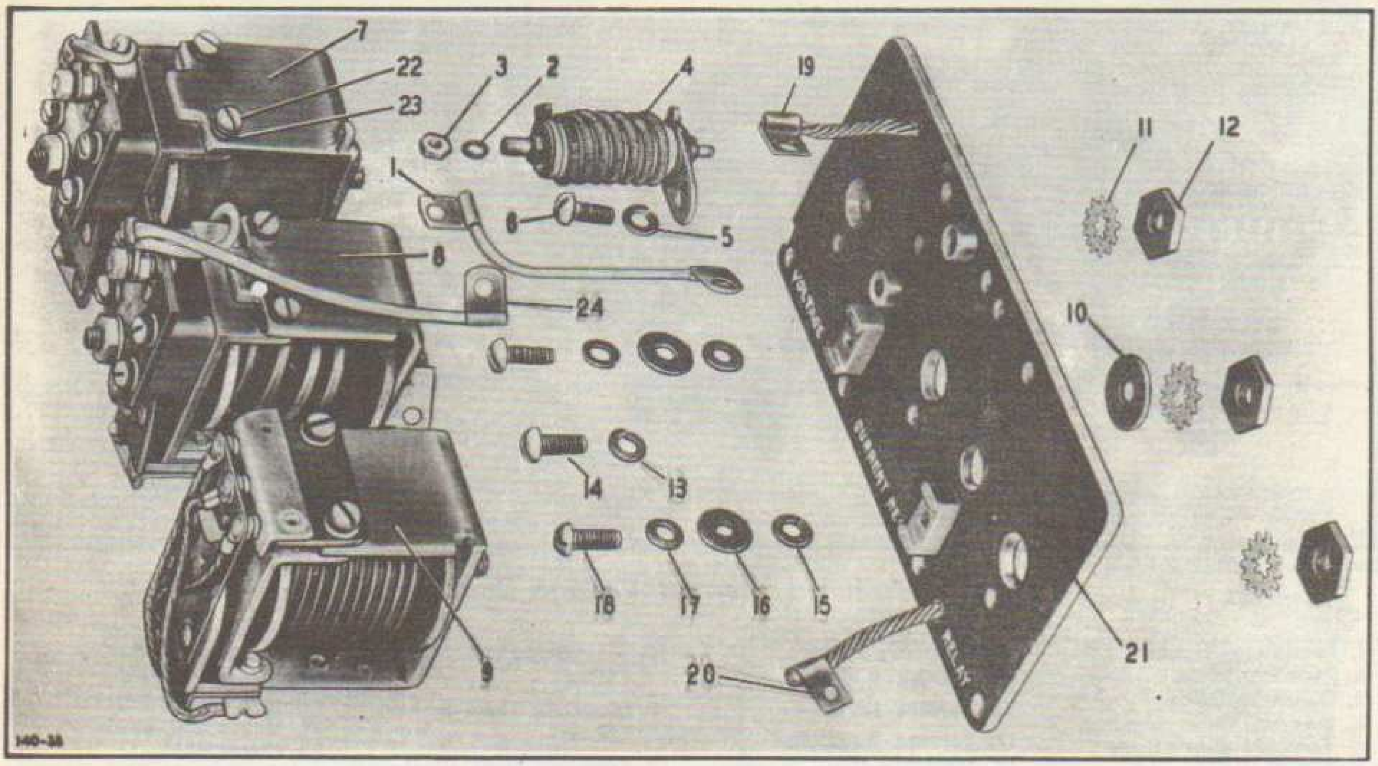

Fig. 73—Exploded View of Voltage Control Units and Plate

1. Base to Resistance
2. Lead Lockwasher
3. Lead Nut
4. Resistance Unit
5. Unit Lockwasher
6. Resistance Screw
7. Voltage Regulator
8. Current Regulator
9. Cut-Out Relay
10. C. R. Washer
11. C. R. Lockwasher
12. Current Regulator Nut
13. Resistance Lockwasher
14. Resistance Screw
15. Leads Washer (Small)
16. Leads Washer (Large)
17. Leads Lockwasher
18. Leads Screw
19. V. R. Lead
20. Cut-Out Relay Lead
21. Mounting Plate
22. Contact Bracket Screw
23. Screw Lockwasher
24. C.R. Winding Lead

Remove voltage regulator (7), current regulator (8) and cut-out relay (9) by removing nuts (12), lockwashers (11) and plain washer (10). [Plain washer on current regulator only].

Remove resistance (4) with lead (1) attached from mounting plate (21) by unscrewing screw (6) and lockwasher (5).

Remove lead (1) from resistance (4) by removing nut (3) and lockwasher (2).

Contact bracket may be further dis-assembled, if necessary, by removing nut (19), lockwasher (18) and contact screw (20). Also contact bracket terminal may be dis-assembled by removing nut (10), lockwasher (9), screw (7) and lockwasher (8). Spring which is riveted to contact bracket is not serviceable.

Detach armature (14) by removing two screws (17), lockwashers (16) and washers (15).

Detach contact bracket support (13) by removing remaining screws (17) and lockwashers (16).

Remove winding assembly (6) by removing nut (12); winding assembly cannot be further broken down.

Remove contact bracket assembly by removing four screws (25), lockwashers (24) and washers (23).

Contact bracket may be further dis-assembled, if necessary, by removing nut (15), lockwasher (14) and screw (16). Also contact bracket terminal may be dis-assembled by

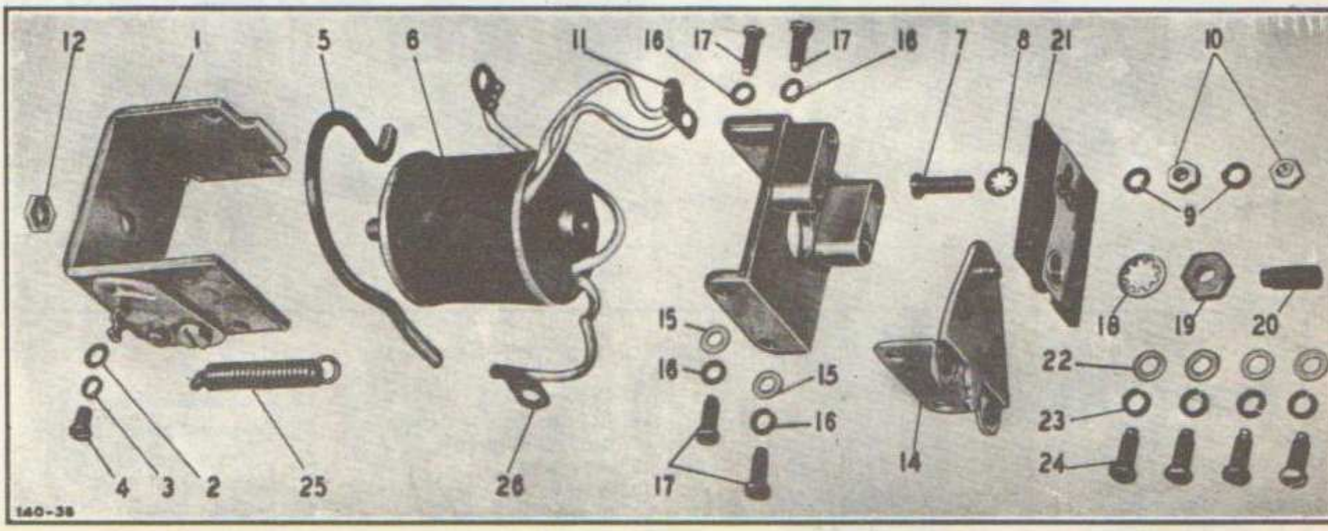

Fig. 74—Exploded View of Voltage Regulator

1. Regulator Base
2. Locking Screw Washer
3. Locking Screw Lockwasher
4. Adjustment Locking Screw
5. Heavy Series Winding
6. Winding Assembly
7. Terminal Screw
8. Terminal Screw Lockwasher
9. Terminal Nut Lockwasher
10. Terminal Nut
11. Lead, Winding to Terminal
12. Winding Assembly Nut
13. Contact Bracket Support
14. Armature
15. Bracket Support Washer
16. Bracket Support Lockwasher
17. Bracket Support Screw
18. Contact Lockwasher
19. Contact Nut
20. Contact Screw
21. Contact Bracket
22. Contact Bracket Washer
23. Contact Bracket Lockwasher
24. Contact Bracket Screw
25. Armature Spring
26. Lead to Current Regulator

Heavy series winding (5) may be removed, if necessary, by unsoldering from base (1).

Adjustment locking screw (4), lockwasher (3) and washer (2) may be removed from base (1). Cam screw and adjustment plate are not serviceable separately from the base (1).

Dis-assembly of Current Regulator

Remove armature spring (26) by unsoldering and lifting off.

Disconnect lead (13) from contact bracket (22) by removing nut (12) and lockwasher (11).

removing nut (12), lockwasher (11), screw (9) and lockwasher (10). Spring which is riveted to contact bracket is not serviceable.

Detach armature (18) by removing two screws (21), lockwashers (20) and washers (19).

Detach contact bracket support (17) by removing remaining screws (21) and lockwashers (20).

Remove winding assembly by removing nut (8). Winding assembly may be broken down as shown into shunt winding assembly (7), series winding assembly (6) and large insulating washer (5).

Adjustment locking screw (4), lockwashers (3), and washer (2) may be removed from base (1).

Cam screw and adjustment plate are not serviceable separately from the base (1).

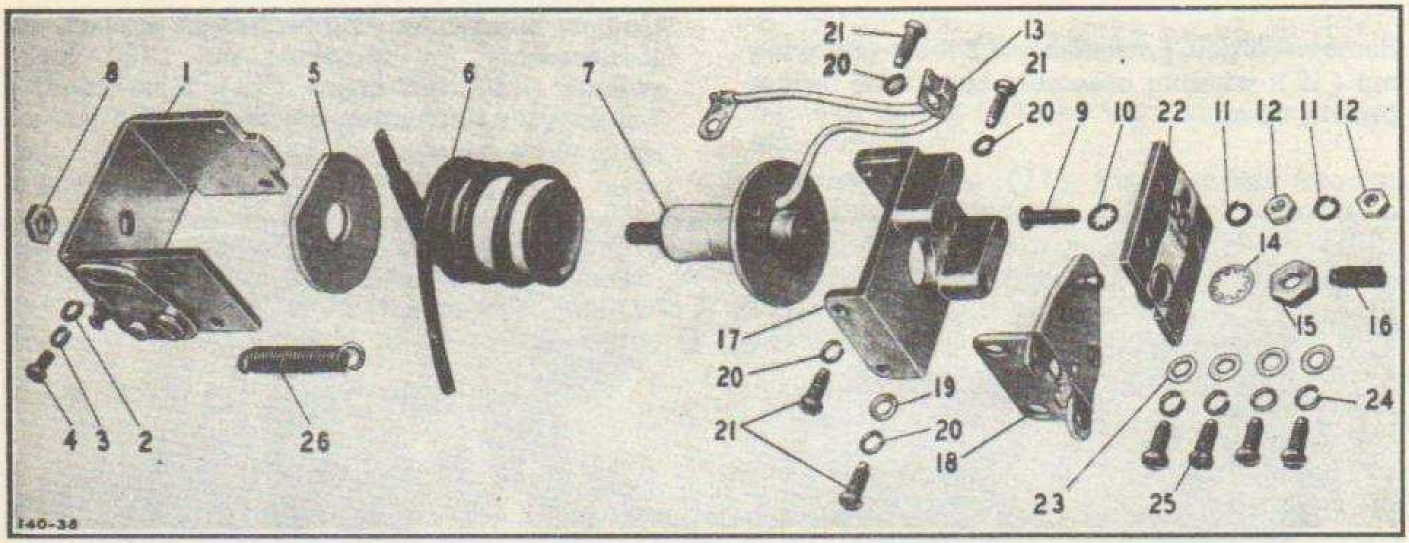

Fig. 75—Exploded View of Current Regulator

1. Regulator Base
2. Screw Washer
3. Screw Lockwasher
4. Adjustment Screw
5. Insulating Washer
6. Series Winding
7. Shunt Winding
8. Winding Nut
9. Terminal Screw
10. Screw Lockwasher
11. Nut Lockwasher
12. Terminal Nut
13. Winding to Terminal
14. Screw Lockwasher
15. Contact Nut
16. Contact Screw
17. Bracket Support
18. Armature
19. Screw Washer
20. Screw Lockwasher
21. Support Screw
22. Contact Bracket
23. Contact Screw Washer
24. Contact Screw Lockwasher
25. Bracket Screw
26. Armature Spring

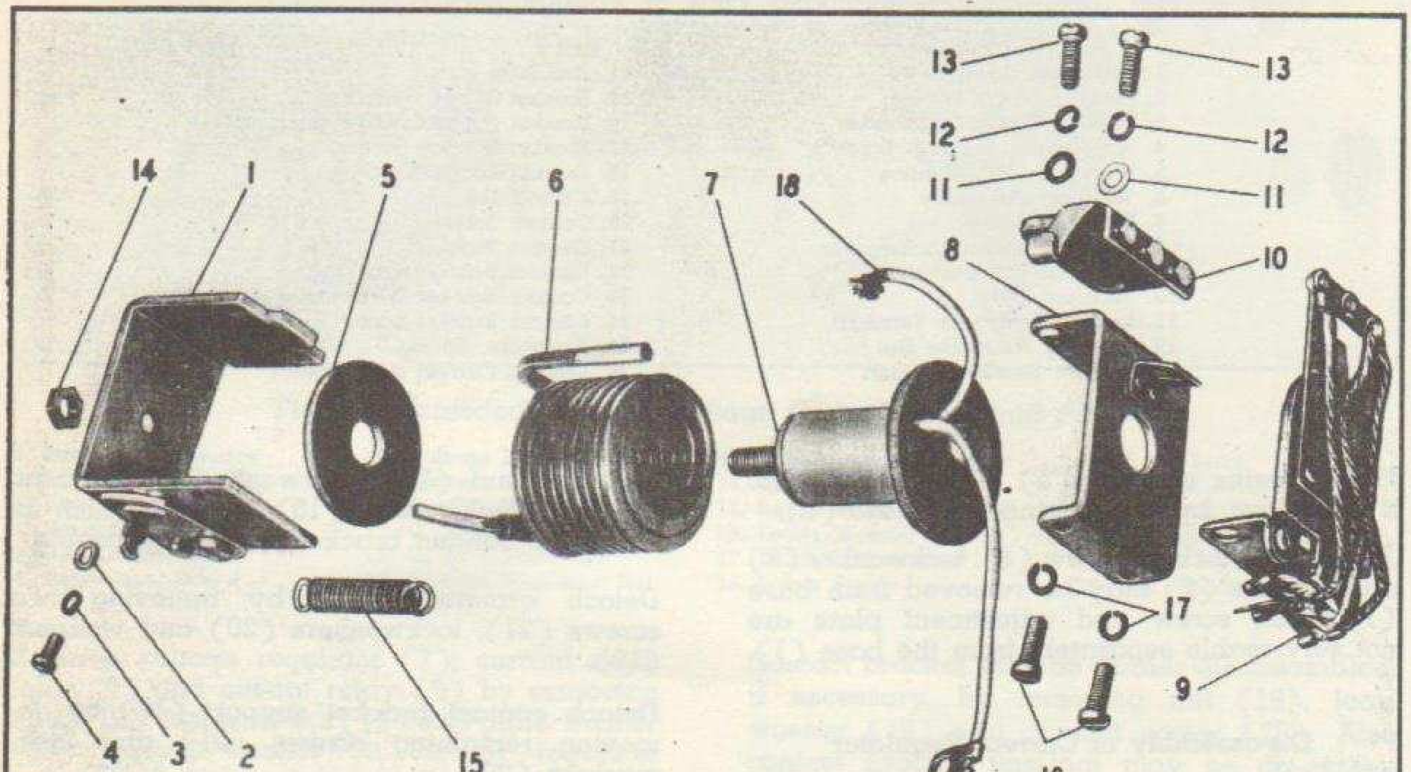

Fig. 76—Exploded View of Cut-Out Relay

1. Relay Base
2. Locking Screw Washer
3. Locking Screw Lockwasher
4. Locking Screw
5. Insulating Washer
6. Series Winding
7. Shunt Winding
8. Armature Stop Bracket
9. Armature & Leads
10. Contact Bracket
11. Contact Bracket Washer
12. Contact Bracket Lockwasher
13. Contact Bracket Screw
14. Winding Assembly Nut
15. Armature Spring
16. Armature Screw
17. Armature Lockwasher
18. Lead to Relay Frame

Dis-assembly of Cut-out Relay

Remove relay spiral armature spring (15) by unsoldering and lifting off. This spring may not be soldered to the armature; if not, do not solder when re-assembling.

Remove contact bracket (10) by taking out screws (13), lockwashers (12) and washers (11).

Detach armature (9) by removing two screws (13) and lockwashers (12).

(7), heavy series winding (6) and large insulating washer (5).

Adjustment locking screw (4), lockwasher (3) and washer (2) may be removed from base (1). Cam screw and adjustment plate are not serviceable separately from base (1).

Dis-assembly of Terminal Plate and Stud Assembly

Remove three nuts (9), three lockwashers (8),

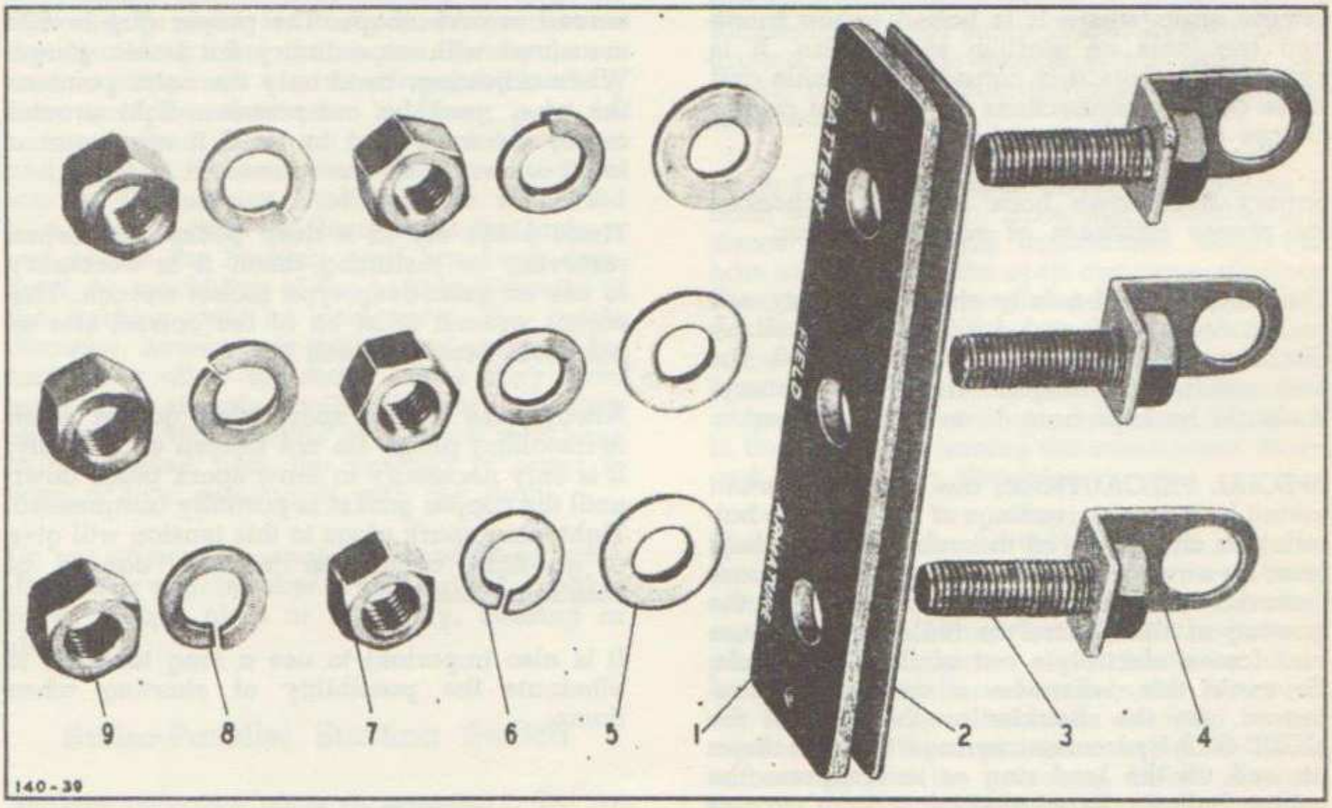

Fig. 77—Exploded View of Terminal Plate

1. Terminal Plate
2. Plate Gasket
3. Terminal Stud
4. Connector Stud
5. Stud Washer
6. Stud Lockwasher
7. Stud Nut (Inner)
8. Lockwasher
9. Stud Nut (Outer)

Leads are not serviceable separately from armature (9).

Lift out armature stop bracket (8).

Unscrew nut (14) and remove shunt winding

three nuts (7), three lockwashers (6) and three washers (5). Three terminal studs (3) may then be pulled out from terminal plate (1) and terminal plate gasket (2).

SECTION 5: REPAIRS

Battery

The battery should be checked at least once a week to obtain maximum service. Test each cell with an accurate hydrometer and at the same time, add sufficient distilled water to bring the liquid level to the bottom of the filler tube as illustrated in Figure No. 1 on page 06-1.

Clean terminals thoroly with a strong solution of ammonia and water and after tightening, coat with vaseline. Clean and tighten ground strap where it is bolted to the frame and terminals on starting motor also. It is important to note that corroded terminals and loose or dirty connections will prevent proper charge and discharge of the battery.

Battery hold down bolts should be checked for proper tightness at each inspection.

The electrolyte of a fully charged battery will be between 1.275 and 1.300 in each cell. A discharged battery will show about 1.000. For best results and longest life of the battery, it should be kept from ¾ to fully charged.

SPECIAL PRECAUTIONS are necessary when taking hydrometer readings of No-Over-Flo batteries on charge out of the vehicle. Vent plugs must be screwed in tight. When vent plugs are removed to take hydrometer readings, the gassing of the electrolyte builds up pressure and forces electrolyte out of the filling hole. To avoid this, whenever a vent plug is removed, use the shoulder on the stem of the EXIDE S-1B hydrometer syringe to press down on and tilt the lead ring or to compress the rubber bellows. Expel electrolyte from syringe and into the cells, remove stem and replace vent plug promptly.

If there is a possibility of open flame being brought near the battery during or after charging, explosive gases formed at the top of the cells during charging should be replaced with air. Raise the valve washer off the valve seat and introduce air into the top of all the cells by a syringe or similar means to force out gases.

Care should be taken to prevent electrolyte being sprayed on the operator.

Spark Plugs

The proper remedy for fouled spark plugs, regardless of whether they are fouled with black soot or oxide deposit, is to clean them in a reliable spark plug cleaner. When properly cleaned the lower end of the insulator should be white, like a new plug. A small file or a piece of sandpaper should be passed thru the gap to clean the firing surfaces of the electrodes.

The gap of a spark plug always wears in a curved or arch shape. The proper gap is .030 measured with an ordinary flat feeler gauge. When adjusting, bend only the outer point as the plug must be compression tight around center electrode and to bend it may start a leak or crack in the porcelain.

These plugs are in a deep pocket and when removing or installing them, it is necessary to use an extra-deep type socket wrench. This socket wrench must be of the correct size or porcelain breakage will occur.

Always use a new spark plug gasket when re-installing plugs. Do not tighten excessively. It is only necessary to draw spark plugs down until the copper gasket is partially compressed. Tightening spark plugs to this tension will give a gas-tight connection without danger of damaging the plug.

It is also important to use a long terminal to eliminate the possibility of shorting when damp.

Distributor

Note: There are few repairs necessary on the distributor, and there are many repairs which should not be attempted. It is far better to replace either the defective part or the entire unit. However, there are some few repairs which may be done satisfactorily.

Probably the most common repair will be the cleaning and filing of the contact points. Pitted, rough, oily, dirty or oxidized points have the effect of high resistance in the primary coil circuit, and reduce the secondary output;

perhaps to the point where the voltage is too low to jump the spark plug gap. The points should be cleaned with a clean fine-cut file. DO NOT REMOVE ANY MORE METAL THAN IS ABSOLUTELY NECESSARY. TRY TO KEEP THE FACES OF THE POINTS FLAT. Should the points be dirty or oily, clean them in carbon tetrachloride. NEVER USE EMERY CLOTH OR SANDPAPER TO CLEAN POINTS. Particles of emery or sand may become embedded in the point surfaces and cause them to burn. Contact point opening must then be checked and reset as outlined in "Section 3: Adjustments."

Occasionally, the bronze shaft bushings in the housing will wear out. If it is a bent shaft that has caused this condition, the shaft must be renewed. To check for faulty bushings, remove the distributor from the engine. If any looseness or sloppiness exists between the bushing sides and the shaft, the bushings must be renewed. Press them out with an arbor press, and press in the new ones. The outside diameter of the service bushings are machined to a press fit with the housing at the factory, and unless the housing itself has been damaged, no machining of the outside diameter of the bushing will be necessary. The inside diameter, however, is drilled undersize at the factory, to allow for shafts which may have worn down slightly. Ordinarily, not more than one or two thousandths of an inch will have to be reamed from the bushing in order to have a good running fit with the shaft.

Do not attempt to repair the condenser, rotor, distributor cap, breaker lever, springs, breaker plate, weight plate or assembly, housing or shaft.

Series-Parallel Starting Switch

Replace defective parts as necessary. Do not attempt to repair any of the component parts of the switch. Should the contact disk or terminal stud faces become scored, clean them with a clean stiff wire brush.

Magnetic Switch

Should the coil terminals or the heavy starting motor lead terminals become bent or otherwise damaged they must be renewed as necessary. The contact disk and studs should be cleaned with a heavy wire brush if they become scored from long use.

Starting Motor

Note: After dis-assembly, all parts should be cleaned, examined, and defective parts renewed.

Armature: Do not clean the armature by any degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth slightly dampened with carbon tetrachloride or similar solvent. If commutator is rough, out of round, has high mica, filled slots, or is burned, it must be turned down in a lathe and the mica undercut.

Ground: Check with test lamp and test points from the commutator to the armature shaft or lamination. If the lamp lights, it indicates a ground, and if the ground is not readily apparent and repairable, the armature must be renewed.

Open Circuit: An open circuited armature is often easy to detect, since this condition produces badly burned commutator bars. The bars connected to the open armature windings soon burn in operation since every time they pass under the brushes they interrupt a flow of current so that heavy arcing occurs. If the bars are not too badly burned, the armature may often be saved by resoldering the leads in the riser bars, turning the commutator down and undercutting the mica.

Short Circuit: A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler, and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature testing shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

Fields: The fields should not be cleaned by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the windings to avoid breaking or weakening the connecting straps between windings. If the field insulation is charred or chaffed so that the windings are exposed, it is sometimes possible to rewrap them with insulating tape and paint them with insulating compound. It must be remembered that if the wrapping is done carelessly so the insulation bulks up too much, it will be impossible to reassemble the coils under the pole shoes. All soldered connections should be made with rosin flux solder.

Brushes: If the brushes are worn down to 5/16 inch (original length 1/2 inch), renew. Make sure that the pigtail leads are tight in the brushes and that the clips are fastened well to the leads.

Brush Springs: The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by placing the armature and commutator end frame together in their normal operating position and then placing the brushes in their holders with the springs in place so that the tension of the springs against the brushes can be measured with a spring gauge. Renew springs if the tension is not correct.

Bushings and Bearings: If the bushings are worn, they should be renewed. Wear will not be even, but on the side which sustains the greatest thrust during cranking. If the ball bearing turns roughly or loosely, replace it. If new bushings are installed, they should be finished as follows: Center bearing bushing burnish to .735-.738 Inside Diam., Drive housing bushing—burnish to .540-.544 Inside Diam. After a bushing is pressed in and reamed to size, the oil wick hole must be drilled out. This throws up a burr, which must be removed with a burnishing tool of the size shown above. Bushings must be reamed concentric with machined registers on castings.

Brush Holders: If the brush holders, insulators, etc., are bent, warped, cracked, burned, or otherwise damaged, renew the commutator end frame. The assembly is of a riveted construction and must be serviced as a unit.

Miscellaneous: Any defective insulator, screw washer, lead, stud, plate, etc., should be renewed. Cracked, bent, worn, burned insulators or washers are defective. Studs or screws which are bent, battered, broken, or which have crossed or damaged threads, are defective. Leads which have broken strands, frayed insulation, are defective.

Starting Motor Drive

Pinion teeth must not be worn, burred, or chipped excessively. Sleeve assembly must be in good condition with parts tightly fastened together.

Generator

Note: After dis-assembly, all parts should be cleaned, examined, and defective parts discarded.

Armature: Do not clean the armature by any degreasing method, since this would damage the insulation and might ruin the armature. Wipe with a clean cloth slightly dampened with carbon tetrachloride or similar solvent. If commutator is rough, out of round, worn, has high mica, filled slots, or is burned, it must be turned down and the mica undercut.

Short Circuit: A shorted armature may be detected on a growler. The growler is a strong electromagnet connected to a source of alternating current. When a shorted armature is placed on the growler, and a hacksaw blade held above the shorted coils in the armature, the blade will be alternately attracted to and repelled from the armature, causing the blade to buzz against the armature. Before discarding an armature tested shorted, inspect the commutator slots carefully, since copper or brush dust sometimes collects in the slots and shorts adjacent bars.

Field Circuit: The field should not be cleaned by any degreasing method, since this would damage the insulation and might ruin the windings. Clean by wiping with a clean, dry cloth. Be careful in handling the winding assembly to avoid weakening or breaking the connecting lead between the two windings. Test the field current draw by connecting a 6-volt battery and an ammeter in series with the two field leads. The current draw should be 1.7-1.9 amperes. Renew if they do not meet specifications. The field insulation should be in good condition. If it is charred or worn away so that the wire is exposed, it is sometimes possible to re-wrap the windings with insulating tape and paint them with insulating compound. All soldered connections should be made with rosin, not acid, flux.

Brushes: If the brushes are worn down to 9/16 in. from an original length of 15/16 in. renew. Make sure the pigtail lead is firmly in place in the brush and that the clip is properly soldered to the lead. New brushes should be seated with a brush seating stone. The brush seating stone is an abrasive material, which held against a revolving commutator, disintegrates and carries under the brushes, thereby seating them in a second or two.

Brush Springs: The brush springs should have sufficient tension to provide the proper pressure between the brushes and commutator after the unit is assembled. This may be checked by assembling the brushes, brush springs, and arms in the commutator end frame and placing the commutator in position in the end frame. Then check with a spring gage the amount of pull required to raise the brush arms from the brushes. Renew springs if tension is not 25 ounces.

Bearings: If the bearings appear to roll roughly or sloppily, renew them. These bearings are the sealed type and do not require lubrication.

Brush Holders: If the brush holders or spring stops are damaged (bent, warped, cracked, etc.) renew the brush end frame. The holders are a riveted construction and the end frame with holders, is serviced as a unit.

Miscellaneous: Any defective insulator, washer, screw, lead, stud, etc., should be renewed. Cracked, bent, battered, worn, burned insulators, and washers are defective. Leads broken, with frayed insulation, are defective. Screws or studs which are bent, battered, broken, or which have had threads are defective.

Voltage Control Unit

Note: After dis-assembly, all parts should be examined, cleaned as necessary, and defective parts repaired or renewed. Particular attention should be given insulators; any found cracked, burned, or otherwise damaged should be renewed.

Winding Assemblies: Winding assemblies should be handled with care, since they contain very fine wire which could be broken by rough treatment. The leads must not be twisted or pulled for the same reason. Make sure that the lead clips are well soldered to the leads and that the insulating tape on the outside of the windings is in place.

Armatures: The cut-out relay armatures, voltage regulator armature, and current regulator armature, all have contact points which should be examined for roughness and pits. Care must be taken in handling the armature, since they have a flat armature spring which must not be bent or distorted. Damaging the flat spring will cause defective operation of the unit after assembly. If the points require cleaning, refer to paragraph on Contact Points for procedure. Avoid touching point surfaces, since any trace of grease or oil may cause points to burn in operation.

Contact Screws: The contact screws of the voltage regulator and current regulator have a contact point which should be examined for roughness or pits. Points are cleaned as outlined in paragraphs on Contact Points. Avoid touching point surfaces, since any trace of grease or oil may cause the points to burn in operation.

Contact Support Bracket: The flat spring on the contact bracket of the voltage regulator and current must not be distorted and must have sufficient tension to rest against fibre at free end. This provides a wiping action between the points in operation. Renew if defective.

Contact Points: Contact points which are pitted, excessively rough, burned, or dirty, may be cleaned with a clean, fine-cut contact file, or on a fine emery wheel or stone. Do not remove more contact material than is absolutely necessary. Make sure all traces of emery or filings are removed from the point surfaces. DO NOT USE EMERY CLOTH OR SANDPAPER, since particles of emery or sandpaper may embed and cause point burning. Do not touch point surfaces or get any grease or oil on them after cleaning, since traces of oil or grease will cause the points to burn in operation.

SECTION 6: LUBRICATION

Starting Motor

On re-assembly, a few drops of light engine oil may be placed in the drive housing and center bushings. The ball bearing, after being washed thoroly, should be repacked with ball bearing grease.

Starting Motor Drive

A trace of very light oil may be placed on the starting motor drive sleeve. Do not overoil the starting motor drive assembly as the surplus oil will tend to pick up dirt, making the operation of the mechanism very sluggish.

No other lubrication is required during re-assembly.

For other lubricating instructions see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

The procedure for re-assembly of the electrical units is the reverse of the dis-assembly with the following exceptions:

Starting Motor

Thread .032 soft iron wire thru holes in center bearing attaching screws and twist ends together.

Starting Motor Drive

Use new lockwashers when re-assembling starting motor, making sure the bent lip fits in the corresponding gap in the drive spring eye, and bending the other lockwasher tang up over a flat side of the screw head after the screw has been tightened.

SECTION 8: SPECIFICATIONS

Battery

MAKE .... Exide
TYPE .... XH M-194
NUMBER PER TRUCK 2
CONNECTED .... Parallel normally, Series for Starting.
PLATES, per cell 19
VOLTAGE, each unit 6
TERMINAL GROUNDED .... Positive
AMPERE HRS. AT 20 HRS. RATE 152
SPECIFIC GRAVITY:
FULLY CHARGED 1.275-1.300
RECHARGE AT 1.200

Ignition Coil

MAKE .... Delco Remy
MODEL 1115149
VOLTAGE 6

Spark Plugs

MAKE .... 14 M.M. Champion
TYPE J-10
POINT GAP .... .030

Distributor

MAKE .... Delco-Remy
MODEL 1110157
TYPE .... Automatic
FIRING ORDER 1-5-3-6-2-4
BREAKER POINT GAP .... .018-.024
TIMING .... 10° B.T.D.C. or 1½ inches or 4¼ teeth on flywheel gear.
CAP No. 1867722
ROTOR No. 1883500
BREAKER ARM 813238
CONTACT BRACKET 1848038
CIRCUIT BREAKER SPRING TENSION .... 17 to 21 ounces.

THE AUTOMATIC SPARK ADVANCE IS:

1°	at	400 R.P.M.
2°	at	600 R.P.M.
5½°	at	1000 R.P.M.
6¾°	at	1200 R.P.M.
9°	at	1400 R.P.M.
11°	at	1600 R.P.M.
13°	at	1800 R.P.M.
16½°	at	2000 R.P.M.
16½°	at	2200 R.P.M. and up

Condenser

MAKE .... Delco-Remy
MODEL 1869704
MINIMUM INSULATION RESISTANCE .... 1000 megohms
CAPACITY .... .18-.23 microfarad
FLASH TEST .... 750 volts D.C.

Series-Parallel Starting Switch

MAKE .... Delco-Remy
MODEL 407-J

Magnetic Switch

MAKE .... Delco-Remy
MODEL 1118008
MAXIMUM VOLTAGE TO CLOSE SWITCH 7.0
CURRENT DRAW AT RATED VOLTAGE 12.0-13.0
RESISTANCE (ohms) 0.9-1.0
BRUSH SPRING TEST .... 2¼ to 2½ lbs.

Starting Motor

MAKE .... Delco-Remy
MODEL 1109104
ROTATION .... Clockwise

Bearings

COMMUTATOR .... Ball Bearing
DRIVE END .... Oil Bushing
CENTER .... Oil Bushing

Gear Reduction

FLYWHEEL TEETH 158
STARTER PINION TEETH 13
RATIO 12.2:1
WINDING .... Series
POLES 6

Service Data

DRIVE .... Bendix RC-13XXX
END-PLAY .... .005" to .030"
COMMUTATOR OUT-OF-ROUND .... .003"
BRUSH SPRING TENSION, OZ. 36-40

No Load Test

AMPERES 65
VOLTS 12
R.P.M. 4500

Lock Test

AMPERES 725
VOLTS 4.8
TORQUE, POUND-FEET 44

Generator

MAKE .... Delco-Remy
MODEL 1105866
VOLTAGE 6
AMPERES 25
ROTATION, VIEWED AT DRIVE END .... Clockwise.
RATIO .... 1.625 times crankshaft

Service Data

END-PLAY .... .005"
BRUSH TENSION, OZ. 25
FIELD CURRENT @ 6 VOLTS, AMPS 1.70-1.90
DRIVE END BEARING .... I.D. .6992-.6990"
O.D. 1.5748-1.5743"
COMMUTATOR END BEARING I.D. .6693-.6990"
O.D. 1.5748-1.5743"

Cold Output

AMPERES 25
VOLTS 8.10
R.P.M. 1150

Hot Output

MAXIMUM OUTPUT .... Controlled by Current Regulator.

Regulator

MAKE	Delco-Remy
MODEL	005628

Service Data

IDENTIFICATION MARK	005628

FOLLOWING ADJUSTMENTS MUST BE MADE WITH VOLTAGE REGULATOR AT OPERATING TEMPERATURE OF 145°F.

Voltage Regulator

VOLTAGE SETTING VOLTS	7.5
POINT OPENING	.015"

Current Regulator

CURRENT SETTING, AMPS.	25
POINT OPENING	.015"

Cut-out Relay

AIR GAP	.057"
POINT OPENING	.020"
POINTS CLOSE, VOLTS	6.7

Lamp Bulbs

HEADLAMP (2) Sealed Beam, Mazda 2400

DRIVING BEAM, Upper		45 CP
PASSING BEAM, Lower		35 CP

	CP	Mazda No.
BLACKOUT DRIVING LAMP (1)		2405-S
BLACKOUT PARKING LAMP (2)	3	63
INSTRUMENT PANEL LAMP (5)	1	51
HEADLAMP BEAM IND. (1)	1	51
BLACKOUT TAIL LAMP (1)	3	C.B. 9225
BLACKOUT STOP LAMP (1)	3	C.B. 9234
SERVICE TAIL & STOP LAMP (1)	21-3	C.B. 9218
BLACKOUT TAIL LAMP (1)	3	C.B. 9225

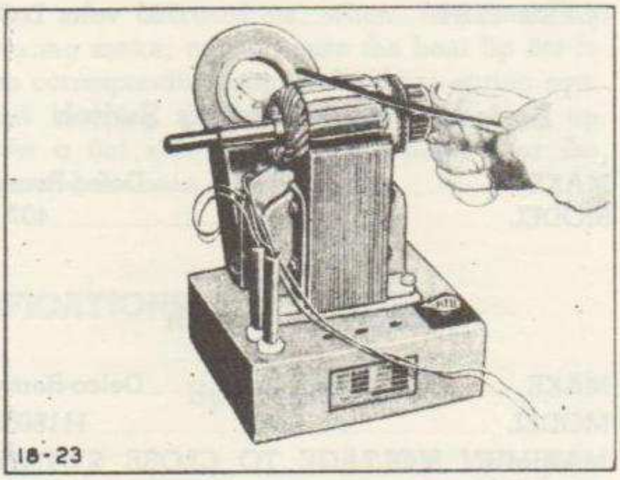

Fig. 78—Growler
(Tool—Federal Stock No. 17-G-5940)

SECTION 9: TOOLS

Part No.	Description
*18-H-1240	Hydrometer, Storage Battery Testing
*17-G-5940	Growler
*41-L-1440	Light, Timing, Tube Type
*17-T-5505	Tester, Battery, Universal Type
*17-T-5520	Tester, Distributor, Cam Angle, and High Tension Circuit
*17-T-5575	Tester, Low-Voltage Circuit
*41-G-105	Gage, Tension, Contact Points

*Federal Stock Numbers

GROUP 07: TRANSMISSION & TRANSFER CASE

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

This Mack unit shown in Figure 1 provides a Transmission and Transfer Case combined as an integral assembly.

The forward section or transmission has five speeds forward and one reverse. The fifth speed is direct drive.

The rear section or transfer case transmits the power to both the front and rear axle drive units. In addition to the normal direct drive, a low range gear gives a reduction of 2.50 to 1. This range gear is employed in the same manner as an auxiliary transmission when abnormal power is required for rough terrain, steep grades or hazardous conditions due to snow, ice or mud. In combination with the main transmission this range gear makes ten forward and two reverse speeds available.

It is important to note that a lock is provided between the range gear and the front axle drive unit declutching mechanism to prevent the range gear from being put in the low range with the front axle drive unit disengaged. When operating conditions necessitate the use of the transfer case low range gear, the front axle drive unit must be engaged.

The case is in two parts as shown in Figure 2. In the forward section is provided the primary set of gears for the normal five speeds forward and one reverse. In the rear section is the secondary set of gears consisting of the fast and slow range gear; the front axle drive unit gear and the power-take-off gear. The bulkhead of the rear section is bolted directly to the flat face of the forward section bulkhead.

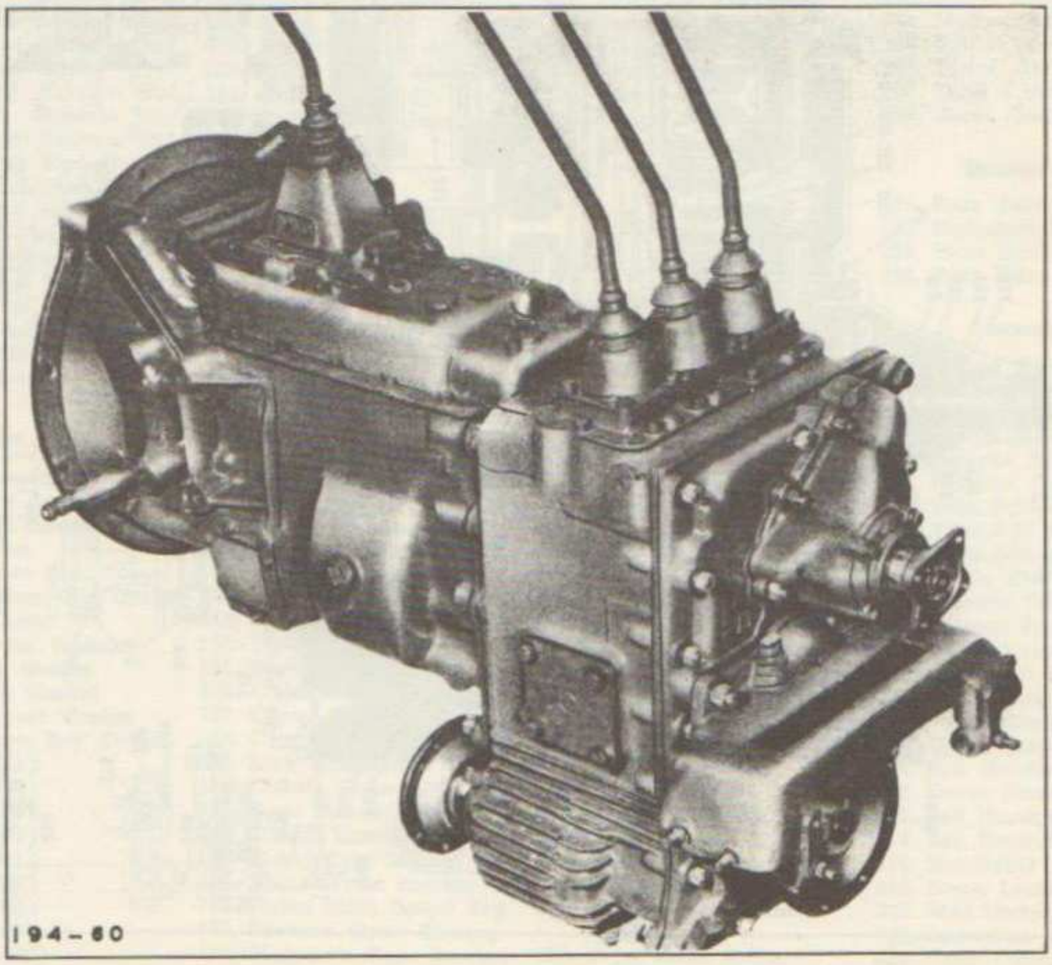

Fig. 1—View of Transmission & Transfer Case

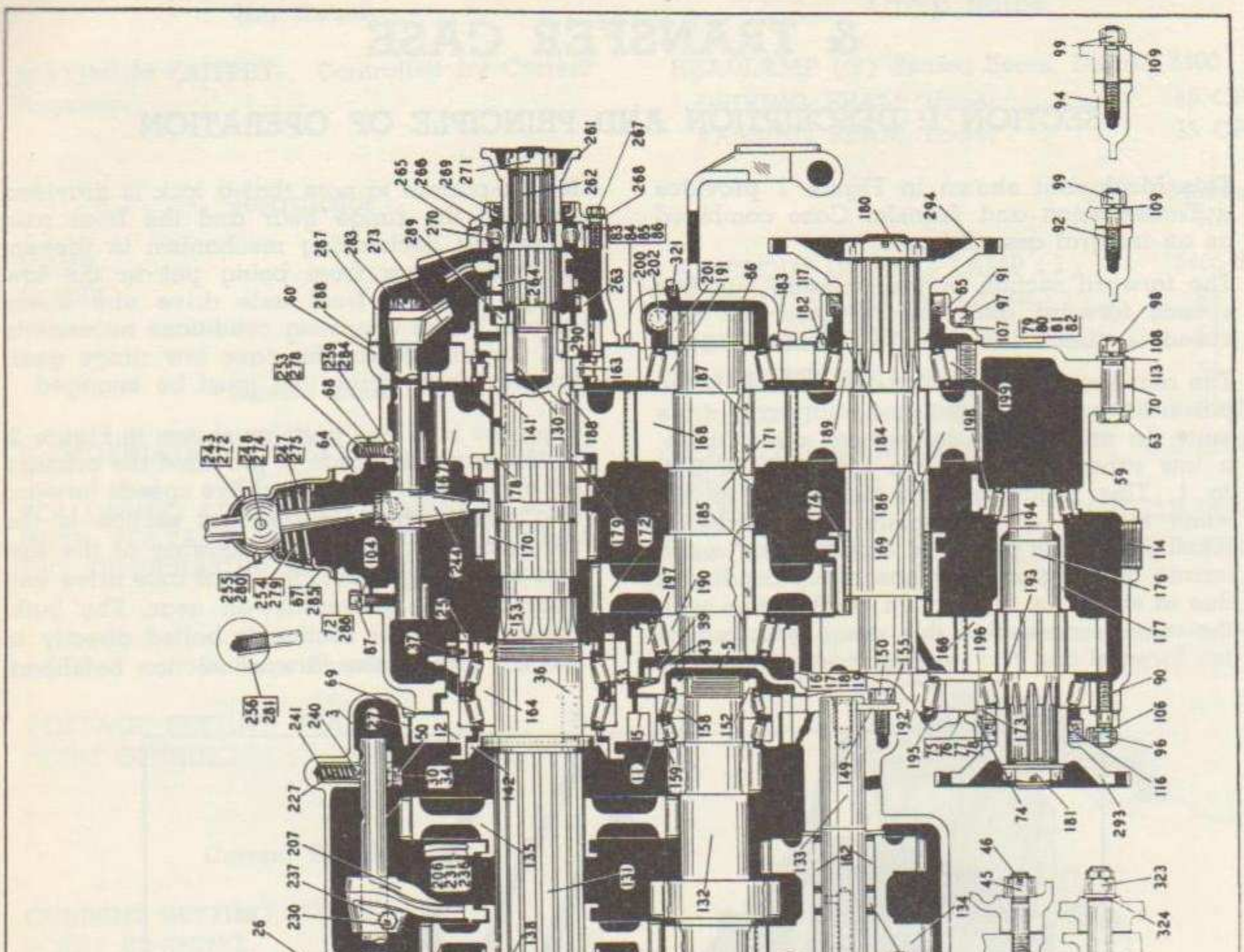

Fig. 2—Sectional View of Transmission & Transfer Case

Transmission

1. Case Assembly
2. Pinion Bearing Cover
3. Shifter Cover
5. Rear Bearing Cover
6. Front Bearing Cover
7. Shifter Cover Breather
9. Bearing Retainer Gasket
10. Bearing Cover Gasket
11. C'shaft Rear Brg. Ret.
12. Center Bearing Retainer
13. Pinion Bearing Retainer
14. C'shaft Front Brg. Ret.
15. Rear Brg. Ret. Gasket
16. Shim (.003)
17. Shim (.005)
18. Shim (.008)
19. Shim (.031)
20. Front Brg. Ret. Gasket
21. Front Cover Gasket
22. Cover End Plate
23. End Plate Gasket
25. Bearing Retainer Nut
26. Shifter Tower Gasket
27. Shifter Cover Gasket
30. Shifter Cover Screw
31. Tower Cover Screw
33. End Plate Screw
34. Shifter Cover Screw
35. Tower Cover Screw
36. Center Brg. Ret. Screw
37. Retainer Nut Setscrew
38. Front Brg. Retainer Stud
39. Rear Brg. Retainer Stud
40. Pinion Brg. Retainer Stud
41. Case Rear Stud
42. Front Brg. Retainer Nut
43. Rear Brg. Retainer Nut
44. Pinion Brg. Retainer Nut
45. Case Rear Stud Nut
46. Stud Nut Cotter
48. End Plate Lockwasher
49. Tower Screw Lockwasher
50. Cover Lockwasher
51. Pinion Ret. Lockwasher
52. C'shaft Ret. Lockwasher
53. C'shaft Ret. Lockwasher
55. Case Drain Plug
56. Cover Breather Elbow

Transfer Case

59. Case Assembly
60. End Plate Assembly
63. End Plate Dowel Bolt
64. Case Cover
65. Rear Drive Brg. Cover
66. C'shaft Rear Brg. Cover
67. Tower Cover
68. Case Cover Gasket
69. Intercase Gasket
70. End Plate Gasket
72. Tower Cover Gasket
74. Front Drive Brg. Cover
75. Shim (.031)
76. Shim (.008)
77. Shim (.005)
78. Shim (.003)
79. Shim (.031)
80. Shim (.008)
81. Shim (.005)
82. Shim (.003)
83. Shim (.0120)
84. Shim (.0149)
85. Shim (.0179)
86. Shim (.0299)
87 Case Cover Screw
90. Front Brg. Cover Stud
91. Rear Bearing Cover Stud
92. End Plate Short Stud
94. End Plate Long Stud
95. Case Front Stud
96. Front Bearing Cover Nut
97. Rear Bearing Cover Nut
98. End Plate Stud Nut
99. End Plate Stud Nut
101. Case Stud Nut
102. Case Stud Cotter
104. Case Cover Lockwasher
106. Brg. Cover Lockwasher
107. Brg. Cover Lockwasher
108. Dowel Lockwasher
109. Stud Lockwasher
112. Case Stud Washer
113. Dowel Washer
114. Case Drain Plug
116. Front Drive Oil Seal
117. Rear Drive Oil Seal

Transmission Case

118. Main Driving Pinion
119. Constant Mesh Gear
120. Pinion Bearing Locknut
121. Pinion Oil Pump Vane
122. Pinion Oil Pump Sleeve
123. Pinion Oil Tube
124. Oil Pump Sleeve Key
125. Pinion Bearing
126. C'shaft Fourth Sp. Gear
127. Fourth Speed Gear
128. C'shaft Third Sp. Gear
129. Third Speed Gear
130. P.T.O. Bushing
131. Mainshaft
132. Countershaft
133. Reverse Gear Shaft
134. Reverse Gear Cluster
135. First Speed Sliding Gear
136. Second Speed Gear
137. Fourth & Fifth Clutch
138. Third Sp. Gear Sleeve
139. Side P.T.O. Gear
140. Fourth Sp. Gear Sleeve
141. Rear Bearing Sleeve
142. Oil Slinger
143. Front Brg. Snap Ring
144. Third & Fourth Speed Gear Bushing
145. Spigot Brg. Snap Ring
146. Thrust Washer Key
147. Reverse Thrust Washer
148. Reverse Bearing Spacer
149. Reverse Shaft Lock
150. Thrust Washer
151. Reverse Lock Screw
152. C'shaft Rear Brg. Nut
153. Center Bearing Nut
154. C'shaft Gears Nut
155. Lock Lockwasher
156. C'shaft Gears Key
157. Gear Sleeve Key
158. C'shaft Rear Brg. Cone
159. C'shaft Rear Bearing Cup
160. C'shaft Front Bearing
161. Pinion Shaft Spigot Brg.
162. Reverse Gear Bearing
163. Mainshaft Rear Bearing
164. Mainshaft Center Bearing

Transfer Case

165. Front Drive Gear
166. Front Drive Driven Gear
167. Constant Mesh Gear
168. Constant Mesh Gear
169. Rear Drive C'mesh Gear
170. Range Gear Sliding Gear
171. Countershaft
172. C'shaft Low Speed Gear
173. Front Brg. Cup Lockpin
174. Front Drive Sliding Clutch
175. Rear Drive Shaft
176. Front Drive Shaft
177. Bearing Spacer
178. C'mesh Gear Sleeve
179. C'mesh Gear Bushing
180. Rear Drive Flange Nut
181. Front Drive Flange Nut
182. Rear Brg. Cup Lockpin
183. C'shaft Bearing Lockpin
184. Rear Bearing Spacer
185. Low Speed Gear Key
186. C'mesh Gear Key
187. C'shaft C'mesh Gear Key
188. C'mesh Gear Sleeve Key
189. Rear Bearing Cone
190. C'shaft Front Brg. Cone
191. C'shaft Rear Brg. Cone
192. Front Bearing Cone
193. Front Bearing Cone
194. Rear Bearing Cone
195. Front Bearing Cup
196. Front Drive Bearing Cup
197. C'shaft Front Brg. Cup
198. Rear Bearing Cup
199. Rear Bearing Cup
200. C'shaft Rear Bearing Cup
201. Speedometer Drive Worm
202. Speedometer Drive Gear

Transmission

206. First & Reverse Fork
207. Second & Third Fork
208. Fourth & Fifth Fork
210. Shifter Lever Rev. Lock
224. Shifter Lever Knob
227. Shaft Ball Spring
229. Reverse Lock Bolt
230. Second & Third Bolt
231. First & Reverse Fork Bolt
232. Fourth & Fifth Screw
234. Lever Ball Ret. Screw
235. Reverse Lock Nut
236. First & Reverse Fork Nut
237. Second & Third Nut
238. First & Reverse Cotter
239. Ball Ret. Lockwasher
240. Shifter Shaft Ball
241. Ball Bushing

Transfer Case

243. Lever Dust Cap
244. Range Gear Fork
246. Interlock
247. Shifter Lever
248. Shifter Ball Pin
250. Range Gear Shifter Shaft
251. Front Drive Shifter Shaft
252. Front Drive Shifter
253. Shaft Ball Spring
254. Shifter Lever Spring
255. Lever Spring Washer
256. Shifter Lever Knob
257. Shifter Setscrew
258. Range Gear Setscrew
259. Shifter Shaft Ball
260. Interlock Plug

Power-Take-Off

261. Drive Shaft Flange
262. Drive Shaft
263. Drive Shaft Clutch
264. Sliding Clutch
265. Bearing Cover Gasket
266. Shaft Bearing Cover
267. Bearing Cover Screw
268. Screw Lockwasher
269. Cover Oil Seal
270. Drive Shaft Bearing
271. Drive Shaft Nut
272. Lever Dust Cap
273. Shifter Fork
274. Shifter Ball Pir
275. Shifter Lever
276. Shifter Shaft
277. Shifter
278. Shaft Ball Spring
279. Shifter Lever Spring
280. Lever Spring Washer
281. Shifter Lever Knob
282. Shifter Setscrew
283. Shifter Fork Nut
284. Shifter Shaft Ball
285. Tower Cover
286. Tower Cover Gasket
287. Shaft & Rear Brg. Cover
288. Cover Gasket

Transfer Case

289. Rear Bearing Locknut
290. Mainshaft Key
293. Front Drive Flange
294. Rear Drive Flange

Transmission

295. Clutch Release Collar
296. Collar Guide Pin
297. Lubricating Tube
298. Clutch Release Shaft
299. Release Yoke
300. Release Collar Spring
302. Yoke Bolt
303. Yoke Bolt Nut
304. Yoke Bolt Cotter
305. Guide Pin Rivet
306. Release Yoke Key
307. Release Ball Bearing
309. Bell Housing
310. Inspection Cover
311. Cover Gasket
312. Cover Gasket
313. Upper Inspection Cover
314. Bell Housing Bolt
315. Cover Screw
316. Bell Housing Stud
317. Bell Housing Nut
318. Nut Cotter
319. Screw Lockwasher
320. Stud Lockwasher
321. Inspection Plug
322. Case Dowel
323. Dowel Nut
324. Dowel Nut Washer

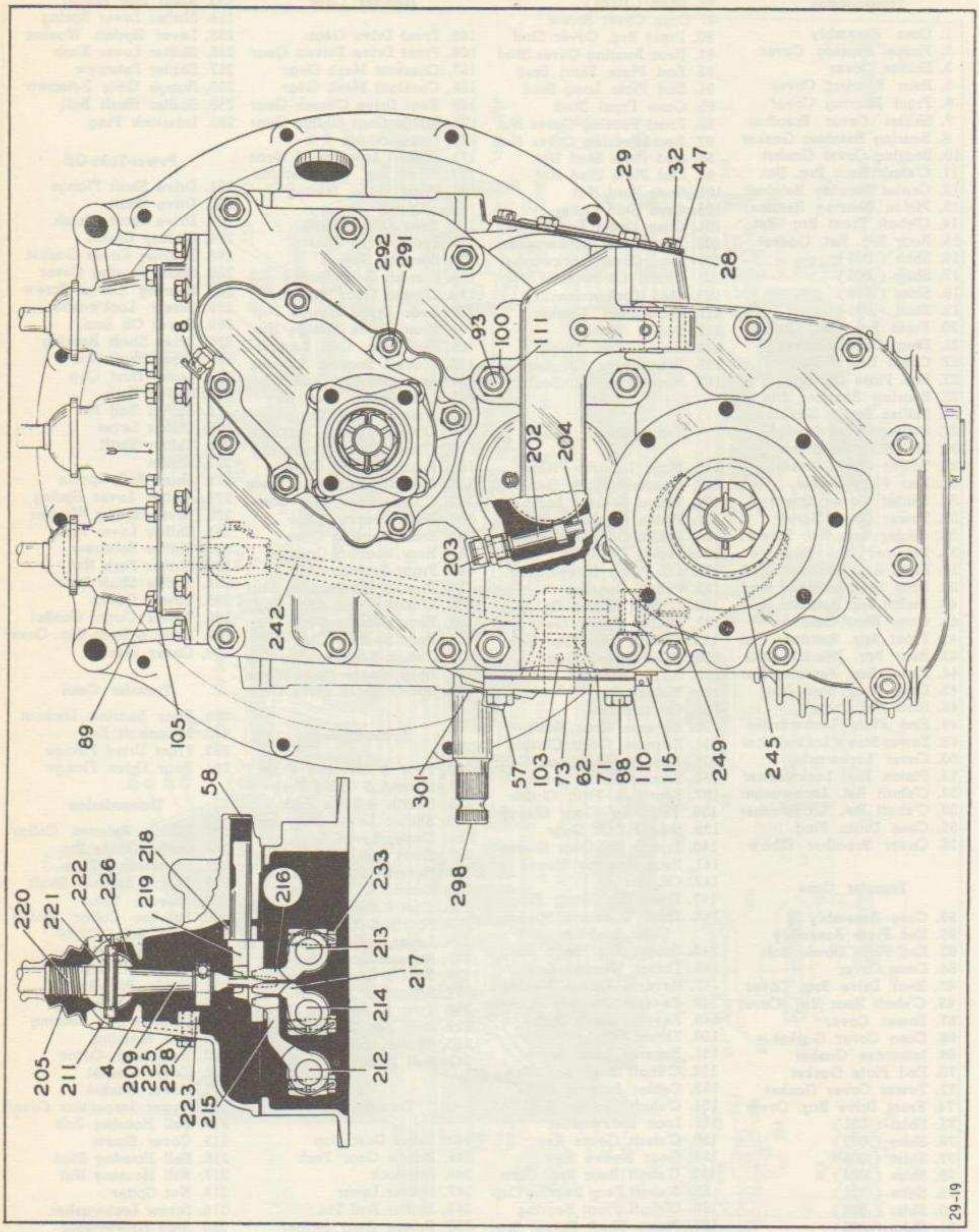

Fig. 3—End View of Transmission & Transfer Case

The gears are shifted manually by hand shifter levers. The primary set of gears is shifted by the main shifter lever mounted in a tower on the transmission. On the transfer case are three shifter lever tower assemblies in a common cover assembly which control the operation of the secondary gears. The high and low range gear is controlled by a "Range Gear" lever located between the seats and to the left of the power-take-off lever. The front axle drive unit gear is controlled by a "Front Axle Drive" lever located between the hand brake lever and the range gear lever. The third control is the power-take-off lever which is located between the range gear and the winch clutch lever. Refer to Figure 4 for shifter lever positions.

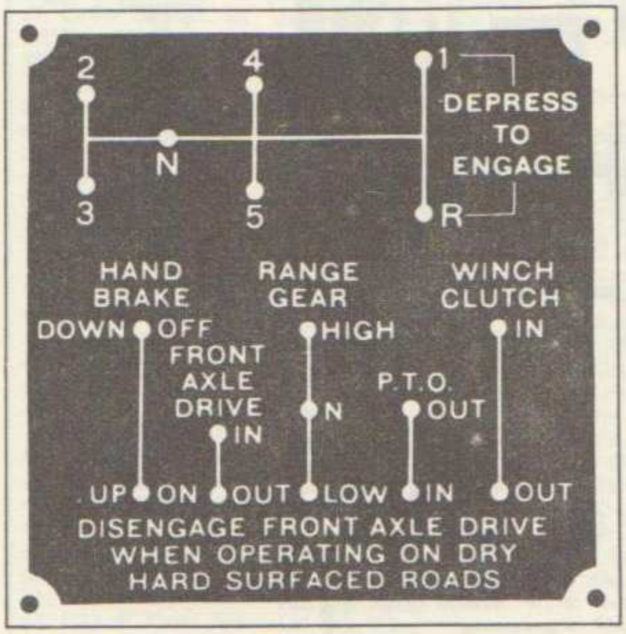

Fig. 4—Shift Diagram

When Shifting EITHER Main Speeds or Range Gear to:

HIGHER RATIO: Accelerate vehicle to governed speed and time the shift to avoid clashing.

LOWER RATIO: Double-clutch as explained under "Shifting Transmission", see page 00-12.

Shifter shafts which carry gear shifter forks and co-act with the shifter levers, are locked in place bv means of poppet balls which are spring loaded. The entire shifter assembly consisting of cover, shifter lever, shifter shafts, forks, poppet springs and balls is removable as a unit.

The main driving pinion is mounted on an annular ball bearing, as is the outer end of the power-take-off drive shaft. Hard rolled bronze bushings are used on the inner end of the take-off shaft, as well as for the third, fourth and range gears on the main shaft. All other bearings are of the roller type.

Helical grooves in main drive pinion which prevent passage of lubricant along the pinion shaft to the clutch, also feed a vane type oil pump which pumps oil at about 8 pounds pressure to the third and fourth speed gear bushings by way of connecting holes drilled in the pinion and mainshaft.

The bell housing is made with two inspection covers which can be readily removed to inspect and adjust the clutch.

Rawhide type of oil seals prevent leakage of lubricant at the power-take-off shaft, front drive shaft and rear drive shaft.

(*Continued on page 07-8*)

4. Transmission Tower Cover
8. Mainshaft Rear Brg. Breather
28. Side P.T.O. Cover Gasket
29. Side P.T.O. Cover
32. Side P.T.O. Cover Screw
47. Screw Lockwasher
57. Transmission Case Filler
58. Tower Welsh Plug
62. Pivot Pin Support
71. Pivot Pin Support Gasket
73. Bell Crank Pivot Pin
88. Pivot Pin Support Screw
89. Transfer Case Tower Screw
93. C'shaft Rear Bearing Cover Stud
100. C'shaft Rear Bearing Cover Nut
103. Pivot Pin Retaining Pin
105. Screw Lockwasher
110. Support Screw Lockwasher
111. Stud Lockwasher
115. Transfer Case Filler Plug
202. Speedometer Driven Gear
203. Speedometer Drive Sleeve
204. Driven Gear Bushing
205. Transmission Lever Dust Cap
209. Transmission Shifter Lever
211. Lever Ball Retainer
212. First & Reverse Shifter Shaft
213. Second & Third Shifter Shaft
214. Fourth & Fifth Shifter Shaft
215. First & Reverse Shifter
216. Second & Third Shifter
217. Fourth & Fifth Shifter
218. Interlock Spacer
219. Shifter Fork Interlock
220. Shifter Lever Spring
221. Shifter Lever Ball
222. Shifter Lever Ball Pin
223. Shifter Lever Reverse Lock
225. Lever Reverse Lock Plate
226. Shifter Lever Ball Retainer
228. Lever Reverse Lockscrew
233. Shifter Screw
242. Front Drive Bell Crank
245. Front Drive Shifter Fork
249. Front Declutch Shifter Shaft
291. Rear Bearing Cover Stud
292. Cover Stud Nut
298. Clutch Release Shaft
301. Release Shaft Bushing

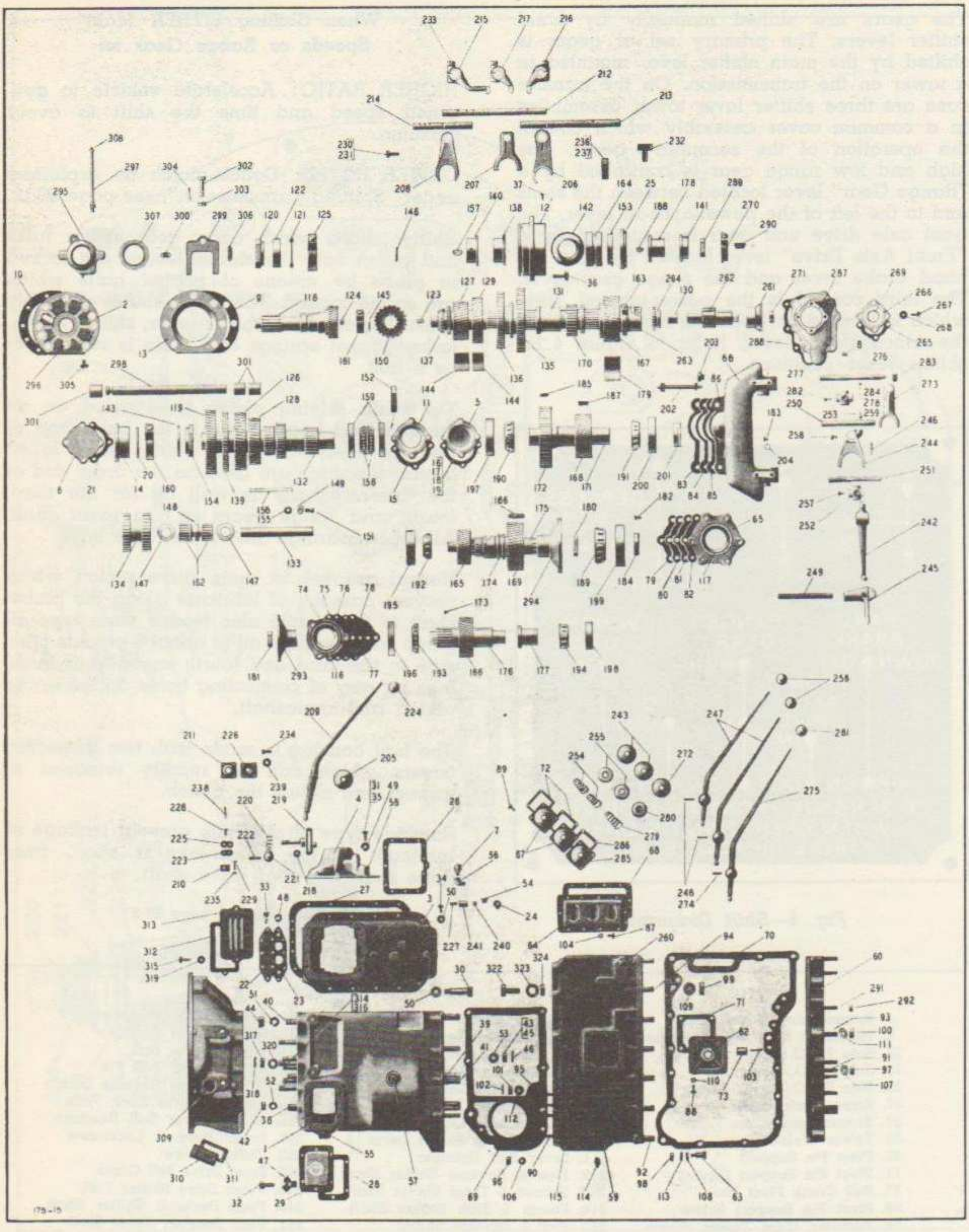

Fig. 5—Exploded View of Transmission & Transfer Case

Transmission Case

1. Case
2. Pinion Brg. Cover
3. Shifter Cover
4. Shifter Tower
5. Rear Brg. Cover
6. Front Brg. Cover
7. Cover Breather
8. Breather
9. Brg. Ret. Gasket
10. Brg. Cover Gasket
11. Rear Brg. Retainer
12. Center Brg. Ret.
13. Pinion Brg. Ret.
14. Bearing Retainer
15. Brg. Ret. Gasket
16. Shim (.003)
17. Shim (.005)
18. Shim (.008)
19. Shim (.031)
20. Brg. Ret. Gasket
21. Brg. Cover Gasket
22. Cover End Plate
23. End Plate Gasket
25. Brg. Retainer Nut
26. Tower Gasket
27. Cover Gasket
28. Side P.T.O. Gasket
29. P.T.O. Cover Screws
30. Shifter Cover
31. Shifter Tower
32. Side P.T.O. Cover
33. Cover End Plate
34. Shifter Cover
35. Shifter Tower
36. Center Brg. Ret.
37. Brg. Ret. Nut Studs
38. C'shaft Front Ret.
39. C'shaft Rear Ret.
40. Pinion Brg. Ret.
41. Case Rear Nut
42. C'shaft Front Ret.
43. C'shaft Rear Ret.
44. Pinion Brg. Ret.
45. Case Rear Stud
46. Nut Lockwasher
47. Side P.T.O. Cover
48. Cover End Plate
49. Shifter Tower
50. Shifter Cover
51. Pinion Brg. Ret.
52. C'shaft Front Ret.
53. C'shaft Rear Ret. Plug
55. Case Drain
56. Breather Elbow
57. Case Filler
58. Tower Welsh Plug

Transfer Case

59. Case
60. End Plate
62. Pivot Pin Support
63. Dowel Bolt
64. Case Cover
65. Rear Brg. Cover
66. Rear Brg. Cover
67. Shifter Tower Cover
68. Cover Gasket
69. Case Gasket
70. End Plate Gasket
71. Support Gasket
72. Tower Gasket
73. Crank Pivot Pin
74. Frt. Brg. Cover
75. Shim (.031)
76. Shim (.008)
77. Shim (.005)
78. Shim (.003)
79. Shim (.031)
80. Shim (.008)
81. Shim (.005)
82. Shim (.003)
83. Shim (.0120)
84. Shim (.0149)
85. Shim (.0179)
86. Shim (.0299)
87. Case Cover
88. Support
89. Shifter Tower Stud
90. Front Drive Cover
91. Rear Drive Cover
92. End Plate (Short)
93. C'shaft Rr. Cover
94. End Plate (Long)
95. Case Front Nut
96. Front Drive Cover
97. Rear Drive Cover
98. End Plate Dowel
99. End Plate Stud
100. C'shaft Rr. Cover
101. Case Stud Pin
102. Stud Nut Cotter
103. Pivot Lockwasher
104. Case Cover
105. Shifter Tower
106. Front Drive Cover
107. Rear Drive Cover
108. End Plate Dowel
109. End Plate Stud
110. Pivot Pin Support
111. C'shaft Rr. Cover
112. Cast Stud Washer
113. End Plate Plug
114. Case Drain
115. Case Oil Seal
116. Front Drive Cover
117. Rear Drive Cover

Transmission Case

118. Pinion Assembly
119. Constant Mesh Gear
120. Pinion Brg. Nut
121. Oil Pump Vane
122. Oil Pump Sleeve
123. Oil Tube
124. Pump Sleeve Key
125. Pinion Bearing
126. Fourth Sp. C'shaft Gear
127. Fourth Speed Gear
128. Third Sp. C'shaft Gear
129. Third Speed Gear
130. P.T.O. Bushing
131. Mainshaft
132. Countershaft
133. Rev. Gear Shaft
134. Reverse Gear
135. First Sp. Sliding Gear
136. Second Sp. Sliding Gear
137. Fourth & Fifth Sp. Sliding Clutch
138. Third Speed Main Shaft Gear Sleeve
139. Side P.T.O. Gear
140. Fourth Speed Main Shifter Shaft
141. Rear Brg. Sleeve
142. Oil Slinger
143. Frt. Brg. Snap Ring
144. Third & Fourth Sp. Gear Bush.
145. Spigot Brg. Snap Ring
146. Thrust Washer Key
147. Reverse Gear Thrust Washer
148. Bearing Spacer
149. Rev. Shaft Lock
150. Fourth Speed Gear Thrust Washer
151. Shaft Lock Screw
152. Rear Brg. Nut
153. Center Brg. Nut
154. C'shaft Gears Nut
155. Screw Lockwasher
156. C'shaft Gears Key
157. Gear Sleeve Key
158. Rear Brg. Cone
159. Rear Brg. Cup
160. C'shaft Front Brg.
161. Spigot Bearing
162. Reverse Gear Brg.
163. Main Shaft Rear Bearing
164. Center Bearing

Transfer Case

165. Front Drive Gear
166. Front Drive Driven Gear
167. Constant Mesh Gear
168. C'shaft Mesh Gear
169. Constant Mesh Gear
170. Range Gear Sliding Gear
171. Countershaft
172. Low Speed Gear
173. Frt. Brg. Lock Pin
174. Frt. Dr. Sliding Clutch
175. Rear Drive Shaft
176. Front Drive Shaft
177. Driven Gear Spacer
178. Gear Sleeve
179. Gear Bushing
180. Rear Dr. Flange Nut
181. Front Dr. Flange Nut
182. Rear Brg. Lock Pin
183. C'shaft Brg. Pin
184. Rear Brg. Spacer
185. Low Sp. Gear Key
186. Rear Dr. Gear Key
187. C'mesh Gear Key
188. C'mesh Gear Key Cone
189. Rear Dr. Rear Brg.
190. C'shaft Frt. Brg.
191. C'shaft Rear Brg.
192. Rear Dr. Frt. Brg.
193. Ft.Dr. Frt. Brg.
194. Frt. Dr. Rear Brg. Cup
195. Rear Dr. Frt. Brg.
196. Frt. Dr. Frt. Brg.
197. C'shaft Front Brg.
198. Frt. Dr. Rear Brg.
199. Rear Dr. Rear Brg.
200. C'shaft Rear Brg. Speedometer
201. Drive Worm
202. Driven Gear
203. Drive Sleeve
204. Drive Gear Bushing

Transmission

205. Lever Dust Cap
206. First & Rev. Fork
207. Second & Third Fork
208. Fourth & Fifth Fork
209. Shifter Lever
210. First & Rev. Lock
211. Lever Ball Ret.
212. First & Rev. Shaft
213. Second & Third Shaft
214. Fourth & Fifth Shaft
215. First & Rev. Shifter
216. Sec. & Third Shifter
217. Fourth & Fifth Shifter
218. Interlock Spacer
219. Interlock
220. Lever Spring
221. Lever Ball
222. Lever Ball Pin
223. Lever Rev. Lock
224. Lever Knob
225. Reverse Lock Plate
226. Lever Ball Ret.
227. Shaft Ball Spring
228. Reverse Lock Screw
229. Lever Lock Bolt
230. Second & Third Bolt
231. First & Rev. Bolt
232. Fourth & Fifth Screw
233. Shifter Screw
234. Ball Ret. Screw
235. Lever Lock Nut
236. Fork Bolt Nut
237. Fork Bolt Nut
238. Lock Nut Cotter
239. Ret. Lockwasher
240. Shaft Ball
241. Ball Bushing

Transfer Case

242. Frt. Dr. Bell Crank
243. Lever Dust Cap
244. Range Gear Fork
245. Front Drive Fork
246. Interlock
247. Shifter Lever
248. Ball Pin
249. Front Declutch Shifter Shaft
250. Range Gear Shifter Shaft
251. Front Drive Shaft Gear Sleeve
252. Front Dr. Shifter
253. Shaft Ball Spring
254. Lever Spring
255. Spring Washer
256. Lever Knob
257. Shifter Setscrew
258. Fork Setscrew
259. Shaft Ball
260. Interlock Plug

Power-Take-Off

261. Drive Shaft Flange
262. Drive Shaft
263. Drive Shaft Clutch
264. Sliding Clutch
265. Brg. Cover Gasket
266. Bearing Cover
267. Bearing Cover Screw
268. Screw Lockwasher
269. Bearing Cover Seal
270. Shaft Bearing
271. Shaft Nut
272. Lever Dust Cap
273. Shifter Fork
274. Shifter Ball Pin
275. Shifter Lever
276. Shifter Shaft
277. Shifter
278. Shaft Ball Spring
279. Lever Spring
280. Spring Washer
281. Lever Knob
282. Shifter Setscrew
283. Shifter Fork Nut
284. Shifter Shaft Ball
285. Shifter Tower
286. Tower Gasket
287. Rear Bearing Cover
288. Cover Gasket
289. Rear Brg. Lock Nut
290. Main Shaft Key
291. Cover Stud
292. Cover Stud Nut Flange
293. Front Drive Shaft
294. Rear Drive Shaft

Transmission

295. Release Collar
296. Collar Guide Pin
297. Lubricating Tube
298. Release Shaft
299. Release Yoke
300. Collar Spring
301. Shaft Bushing
302. Yoke Bolt
303. Yoke Bolt Nut
304. Yoke Bolt Cotter
305. Guide Pin Rivet
306. Release Yoke Key
307. Release Bearing
308. Lubricant Fitting
309. Bell Housing
310. Inspection Cover
311. Cover Gasket
312. Cover Gasket
313. Insp. Upper Cover
314. Bolt
315. Cover Screw
316. Stud
317. Stud & Bolt Nut
318. Case Bolt Cotter
319. Screw Lockwasher
320. Bolt Washer
321. Inspection Plug
322. Dowel
323. Dowel Nut
324. Washer

Helical gears are used for the constant mesh, intermediate and high speeds. The lower speeds employ spur gears. A sliding gear clutch sleeve on the main shaft is used to engage intermediate and high speed. A similar clutch engages the "fast" and "slow" drive.

Altho the dis-assembly, repairs, and reassembly of the power-take-off is considered in this group, see "Group 19: Winch" for additional information.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Noise

Note: Before doing any work on the transmission, be sure noise is not coming from another part of the chassis. Make a thoro check, riding with driver if at all possible. After other causes are eliminated, check the following:

PROPELLER SHAFT MISALIGNED OR OUT OF BALANCE.......Readjust the following: Check loose universal joints for worn needle bearings. Renew if necessary. Check propeller shaft for alignment. Realign. Check universal flanges for loose bolts. Tighten and renew when necessary.

LACK OF LUBRICATION.......Refill to proper level and check viscosity of lubricant.

WORN GEARS.......Check for excessive back lash and renew if necessary.

LOOSE GEAR FIT.......Renew all necessary parts of loose fit.

WORN OR LOOSE BEARINGS ON SHAFTS OR IN GEARS.......Renew worn parts.

TRANSMISSION MISALIGNED WITH CLUTCH HOUSING.......Realign.

MAIN DRIVING PINION OR CLUTCH SHAFT WORN AND OUT OF ALIGNMENT.......Realign and renew worn parts where necessary.

CLUTCH HOUSING LOOSE ON ENGINE.......Tighten clutch housing mounting bolts.

TRANSMISSION LOOSE ON CLUTCH HOUSING.......Tighten transmission mounting bolts.

REAR SECTION LOOSE ON FRONT SECTION OF TRANSMISSION.......Tighten mounting bolts.

Slipping Out of Gear

WEAK POPPET SPRINGS IN SHAFT RAILS.......Clean poppets and springs and renew if necessary.

CLASHING OF GEARS CAUSING TAPERED WEAR OF GEAR TEETH.......Renew worn or damaged gears.

LOOSE FIT OF GEARS ON SPLINES OR SHAFT DUE TO WEAR.......Renew worn parts.

PARTIAL ENGAGEMENT OF GEARS CAUSING TAPERED WEAR OF TEETH.......Renew worn gears and adjust for proper engagement.

WORN BEARINGS CAUSING LOOSENESS.......Renew worn parts.

Hard Shifting

CLUTCH DOES NOT RELEASE.......Adjust or renew worn parts. See "Group 02: Clutch, Section 3, Adjustments."

SHIFTER SHAFT SCORED.......Install new parts.

Loss of Lubricant

DEFECTIVE GASKETS.......Install new gasket.

WORN OR DAMAGED OIL SEAL.......Install new seal.

EXCESSIVE LUBRICANT.......Remove filler plug and drain to level of plug.

SECTION 3: ADJUSTMENTS

Note: No Transmission & Transfer Case adjustments are included in this section as they require partial dis-assembling. See "Section 7: Re-assembly" and "Section 8: Specifications", for adjustments and fits.

SECTION 4: DIS-ASSEMBLY

Removing Transmission & Transfer Case from Chassis

Three men may be employed to advantage to remove the transmission and transfer case from the chassis in short time.

Drain oil from transmission and transfer case.

Raise engine hood and disconnect hand throttle by removing stop on wire. Then take out cotter pins on each end of accelerator link and pull out link.

Roll up cab top and then lower windshield to horizontal position by releasing clamps at each side and pushing forward.

Remove draft mats around steering post and shifting levers for transmission and transfer case.

Remove accelerator pedal linkage by unscrewing nut and removing washer and pin from underneath pedal.

Take out three countersunk screws and release brake valve. Care must be taken not to disturb the hexagon head screws as they retain the brake valve assembly.

After taking out capscrews from toe and floor board and the split plates around transfer case levers, remove both plates and toe and floor board.

(See Figure 6)

Working underneath the truck disconnect propeller shaft between rear of transfer case and forward rear axle drive unit. Because of the inaccessibility of the upper bolts, it will be necessary to either move the vehicle sufficiently to turn the disk or jack up both rear axle units at the same side and by using a bar in the universal joint or by rotating the free wheels accomplish the same purpose. After all bolts are removed pull propeller shaft to the rear out of the hand brake assembly, and then draw it as far to the right side as possible and wire up.

Remove the nuts, bolts and lockwashers from the rear flange of the front axle propeller shaft and disconnect from transfer case. Draw propeller shaft as far to the right side as possible and wire up temporarily.

Working in cab remove nuts, bolts and lockwashers at each end of toe and floor board support channel. Turn channel and remove.

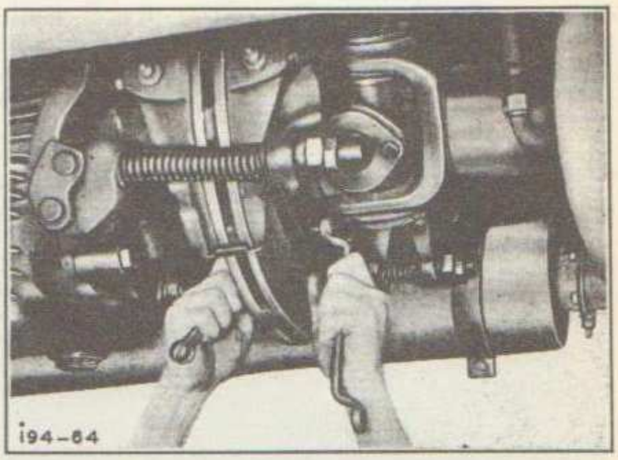

Fig. 6—Removing Rear Propeller Shaft

Remove capscrews from transmission shifter tower and then remove tower. Care should be taken not to damage the gasket. Place a clean rag or other covering over the opening.

Remove capscrews from transfer case shifter towers and then remove towers. Care should be taken not to damage gaskets. Place clean rags or other coverings over openings. These towers should be marked for their respective positions and should be removed individually —not all three together as an assembly since re-installation will be complicated by such a procedure.

Remove nuts, bolts and lockwashers from each flange on the power-take-off shaft and remove shaft.

Disconnect speedometer cable at transmission.

Place a single sling around the transmission immediately forward of the transfer case lower extension.

Place a jack under the rear of the transmission and elevate slightly so as to support the weight of the transmission while removing bell housing bolts.

Loosen engine rear support adjusting bolts so that brackets may be freed.

Remove engine rear support bracket bolts, side and top. Also detach speedometer cable clamp on the left hand side of transmission shifter rods cover.

Remove engine rear support brackets.

Take out bolts on right and left hand fender and remove fender rear cross brace.

Unscrew holding bolt and knock clutch lever off serrated shaft.

(See Figure 7)

Adjusting the jack beneath for clearance, place a ⅝" to 1" thick block between engine

Fig. 7—Placing Supporting Block

rear support ear and bracket in frame on each side. Let transmission down so that engine ears rest on these blocks.

Detach speedometer cable at bell housing by removing capscrew.

Remove bell housing capscrews, pilot stud nuts and washers.

Remove clevis pins on left and right side of hand brake push rods.

Hoist assembly slightly so that jack can be removed.

Pry transmission from engine bell housing with a pinch bar.

Hold transmission away from engine with bar so that spline shaft will not be damaged and lower to ground.

Remove sling. Transmission may be supported on blocks or rolled over and taken away.

Dis-assembly of Transmission and Transfer Case

Note: Certain parts can be inspected without dis-assembling and these items need not be taken apart unless they require renewal. In actual practice all sub-assemblies are stripped from the transmission and taken apart later if necessary. In order to avoid scattered description, both these operations are covered together in most cases. All staked locknuts are turned off, shearing staked part of nut in keyway. The following operations cover the full dis-assembly of this unit.

Drain oil out of transmission case and transfer case by removing pipe plugs (55) and (114).

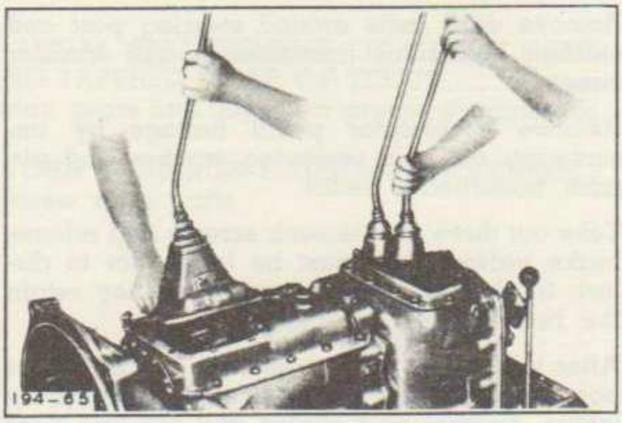

Fig. 8—Removing Shifter Towers

Remove transfer case tower capscrews (89) and detach the three shifter tower assemblies (67) and (285) and their respective gaskets (72) and (286). Also remove transmission shifter tower capscrews (31) and (35) and detach shifter tower (4) and gasket (26).

(See Figure 9)

Remove shifter shaft cover capscrews (30) and (34) and lift cover assembly (3) and gasket (27) off transmission case (1). Also

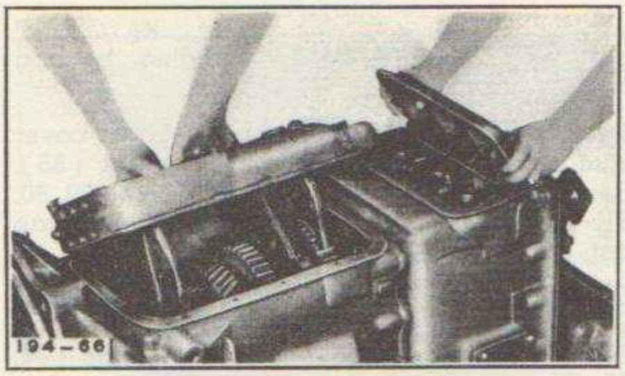

Fig. 9—Removing Shifter Shaft Covers

remove transfer case cover capscrews (87) and lift off cover assembly (64) and gasket (68). Lift out the three shifter shaft ball springs (253) and (278). The three poppet balls (259) and (284) are removed later after shifter shafts are taken out.

Dis-assembling Transfer Case

Note: When dis-assembling, care should always be taken to keep bearing shim packs intact. This will save time in re-assembling and in making bearing adjustments as it will probably be found necessary to remove or add only one or two shims for correct adjustment.

Lock both the transfer case rear drive shaft (175) and front drive shaft (176) by sliding range gear sliding gear (170) into mesh, sliding front drive clutch (174) into mesh and

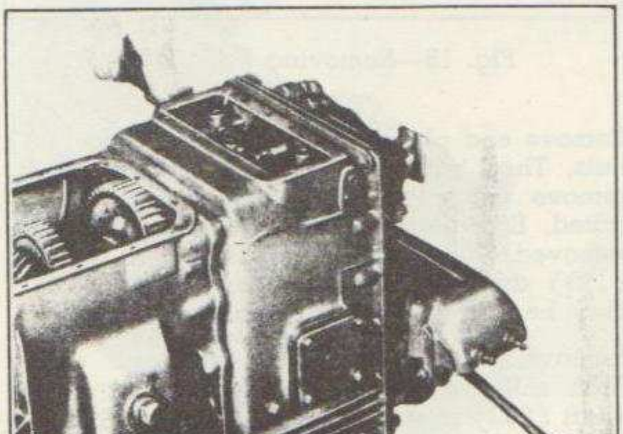

Fig. 10—Removing Rear Drive Shaft Flange Nut
(Tools—Snap-On Part No's. L-53 and L-803)

then moving two sets of gears, mainshaft first (135) and second (136) speed, in the transmission, into mesh at the same time with their respective countershaft gear. Remove rear drive shaft flange nut (180), also front drive

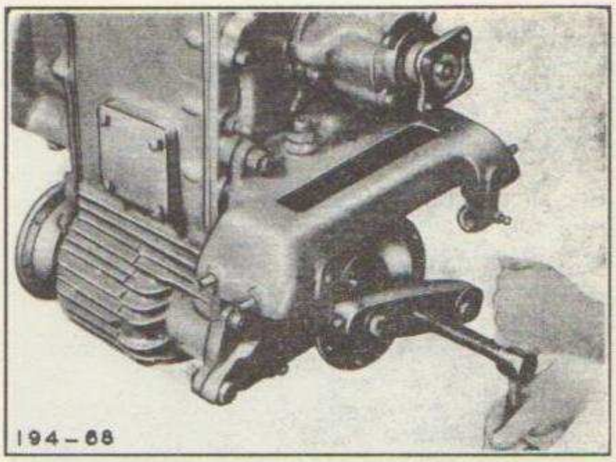

Fig. 11—Removing Rear Drive Flange
(Tool—Federal Stock No. 41-P-2905-60)

shaft flange nut (181), and in this case Tools —Snap-On Part No's. L-683 and L-803.

Remove rear drive flange (294) and front drive flange (293) with aid of puller tool as illustrated, or in an emergency by directing heavy blows against rear face of flange with a soft hammer using care.

Remove power-take-off assembly located at the top of the case as a unit as follows: Detach power-take-off shaft cover stud nuts (292).

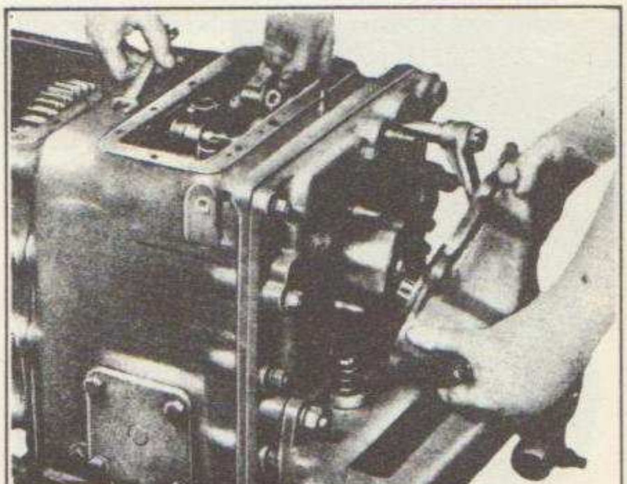

Fig. 12—Removing Power-Take-Off Assembly

Reach into transfer case (59) and remove power-take-off shifter setscrew (282) in shifter (277). Taking hold of power-take-off drive flange (261) and power-take-off shaft cover (287), separate power-take-off assembly from transfer case (59) while holding shifter (277) as shifter shaft (276) slides out. Lift out shifter shaft poppet ball (284). Detach power-take-off shaft cover gasket (288).

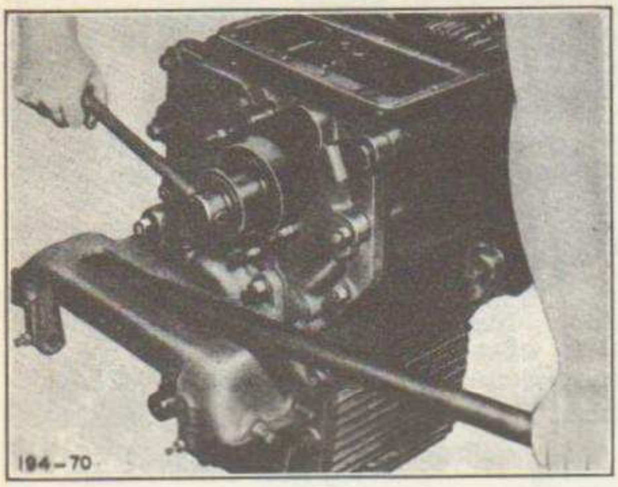

Fig. 13—Removing Mainshaft Rear Bearing Lock Nut
(*Tool—Mack Part No.* 17-T-1496)

With mainshaft (131) assembly still in locked position, remove mainshaft rear bearing lock nut (289) using special wrench as illustrated.

Turn out speedometer drive sleeve (203) and then remove speedometer driven gear (202). Caution: The driven gear (202) is preferably removed before detaching countershaft rear bearing cover and brake bracket (66).

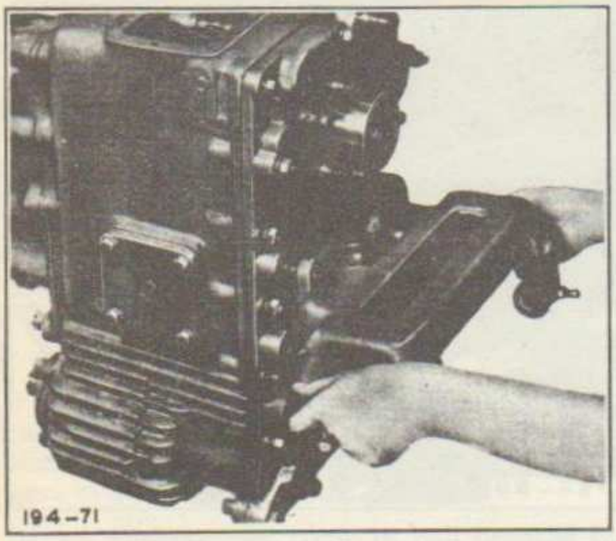

Fig. 14—Removing Countershaft Rear Bearing Cover and Brake Bracket

Detach cover stud nut (100) and remove bracket (66).

Remove and wire together countershaft rear bearing cover shims (83, 84, 85 and 86). Countershaft rear bearing cup lock pin (183) is not usually removed. This also applies to all similarly applied pins holding bearing cups.

Detach rear drive shaft rear bearing cover stud nuts (97) and then remove cover (65). Remove and wire together cover shims (79, 80, 81, and 82). Slide off spacer (184) and tap out oil seal (117).

Detach front drive shaft front bearing cover stud nuts (96) and then remove cover (74). Remove and wire together cover shims (75, 76, 77, and 78). Tap out oil seal (116).

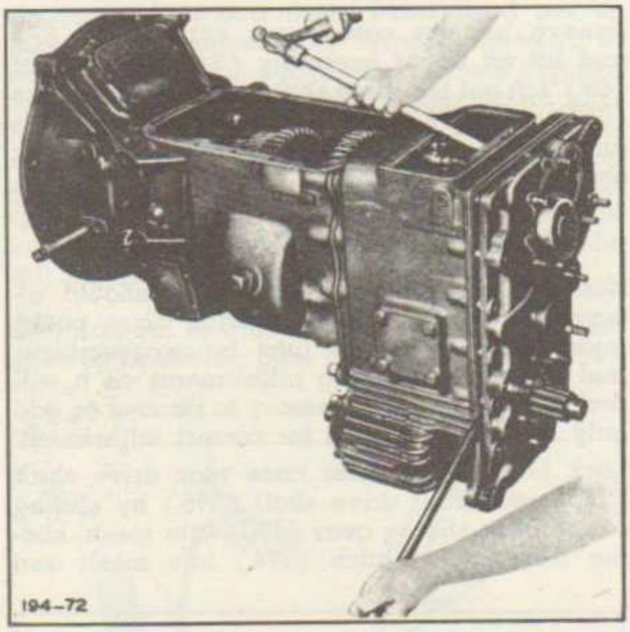

Fig. 15—Removing End Plate

Remove end plate dowel (98) and stud (99) nuts. Then with aid of pinch bar and drift, remove end plate (60) from case as illustrated. End plate gasket (70) may now be removed. Cups of rear drive shaft rear bearing (199) and countershaft rear bearing (200) may be tapped out if necessary.

Remove front drive shifter setscrew (257) from shifter (252). Place range gear shifter shaft (250) in neutral, hold shifter (252) and then remove front drive shifter shaft (251). Be sure to retrieve shifter shaft poppet ball (259).

(See Figure 16)

Remove pivot pin support capscrews (88) and then lift out pivot pin support (62). Then remove front drive shifter bell crank (242) thru top of case. Bell crank pivot pin (73) may be driven out of support after cotter pin is removed.

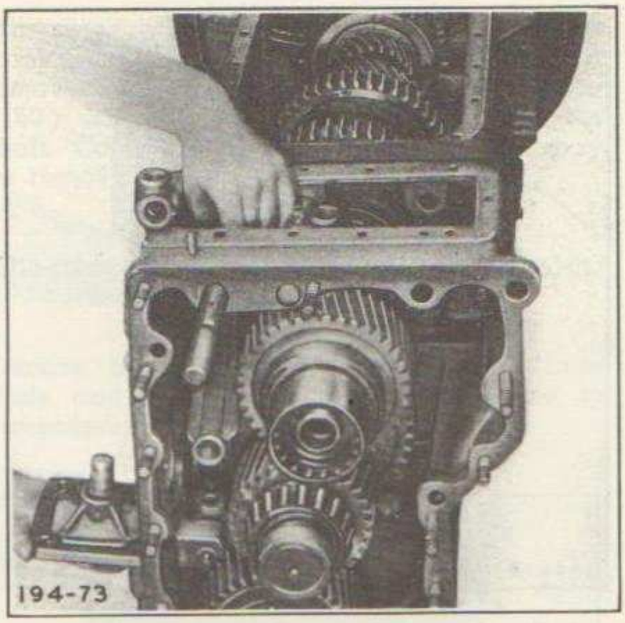

Fig. 16—Removing Pivot Pin Support and Bell Crank

Remove range gear shifter fork setscrew (258) and lift out fork (244) while sliding out shifter shaft (250). Remove shifter shaft poppet ball (253). Take out shifter shaft interlock plug (260) and then slide out range gear and front drive shift rail interlock (246).

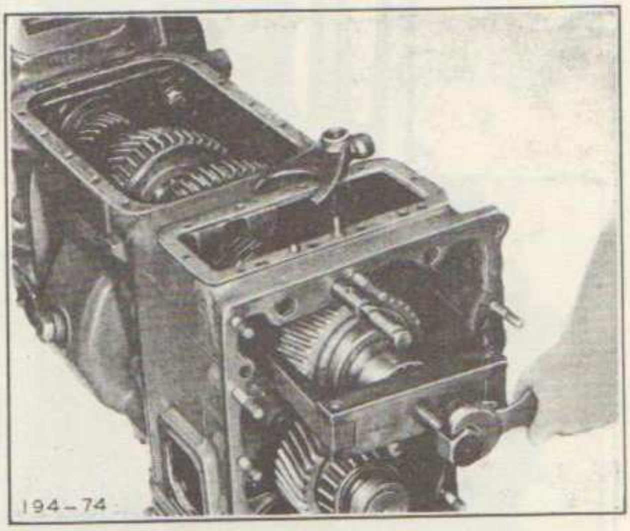

Fig. 17—Removing Mainshaft Gears
(Tool—Federal Stock No. 41-P-2911)

Attach puller to mainshaft constant mesh gear (167) as illustrated and pull off constant mesh gear (167), mainshaft rear bearing (163), rear bearing sleeve (141) and power-take-off drive shaft clutch (263).

Slide off mainshaft constant mesh gear sleeve (178) and range gear sliding gear (170). Drive out constant mesh gear bushing (179) if worn, and keys (188 and 290) if necessary.

Countershaft

Reach into case and remove countershaft (171) and parts.

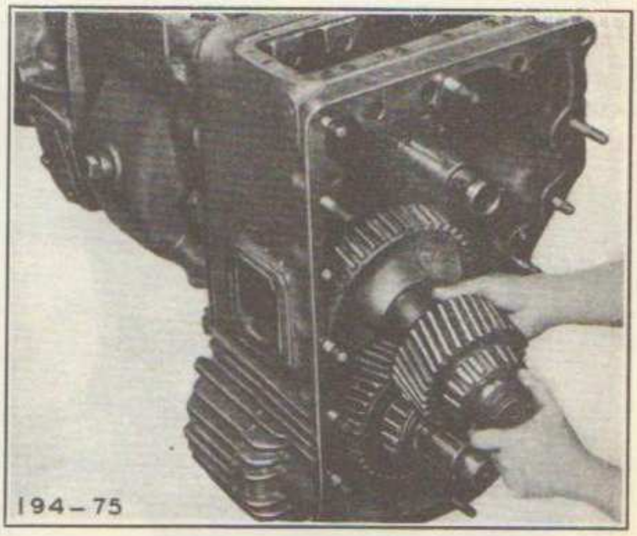

Fig. 18—Removing Countershaft

Place countershaft in power press and block-up low speed gear (172). Oil the shaft to aid the gear removal and then press shaft out of low speed gear (172) and front bearing cone (190).

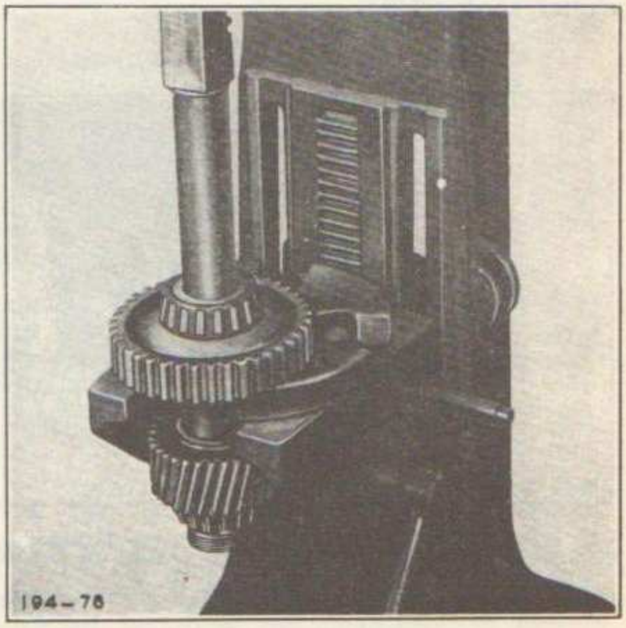

Fig. 19—Removing Low Speed Gear

Turn countershaft over and block-up constant mesh gear (168). Oil the shaft to aid the gear removal and power press constant mesh gear (168), rear bearing cone (191) and speedometer drive worm (201) off the shaft. The low speed gear key (185) and constant mesh gear key (187) may be removed if necessary.

Rear Drive Shaft

Reach into case thru pivot pin support opening and remove cotter pin as illustrated.

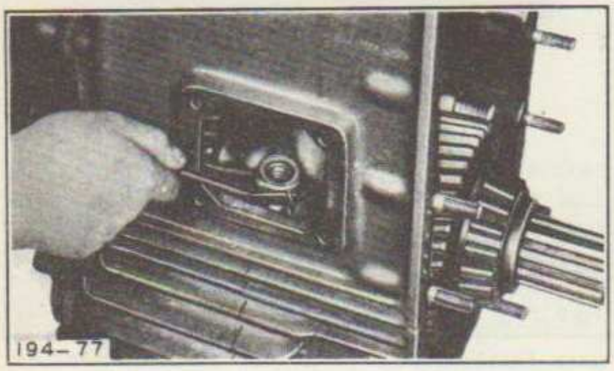

Fig. 20—Removing Cotter Pin in Front Drive Declutch Shaft

Push rear drive shaft assembly slightly to one side, as illustrated, and then screw a long 3/8" capscrew into front drive declutch shifter shaft (249).

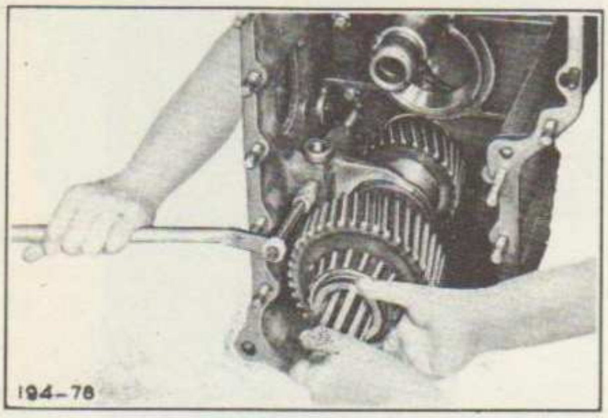

Fig. 21—Removing Front Drive Declutch Shaft

Withdraw shaft (249) toward the rear by prying under head of capscrew with pinch bar. Remove front drive fork (245).

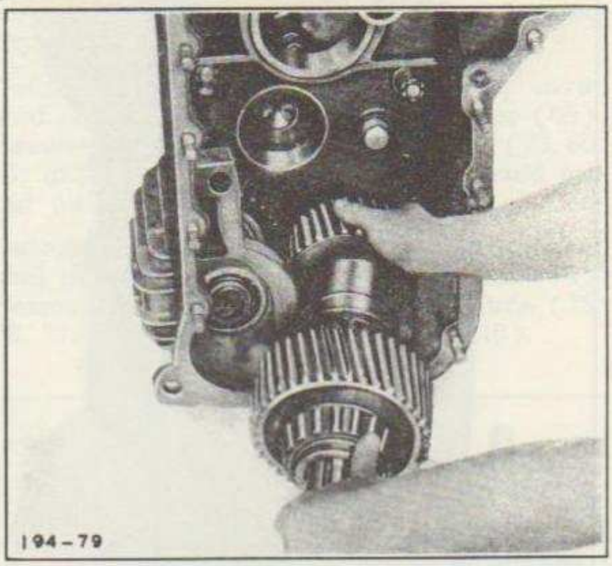

Fig. 22—Removing Rear Drive Shaft

Lift front drive shaft (175) and its parts out of case.

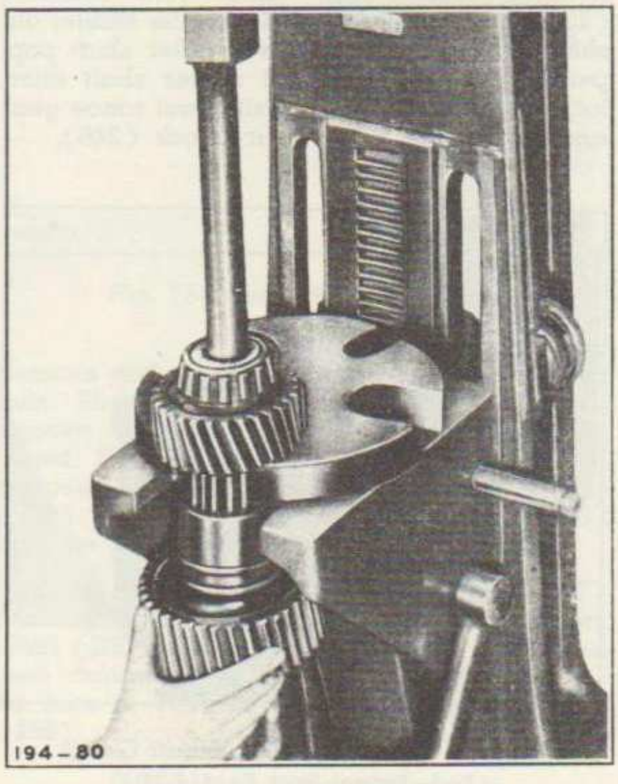

Fig. 23—Removing Front Drive Driving Gear

Place drive shaft in power press and block-up front drive driving gear (165). Oil the shaft to aid the gear removal and then press shaft out of front drive driving gear (165) and front bearing cone (192). Slide off front drive sliding clutch (174).

Turn drive shaft over and block-up constant mesh gear (169). Oil the shaft to aid the gear removal and power press constant mesh gear (169) and rear bearing cone (189) off the shaft. Constant mesh gear key (186) may be removed if necessary.

Dis-assembling Transfer Case From Transmission Case

Remove transmission case nuts (45) from studs and dowels holding transfer case to transmission case.

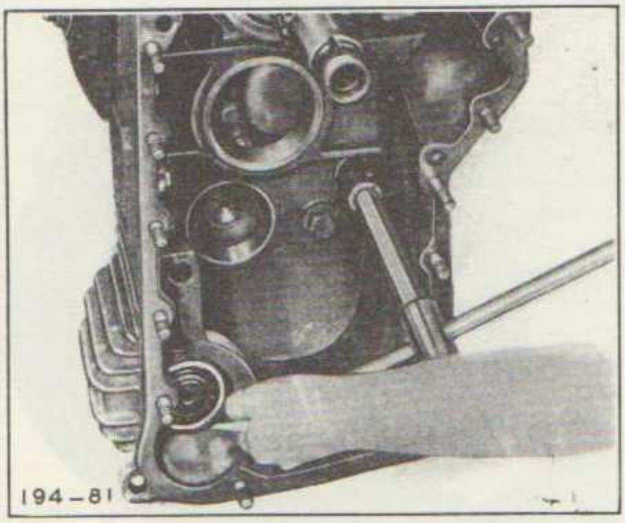

Fig. 24—Removing Transmission Case Stud Nuts

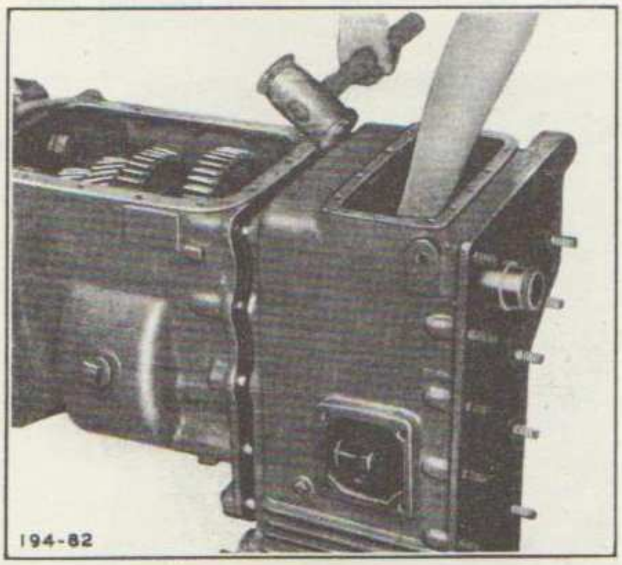

Fig. 25—Removing Transfer Case from Transmission Case

Separate transfer case (59) from transmission case (1) by prying around mating edges with a pinch bar and driving with a drift. Detach intercase gasket (69).

Front Drive Shaft

With transfer case on the floor, enter drift against front drive shaft (176) thru end plate

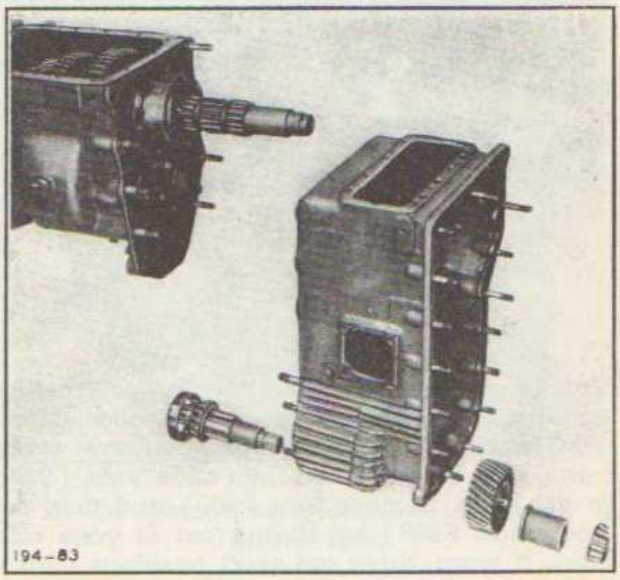

Fig. 26—Front Drive Shaft Removed

opening and in so doing drive out shaft which will carry with it front bearing cone (193). Lift front driven gear (166), spacer (177), and rear bearing cone (194) out of case.

Dis-assembling Transmission

Note: When dis-assembling, always take care to keep bearing shim packs intact. This will save time in re-assembling and making bearing adjustments as it probably will be found necessary to remove or add only one or two shims for correct adjustment.

Remove countershaft rear bearing retainer stud nuts (43) and then rear bearing cover (5). Detach and wire together rear bearing shims (16, 17, 18 and 19).

(See Figure 27)

With first (135) and second (136) speed mainshaft gears still locked as described in a preceding paragraph, remove countershaft rear bearing nut (152). Use a wrench with sufficient leverage, as illustrated, to enable shearing off staked part of nut in the countershaft keyway. This nut has a left-hand thread.

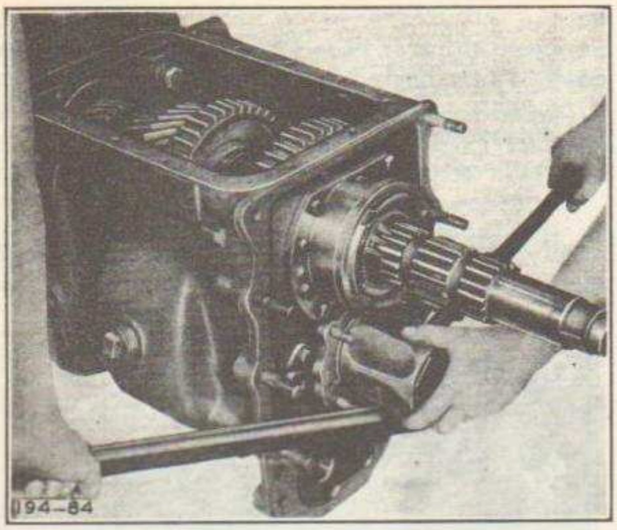

Fig. 27—Removing Countershaft Rear Bearing Nut
(Tool—Snap-On Part No. L-53 and L-843)

Clutch Release Shaft

Unhook clutch release bearing retracting spring (300) and remove clutch collar (295) and bearing (307) assembly. Remove pinch bolt (302) on yoke and then slide yoke (293) to one side. Remove key (306) and then extract shaft (298) by sliding out of yoke and case. If worn, drive out shaft bushings (301).

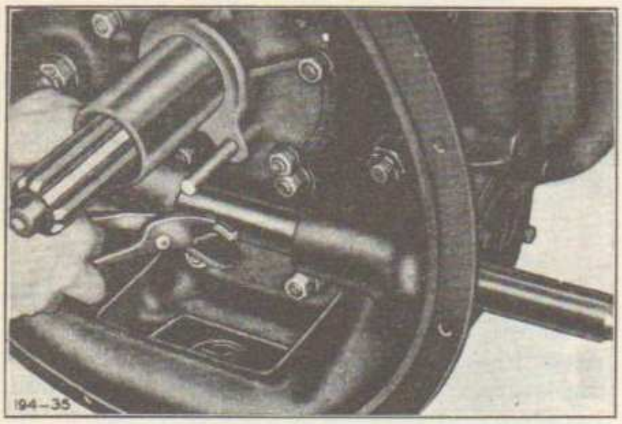

Fig. 28—Removing Cluch Release Shaft

Main Driving Pinion
(See Figures 29, 30 and 31)

Remove bearing retainer stud nuts (44) that hold main drive pinion bearing cover (2) in place. While removing cover (2) care should be taken not to damage oil pump vane (121). Extract vane (121) and detach cover gasket (10).

Insert puller screws into tapped holes of bearing retainer (13) and gradually remove pinion assembly (118) by applying pressure evenly to these screws, to avoid binding retainer in case. Detach bearing retainer gasket (9).

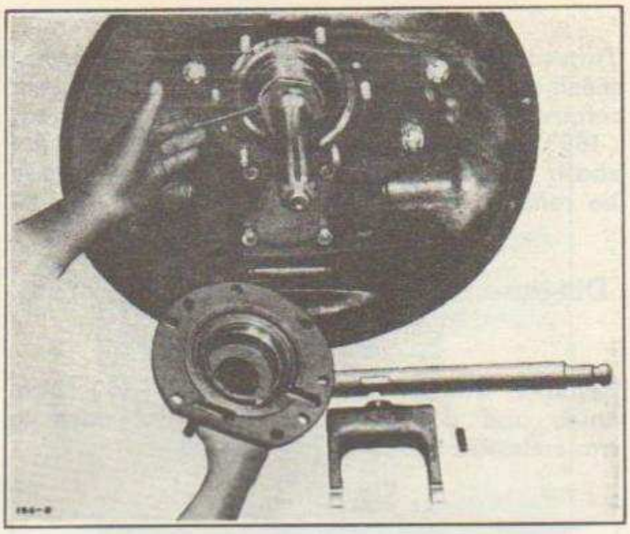

Fig. 29—Removing Pinion Bearing Cover

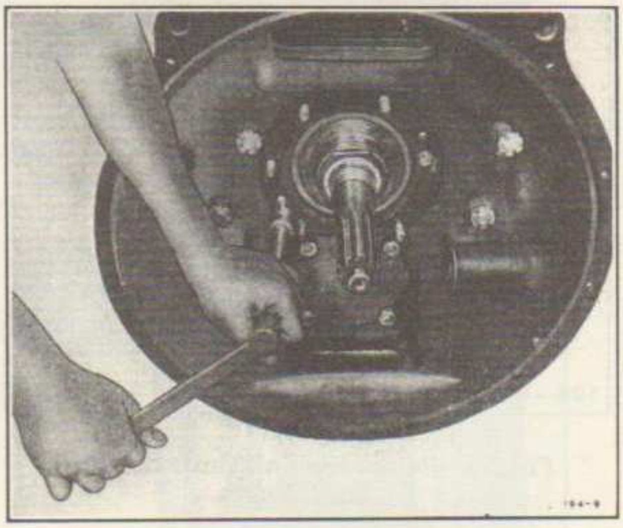

Fig. 30—Removing Pinion Retainer and Bearing

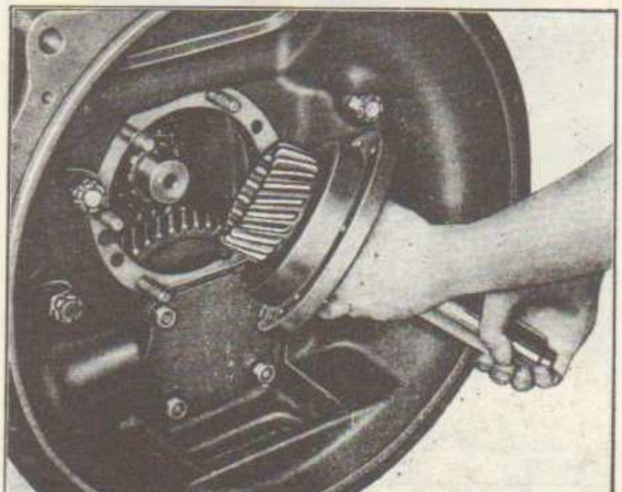

Fig. 31—Removing Pinion Assembly

Dis-assembling Main Driving Pinion (See Figures 32 and 33)

Tap retainer (13) off bearing. Holding pinion assembly in a vise, if fixture is not available, pry out snap ring (145) and pull spigot bearing (161) out of pinion with spigot bearing puller tool as illustrated. Remove oil tube

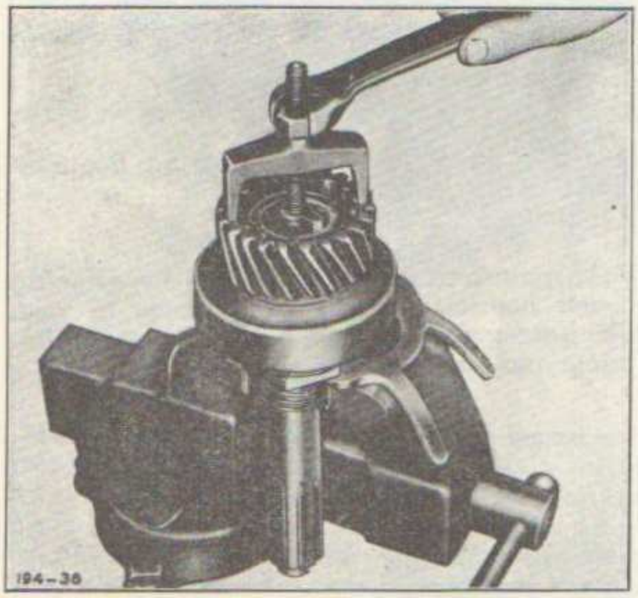

Fig. 32—Removing Pinion Spigot Bearing
(Tool—Mack Part No. 17-T-274)

(123) with pliers or thread tube to employ puller capscrew. Then reverse position of pinion assembly by placing teeth of pinion in soft jaws of vise and turn off locknut (120).

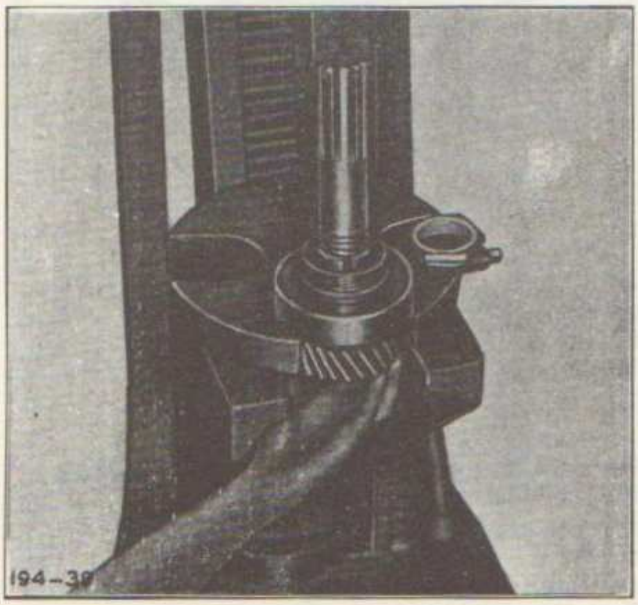

Fig. 33—Removing Pinion Bearing

Block up pinion bearing (125) in a press and press pinion thru bearing and oil pump sleeve (122).

Mainshaft and Gears

Dis-assemble mainshaft (131) partially within case before removing. Proceed as follows:

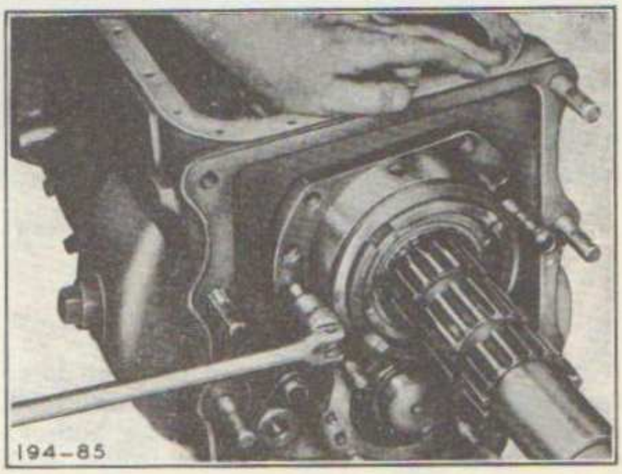

Fig. 34—Removing Mainshaft Assembly Toward Rear

Remove center bearing retainer capscrews (36). Then by using puller screws turned into tapped holes in retainer (12), move mainshaft assembly to the rear several inches.

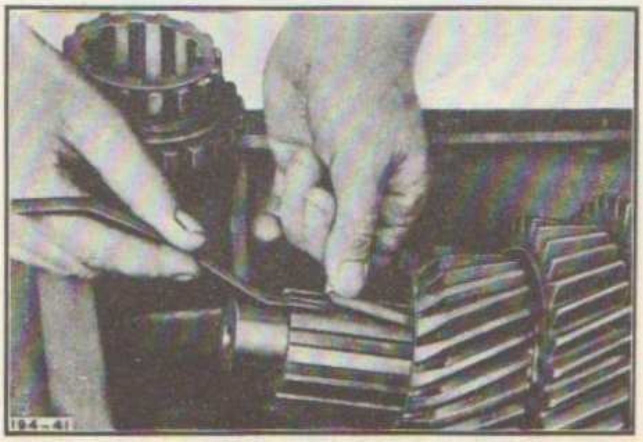

Fig. 35—Removing Locking Key

Slide fourth and fifth speed sliding clutch (137) off shaft. Pry special locking-key (146) out of imbedded position between splines and remove.

Fig. 36—Removing Fourth Speed Gear and Thrust Washer

Insert and wedge a small tool between internal teeth of fourth speed gear (127) and teeth of thrust washer (150), then rotate both together until splines of washer align with splines of shaft. Slide the gear and washer off shaft together.

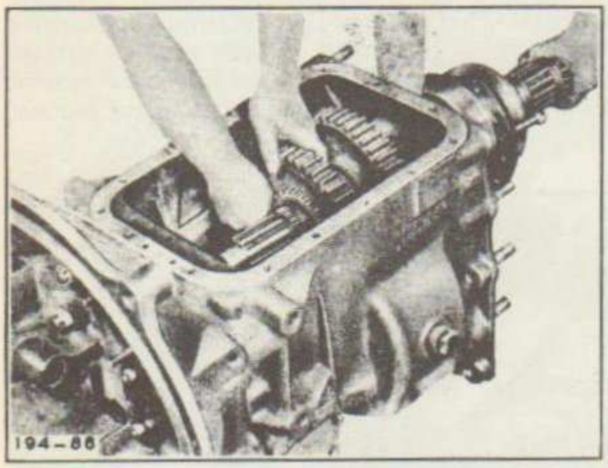

Fig. 37—Removing Mainshaft From Case

Slide off fourth speed gear sleeve (140), third speed gear (129) and third speed gear sleeve (138). Pull the mainshaft out thru the case rear bore, meanwhile, removing second speed sliding gear (136) and first and reverse speed sliding gear (135). Third and fourth speed gear bushing (144) may be driven out if worn. Do not lose gear sleeve key (157).

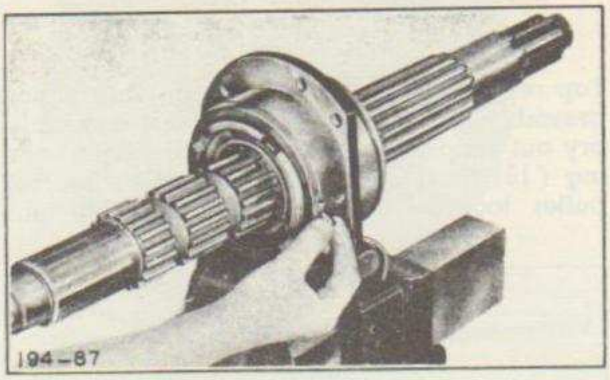

Fig. 38—Removing Center Bearing Retainer Nut Setscrew

Hold mainshaft assembly in vise by gripping center bearing retainer (12) flange in vise. Using screwdriver, remove center bearing retainer nut setscrew (37).

Fig. 39—Removing Center Bearing Retainer Outer Nut

Drive off mainshaft center bearing retainer outer nut (25) with drift and hammer if special spanner wrench, Mack Part No. 17-T-1497, is not available.

(See Figure 40)

Re-assemble a sliding gear on mainshaft and hold this assembly in a vise by gripping flat surface of hub of sliding gear. Now turn off center bearing inner nut (153) with a drift and hammer if special spanner wrench, Mack Part No. 17-T-1498, is not available.

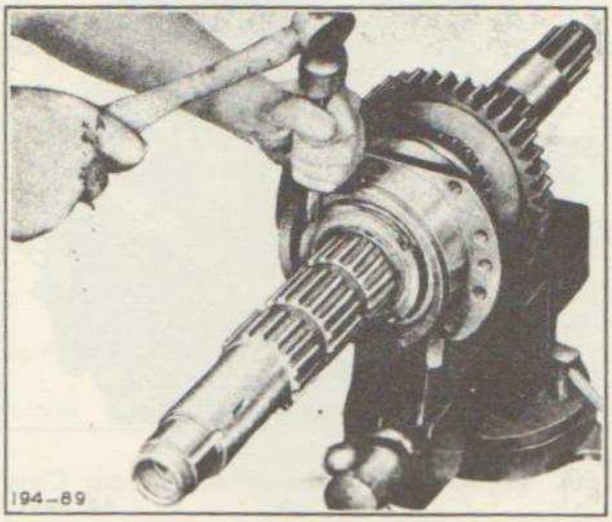

Fig. 40—Removing Center Bearing Inner Nut

Place mainshaft (131) in power press and block up center bearing retainer (12). Insert a drift bar in the power-take-off end of the mainshaft and press shaft out of center bearing (164) and oil slinger (142). Drive bearing cup and spacer out of retainer. Remove mainshaft power-take-off bushing (130) if worn.

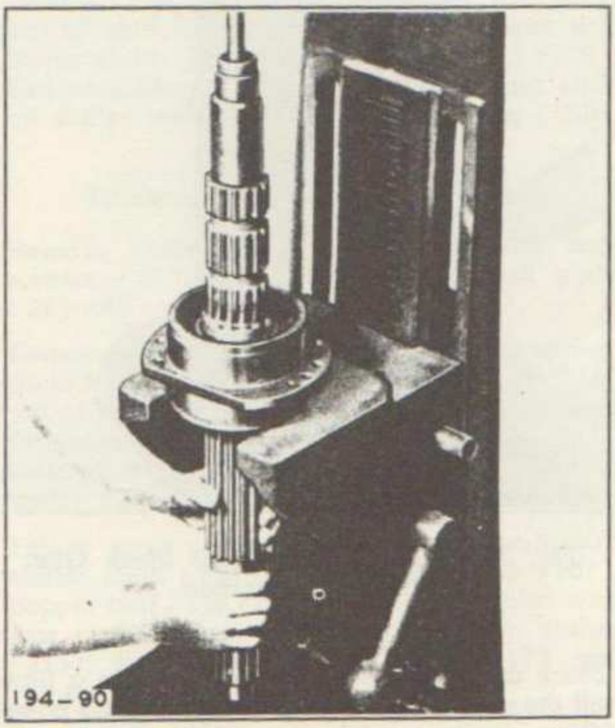

Fig. 41—Removing Center Bearing and Oil Slinger

Reverse Gear Shaft

Remove reverse gear shaft lock capscrew (151) and shaft lock (149). Then withdraw

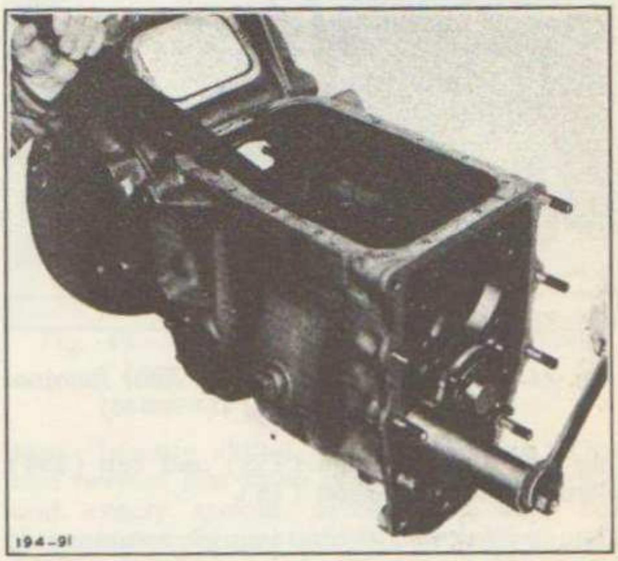

Fig. 42—Removing Reverse Gear Shaft
(Tool—Mack Part No. 17-T-1425)

reverse gear shaft (133) from case by using a puller tool which utilizes the ⅝"-11 U.S.S. tapped hole in the shaft.

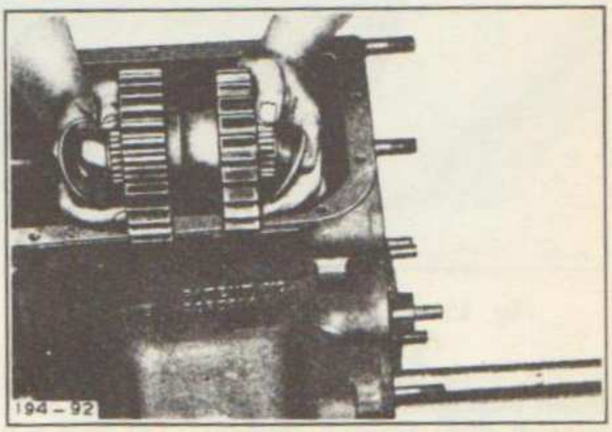

Fig. 43—Removing Reverse Gear Cluster

As reverse shaft (133) slides out, reach into case and lift out reverse gear cluster (134). Bearing (162) and bearing spacer (148) will slide out of gear cluster readily.

Countershaft

Using puller tool as illustrated remove countershaft rear bearing retainer (11) contain-

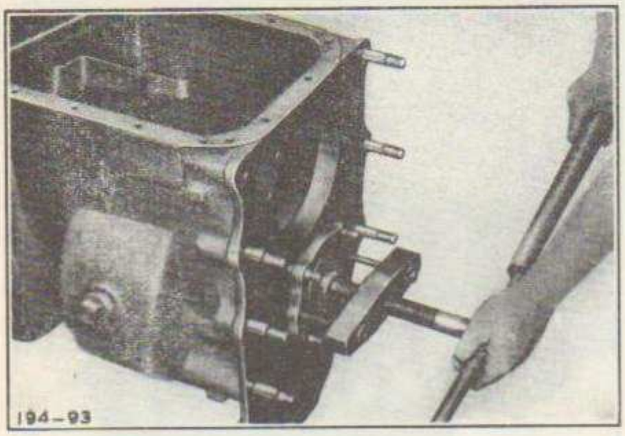

Fig. 44—Removing Countershaft Rear Retainer
(Tool—Federal Stock No. 41-P-2905-60)

ing rear bearing cone (158) and cup (159). Detach retainer gasket (15).

Detach countershaft front bearing retainer stud nuts (42), cover (6) and cover gasket (21).

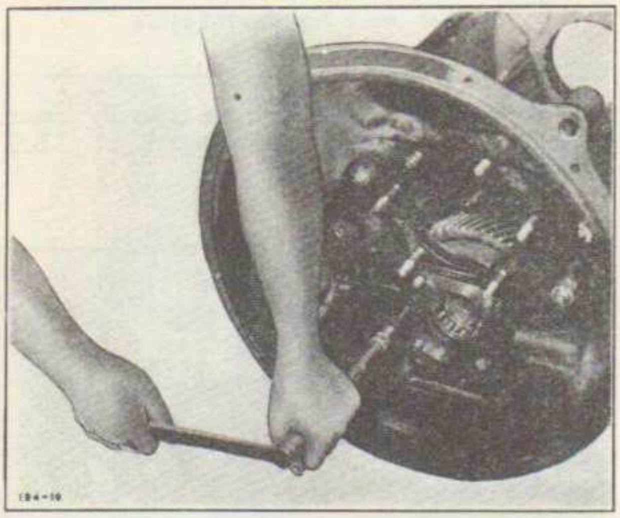

Fig. 45—Pulling Countershaft Front Retainer and Bearing

Insert puller screws into tapped holes in countershaft front bearing retainer (14) and pull retainer (14) containing front bearing (160) out only enough to allow countershaft (132) to swing out of case.

(See Figure 46)

Push countershaft (132) to the rear of case and remove by tilting forward and upward thru top opening in case.

Fig. 46—Removing Countershaft from Case

Remove front bearing retainer (14) entirely from case. Before pressing bearing (160) out of retainer, pry out snap ring (143).

Dis-assembling Countershaft

Hold countershaft in soft jaws of vise, remove locknut (154). Pry off inner race of front bearing.

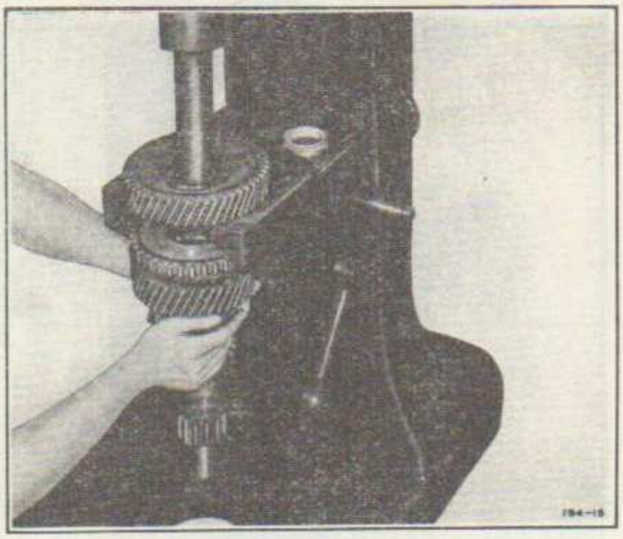

Fig. 27—Removing Constant Mesh Gear from Countershaft

Block up each successive gear one at a time, oil the shaft to aid the gear removal and power press constant mesh gear (119), P.T.O. gear (139), fourth speed gear (126), and third speed gear (128) off the shaft in this order. Remove key (156) if necessary.

Transmission Shifter Tower

Swing shifter lever (209) to one side and then

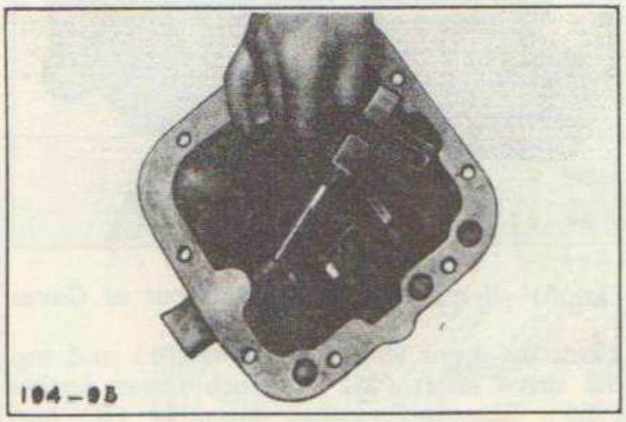

Fig. 48—Removing Shifter Fork Interlock

slide out shifter fork interlock (219) and interlock spacer (218).

Remove first and reverse shifter lever lock bolt (229) and lock (210). Take out reverse lock screw (228) and remove reverse lock plate (225) and reverse lock (223).

Remove shifter knob (224). Detach dust cover (205). Take out shifter lever ball retainer screws (234) and lift shifter lever and parts out of shifter tower (4). Remove upper and lower shifter ball retainers (211) and (226). Extract shifter lever ball pin (222) and slide off shifter lever ball (221) and spring (220).

Transmission Shifter Shaft Cover

Remove shifter shaft cover end plate capscrews (33), lockwashers (48), end plate (22) and gasket (23).

Remove capscrews holding forks and shifter. Slide fourth and fifth speed shifter shaft (214) out of cover, meanwhile removing fourth and fifth speed shifter fork (208) and shifter (217), taking care not to lose poppet ball (240) and spring (227) as the shaft slides out.

Follow same procedure with second and third shifter shaft (213), shifter (216), fork (207), poppet ball (240) and spring (227); also with first and reverse shifter shaft (212), shifter (215), fork (206), poppet ball (240) and spring (227).

Remove and clean breather assembly (7). Shifter shaft ball bushing (241) may be tapped or pulled out if necessary.

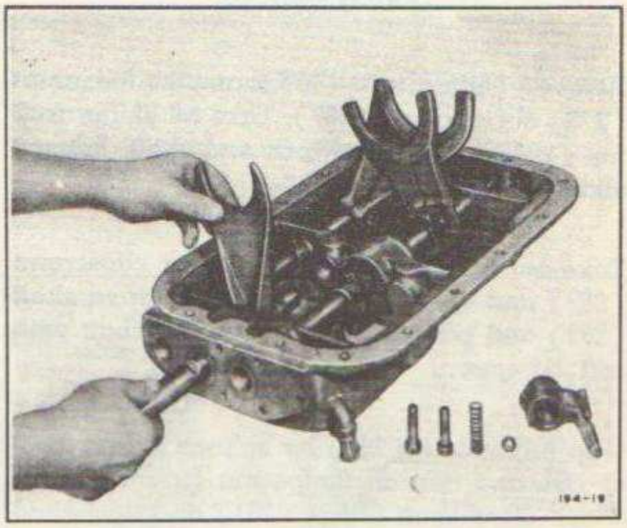

Fig. 49—Removing Shifter Shaft, Shifter, Fork, Poppet Ball and Spring

Note: Identify shifter shafts as follows: First and reverse has three poppet notches widely and evenly spaced, second and third has three unequally spaced poppet notches, and fourth and fifth is short with three evenly spaced poppet notches.

Transfer Case Shifter Levers

All three assemblies are identical. Using a screwdriver pry out spring (254) and washer (255).

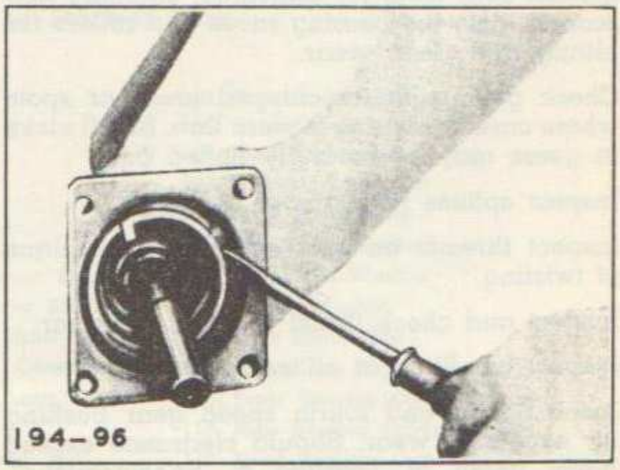

Fig. 50—Removing Shifter Lever Spring

Remove shifter knob (256) and slide off dust cover (243). Tap out ball pin (248) and pull shifter lever (247) out of cover (67).

Power-Take-Off

Remove shifter fork (273) and shifter shaft (276) out of cover (287). Take off shifter fork nut (283) to separate fork and shaft. Lift out sliding clutch (264).

Take out drive shaft bearing cover capscrews (267) and then drive out of cover drive shaft (262) and parts by striking end of shaft with soft hammer.

Grip drive shaft (262) by splines in soft jaws of vise and turn off flange nut (271). Tap off winch drive shaft flange (261) and then slide drive shaft bearing cover (266) off flange. Tap oil seal (269) out of cover.

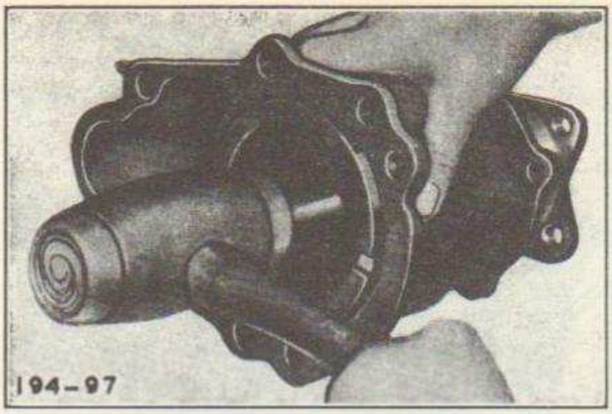

Fig. 51—Removing Drive Shaft out of Cover

Block up drive shaft bearing (270) and tap out drive shaft (262). Detach cover gasket (265). Remove breather assembly (8) and clean.

SECTION 5: REPAIRS

Note: Before re-assembly, all parts should be thoroly cleaned with suitable solvent to remove all traces of dirt and oil. Inspection should be thoro, parts showing excessive wear should be renewed. Most gaskets and oil seals are preferably renewed. All cotter pins, locking washers and locking wires must be renewed to avoid failure.

Always operate the unit slowly at first to allow lubricant to work its way to all parts.

Inspect gear teeth for brinelling, chipping and scoring, also the bearing races and rollers for pitting and deep wear.

Check gear teeth for chipped areas or spots where case hardening is worn thru. Small nicks in gears may be carefully honed out.

Inspect splines for signs of twisting.

Inspect threads on nuts and shafts for signs of twisting.

Inspect and check thrust washers for wear.

Inspect condition of oil seals.

Inspect third and fourth speed gear bushing for excessive wear. Should clearance exceed limits given in "Section 8: Specifications", gears should be refitted with service bushings. This also applies to transfer case mainshaft constant mesh gear bushing.

When it becomes necessary to install service bushings in the third and fourth speed main shaft gears, care should be taken to assure proper alignment of bushing in gear. The use of a broaching tool as shown is necessary to insure the correct clearance between inside of bushing and gear sleeve. Refer to "Section 8: Specifications" for clearances.

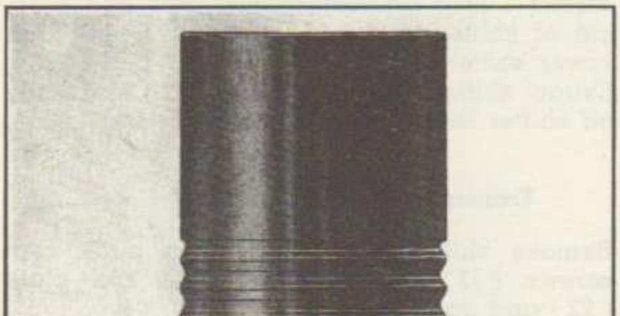

Fig. 52—View of Broaching Tool Used When Installing New Gear Bushings
(Tool—Mack Part No. 17-T-1440)

Inspect and check clutch and gear spline clearances.

Inspect bearings of reverse idler shaft for wear, also to see if reverse shaft is cut or worn flat in spots.

Inspect and check tension of all springs.

Inspect condition of locknuts due to staking.

Inspect and check oil pump vane.

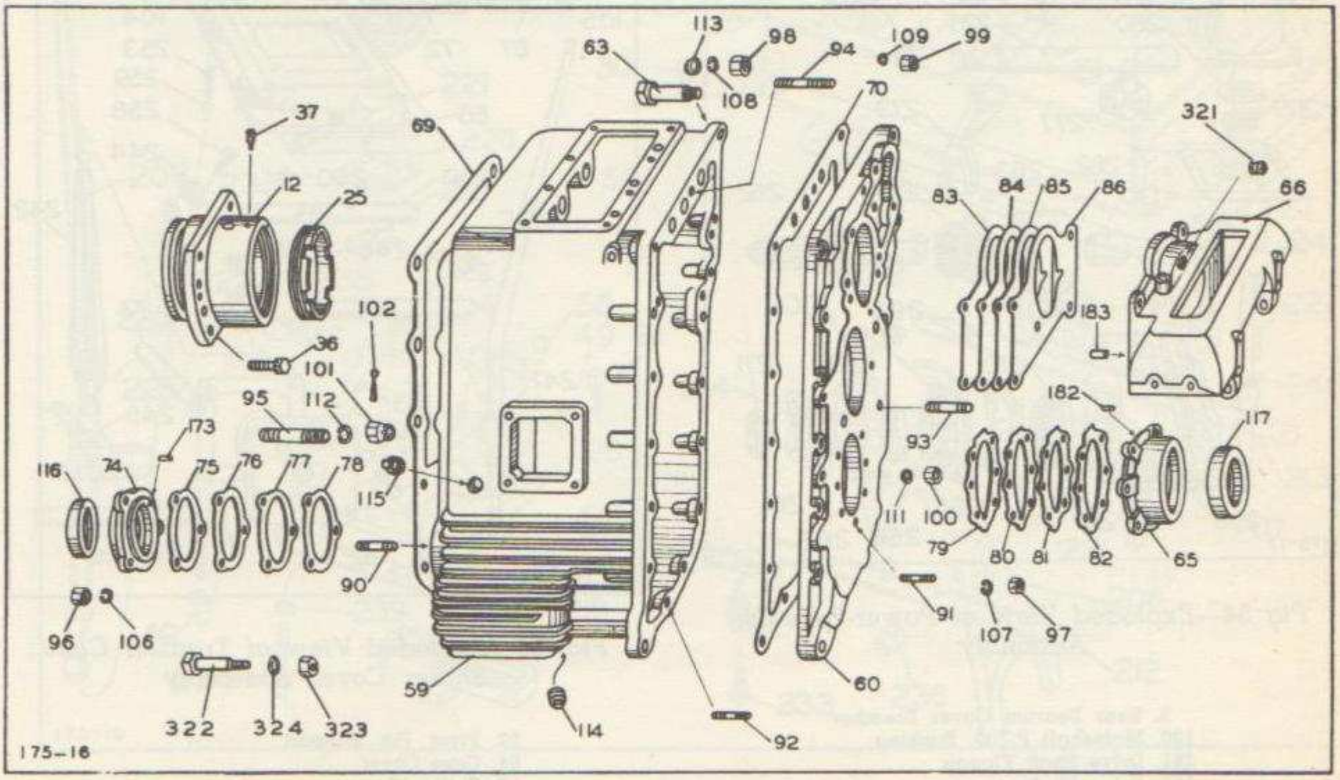

Fig. 53—Exploded View of Transfer Case

12. Center Bearing Retainer
25. Bearing Retainer Outer Nut
36. Bearing Retainer Screw
37. Retainer Nut Setscrew
59. Case Assembly
60. End Plate Assembly
63. End Plate Dowel Bolt
65. Rear Drive Rear Bearing Cover
66. C'shaft Rear Bearing Cover
69. Case Gasket
70. End Plate Gasket
74. Front Drive Front Bearing Cover
75. Shim (.031)
76. Shim (.008)
77. Shim (.005)
78. Shim (.003)
79. Shim (.031)
80. Shim (.008)
81. Shim (.005)
82. Shim (.003)
83. Shim (.0120)
84. Shim (.0149)
85. Shim (.0179)
86. Shim (.0299)
90. Front Bearing Cover Stud
91. Rear Bearing Cover Stud
92. End Plate Stud (Short)
93. C'shaft Rear Brg. Cover Stud
94. End Plate Stud (Long)
95. Case Front Stud
96. Front Bearing Cover Nut
97. Rear Bearing Cover Nut
98. End Plate Dowel Nut
99. End Plate Stud Nut
100. C'shaft Rear Brg. Cover Nut
101. Case Stud Nut
102. Case Stud Cotter
106. Front Cover Lockwasher
107. Rear Cover Lockwasher
108. Dowel Lockwasher
109. Stud Lockwasher
111. Cover Stud Lockwasher
112. Case Stud Washer
113. Dowel Washer
114. Case Drain Plug
115. Case Filler Plug
116. Front Bearing Cover Oil Seal
117. Rear Bearing Cover Oil Seal
173. Front Bearing Cup Lockpin
182. Rear Bearing Cup Lockpin
183. C'shaft Rear Bearing Cup Lockpin
321. Rear Bearing Cover Plug
322. Dowel
323. Dowel Nut
324. Washer

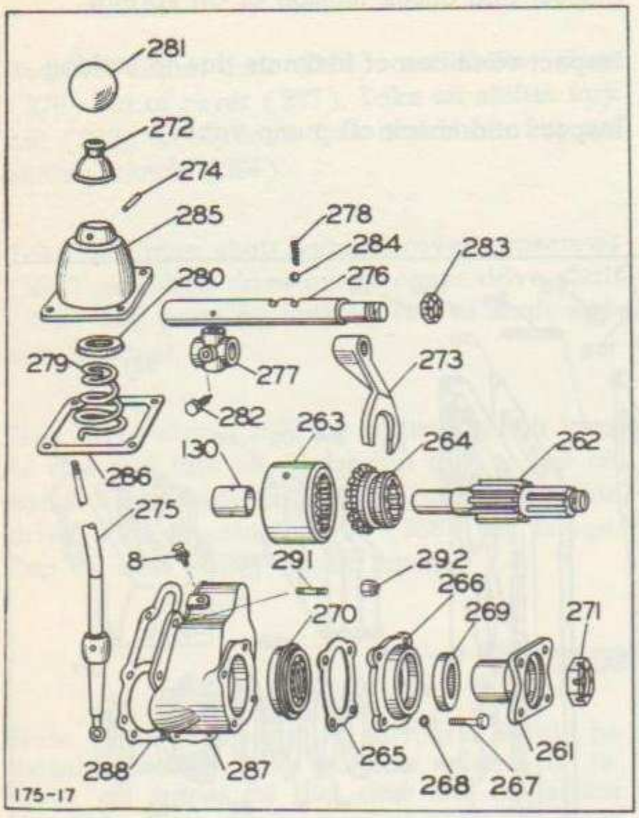

Fig 54—Exploded View of Power-Take-Off Assembly

8. Rear Bearing Cover Breather
130. Mainshaft P.T.O. Bushing
261. Drive Shaft Flange
262. Drive Shaft
263. Drive Shaft Clutch
264. Sliding Clutch
265. Bearing Cover Gasket
266. Bearing Cover
267. Bearing Cover Screw
268. Cover Screw Lockwasher
269. Bearing Cover Seal
270. Drive Shaft Bearing
271. Drive Shaft Flange Nut
272. Lever Dust Cap
273. Shifter Fork
274. Shifter Ball Pin
275. Shifter Lever
276. Shifter Shaft
277. Shifter
278. Shaft Ball Spring
279. Lever Ball Spring
280. Lever Spring Washer
281. Lever Knob
282. Shifter Setscrew
283. Shifter Fork Nut
284. Shifter Shaft Ball
285. Shifter Tower
286. Tower Gasket
287. Mainshaft Rear Bearing Cover
288. Cover Gasket
291. Cover Stud
292. Cover Stud Nut

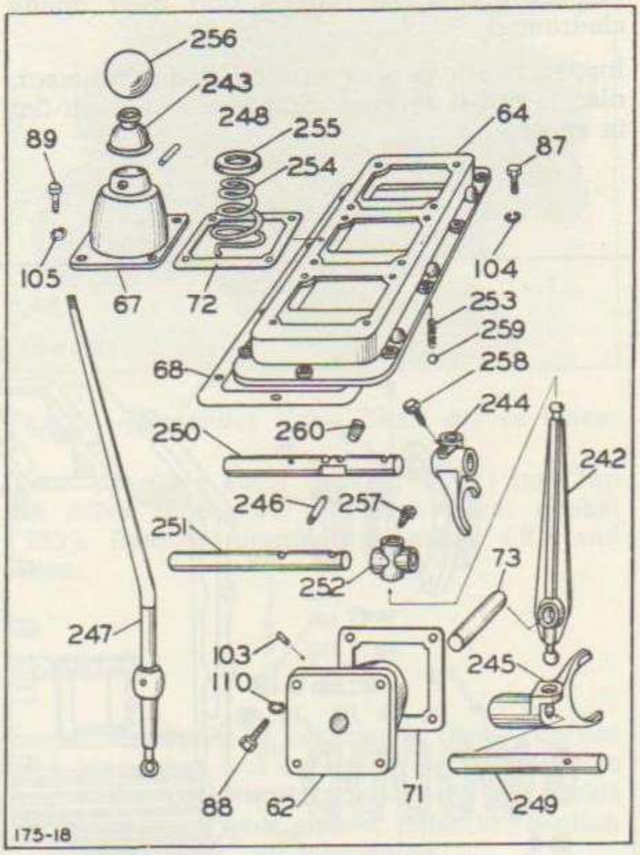

Fig. 55—Exploded View of Transfer Case Shifter Cover Assembly

62. Pivot Pin Support
64. Case Cover
67. Shifter Tower
68. Case Gasket
71. Pivot Pin Support Gasket
72. Shifter Tower Gasket
73. Bell Crank Pivot Pin
87. Case Cover Screw
88. Support Screw
89. Shifter Tower Screw
103. Pivot Pin
104. Cover Screw Lockwasher
105. Tower Screw Lockwasher
110. Support Lockwasher
242. Front Drive Shifter Bell Crank
243. Lever Dust Cap
244. Range Gear Shifter Fork
245. Front Drive Shifter Fork
246. Shift Rail Interlock
247. Shifter Lever
248. Shifter Ball Pin
249. Front Declutch Fork Shifter Shaft
250. Range Gear Shifter Shaft
251. Front Drive Shifter Shaft
252. Front Drive Shifter
253. Shifter Shaft Ball Spring
254. Shifter Lever Spring
255. Lever Spring Washer
256. Shifter Lever Knob
257. Front Drive Shifter Setscrew
258. Range Gear Fork Setscrew
259. Shifter Shaft Ball
260. Interlock Plug

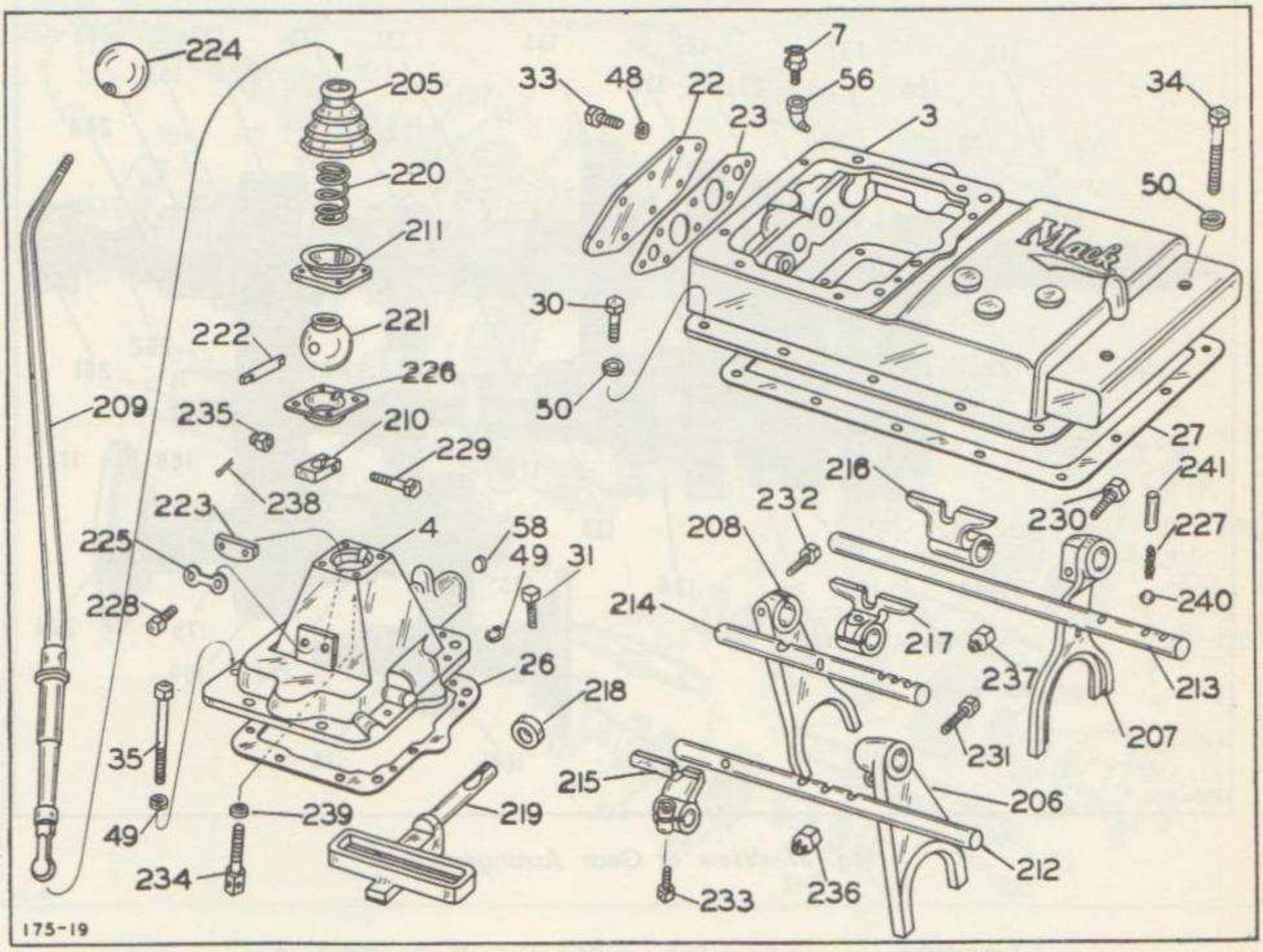

Fig. 56—Exploded View of Transmission Shifter Cover Assembly

3. Shifter Cover
4. Shifter Tower
7. Shifter Cover Breather
22. Cover End Plate
23. End Plate Gasket
26. Tower Gasket
27. Shifter Cover Gasket
30. Shifter Cover Screw
31. Tower Screw
33. End Plate Screw
34. Shifter Cover Screw
35. Tower Screw (Long)
48. End Plate Lockwasher
49. Tower Lockwasher
50. Shifter Cover Lockwasher
56. Case Breather Elbow
58. Tower Welsh Plug
205. Lever Dust Cap
206. First & Reverse Shifter Fork
207. Second & Third Shifter Fork
208. Fourth & Fifth Shifter Fork
209. Shifter Lever
210. First & Reverse Shifter Lever Lock
211. Lever Ball Retainer
212. First & Reverse Shifter Shaft
213. Second & Third Shifter Shaft
214. Fourth & Fifth Shifter Shaft
215. First & Reverse Shifter
216. Second & Third Shifter
217. Fourth & Fifth Shifter
218. Interlock Spacer
219. Shifter Fork Interlock
220. Lever Spring
221. Lever Ball
222. Lever Ball Pin
223. Lever Reverse Lock
224. Lever Knob
225. Lever Reverse Lock Plate
226. Lever Ball Retainer
227. Shaft Ball Spring
228. Lever Reverse Lock Screw
229. First & Reverse Shifter Lever Lock Bolt
230. Second & Third Shifter Fork Lock Bolt
231. First & Reverse Shifter Fork Bolt
232. Fourth & Fifth Shifter Fork Screw
233. Shifter Screw
234. Ball Retainer Screw
235. First & Reverse Shifter Lever Lock Nut
236. First & Reverse Shifter Fork Bolt Nut
237. Second & Third Shifter Fork Bolt Nut
238. First & Reverse Shifter Lever Bolt Cotter
239. Ball Retainer Lockwasher
240. Shifter Shaft Ball
241. Shifter Shaft Ball Bushing

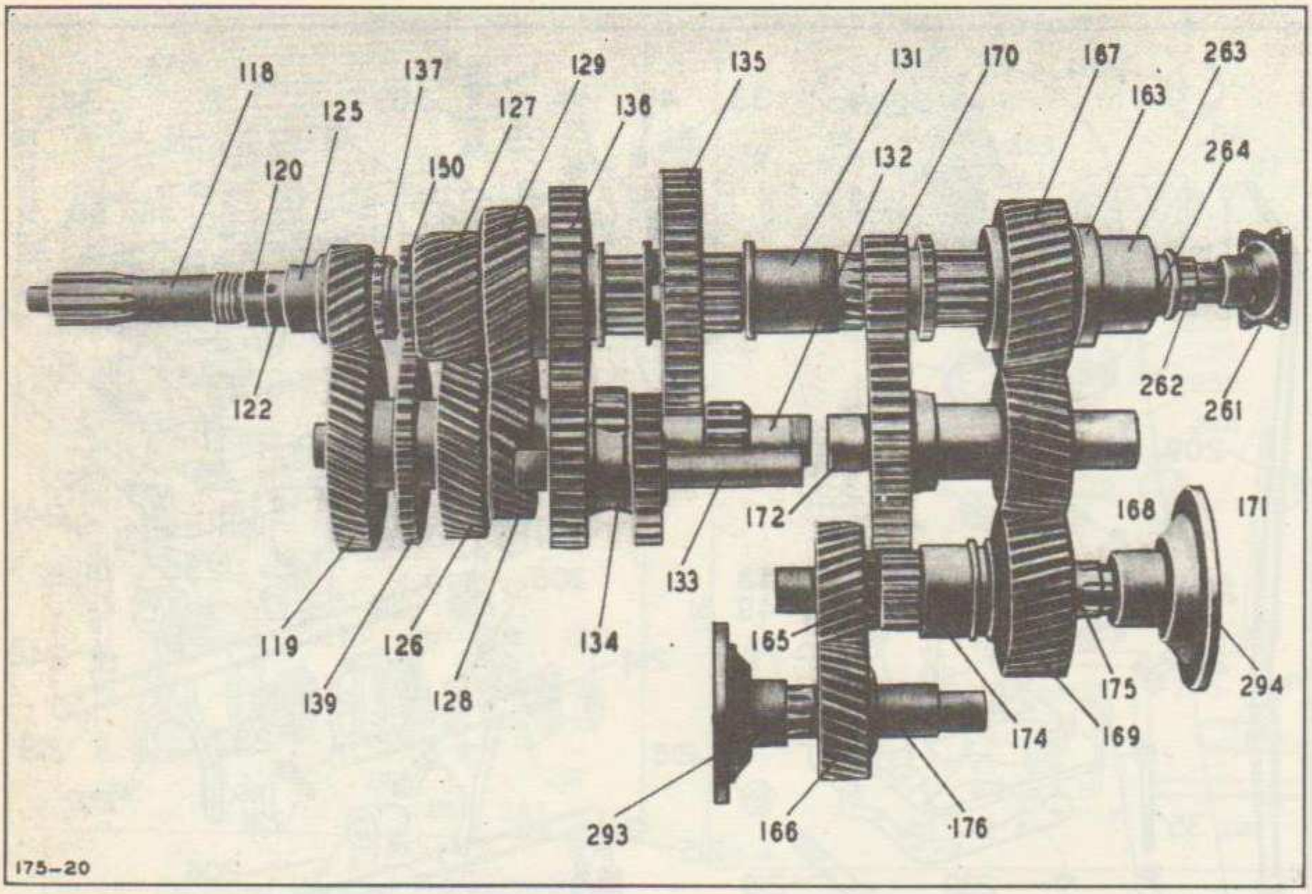

Fig. 57—View of Gear Arrangement

Transmission

118. Main Driving Pinion
119. Constant Mesh Gear
120. Pinion Bearing Locknut
122. Pinion Oil Pump Sleeve
125. Pinion Bearing
126. C'shaft Fourth Speed Gear
127. Mainshaft Fourth Speed Gear
128. C'shaft Third Speed Gear
129. Mainshaft Third Speed Gear
131. Mainshaft
132. Countershaft
133. Reverse Gear Shaft
134. Reverse Gear
135. First Speed Sliding Gear
136. Second Speed Sliding Gear
137. Fourth & Fifth Sliding Clutch
139. Side P.T.O. Gear

Transfer Case

165. Front Drive Gear
166. Front Driven Gear
167. Constant Mesh Gear
168. C'shaft Constant Mesh Gear
169. Rear Drive Constant Mesh Gear
170. Range Gear Sliding Gear
171. Countershaft
172. C'shaft Low Speed Gear
174. Front Drive Sliding Clutch
175. Rear Drive Shaft
176. Front Drive Shaft
261. Power-Take-Off Drive Shaft Flange
262. Power-Take-Off Drive Shaft
293. Front Drive Shaft Flange
294. Rear Drive Shaft Flange

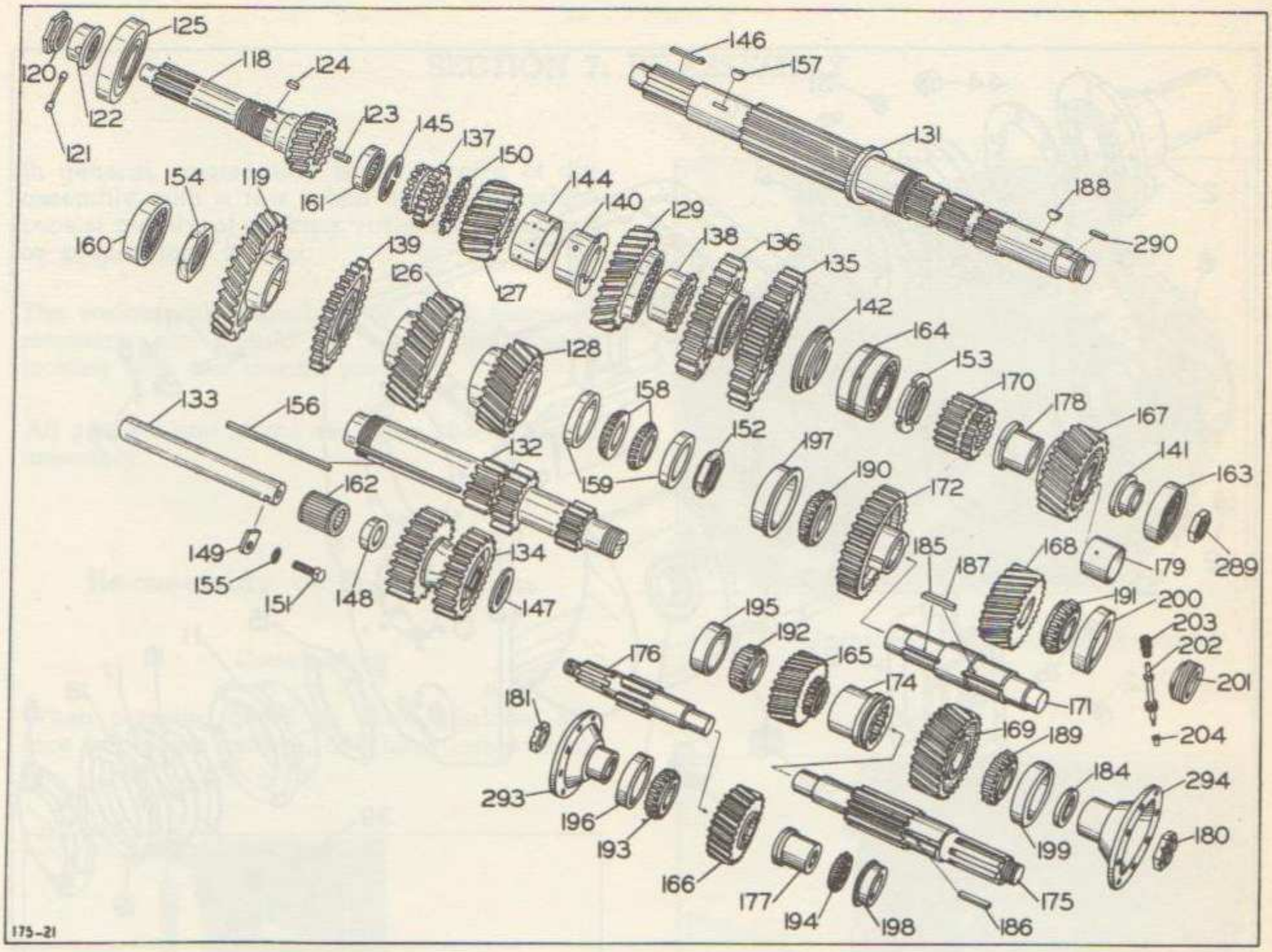

Fig. 58—Exploded View of Gear Arrangement

118. Main Driving Pinion
119. Constant Mesh Gear
120. Pinion Bearing Locknut
121. Pinion Oil Pump Vane
122. Pinion Oil Pump Sleeve
123. Pinion Oil Tube
124. Oil Pump Sleeve Key
125. Pinion Bearing
126. C'shaft Fourth Speed Gear
127. Mainshaft Fourth Speed Gear
128. C'shaft Third Speed Gear
129. Mainshaft Third Speed Gear
131. Mainshaft
132. Countershaft
133. Reverse Gear Shaft
134. Reverse Gear
135. First Speed Sliding Gear
136. Second Speed Sliding Gear
137. Fourth & Fifth Sliding Gear
138. Third Speed Gear Sleeve
139. Side P.T.O. Gear
140. Fourth Speed Gear Sleeve
141. Rear Bearing Sleeve
142. Center Bearing Oil Slinger
144. Third & Fourth Gear Bushing
145. Spigot Bearing Snap Ring
146. Thrust Washer Key
147. Reverse Gear Thrust Washer
148. Reverse Gear Bearing Spacer
149. Reverse Gear Shaft Lock
150. Fourth Speed Gear Thrust Washer
151. Reverse Shaft Lockscrew
152. C'shaft Rear Bearing Nut
153. Center Bearing Nut (Inner)
154. C'shaft Gears Nut
155. Reverse Shaft Lockwasher
156. C'shaft Gears Key
157. Third & Fourth Gear Sleeve Key
158. C'shaft Rear Bearing Cone
159. C'shaft Rear Bearing Cup
160. C'shaft Front Bearing
161. Spigot Bearing
162. Reverse Gear Bearing
163. Mainshaft Rear Bearing
164. Mainshaft Center Bearing
165. Front Drive Gear
166. Front Drive Gear
167. Constant Mesh Gear
168. C'shaft Constant Mesh Gear
170. Gear Range Gear Sliding Gear
171. Countershaft
172. C'shaft Low Speed Gear
174. Front Drive Sliding Clutch
175. Rear Drive Shaft
175. Rear Drive Shaft
176. Front Drive Shaft
177. Gear Bearing Spacer
178. Constant Mesh Gear Sleeve
179. Constant Mesh Gear Bushing
180. Rear Drive Shaft Flange Nut
181. Front Drive Shaft Flange Nut
184. Rear Bearing Spacer
185. Low Speed Gear Key
186. Constant Mesh Gear Key
187. C'shaft Constant Mesh Gear Key
188. Gear Sleeve Key
189. Rear Bearing Cone
190. Front Bearing Cone
191. Rear Bearing Cone
192. Front Bearing Cone
193. Front Bearing Cone
194. Rear Bearing Cone
195. Front Bearing Cup
196. Front Bearing Cup
197. Front Bearing Cup
198. Rear Bearing Cup
199. Rear Bearing Cup
200. Rear Bearing Cup
201. Speedometer Drive Worm
202. Speedometer Driven Gear
203. Speedometer Drive Sleeve
204. Speedometer Gear Bushing
289. Rear Bearing Locknut
290. Mainshaft Key
293. Front Drive Shaft Flange
294. Rear Drive Shaft Flange

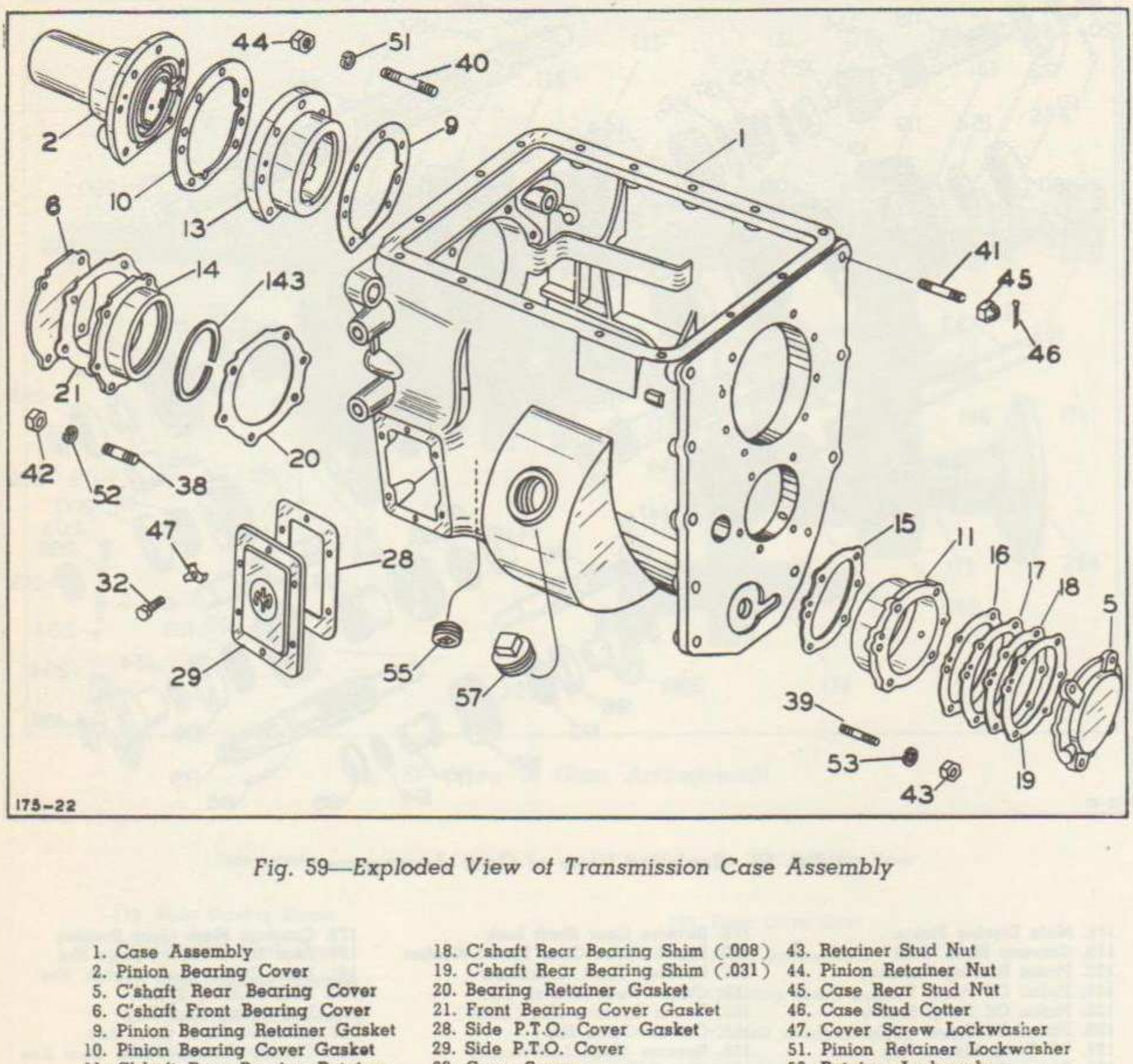

Fig. 59—Exploded View of Transmission Case Assembly

1. Case Assembly
2. Pinion Bearing Cover
5. C'shaft Rear Bearing Cover
6. C'shaft Front Bearing Cover
9. Pinion Bearing Retainer Gasket
10. Pinion Bearing Cover Gasket
11. C'shaft Rear Bearing Retainer
13. Pinion Bearing Retainer
14. C'shaft Front Bearing Retainer
15. Bearing Retainer Gasket
16. C'shaft Rear Bearing Shim (.003)
17. C'shaft Rear Bearing Shim (.005)
18. C'shaft Rear Bearing Shim (.008)
19. C'shaft Rear Bearing Shim (.031)
20. Bearing Retainer Gasket
21. Front Bearing Cover Gasket
28. Side P.T.O. Cover Gasket
29. Side P.T.O. Cover
32. Cover Screw
38. Front Bearing Retainer Stud
39. Rear Bearing Retainer Stud
40. Pinion Bearing Retainer Stud
41. Case Rear Stud
42. Retainer Stud Nut
43. Retainer Stud Nut
44. Pinion Retainer Nut
45. Case Rear Stud Nut
46. Case Stud Cotter
47. Cover Screw Lockwasher
51. Pinion Retainer Lockwasher
52. Retainer Lockwasher
53. Retainer Lockwasher
55. Case Drain Plug
57. Case Filler Plug
143. Front Bearing Snap Ring

SECTION 6: LUBRICATION

All parts, especially plain bearings, ball and roller type bearings, gears, thrust washers, oil seals, splines, screw threads, shifter shafts, etc. should be generously coated with oil.

This will insure immediate lubrication when first starting and will prevent seizure of these parts.

For other lubricating instructions see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

In general, re-assembly is the reverse of disassembly with a few minor exceptions which consist mainly of making various adjustments or preparatory fittings.

The various sub-assemblies of gears, bearings, retainers, etc. should be made first, finally locking with the means provided.

All gaskets and shims are to be shellacked at assembly.

Re-assembly of Transmission

Countershaft

When pressing gears on shaft lubricate surface to prevent seizure, and blow out possible chips or dirt that may fall between gears just before gears come together.

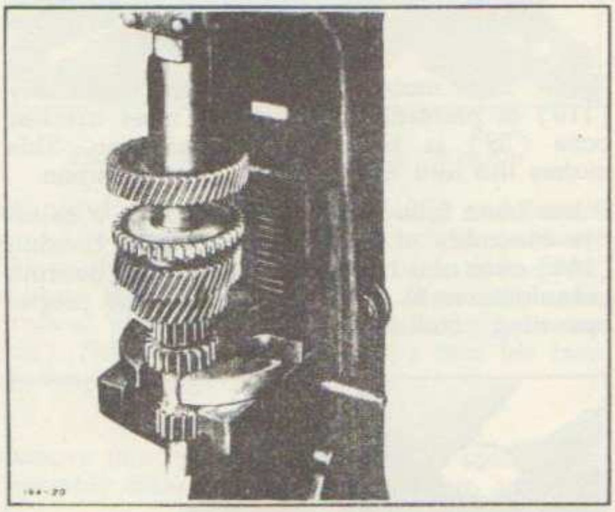

Fig. 60—Installing Countershaft Constant Mesh Gear

When installing countershaft (132) into transmission, take care in joining front bearing (160) to avoid damaging fine mating surfaces.

Fig. 61—Installing Countershaft Assembly in Case

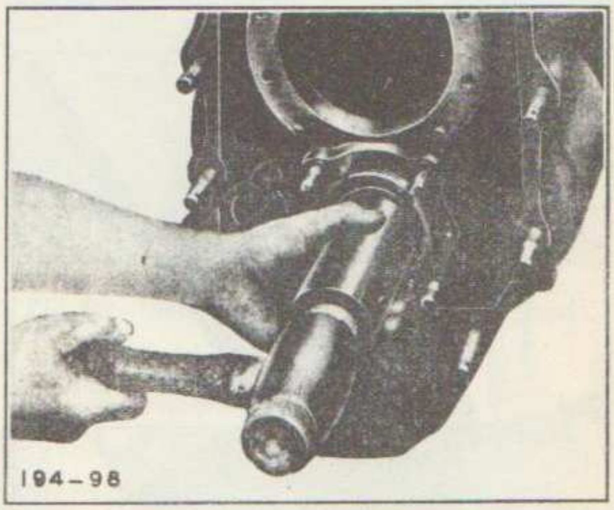

Fig. 62—Installing Countershaft Rear Bearing

Drive in rear bearing cone (158), cup (159) and retainer (11).

Reverse Shaft
(See Figure 63)

To avoid undue work, be sure to align locking notch in proper position before driving in reverse shaft (133).

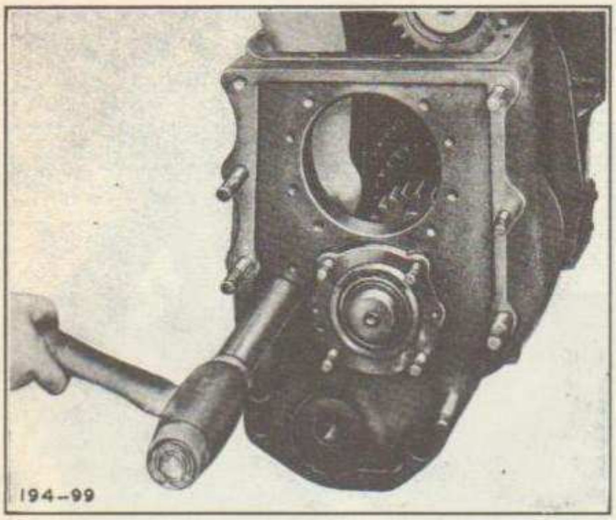

Fig. 63—Installing Reverse Idler Shaft and Gear Assembly

Countershaft Bearing Adjustment

At this point the countershaft rear bearing nut (152) is installed, tightened and staked.

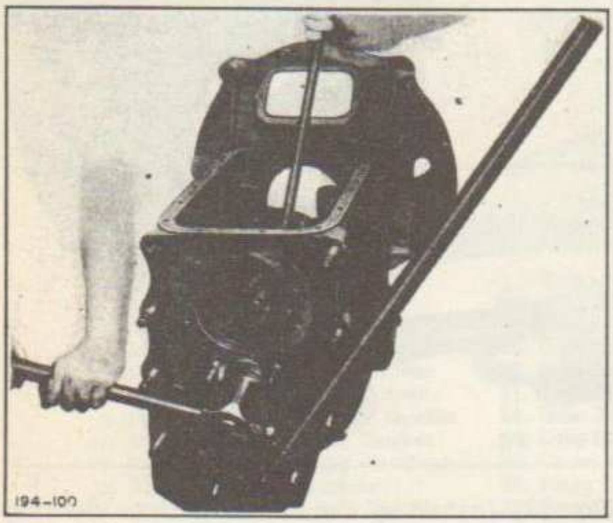

Fig. 64—Tightening Rear Bearing Locknut

To make bearing adjustment, bolt up rear bearing cover (5), temporarily leaving out rear bearing shims (16, 17, 18 and 19). Place an indicator thru oil over-flow hole in bearing cover (5) against countershaft rear end and measure end-play created by prying on countershaft (132) in case with pinch bars.

Tighten or loosen rear retainer stud nuts (43) to give .000"-.002" end-play. Check size of shims needed by inserting feelers in space between retainer (11) and cover flanges. Locate necessary thickness of shims (16, 17, 18 and 19) and then bolt-up cover (5). Recheck adjustment, be sure shaft rolls freely.

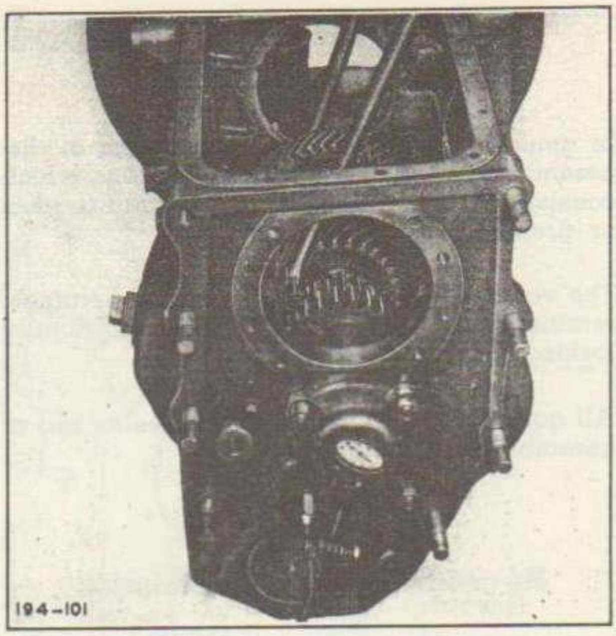

Fig. 65—Checking End-Play of Countershaft

Mainshaft

Note: The main driving pinion assembly (118) is preferably assembled after transfer case (59) is bolted to transmission. This makes the unit more "solid" to work upon.

It has been found necessary to make a selective assembly of the mainshaft center bearing (164) over and beyond that made by bearing manufacturer to give this bearing the proper operating conditions.

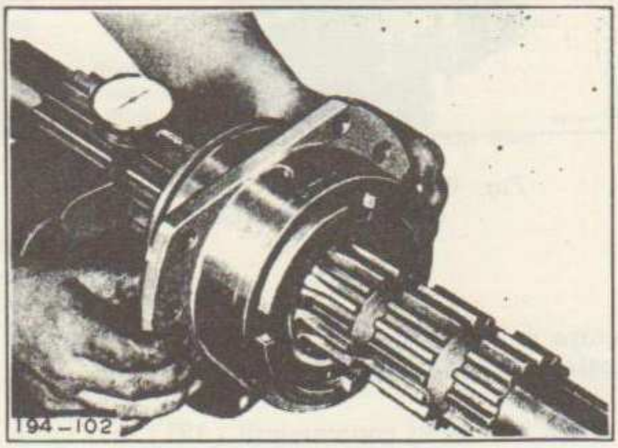

Fig. 66—Checking End-Play of Center Bearing Retainer

The procedure for this adjustment is as follows: Install oil slinger (142) on mainshaft (131). Then press inner cup of bearing (164) into retainer (12). After locating retainer (12) on mainshaft (131), press bearing cone on shaft. Install bearing cup spacer and then tap in bearing outer cup. Turn up tight bearing inner nut (153) and bearing retainer outer nut (25). Hold mainshaft while measuring with an indicator the end-play of retainer (12) on bearing (164). This end-play should be .000"-.003" maximum. Select new bearing cup spacer or grind down to suit. Lock bearing inner nut (153) by staking and bearing retainer outer nut (25) by drilling ¼" hole to receive set screw (37).

A trial assembly is made of certain parts on the bench to get the desired end-play in the fourth speed helical gear (127). In this regard,

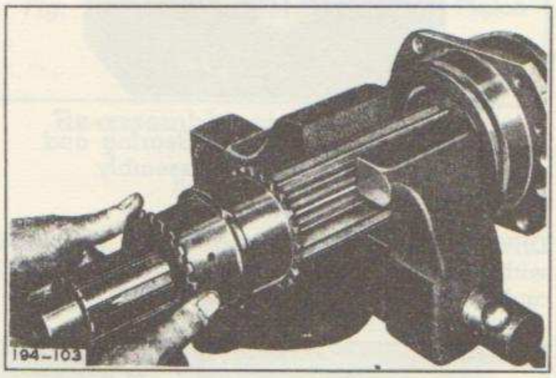

Fig. 67—Checking Thrust Washer

slip third speed gear sleeve (138) and fourth speed gear sleeve (140) into position on shaft. Select thrust washer (150) and slide over splines into normal position, then rotate in groove. Washer fit should be stiff (by rotation). Select locking key (146) that fits into keyway loosely.

(See Figure 68)

Remove fitted parts from shaft and commence assembly after shaft is installed into case.

(See Figure 69)

Locate keys, sleeves and gears and slide thrust washer (150) into position.

(See Figure 70)

Insert and wedge small tool between internal teeth of fourth speed gear (127) and thrust washer (150), then rotate both together until keyway in shaft and spline root of washer align. Insert locking key (146) into keyway, wherein thick portion of key will straddle and hold locking thrust washer in position. Add fourth and fifth speed sliding clutch. Bolt up center bearing retainer (12).

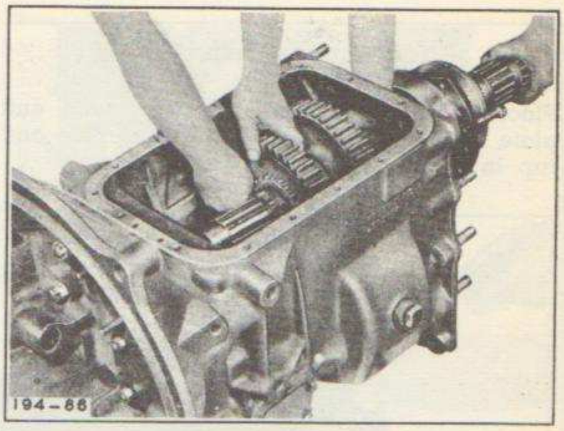

Fig. 68—Installing Mainshaft in Case

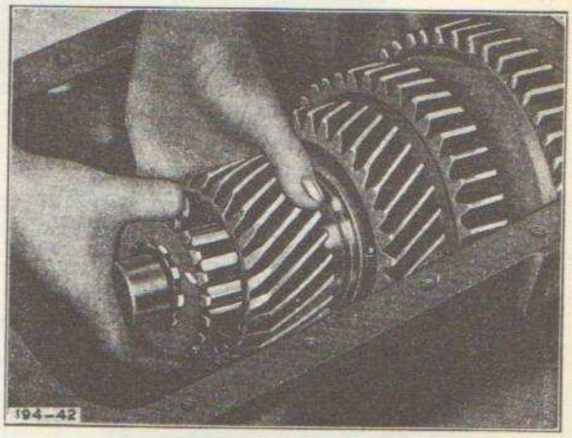

Fig. 69—Installing Fourth Speed Gear and Thrust Washer

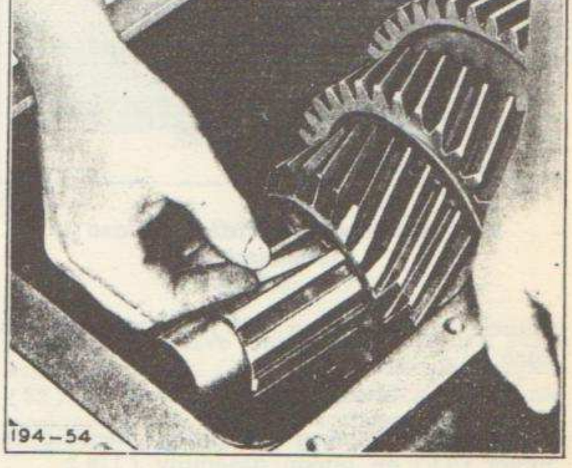

Fig. 70—Installing Locking Key

Attaching Transfer Case

Place transfer case (59) on floor with end plate (60) opening downward. Assemble and tap in front drive shaft (176) assembly.

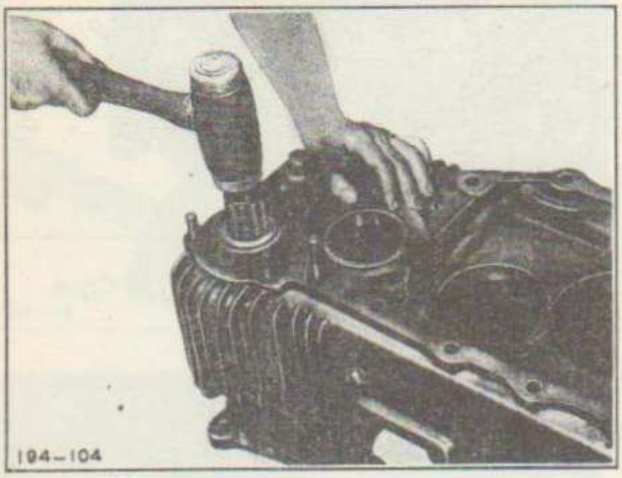

Fig. 71—Installing Front Drive Shaft

Bolt up front drive shaft front bearing cover (74) but omit shims (75, 76, 77, and 78) and drive flange (293) at this time.

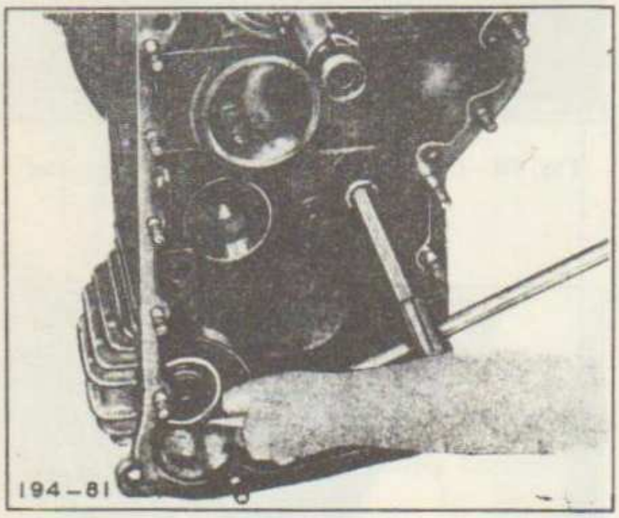

Fig. 72—Attaching Transfer Case to Transmission

Attach transfer case (59) to transmission case (1).

Main Driving Pinion

Press spigot bearing (161) and bearing retainer (11) on pinion assembly (118).

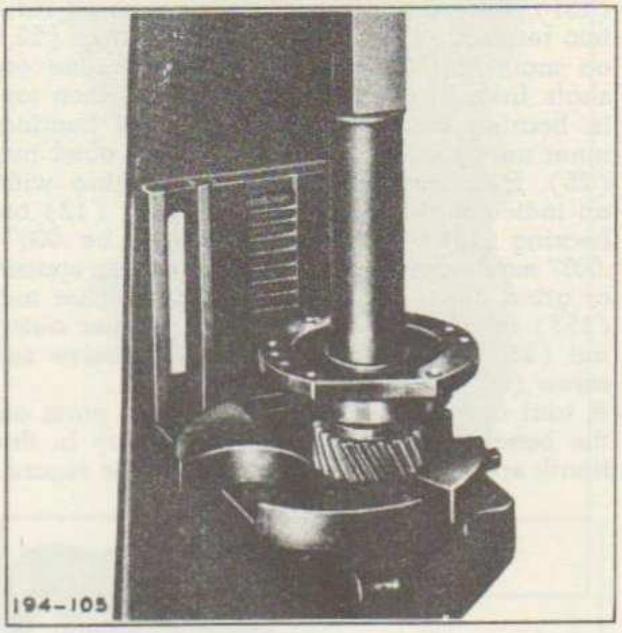

Fig. 73—Pressing Spigot Bearing and Retainer on Pinion Assembly

Drive main driving pinion (118) into case with care, to avoid damaging oil tube (123) and fine surfaces of bearing (161).

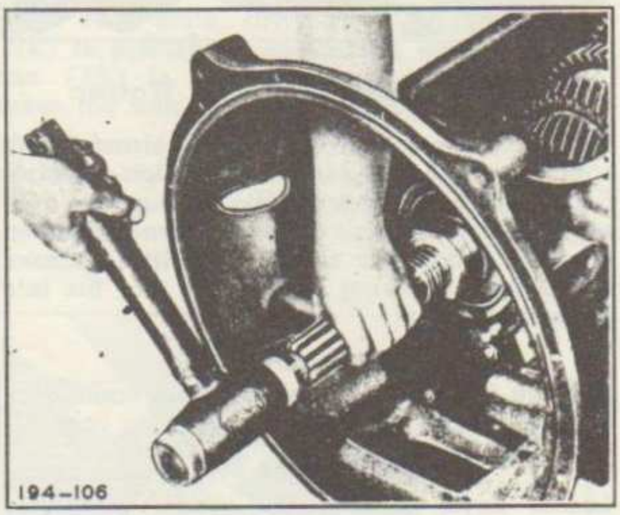

Fig. 74—Installing Main Driving Pinion

(See Figure 75)

After installing oil pump vane (121) and cover gasket (10), pinion bearing cover (2) can be put in place and bolted up with retainer stud nuts (44). Clutch release shaft (298) assembly is now installed.

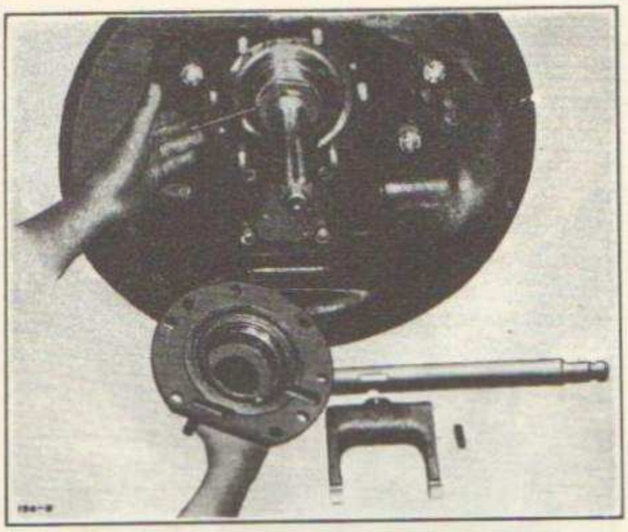

Fig. 75—Installing Main Driving Pinion Oil Vane and Cover

Re-assembly of Transfer Case

Rear Drive Shaft

Assemble rear drive shaft (175) assembly into transfer case.

Fig. 76—Installing Rear Drive Shaft Assembly

(See Figure 77)

Caution: Do not fail to replace cotter pin in front drive declutch shifter shaft (249).

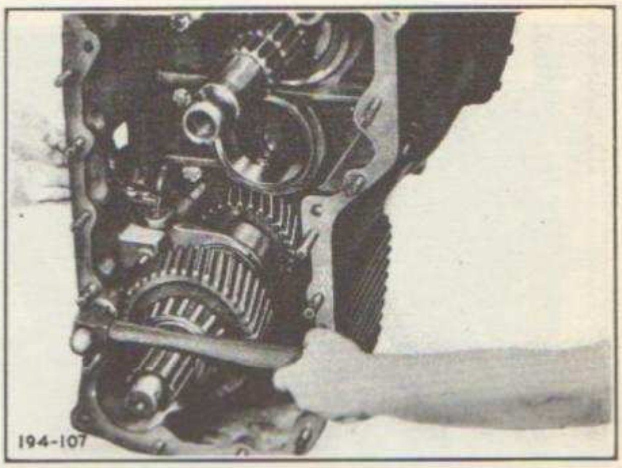

Fig. 77—Installing Front Drive Declutch Shaft and Cotter Pin

Countershaft

Install countershaft (171) assembly into case.

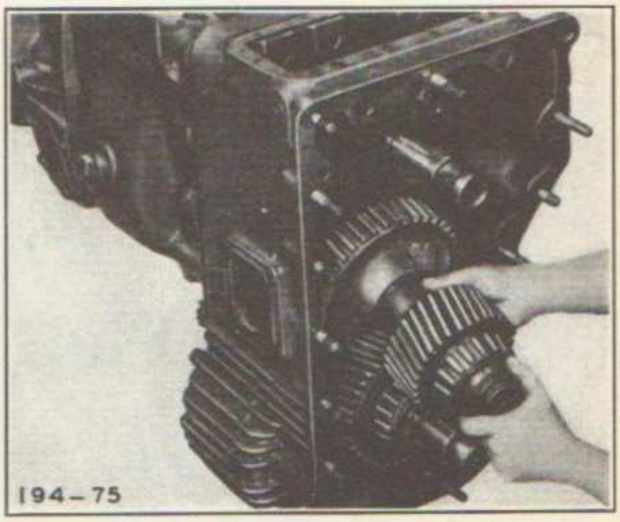

Fig. 78—Installing Countershaft Assembly in Case

Front Drive Shifter Shaft

(See Figure 79)

Install front drive shifter bell crank (242), crank pivot pin (73) and pivot pin support (62). Be certain to insert interlock (246) into position before front drive shifter shaft (251) and parts are located.

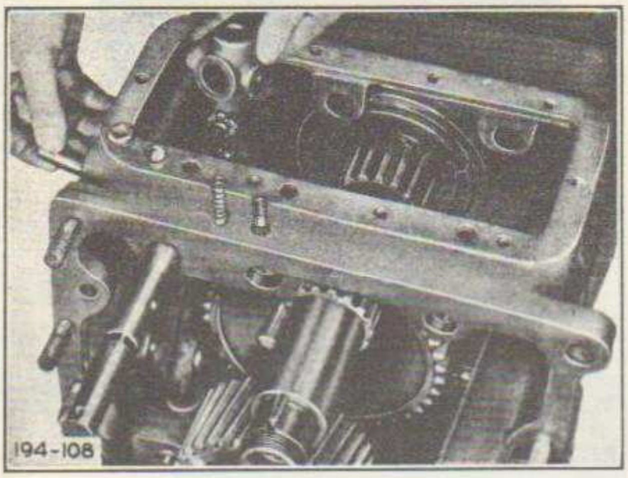

Fig. 79—Installing Interlock and Front Drive Shifter Shaft

Range Gear

Install range gear shifter shaft (250), fork (244) and parts. Then locate range gear sliding gear (170) on mainshaft (131). Install

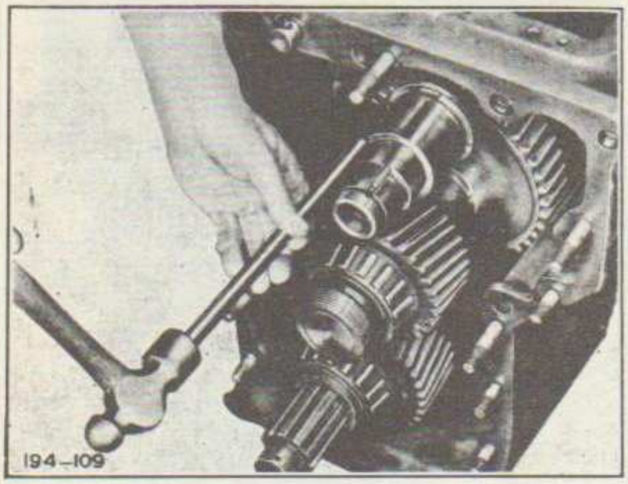

Fig. 80—Installing Constant Mesh Gear Sleeve on Mainshaft

gear sleeve key (188) and drive constant mesh gear sleeve (178) on mainshaft with drift and hammer.

(See Figure 81)

Install constant mesh gear (167), mainshaft rear bearing sleeve (141), rear bearing (163), mainshaft key (290) and then drive on power-take-off drive shaft clutch (263).

The bearing adjustments on the rear drive shaft, countershaft, and front drive shaft are

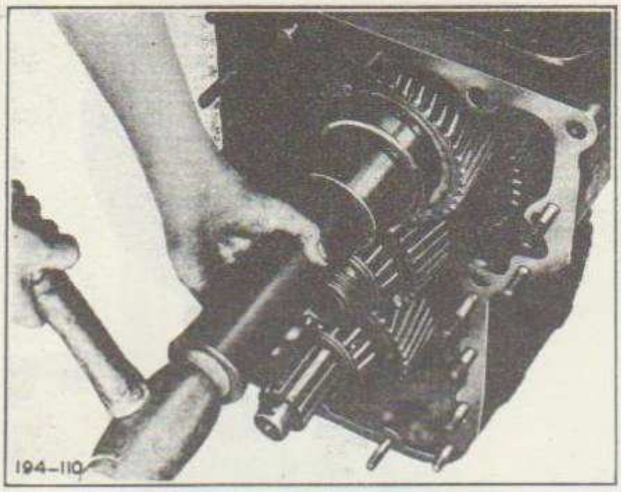

Fig. 81—Installing Power-Take-Off Drive Shaft Clutch

made after the end plate assembly (60) is in place. The front drive shaft may also be adjusted when alone in transfer case.

Rear Drive Shaft Bearing Adjustment

Bolt up rear bearing cover (65) leaving shims (79, 80, 81, and 82) out. Turn on drive flange nut (180) lightly.

Place an indicator against shaft end and measure end-play created by prying under flange nut. Tighten or loosen cover (65) to give required .000"-.002" end-play. Check size of shims needed by inserting feelers in

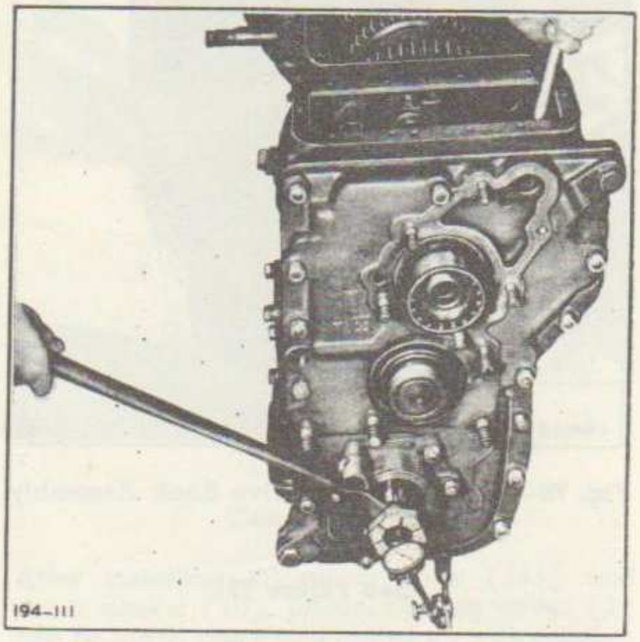

Fig. 82—Checking End-Play of Rear Drive Shaft

space between case and flange of cover. Install necessary thickness of shims (79, 80, 81 and 82) and tighten up rear bearing cover stud nuts (97).

Countershaft Bearing Adjustment

Using same procedure as for rear drive shaft bearing adjustment, remove plug (321) in rear bearing cover and brake bracket assembly to reach end of shaft with indicator.

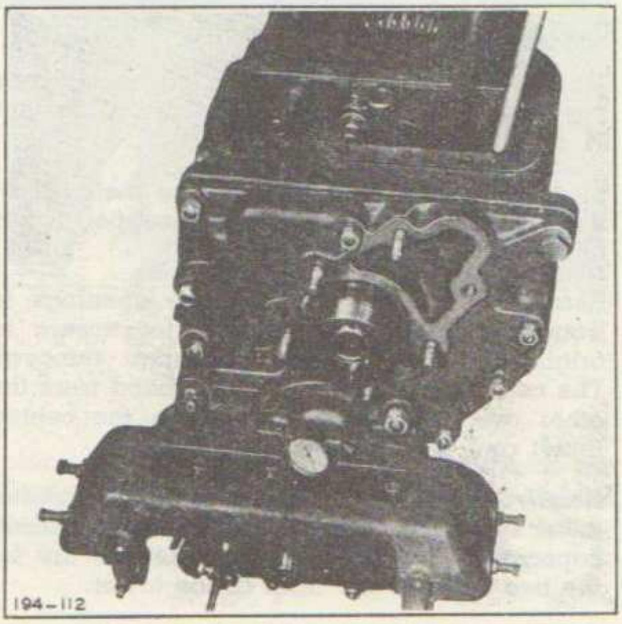
194-112

Fig. 83—Checking End-Play of Countershaft

Using pinch bars in the case, check end-play which should be .000"-.002". Install necessary thickness of shims (83, 84, 85, and 86) and tighten cover nuts (100).

Caution: Insert speedometer gear (202) into cover after cover assembly is permanently bolted to case. Attach speedometer sleeve (203) and then turn gear with screwdriver in slot to be certain that backlash exists between gear and mating worm (201).

Front Drive Shaft Bearing Adjustment

Use same procedure as for rear drive shaft bearing adjustment. Adjust shims (75, 76, 77, and 78) to obtain .000"-.002" end-play in front drive shaft bearings.

Tap on drive flanges and turn up both front drive flange nut (181) and rear drive flange nut (180) tightly.

Mainshaft Rear Bearing

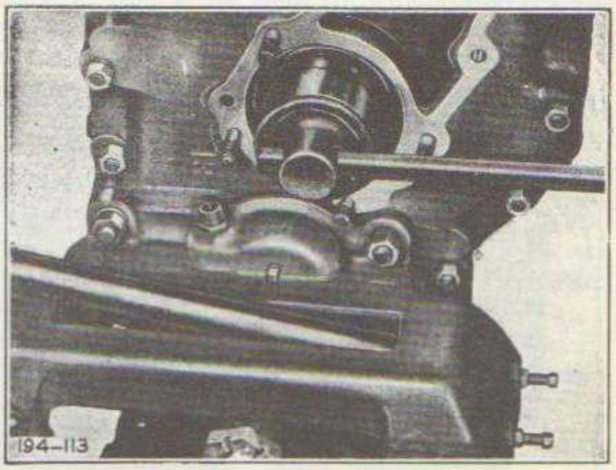
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Fig. 84—Installing Mainshaft Rear Bearing Locknut
(Tool—Mack Part No. 17-T-1496)

After tightening mainshaft rear bearing lock nut (289) with special wrench as illustrated, stake nut into keyway in shaft.

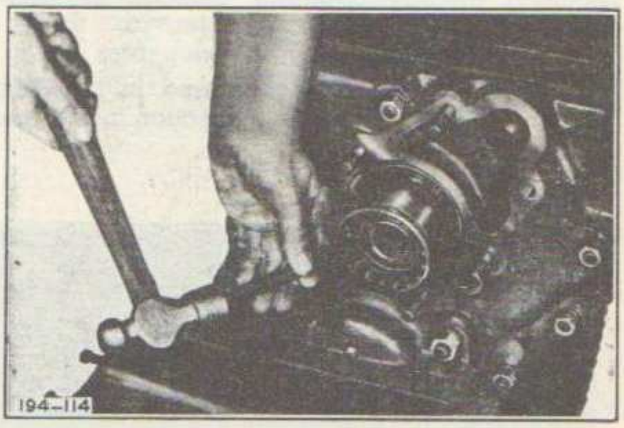

194-114

Fig. 85—Staking Locknut in Keyway

Add power-take-off, shifter shaft cover, and shifter lever assemblies.

Installing Transmission and Transfer Case In Chassis

Three men may be employed to advantage to install the transmission and transfer case in the chassis in short time.

Lower sling down thru cab floor to right of winch clutch lever and in same opening. Attach sling.

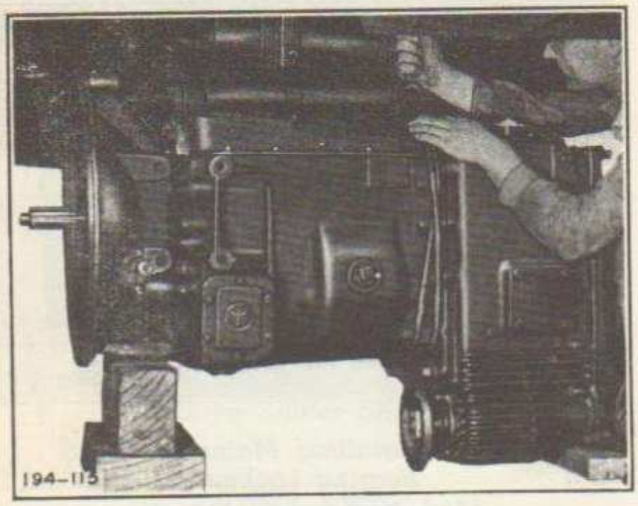


Fig. 86—Transmission and Transfer Case With Lifting Cable in Position

Hoist transmission and use pinch bar to keep main driving pinion shaft clear of engine housing thereby avoiding damage to shaft. Insert shaft into clutch.

Should difficulty be encountered in inserting the shaft, remove clutch inspection plate and use pliers to turn shaft to facilitate its insertion. Care must be taken to avoid damaging splines. Replace inspection plate.

Fig. 87—Working Thru Clutch Inspection Plate to Install Main Driving Pinion Shaft

Place jack under rear of transmission and elevate slightly.

Insert and tighten pilot stud nuts and bell housing capscrews.

Attach speedometer cable clamp to bell housing capscrew to left of top left hand pilot stud.

Place engine rear support brackets with rubber biscuits on bracket. Insert and tighten capscrews.

Place bolts thru the frame brackets, rubber biscuits and engine supports. Tighten down with washers, castellated nuts and cotter pin thru each bolt.

Tighten adjusting bolts on the left hand frame brackets so as to maintain proper alignment of engine and transmission.

Elevate jack slightly and remove the support blocks under the engine rear support ears. Lower and remove jack.

Remove covering from the three openings in transfer case and replace shifter towers in original position as marked upon removal. The center lever has a different bend from the other two, and should be put in the center. Insert and tighten all capscrews.

Remove covering from transmission shifter tower opening and install shifter tower. Insert capscrews. The two longer capscrews are for the two holes to the front of the tower.

Attach speedometer cable clamp to transmission at the left hand side of shifter rod cover.

Replace clutch lever on serrated shaft so that roller is against cam end. Using care not to damage shaft end, tap lever into place. Insert holding bolt and tighten nut.

Attach front fender rear cross brace and bond strap and stay from right front spring rear bracket.

Connect propeller shaft between front of transfer case and front axle drive.

Connect speedometer drive cable by placing clamp on top left hand stud on rear of transfer case.

Replace power-take-off shaft with slip joint to rear. Because of space limitations place lockwashers on the bolts for rear flange attachment at the head of the bolt with threads to the rear.

Connect hand brake push rods on each side.

(See Figure 88)

With one man supporting the propeller shaft between the rear of the transfer case and the forward rear axle drive unit, a helper should

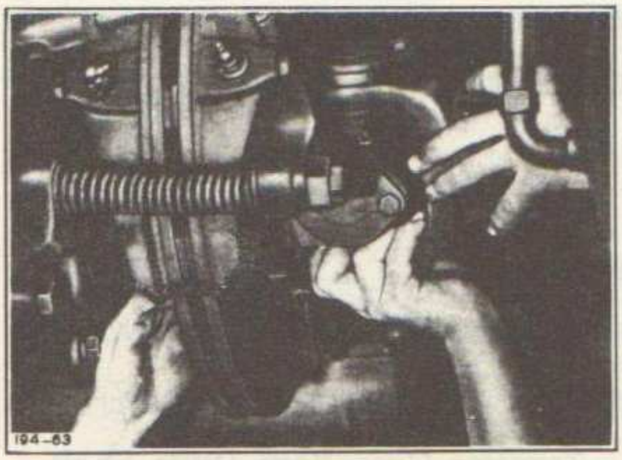


Fig. 88—Installing Propeller Shaft to Forward Rear Axle

place the bolts thru brake disk to attach the flange to disk. Tighten in place. To tighten bolts on upper part of flange, it will be necessary to rotate the disk by either moving the vehicle or rotating the rear axle wheels, which must be jacked up on the same side.

Install cab toe and floor board support and split floor plate around transfer case shifter levers. Now install toe and floor board.

Install air brake treadle to valve by supporting valve from below and inserting and tightening countersunk screws.

Replace draft mats around steering post and transfer case shifter levers.

Attach accelerator pedal linkage.

Push cab windshield to upright position and tighten clamps on each side.

Open engine hood and install accelerator link and throttle hand control wire. Push stop up as far as possible on control wire and tighten nut. Close engine hood.

Fill transmission and transfer case with oil before driving. For information regarding grade and quantity of oil, see "Lubrication" group.

SECTION 8: SPECIFICATIONS

MAKE	Mack
MODEL	TRDXT-36
TYPE	Unit Transmission and Transfer Case
MOUNTING	Integral with power plant

Ratios

	Slow	Fast
FIRST SPEED	20.13	8.05
SECOND SPEED	11.42	4.57
THIRD SPEED	6.53	2.61
FOURTH SPEED	3.63	1.45
FIFTH SPEED	2.50	1.00
REVERSE SPEED	20.30	8.13

Main Driving Pinion

CLUTCH RELEASE BEARING 214-CTQ (Ball) — MRC Gurney

REAR BEARING (Ball) — Similar to SKF 6313-2Z

OIL PUMP VANE, LENGTH ACROSS ENDS 3.422-3.420.

Clutch Yoke Shaft

BUSHINGS (8BM123) dia. ream 1.2530-1.2505

Mainshaft

FRONT SPIGOT BEARING SKF-1-71033

CENTER BEARING CONE Timken 496D

CENTER BEARING CUP (2) Timken 493

CENTER BEARING SPACER Y-1-S493

REAR BEARING Hyatt #U-1213-TM

4th SPEED GEAR THRUST WASHER THICKNESS (8CF226A) .256-.250.

4th SPEED GEAR SLEEVE SHOULDER THICKNESS (786KC22A) .189-.187

3rd SPEED GEAR SLEEVE SHOULDER THICKNESS (783KC22A) .189-.187

4th SPEED GEAR BUSHING DIAMOND BORE 3.4875-3.4870

3rd SPEED BUSHING DIAMOND BORE 3.4875-3.4870

TRANSFER CASE CONSTANT MESH GEAR BUSHING DIAMOND BORE 2.8438-2.8433

Countershaft

FRONT BEARING Hyatt A-1309 TS or SKF 1-74309

FRONT REAR BEARING CONE Timken 385A

FRONT REAR BEARING CUP Timken 383A

REAR REAR BEARING CONE Timken 385A

REAR REAR BEARING CUP Timken 383A

END-PLAY .000"-.002"

Transfer Case Countershaft

FRONT BEARING CONE Timken 555S

FRONT BEARING CUP Timken 552B

REAR BEARING CONE Timken 555S

REAR BEARING CUP Timken 552AW

END-PLAY .000"-.002"

Reverse Shaft

BEARINGS Similar to Hyatt 95932

REVERSE CLUSTER GEAR END PLAY .006-.024.

Transfer Case Rear Drive Shaft

FRONT BEARING CONE Timken 526A

FRONT BEARING CUP Timken 522

REAR BEARING CONE Timken 555S

REAR BEARING CUP Timken 552AW

END-PLAY .000"-.002"

Transfer Case Front Drive Shaft

FRONT BEARING CONE Timken 49580

FRONT BEARING CUP Timken 49520W

REAR BEARING CONE Timken 338T

REAR BEARING CUP Timken 3329B

END-PLAY .000"-.002"

Power-Take-Off Shaft

FRONT BUSHING Bore dia. 1.126"-1.125"

REAR BEARING MRC 308SFG or SKF 6308ZNR

Clearances: (New Limits)

SPLINES AND SLIDING CLUTCHES:
4th & 5th SPEED CLUTCH .001-.003
P.T.O. CLUTCH .002-.006

SHIFTER FORK AND SLIDING GEARS .009-.017

3rd SPEED GEAR BUSHING & SLEEVE .0042-.0052

4th SPEED GEAR BUSHING & SLEEVE .0042-.0052

TRANSFER CASE CONSTANT MESH GEAR BUSHING & SLEEVE .0036-.0046

END-PLAY IN HELICAL GEARS .004-.007

P.T.O. SHAFT & FRONT BUSHING .002"-.004"

Shifting

SHIFTER SHAFT POPPET SPRING (8CJ124) FREE HEIGHT 1¾"-1-25/32"

LBS. PRESSURE @ 1⅛" 20-24

GEAR SHIFTER LEVER REVERSE SPRING (8AB131A) FREE HEIGHT 2"

LBS. PRESSURE @ 11/16" 24

TRANSFER CASE SHIFTER SHAFT POPPET SPRING (112KD11)

FREE HEIGHT 1.360"

LBS. PRESSURE @ .900" 20-24

TRANSFER CASE LEVER SPRING (116KD11)

FREE HEIGHT 2¾" approx.

LBS. PRESSURE @ 1⅛" 45-55

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
L-803	Wrench, Socket, 2½" flats	$8.50	Snap-On-Tools
L-843	Wrench, Socket, 2⅝" flats	9.50	Snap-On-Tools
L-53	Handle, Socket Wrench	6.50	Snap-On-Tools
L-683	Wrench, Socket, 2⅛" flats	5.90	Snap-On-Tools
*41-P-2905-60	Puller, Universal		
17-T-1496	Wrench, Mainshaft Locknut		Mack Mfg. Corp.
*41-P-2911	Puller, Gear, Universal Type, 8 inch capacity		
17-T-274	Puller, Bearing		Mack Mfg. Corp.
17-T-1497	Wrench, Spanner		Mack Mfg. Corp.
17-T-1498	Wrench, Spanner		Mack Mfg. Corp.
17-T-1425	Puller, Reverse Shaft		Mack Mfg. Corp.
17-T-1440	Broach, Gear Bushing		Mack Mfg. Corp.

*Federal Stock Number

GROUP 09: PROPELLER SHAFT

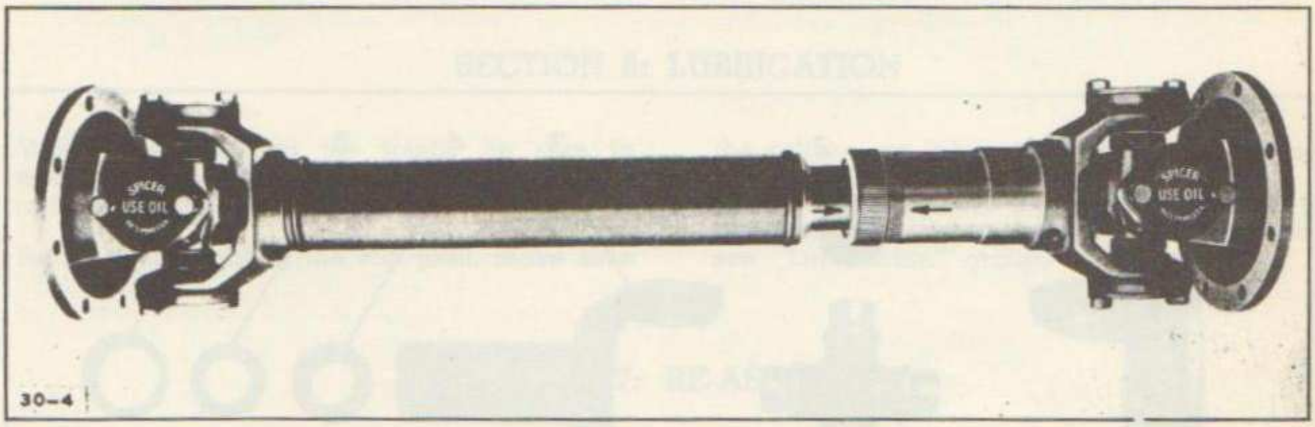
SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

There are three propeller shafts used on this vehicle. Each propeller shaft consists of a tubular shaft with a permanent or non-slip universal joint and a slip-type universal joint. The slip joint permits variations in length between the connected units, caused by the flexing of the groups while the vehicle is in motion.

Each propeller shaft is balanced after the universal joints are assembled. In the event of breakage, a new propeller shaft should be installed. Welding of a broken shaft is not recommended, because this operation requires special facilities which are not always available.

The needle bearing universal joints are so designed that correct assembly is a very simple matter. No hand fitting or special tools are required.

The journal trunnions and needle bearing assemblies are the only parts subject to wear, and when it becomes necessary to replace these for any reason, the work may be done without removing the propeller shaft from the vehicle.



Non-Slip Joint *Fig. 1—Propeller Shaft* *Slip Joint End*

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Excessive Vibration

SHAFT SPRUNG FROM CONTACT WITH OBSTRUCTION ...... Renew shaft.

CAUTION ...... Do not attempt to straighten shaft as special facilities are necessary.

Noise in Universal Joint

BACKLASH DUE TO WORN JOURNAL, BEARINGS OR YOKE ...... Renew worn parts.

Loss of Lubricant

FAULTY OIL SEALS OR LOSS OF LUBRICATION FITTING ...... Renew parts.

SECTION 4: DIS-ASSEMBLY

Removing Shaft from Vehicle

Where companion flanges are used the complete propeller shaft can be removed by disconnecting the flange bolts, nuts, and washers.

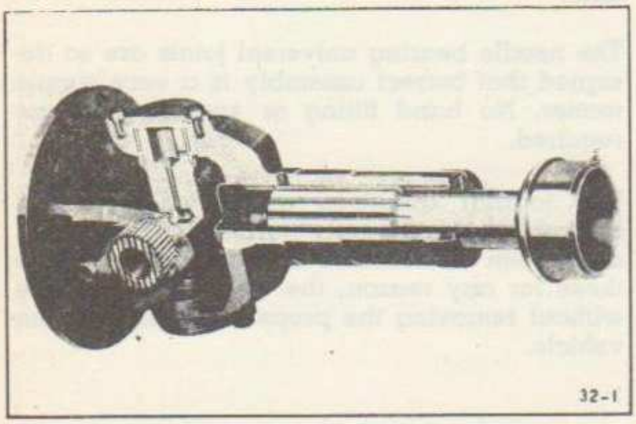


Fig. 2—Cut-away View of Universal Joint

Where end yoke construction is used it is necessary to dis-assemble the universal joints on both ends of the shaft before the propeller shaft can be removed.

Removing Slip Joint

Before the slip joint can be removed from the tubular shaft the dust cap (6) must be unscrewed from the sleeve yoke assembly (3).

Look for arrow marks (see illustration on page 09-1) on the spline shaft and sleeve yoke assembly. If these marks are not readily discernible, before dis-assembly punch mark both members in order that they may be re-assembled in exactly same relative position. When clearly marked, withdraw the tubular shaft.

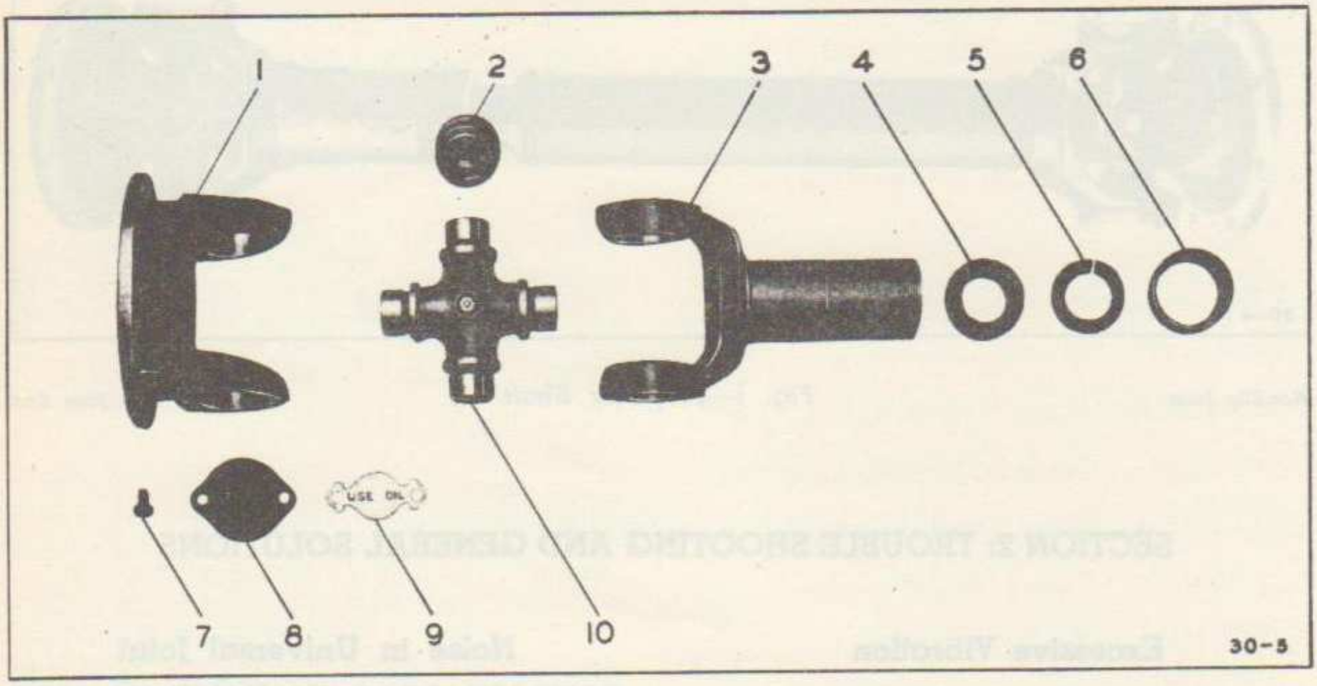


Fig. 3—Exploded View of Universal Joint

1. Flange Yoke
2. Needle Bearing
3. Sleeve Yoke
4. Cork Washer
5. Steel Washer
6. Dust Cap
7. Bolt
8. Bearing Cap
9. Lock Plate
10. Journal

Dis-Assembling Universal Joints

Bend down the locking lug on the lock plate (9) with a screwdriver, and remove the bolts (7) which hold the bearing cap (8). This allows the needle bearing assembly (2) to be removed from the yokes (1 & 3), by first tapping on the exposed face of one of the needle bearing cages until the opposite needle bearing assembly comes out. Then tap the exposed end of the journal (10) until the opposite bearing is free. The journal is now free for removal and by sliding to one side of the yoke, the end of the trunnion bearing will now be free to tip and clear the lug on the yoke, and can be completely removed from the assembly.

SECTION 5: REPAIRS

Clean all parts, using suitable cleaning fluid. Allow needle bearings to remain in cleaner for some time to loosen up any particles of grease or foreign matter.

Needle type roller bearings should not be dis-assembled. Clean with short stiff brush and blow out with compressed air. Work small quantity of lubricant into roller assembly and turn bearing on trunnion to check wear.

If the needle bearing assemblies are worn and show excessive side movement on the journal trunnions, then the bearings only should be renewed.

If the journal is worn and requires renewal, it is also advisable to renew the needle bearing assembly. Otherwise, the use of worn bearings with a new journal will result in rapid wear requiring subsequent renewal in a short while.

SECTION 6: LUBRICATION

When re-assembling the joints, be sure to work small quantity of chassis-grease into the roller assemblies.

Before re-assembling the slip joint, make sure the splines are lubricated with chassis-grease.

No other lubrication is required during re-assembly. For other lubricating instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

Assembling Universal Joints

Make sure the universal joint bearings are clean and well lubricated before assembly.

Inspect journals and yokes carefully and remove any burrs or rough spots on the bearing surfaces and the ends of journal trunnions.

Install NEW cork gaskets in the four retainers on the journal.

Insert one trunnion of the journal (10) into the bearing hole in the lug of the yoke from the inside between the lugs and tilt until journal trunnion will enter the opposite hole in the lug.

Insert bearings (2) from the outside of the yoke, tapping them into place on the journal (10) with a soft drift so as not to injure the parts or surfaces.

Install bearing cap (8). Be sure the key on the bearing cap matches the groove in the bearing (2), use a NEW lock plate (9) and assemble cap screw (7) and tighten screws evenly. With a screwdriver, bend up the locking lugs of the lock plate (9) around the flat head of the cap screw (7) to prevent the screws from working loose.

When assembled, if the joint appears to bind, tap the lugs lightly with a hammer which will relieve any pressure of the bearing on the end of the journal.

Assembling Slip Joint on Shaft

Before assembling the slip joint on the tubular shaft, make sure the splines are lubricated. When inserting the spline of the propeller shaft into the slip joint, BE SURE the arrows on the spline shaft and slip joint are in line, in order that the yokes on the universal joints will be in the same plane. Otherwise excessive vibration will result.

The cork washer (4) on the slip joint should be renewed if necessary before assembling the dust cap (6) and steel washer (5) on the sleeve yoke assembly (3).

Installing Propeller Shaft

Check the propeller shaft for runout. The shaft tube must not run out to an indicator reading in excess of .020" and the neck of the spline .005".

The propeller shaft must be installed with the slip joint assembled nearest the source of power; that is, at the front and rear of the transfer case, and at the rear of the forward rear axle.

At the positions where companion flanges are used, the flange bolts are to be tightened up evenly after the nuts and the lock washers are in place.

At the positions where end yokes are used, follow the instructions for "Assembling Universal Joints."

SECTION 8: SPECIFICATIONS

Transmission to Front Axle

MAKE .... Spicer
SERIES .... 1601-1608 B/P 8899-2SF
UNIVERSAL JOINT (TRANSMISSION) .... 1601 Slip Joint
UNIVERSAL JOINT (FRONT AXLE) .... 1608 Permanent Joint
OVERALL LENGTH .... 38-27/32"
DIAMETER .... 3"

Transmission to Forward Rear Axle

MAKE .... Spicer
SERIES .... 1801-1808 B/P 9133-2SF
UNIVERSAL JOINT (TRANSMISSION) .... 1801 Slip Joint
UNIVERSAL JOINT (FORWARD REAR AXLE-FRONT) .... 1808 Permanent Joint
OVERALL LENGTH .... 48⅜"
DIAMETER .... 3½"

Forward Rear to Rear Rear Axle

MAKE .... Spicer
SERIES 9117-SF
UNIVERSAL JOINT (FORWARD REAR AXLE-REAR) .... KRL 1701 Slip Joint
UNIVERSAL JOINT (REAR REAR AXLE) .... KRL 1708 Permanent Joint
OVERALL LENGTH .... 39"
DIAMETER .... Solid

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
L-803	Wrench, Socket, 2½" flats (Rear of Transmission)	$ 8.50	Snap-On Tools
L-683	Wrench, Socket, 2⅛" flats (Front of Transmission and at Front Axle Carrier)	5.90	Snap-On Tools
L-883	Wrench, Socket, 2¾" flats (Forward Carrier—front)	10.00	Snap-On Tools
L-643	Wrench, Socket, 2" flats (Forward Carrier—rear and Rear Carrier)	5.75	Snap-On Tools
L-53	Handle, Socket Wrench	6.50	Snap-On Tools

GROUP 10: FRONT AXLE

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

As illustrated by Figure 1, a phantom view of complete front axle assembly with the right hand wheel removed, the *Axle Drive Unit* enclosed in the center axle housing (or banjo), transmits power thru its axle shafts to the right hand and left hand *Wheel Drive Units.*

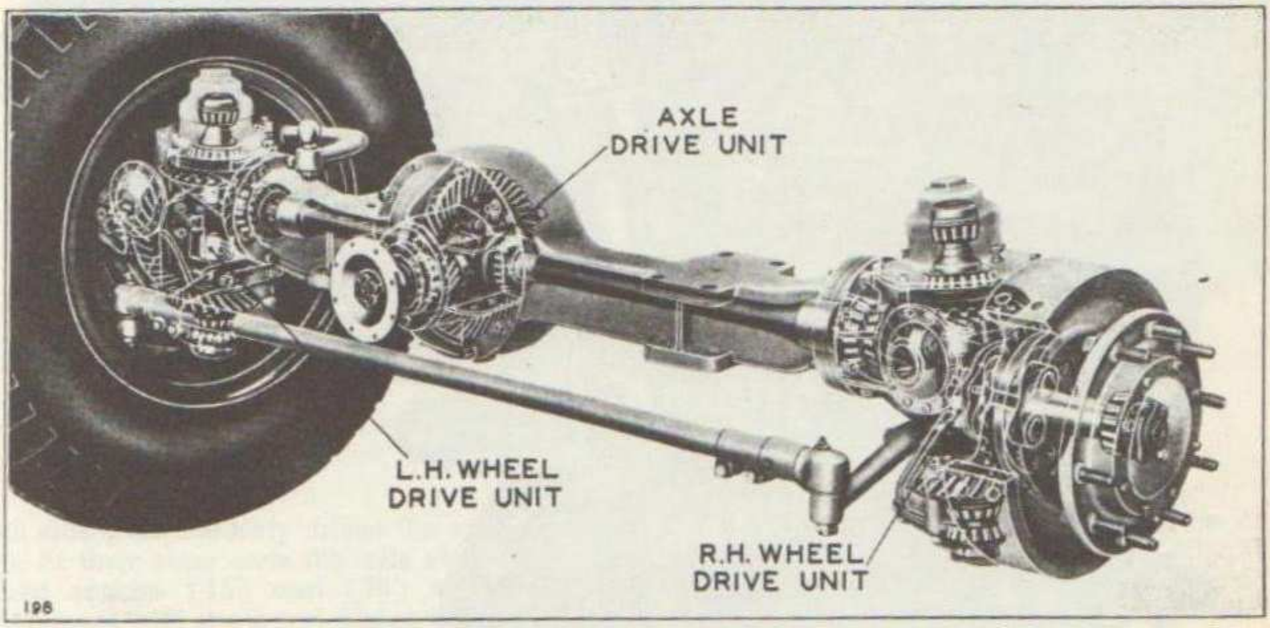


Fig. 1—Phantom View of Front Axle Assembly with Right Hand Wheel Removed

As shown by Figure 2, a skeleton view of the driving gear train, the axle drive unit provides the first of three gear reductions, the second and third reductions being in the wheel drive units. The gears for all three reductions are of the spiral-bevel type.

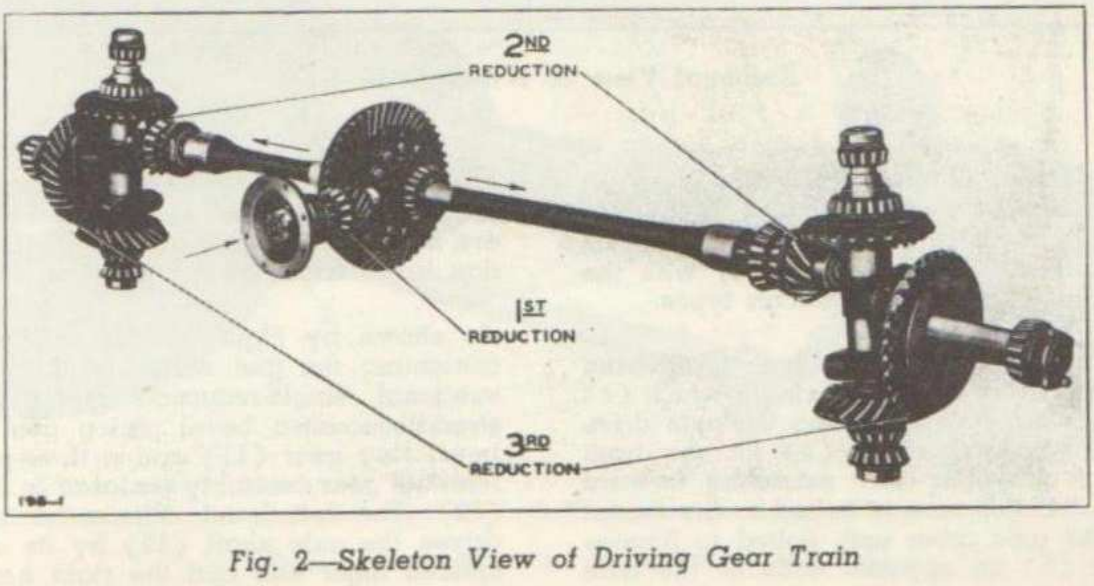
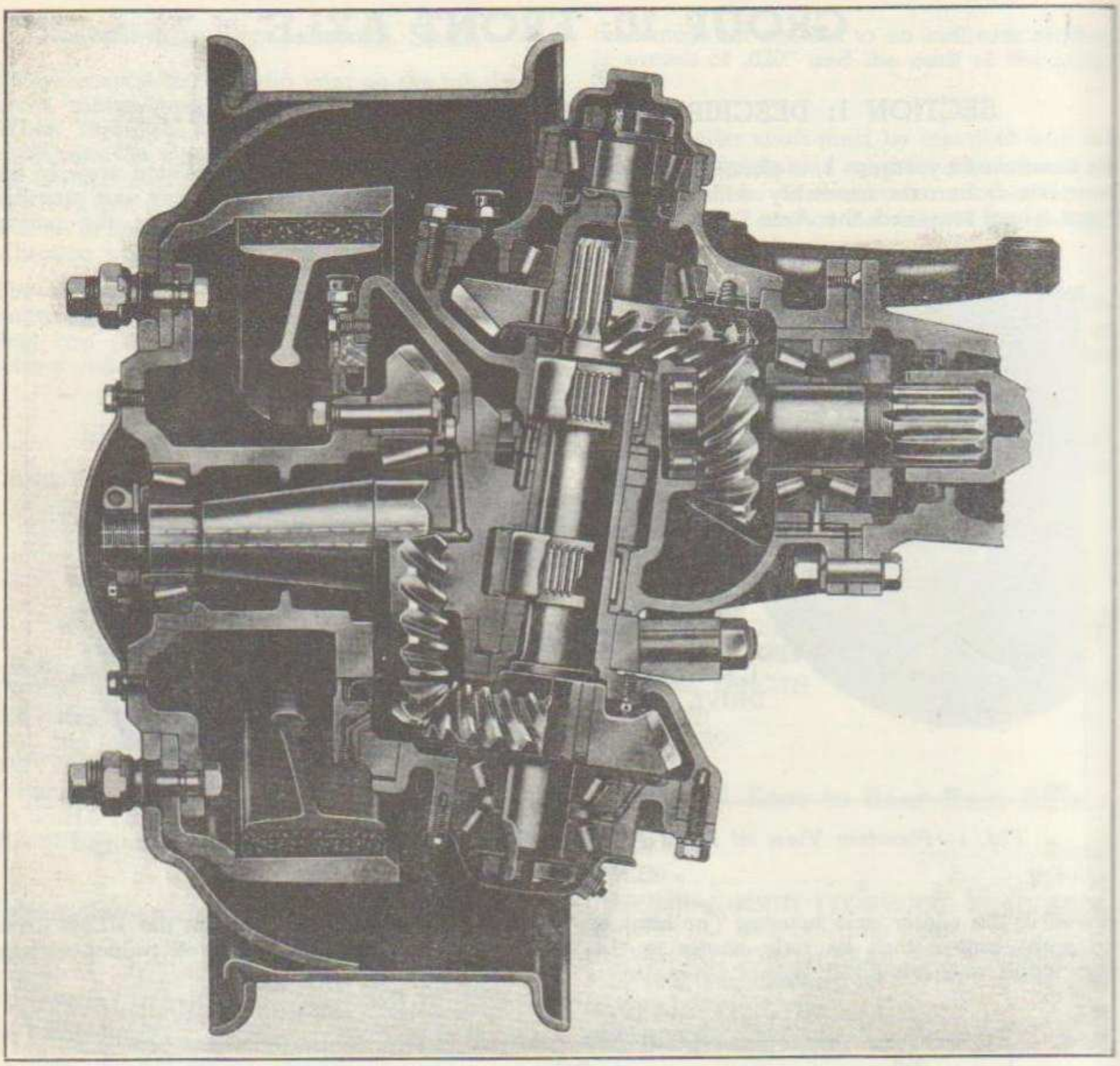


Fig. 2—Skeleton View of Driving Gear Train



Sectional View of Wheel Drive Unit

The wheel drive units are of a type in which bevel gears concentric with the king pins provide for steering as well as driving the wheels, thereby dispensing entirely with the universal joints required by other types.

Figures 3 and 4 are, respectively, front and rear views of the complete axle, in which (1) is the housing, fully enclosing the axle drive unit and having perches (2) for the front springs. A propeller shaft extending forward from the transfer case is bolted to the flange (3) of the axle drive unit. Bolted to flanges (4) and (5) on opposite ends of the axle housing (1) are housings (6) and (7) for the second-reduction gears and below them are housings (8) and (9) for the third-reduction gears which swing with the wheels.

As shown by Figure 6, the axle drive unit containing the first reduction is of the conventional single-reduction type, having a straddle-mounted bevel pinion gear (10), a bevel ring gear (11) and a three-pinion differential gear assembly enclosed in the casing (12). The left hand differential side gear drives the axle shaft (13) by its externally splined inner end and the right hand differ-

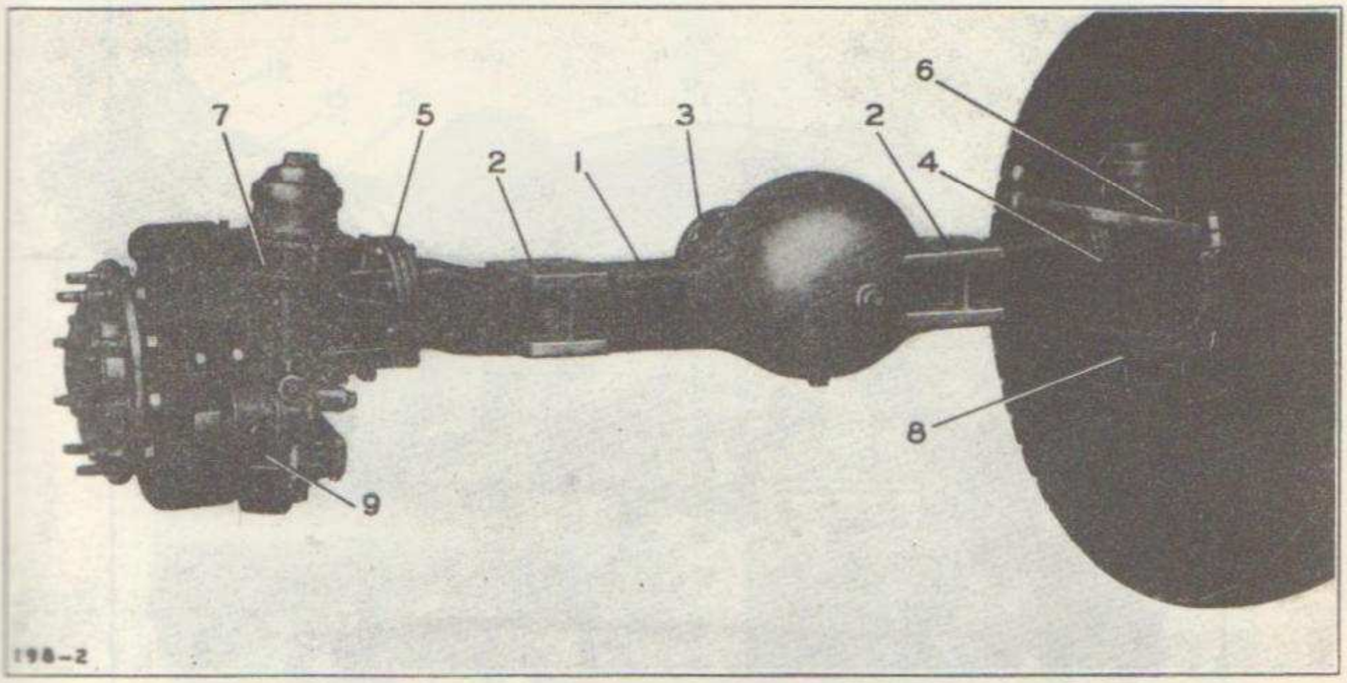


Fig. 3—Front View of Complete Axle

ential side gear similarly drives the axle shaft (14). At their outer ends the axle shafts have splined sockets (15) and (16) for driving engagement with the bevel pinion gears (17) and (18), which drive, respectively, the second-reduction bevel gears (19) and (20). The latter are splined on drive shafts passing thru the tubular king pins, pivoted in needle bear-

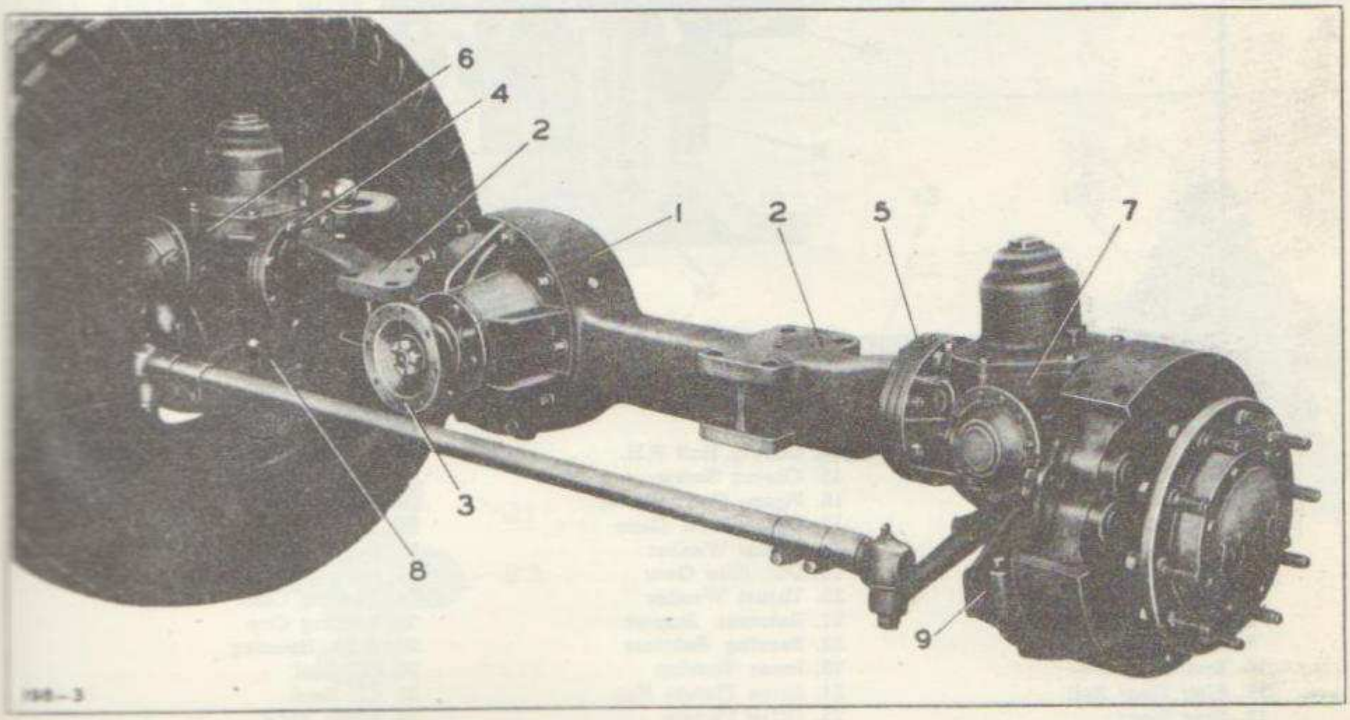


Fig. 4—Rear View of Complete Axle

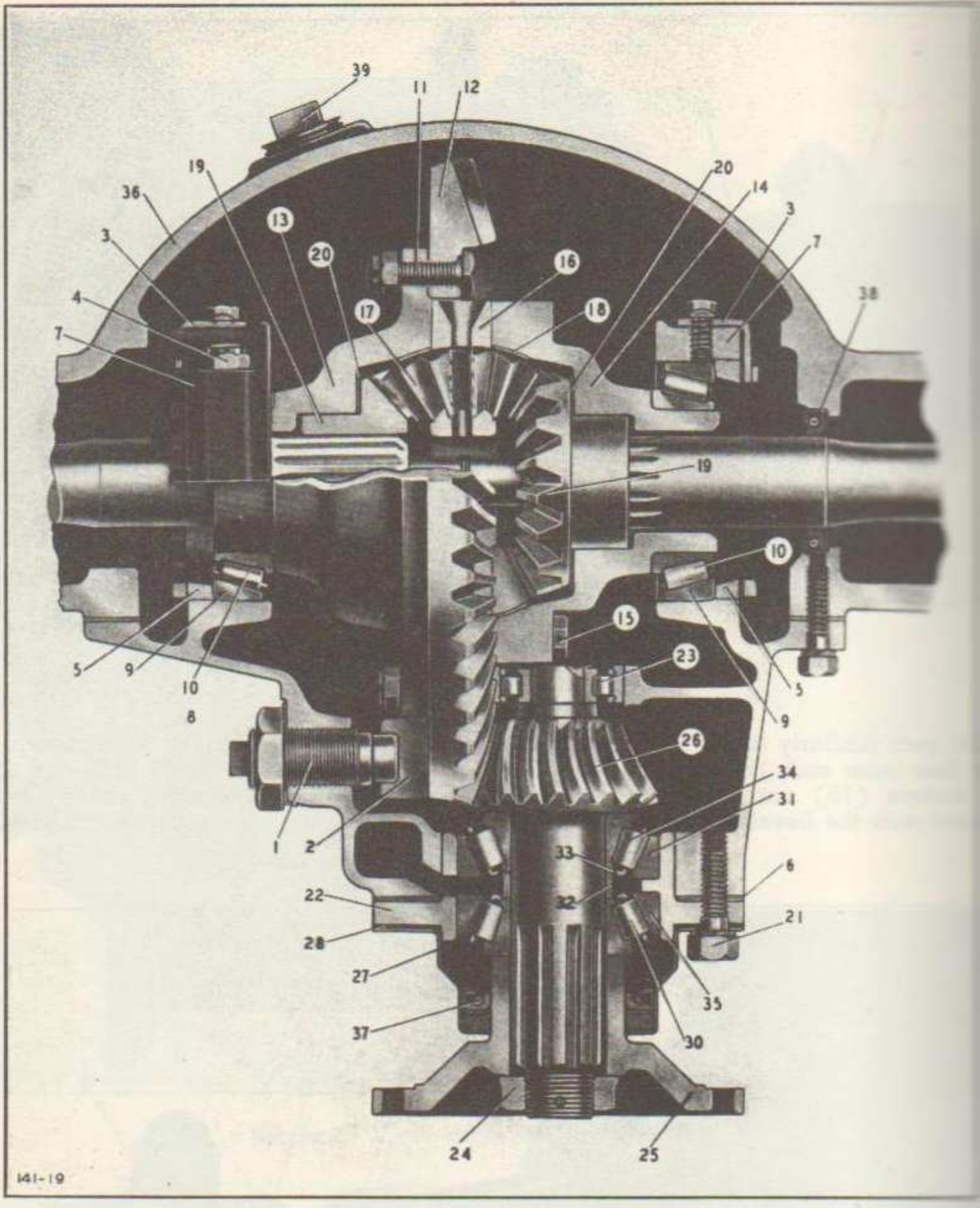


Fig. 5—Horizontal Section of Axle Drive Unit

1. Thrust Screw
2. Thrust Shoe
3. Nut Lock
4. Bearing Cap Nut
5. Adjusting Nut
6. Shim Pack
7. Bearing Cap
8. Carrier Housing
9. Bearing Cup
10. Bearing Cone
11. Ring Gear Bolt
12. Ring Gear
13. Casing Half L.H.
14. Casing Half R.H.
15. Casing Screw
16. Pinion Gear Spider
17. Diff. Pinion Gear
18. Thrust Washer
19. Diff. Side Gear
20. Thrust Washer
21. Retainer Screws
22. Bearing Retainer
23. Inner Bearing
24. Drive Flange Nut
25. Drive Flange
26. 1st Red. Pinion Gear
27. Bearing Cover
28. Cover Gasket
30. Bearing Cone
31. Bearing Cup
32. Bearing Spacer
33. Shim Pack
34. Bearing Cone
35. Bearing Cup
36. Axle Housing
37. Oil Seal
38. Oil Seal
39. Filler Plug

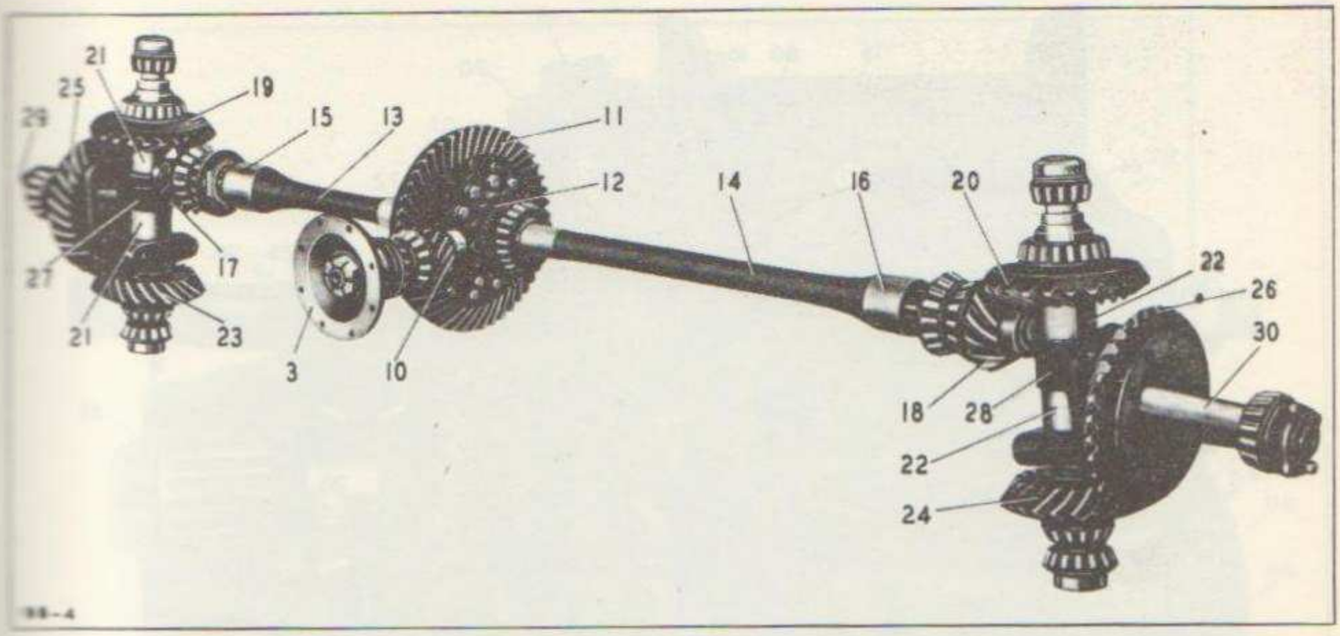


Fig. 6—Skeleton View of Driving Gear Train

ings (21) and (22) carried by the second-reduction gear housings (6) and (7) shown by Figures 3 and 4. Keyed to the lower ends of the drive shafts are bevel pinion gears (23) and (24) which drive, respectively, the third-reduction bevel gears (25) and (26), enclosed in the housings (8) and (9) which swing with the steering knuckles (27) and (28). These gears drive the wheels, being bolted to their hubs (not shown) which turn on bearings mounted on the wheel spindles (29) and (30) of the steering knuckles.

The gearing principle whereby steering as well as driving is accomplished without the employment of universal joints, is more clearly illustrated by Figure 7, a rear view of the gearing on the left side. When the wheels are

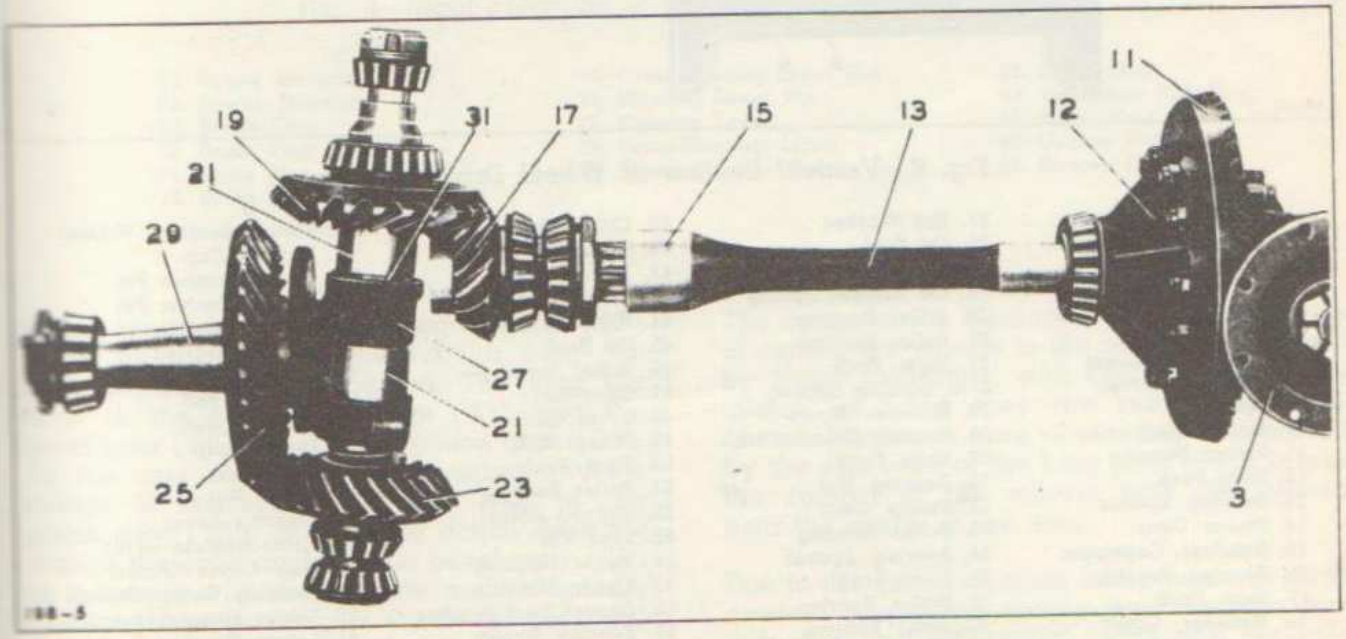


Fig. 7—Skeleton View of Left Hand Gear Train

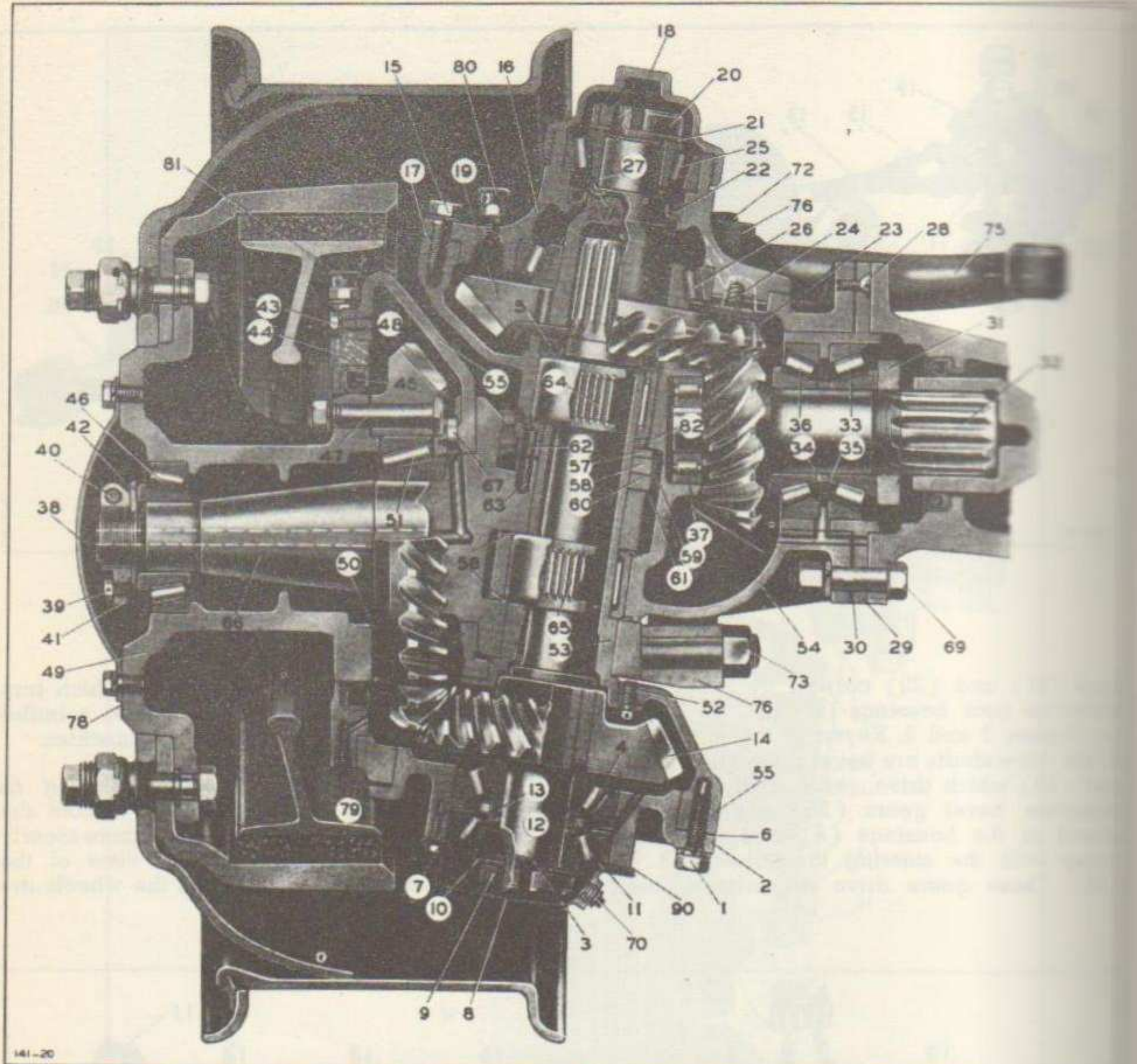


Fig. 8—Vertical Section of Wheel Drive Unit

1. Retainer Capscrew
2. Bearing Retainer
3. Drive Shaft
4. Roller Bearing
5. Oil Seal
6. Shim Pack
7. Cover Capscrew
8. Retainer Cover
9. Locknut
10. Nut Washer
11. Roller Bearing
12. Shim Pack
13. Bearing Spacer
14. Pinion Gear
15. Retainer Capscrew
16. Bearing Retainer
17. Shim Pack
18. Retainer Cover
19. Bevel Gear
20. Locknut
21. Nut Washer
22. Oil Seal
23. Oil Scraper
24. Oil Scraper Spring
25. Roller Bearing
26. Roller Bearing
27. Shim Pack
27A. Bearing Spacer
28. Retainer Screw
29. Bearing Retainer
30. Shim Pack
31. Bearing Nut
32. Pinion Gear
33. Roller Bearing
34. Bearing Spacer
35. Shim Pack
36. Roller Bearing
37. Inner Bearing
38. Wheel Hub Cover
39. Lock Screw
40. Clamp Bolt
41. Adjusting Nut
42. Nut Washer
43. Cover Capscrew
44. Housing Cover
45. Oil Seal
46. Roller Bearing
47. Gear Bolt
48. Bevel Gear
49. Wheel Hub
50. Shim Pack
51. Roller Bearing
52. Tapped Holes
53. King Pin
54. Upper Housing
55. Lower Housing
56. Grease Seal Washer
57. Bearing Spacer
58. Thrust Bearing Washer
59. Washer Cup
60. Thrust Bearing Washer
61. Washer Cup
62. Thrust Washer Pin
63. Thrust Washer Pin
64. Needle Bearing
65. Needle Bearing
66. Steering Knuckle
67. Knuckle Bolt
69. Housing Bolt
70. Drain Plug
72. Pinch Bolt
73. Lever Nut
75. Steering Lever
76. Cross-Steering Lever
78. Hub Cover Gasket
79. Housing Cover Gasket
80. Upper Housing Breather
81. Lower Housing Breather
82. Thrust Washer Spacer
90. Lower Cover Gasket

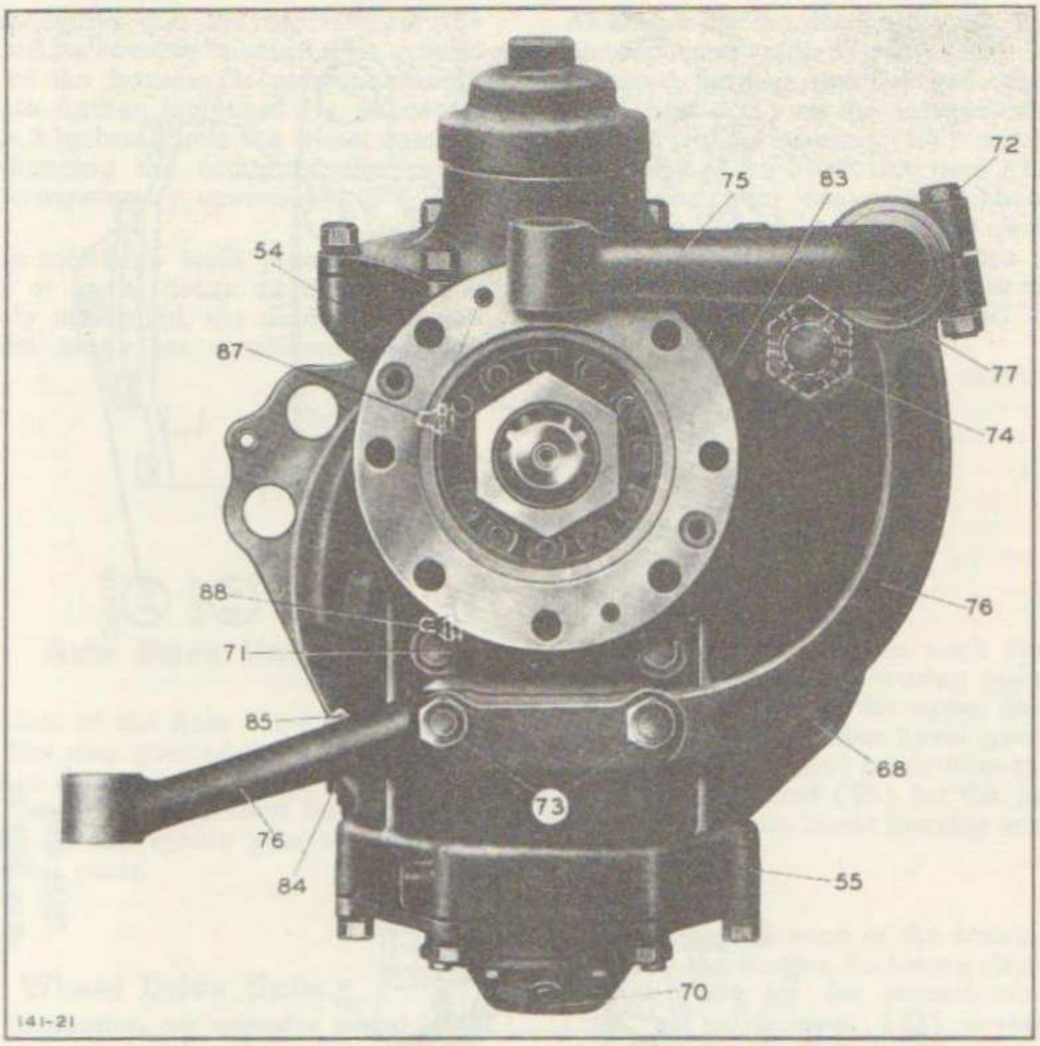


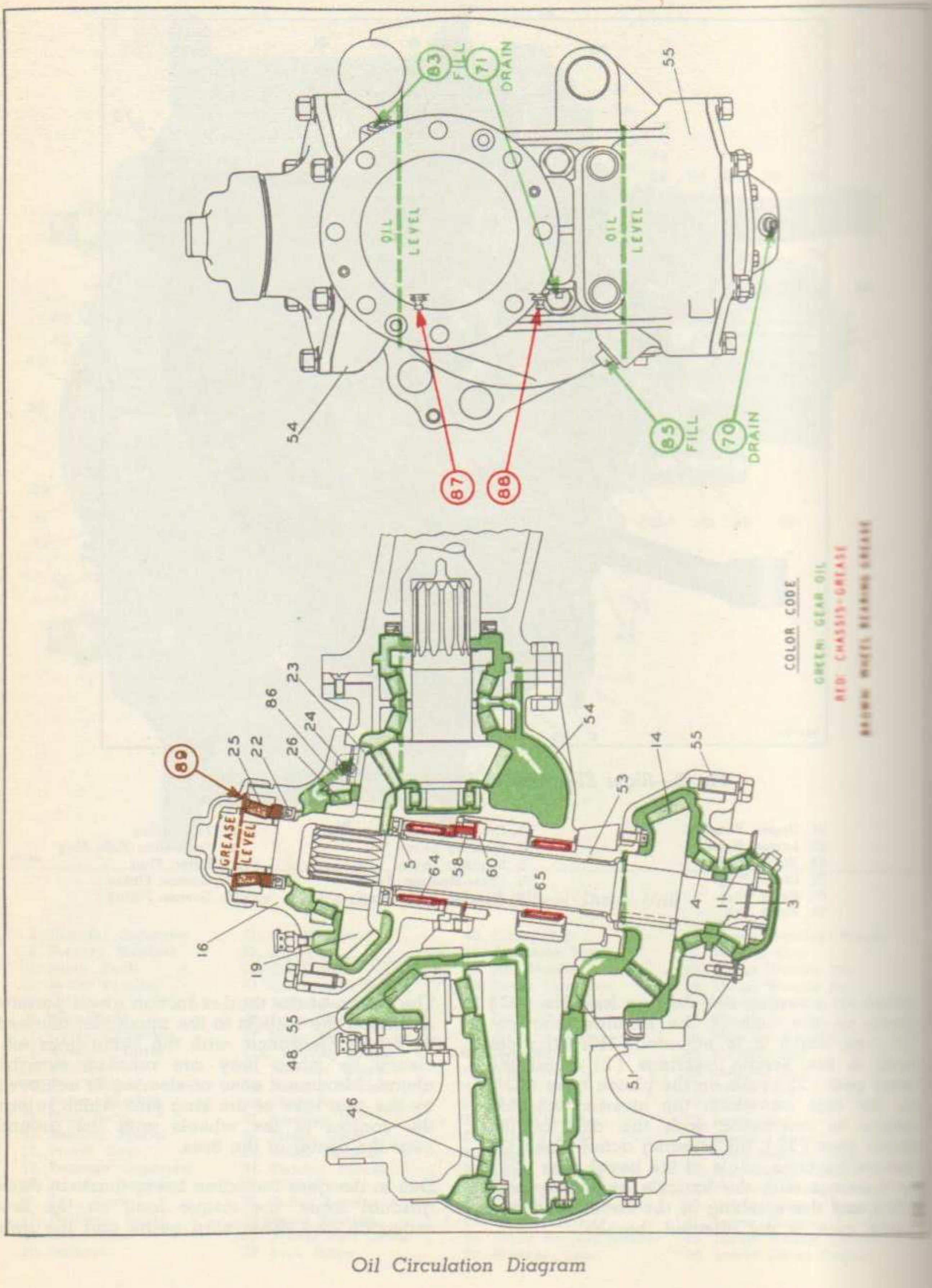
Fig. 9—Right Elevation of Left Hand Wheel Drive Unit

54. Upper Housing
55. Lower Housing
68. Brake Cam
70. Drain Plug
71. Drain Plug
72. Pinch Bolt
73. Cross-Steering Lever Nut
74. Steering Lever Nut
75. Steering Lever
76. Cross-Steering Lever
77. Steering Lever Key
83. Filler Plug
84. Inspection Hole Plug
85. Filler Plug
87. Grease Fitting
88. Grease Fitting

turned for steering, the steering knuckle (27) pivots on the axis of the tubular king pin (28) on which it is mounted. The king pin turns in the needle bearings (21) and the bevel gear (25) rolls on the pinion gear (23). As the axis on which the steering knuckle swings is concentric with the axis of the pinion gear (23), the steering action does not change the cone angle of the bevel gear (25) as it swings with the knuckle and its spindle (29), and the meshing of the bevel gear and pinion gear is not affected thereby.

The action of the third-reduction gears permits of cutting the wheels to the maximum allowed by frame clearance, with the same gear efficiency as when they are running straight-ahead. Maximum ease of steering is achieved by the side rake of the king pins which brings the contact of the wheels with the ground near the center of the tires.

Due to the gear reduction being made in three gradual steps, the torque load on the first reduction and differential gears and the axle



Oil Circulation Diagram

shafts is moderate and the diameter of the ring gear and its housing is small. The ground clearance of the housing is correspondingly great and is further increased by its center being about 3 inches above the wheel centers, greatly enhancing the utility of the prime mover for cross-country operation.

To maintain moderate tooth pressures in the three pairs of bevel gears as the torque is progressively multiplied, the diameters of the bevel pinion gears are correspondingly increased.

As shown by the sectional view, Figure 5, the first-reduction pinion gear (26) is straddle-mounted, having two tapered-roller bearings (30) and (34) on its integral shaft and a straight roller bearing (23) on its inboard end. Back of the bevel ring gear (12) opposite the pinion gear center, is a shoe (2) with adjusting screw (1) to limit the gear deflection under extreme loads. The two differential bevel side gears (19) are enclosed in casing halves (13) and (14) carried on widely-

(Continued on page 10-10)

Lubricating System

Axle Drive Unit

The lubrication of the Axle Drive Unit is conventional. The ring gear of the first reduction gears runs in a reservoir of gear oil and carries oil to the pinion gear and bearings. Oil enters holes in the spider pins to lubricate the differential parts.

Wheel Drive Units

(See illustration on opposite page)

The lubrication of the Wheel Drive Units is unique and should be thoroly understood. All gears and most of the bearings run in reservoirs of gear oil. Contrary to usual practise, the wheel bearings are automatically lubricated by a continuous circulation of gear oil, instead of wheel bearing grease. Therefore, it is unnecessary to remove the front wheels to lubricate the wheel bearings. The lubrication of the various parts is explained in detail below:

The second-reduction gears are inclosed in housing (54) and the third-reduction gears in a separate housing (55) each pair of gears being individually lubricated. Oil circulated by the rotation of the gears provides lubrication not only for the gears but for the bearings inclosed in the same housing with each pair.

The oil circulation diagram shows the manner in which the gear oil (green color) circulates independently in each housing and also shows the wheel bearing grease (brown color) lubrication of the upper bearing (25) for the second-reduction bevel gear, the chassis-grease (red color) lubrication of the needle bearings (64) and (65) for the tubular king pin (53) and the thrust bearing washers (58) and (60).

Oil circulates in each of the housings as indicated by the arrows. To insure circulation thru bearing (26) for the second-reduction gear (19), an oil scraper (23) pressed by the spring (24) against the upper face of the gear, causes the oil to flow upward thru the hole (86) in retainer (16) to a point above the bearing. The oil seal (22) prevents the oil from reaching the upper bearing (25), which is packed with wheel bearing grease. The oil seal (5) prevents the oil from reaching the needle bearings (64) and (65) and the thrust bearing washers (58) and (60), which are lubricated with chassis-grease thru the fittings (87) and (88).

No oil-scraper is required for the third-reduction gear (48) as its rotation lifts the oil to the top of housing (55) from whence it flows down thru a vertical passage in the steering knuckle leading to a central passage in the integral wheel spindle. From the outer end of the latter the oil circulates thru the wheel bearings (46) and (51), around the pinion (14) and thru the lower bearings (4) and (11) of the drive shaft (3), back to the low point of the housing.

spaced roller bearings (10). The three differential pinion gears (17) have ground spherical backs bearing in spherical thrust washers (18) within the casing. The three pinion gear pins are forged integrally in a spider (16) having its outer ends locked between the casing halves (13) and (14).

As shown by Figure 8, a sectional view of the left hand wheel drive unit, the second reduction pinion gear (32) is straddle-mounted, having two tapered-roller bearings (33) and (36) on its integral shaft and a straight roller bearing (37) on its inboard end. The second-reduction bevel gear (19) is splined to the upper end of the drive shaft (3). This gear has an integrally-forged stub shaft supported by two tapered-roller bearings (25) and (26), enclosed in a retainer (16) at the top of the housing (54).

The third-reduction pinion gear (14) is pressed on and keyed to the lower end of the drive shaft (3) which turns in two tapered-roller bearings (4) and (11). The drive shaft passes thru the tubular king pin without touching it, so that the driving and load carrying means are entirely independent. The third-reduction bevel gear (48) is bolted to the wheel hub (49) which turns on two widely spaced tapered-roller bearings (46) and (51) on the wheel spindle of the steering knuckle (66). The pinion (14) and gear (48) are enclosed in the housing (55).

The tubular king pin (53) provides a means of connection between the housing (54) and the yoked steering knuckle (66). The king pin pivots in two needle bearings (64) and (65), carried by housing (54). A hardened steel thrust bearing assembly consisting of washers (58) and (60), between the top of the steering knuckle yoke and the housing (54), sustains the weight carried by the wheel.

Figure 9 is a right elevation of the left wheel drive unit showing the several oil filler and drain plugs and the fittings for greasing the needle bearings. Also shown is the steering lever (75), the forward end of which is drawn by a nut (74) into a tapered socket with a key (77) in the upper portion of housing (54). Also the cross-steering lever (76) which is attached to the steering knuckle (66) by studs and nuts (73). The forward extension of the cross-steering lever curves upward to reinforce the steering lever, which passes thru a split clamp at its upper end, having a pinch bolt (72).

As shown by Figure 4, the cross steering levers are attached at such a height that the tubular tie rod is protected by being above the bottom of the axle housing (1). The exceptional ground clearance of the axle housing and its complete protection of the tie rod is indicated by Figure 3, a front view in which the tie rod is entirely concealed by the axle housing. The height of the engine crankcase, at the point where the tie rod passes under it, permits the use of a straight tube having right and left hand threads on its opposite ends, for adjusting the toe-in of the wheels.

Altho the brakes are closely associated with the wheel-drive units, they are referred to in this group only where necessary in the sections relating to dis-assembly and re-assembly. "See Group 12: Brakes" for detailed information relating to them.

Each set of gears, their bearings and all other moving parts are fully inclosed in their own housings and the clean oil with which they are lubricated is impervious to contamination. Oil seals prevent the transfer of oil from one compartment to another and prevent its mixture with the grease used in roller bearing (25) and needle bearings (64) and (65).

It will be seen from the maintenance instructions which follow that the axle drive and wheel drive units can be independently removed for subsequent dis-assembly and repair at the bench, or for their separate replacement with interchangeable units, without disturbing the other components. The facility with which the complete axle can be taken apart and reassembled, because of the accessibility of the parts, will also be evident.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Axle Drive Unit

Backlash

EXCESSIVE PINION AND RING GEAR CLEARANCE .... Adjust as per text.

EXCESSIVE AXLE-SHAFT SPLINE CLEARANCE .... Renew worn parts.

Noise in Carrier

PINION CARRIER LOOSE ON HOUSING .... Tighten capscrews.

WORN BEARINGS .... Renew

WORN GEARS .... Renew

LUBRICANT AT LOW LEVEL .... Renew as per text.

Gear Noise

CONTINUOUS HUM .... Adjust wheel bearings and bearings of pinion and ring gears.

COASTING HUM .... Inspect adjustment of pinion gear in relation to ring gear and adjust pinion gear if necessary.

PULLING HUM .... Inspect adjustment of ring gear and pinion gear and change if incorrect.

Wheel Drive Units

GEAR HUM .... If not corrected by adjustments specified above, check gear and bearing adjustments of 2nd and 3rd reductions and adjust if necessary.

Hard Steering

STEERING LINKAGE TOO TIGHT .... Adjust tie-rod and drag link sockets. Also check steering column bushing.

STEERING COLUMN SPRUNG .... Loosen steering column bracket and shim into alignment.

Wander

LOOSE STEERING LINKAGE .... Adjust drag link.

INSUFFICIENT CASTER, TOO MUCH LOAD ON FRONT AXLE .... Check caster and add tapered shims to front axle, or redistribute load to put more on rear axle.

TOE-OUT OF FRONT WHEELS .... Check and reset for 1/8" to 3/16" toe-in.

Shimmy

TIRE AND WHEEL OUT OF BALANCE .... Check and balance.

LOOSE STEERING LINKAGE .... Check and adjust.

WORN KING PINS .... Check and renew parts of both sides.

Negative camber

OVERLOADED AXLE .... Check front and rear loads and redistribute.

BENT AXLE OR SPINDLE .... Check and straighten or renew.

Improper Toe-In

BENT STEERING LEVERS OR TIE-ROD .... Renew.

CHANGE IN CASTER OR CAMBER .... Check caster and camber.

Wheels Do Not Straighten After Turns Are Made

INSUFFICIENT CASTER .... Check load distribution and spring camber, then add tapered shims under front springs if necessary.

TIGHT STEERING PARTS .... See "Hard Steering".

UNEQUAL CASTER OR BENT AXLE HOUSING .... Check caster and axle housing. If bent, renew axle.

SECTION 3: ADJUSTMENTS

Note: The only adjustments included in this section are those relating to front wheel alignment, as other adjustments require partial disassembling. See "Section 7: Re-assembly" and "Section 8: Specifications", for adjustments and fits.

Front Wheel Alignment

To attain long life and easy steering the steering system should be checked and maintained at regular intervals. The most important items to check are caster, camber and toe-in.

In addition to the regular periodic inspection, the front wheel and axle alignment should be checked if the axle has been subjected to any heavy impacts.

The dimensions and tolerances listed on page 10-13 for front wheel alignment must be closely adhered to. The instruments used to check steering geometry should be precision tools and should be frequently checked for accuracy.

Steering Geometry Terms

The term "steering geometry" refers to the angular relation of the wheels, steering levers and linkage between steering gear and wheels.

The above mentioned steering factors may be defined as follows:

Front axle caster is the angle (expressed in degrees) that the steering knuckle pin is inclined from a vertical line. Positive caster is a backward inclination of the top of the steering knuckle pin. Negative caster is a forward inclination of the top of the steering knuckle pin.

Camber or pitch is the amount the front wheels incline outward at the top (expressed in degrees from a vertical line). The wheels are in reverse camber if they are inclined inward at the top.

Toe-in or foregather is the difference in the distance between the front wheels in front of and back of the axle, measured at the point of greatest tire section.

Checking Procedure

Examine the steering connections for looseness and wear, be certain that none of the parts are excessively worn. Steering gear parts can best be inspected for looseness or wear with the wheels off the floor. Also check the wheels, tires and rims to see if they are true.

All tests for caster, camber and toe-in should be made on a level floor with properly adjusted wheel bearings and the correct tire inflation.

The three elements considered in front axle alignment (caster, camber and toe-in) are inter-related and should be tested in that order. Toe-in is affected by any change in caster or camber, and camber is affected by any change in caster; but caster is not affected by any change in either camber or toe-in. Therefore, caster should be tested first and corrected, then camber, and lastly toe-in.

The front axle is given a certain amount of caster to provide steering stability and to help bring the front wheels back to the straight-ahead position after making a turn. A limited amount of caster reduces the tendency of the front wheels to shimmy, but too much will cause a slow-speed shimmy.

The caster should be measured if the vehicle has any tendency to wander, steer hard, shimmy or lead to one side. The check should be made with a suitable instrument and the cause of any variation from the specified amount should be isolated with the aid of the Trouble Shooting list on page 10-11.

The caster can be changed by placing tapered shims between the springs and the spring pads on the front axle. To increase the caster insert the shims with the thick edge to the rear. To decrease the caster, the thin edge should be toward the front. The caster on the empty truck should be between 1 and 2 degrees and when loaded, the caster should increase to 1½ to 2½ degrees positive.

The front wheels are cambered to offset axle deflection and to compensate for wear and looseness of the wheel bearings and king pins. The camber may be measured by a special gage made for that purpose or by a square and scale as indicated by Figure 10.

The camber is designed into the axle and cannot be adjusted.

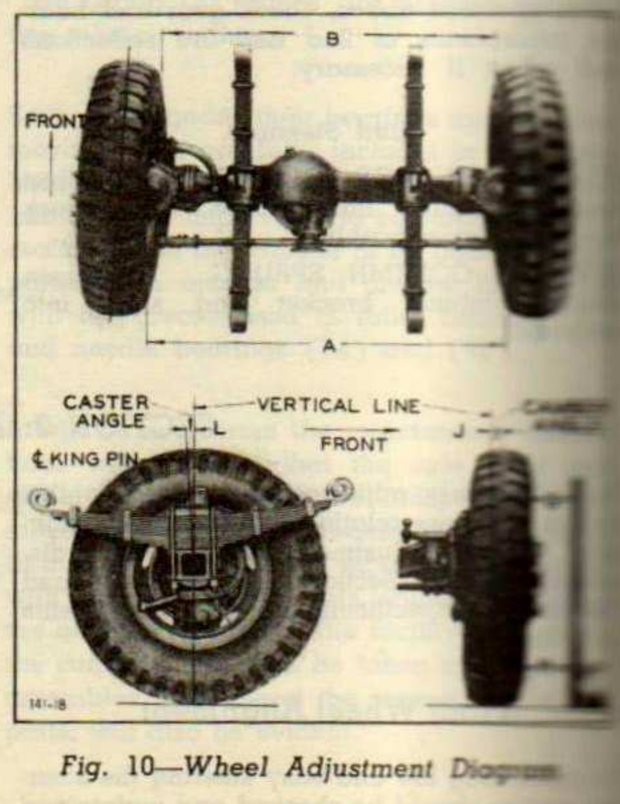


Fig. 10—Wheel Adjustment Diagram

Inequality in camber or caster of one side to the other, indicates a bent axle or excessively worn parts and renewal rather than straightening is recommended.

Toe-in is provided to offset the effect of camber on tire wear, it also keeps the steering linkage under tension after wear has occurred.

Toe-in should always be measured with the wheels straight ahead.

To adjust toe-in, loosen the two clamping bolts at each end of the tie-rod and turn the tube. The right end has a right hand thread and the left end has a left hand thread, so that turning the top of the tube toward the rear of the vehicle shortens the link.

Caster, camber and toe-in can all be measured by means of the single instrument specified. The instructions furnished with the instrument should be followed.

Fixed stops limit the turning of the wheels to the angles shown below, no adjustment means being provided or required.

The letters in the following table refer to the angles and dimensions indicated by Figure 10.

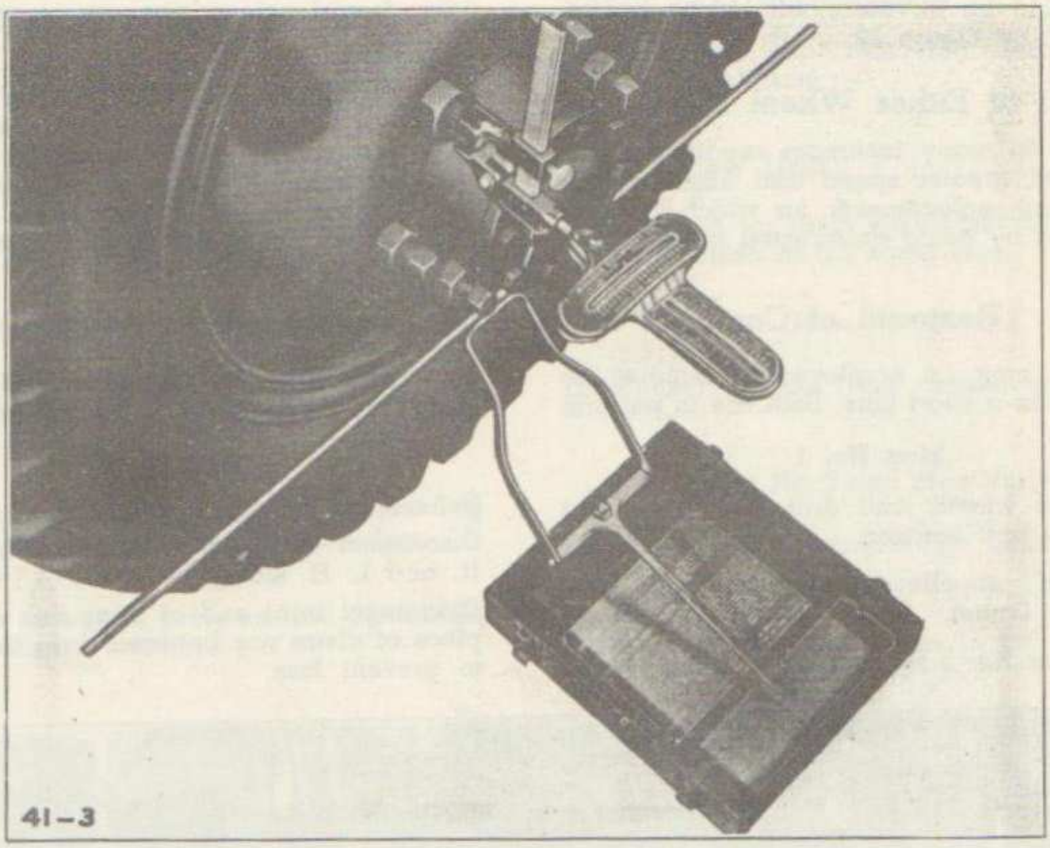


Fig. 11—Instrument for Checking Wheel Alignment
(Tool—Federal Stock No. 41-I-130)

Front Wheel Adjustments

CASTER ANGLE L, VEHICLE EMPTY .... 1° to 2° Positive

CASTER ANGLE L, VEHICLE LOADED .... 1½° to 2½° Positive

CAMBER ANGLE J .... Positive ½° to ¾°

CAMBER, H MINUS G .... ⅛" to ¼"

TOE IN, A MINUS B .... ⅛" to 3/16"

LEFT HAND TURNING ANGLE:

LEFT WHEEL .... 29°

RIGHT WHEEL .... 24°

RIGHT HAND TURNING ANGLE:

LEFT WHEEL .... 24°

RIGHT WHEEL .... 29°

SECTION 4: DIS-ASSEMBLY

Removal of Complete Front Axle Assembly From Vehicle

In case the complete axle assembly, which includes the axle drive unit as well as the two wheel drive units, is to be exchanged for a replacement axle, the dis-assembly procedure should be as described below and as illustrated by Figure 12.

Removal of Either Wheel Drive Unit

However, in many instances repairs can be made with greater speed and efficiency by making unit replacements, for which the axle is adapted by being constructed in separable components. The procedure for removing either of the wheel drive units is described below. Figure 13 shows both units removed, but obviously either may be removed independently without disturbing the axle drive unit.

Removal of Axle Drive Unit

In order to remove the axle drive unit from the axle housing (or banjo), it is necessary to detach the two wheel drive units and withdraw the axle shafts far enough to free them from the differential side gears in which they are splined. Figure 13 shows the axle drive unit removed complete in its carrier.

Removal of Complete Front Axle Assembly From Vehicle

Two men may be employed to remove the front axle in a short time. Both are to perform the duties listed for them simultaneously, so that they will finish at the same time.

Man No. 1

Block rear wheels and drain oil from front axle drive unit housing.

Disconnect propeller shaft from front axle drive unit flange.

Assist Man No. 2 by turning steering wheel.

Man No. 2

Relieve air system of pressure.

Disconnect air lines at brake chambers (R. H. and L. H. sides).

Disconnect front end of drag link and insert piece of clean rag between drag link sockets to prevent loss.

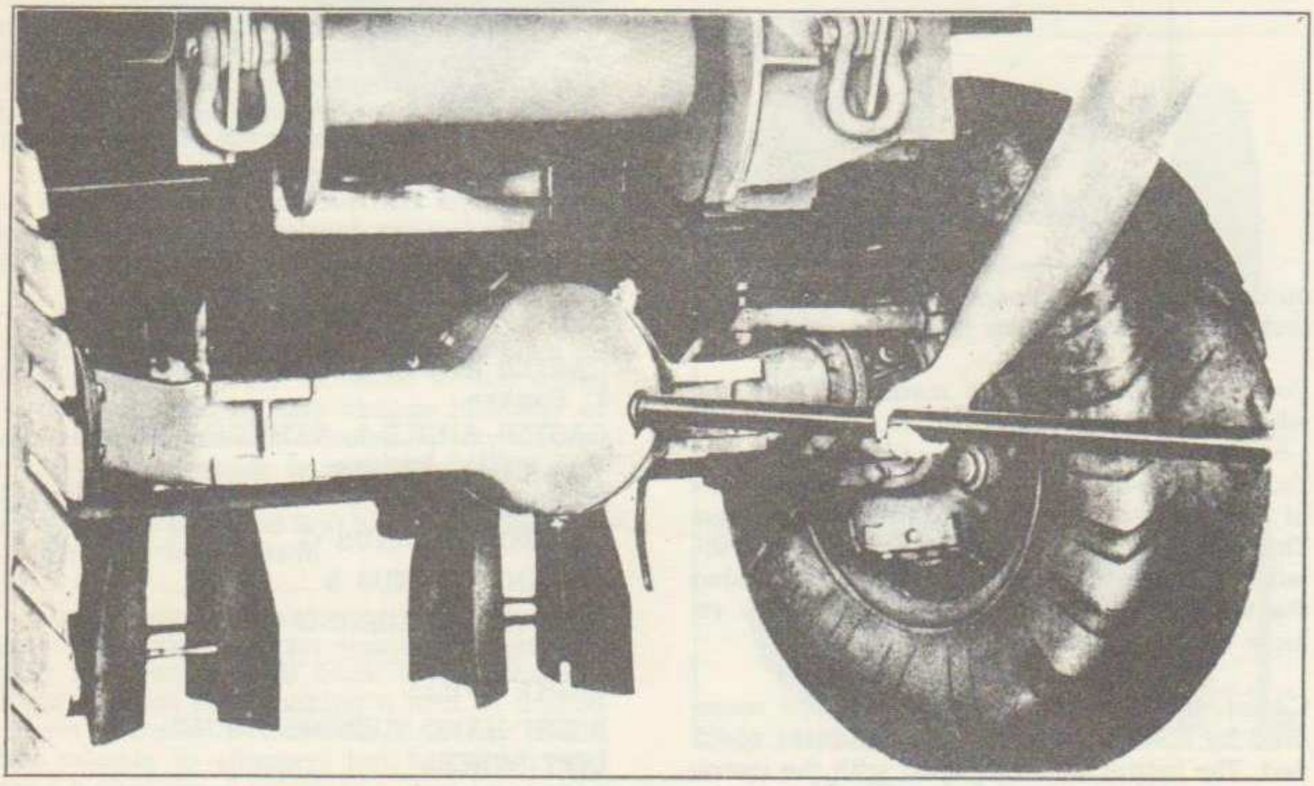


Fig. 12—Removing Complete Front Axle From Chassis

Man No. 1 and Man No. 2

Remove spring clips (R. H. & L. H.). The R. H. front clip is not removed completely but is pushed upward until it strikes winch propeller shaft, and is then pushed to rear for axle removal clearance.

Man No. 1

Insert wooden pole into filler plug hole and use as lever to prevent housing from turning over.

Roll axle assembly forward balancing same with lever.

Man No. 2

Attach chain or sling to a hoist for lifting vehicle off of axle assembly.

Guide wheels while removing assembly from underneath chassis.

Removal of Either Wheel Drive Unit

Three men may be employed to remove either unit in a short time. All are to perform the duties listed for them simultaneously, so that they will finish at the same time.

Man No. 1 and Man No. 2

Jack up axle housing (or banjo). Remove wheel and brake assembly.

Man No. 1

Disconnect drag link and insert clean rag between drag link sockets to prevent loss. (L. H. unit only).

Relieve air system of pressure and disconnect air line at brake chamber.

Man No. 3

Disconnect tie rod from cross-steering lever.

Man No. 2 and Man No. 3

Remove upper housing flange bolts.

(Continued on page 10-16)

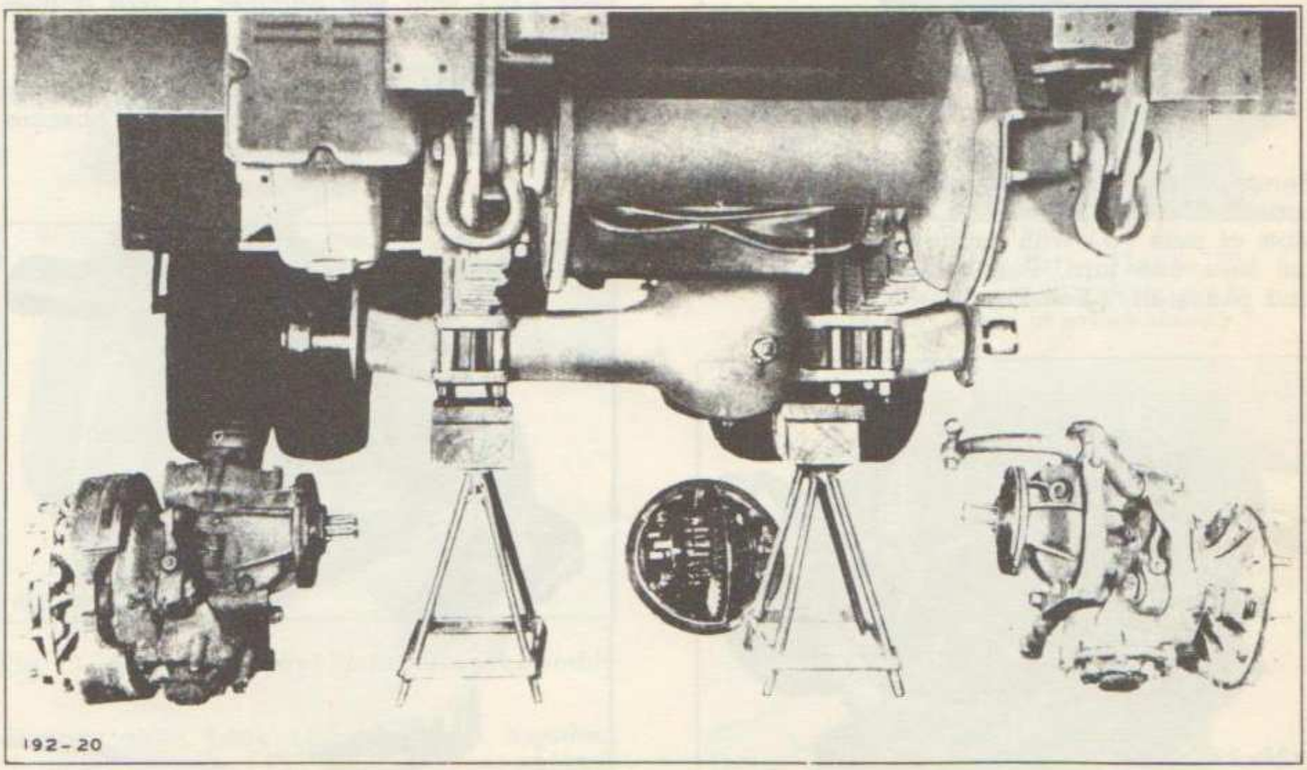


Fig. 13—Axle Drive Unit and Both Wheel Drive Units Removed

Men No's. 1, 2, and 3

Install sling around housing and take up slack with a hoist. Insert long bar thru sling and over front spring to guide housing assembly out from under fender being careful not to damage oil seal or spline.

Dis-assembly of Axle Drive Unit

Note: Certain parts can be inspected without dis-assembly, and these items need not be taken apart unless they require renewal.

The numerals designating parts of this unit refer to the numerals in Figure 5.

Differential

With axle drive unit out of axle housing (36), back out thrust screw (1), turn ring gear (12) and remove shoe (2). (See Figure 14).

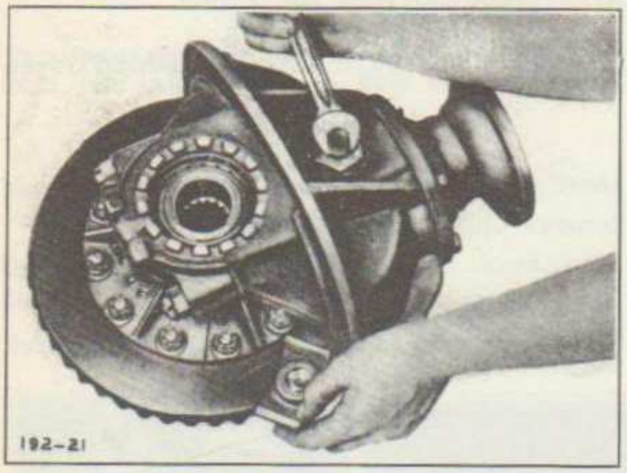


Fig. 14—Removing Ring Gear Thrust Shoe

Remove bearing adjustment nut locks (3). Loosen bearing cap nuts (4) slightly. Straddle slots of nuts (5) with suitable tool and back out nuts one turn. Punch-mark mating caps and pedestals. (See Figure 15).

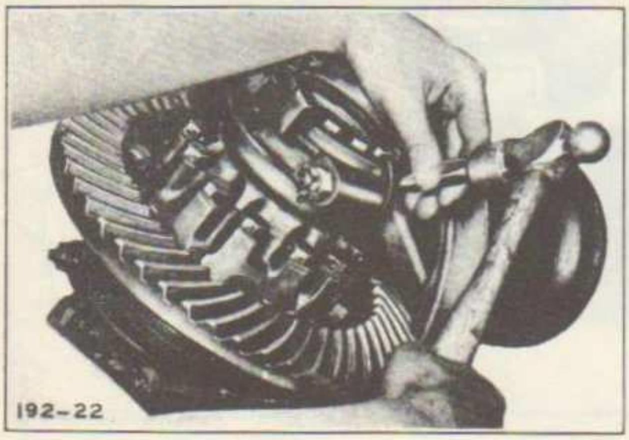


Fig. 15—Marking Caps and Pedestals

Remove bearing caps (7). Lift entire differential and ring gear assembly from carrier housing (8). (See Figure 16).

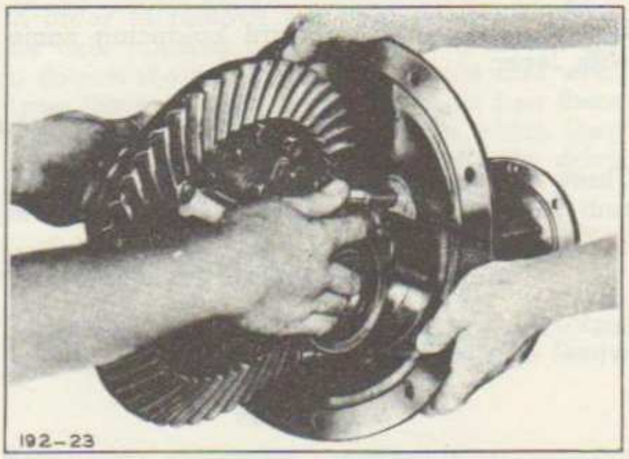


Fig. 16—Removing Differential Assembly

Slide off bearing cups (9) and remove cones (10) with aid of drift and hammer. Remove bolts (11) and tap around back face of bevel gear (12) with soft hammer to free it from pilot of casing (13).

The casing halves (13) and (14) are matched and punch-marked. If marks are obscure, make fresh marks. (See Figure 17).

Fig. 17—Marking Differential Casings

Remove spider (16) with pinion gears (17) and thrust washers (18). Remove side gears (19) and thrust washers (20). (See Figure 18).

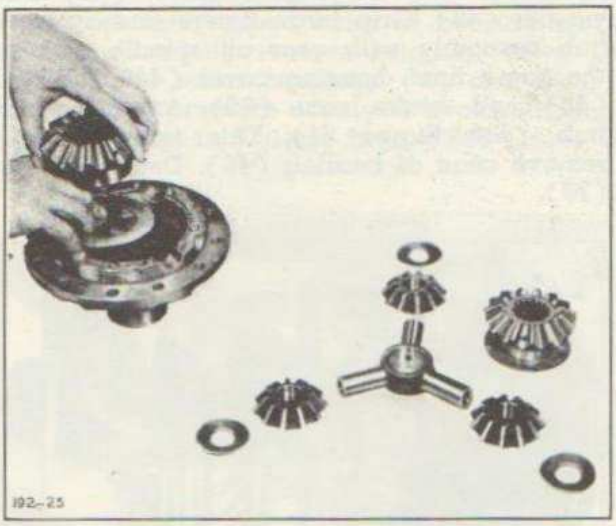


Fig. 18—Removing Gears and Thrust Washers

Bevel Pinion

Remove bearing retainer screws (21). Insert puller screws into tapped holes of retainer (22), and remove bevel pinion assembly by applying pressure evenly to these screws to avoid binding retainer in housing bore. (See Figure 19).

Fig. 19—Removing Bevel Pinion Gear Assembly

Remove shim pack (6) and wire together. If inner bearing (23) requires renewal, remove from shaft with aid of press. (See Figure 20).

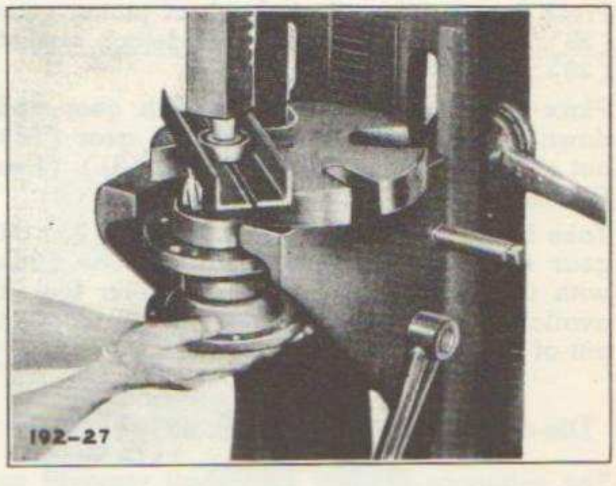


Fig. 20—Removing Inner Bearing from Pinion Gear End

Bolt metal strap to drive flange (25). Hold flange in soft jaws of vise and remove drive flange nut (24). (See Figure 21).

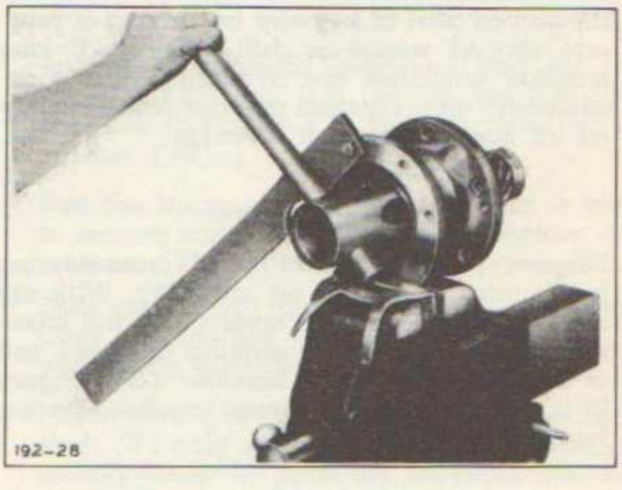


Fig. 21—Removing Drive Flange Nut
(Tools—Snap-On Part No's. LDH-682 & L-52 may be used instead of wrench shown)

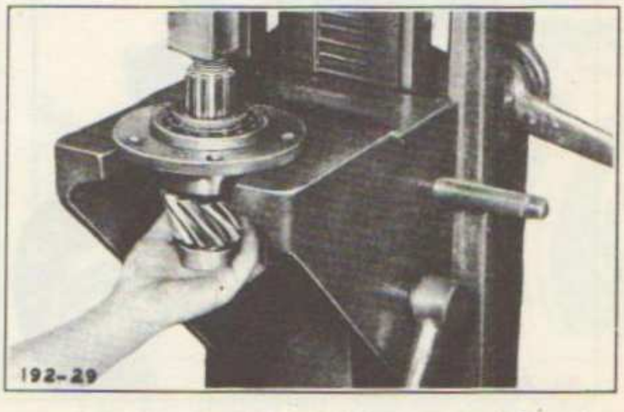


Fig. 22—Pressing Pinion Gear out of Bearings

Press flange (25) off of shank of pinion gear (26). Pry off cover (27), and detach gasket (28).

Place retainer (22) in press with gear end downward. Press shank of pinion gear (26) out of bearing cone (30) and cup (31). (See Figure 22).

Take bearing spacer (32) and shims (33) off gear shank and remove bearing cone (34) with aid of drift and hammer puller tool if available. Tap bearing cups (31) and (35) out of retainer.

Dis-assembly of Wheel Drive Units

The sequence of gear and shaft removal as well as subsequent replacement given under "Section 7: Re-assembly," is specified in accordance with factory practice.

The numerals designating parts of these units refer to the numbers on Figures 8 and 9.

All bearing adjustment nuts which are locked by staking shoulder portion into keyway may be unstaked. This can be done by lifting out the staked part of keyway by driving a properly shaped wedge or drift under it. If long handled wrenches are available, this is unnecessary as the staked portions can be sheared off due to the great leverage.

Steering Lever

Remove pinch bolt (72) and cross-steering lever nuts (73). Turn off nut (74). With aid of drift, loosen steering lever (75) and cross-steering lever (76), by striking threaded end of steering lever with hammer (See Figure 23). Remove steering levers together. Do not lose key (77).

Fig. 23—Removing Steering Levers

Wheel Hub Assembly

Remove cover (38) and gasket (78). Remove capscrews (43), lock screw (39) and clamp bolt (40) in that order with wrench, Mack Part No. 17-AK-27, adjusting nut (41) and washer (42). Grip large flange and pull out hub assembly with gear off spindle and, at the same time, housing cover (44), oil seal (45) and brake cam (68), together with hub. (See Figure 24). This operation will remove cone of bearing (46). Detach gasket (79).

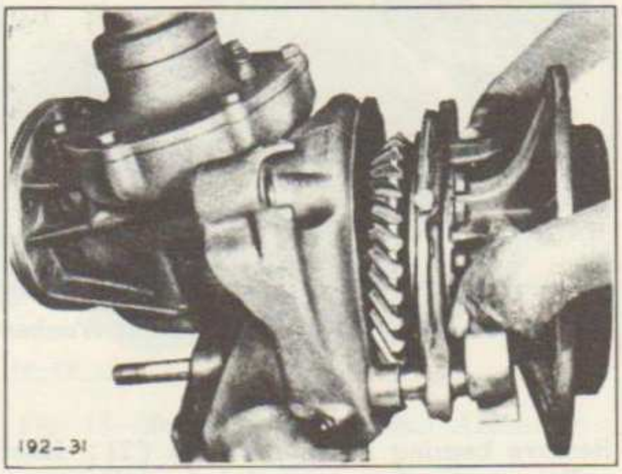


Fig. 24—Removing Wheel Hub Assembly

Rest hub assembly on bench, unscrew nuts from gear bolts (47). Tap bolts downward with flat bar and hammer. Turn assembly over, remove bolts with pinch bar.

Tap gear (48) off hub (49) with soft hammer. (See Figure 25). Wire shims (50) together. Separate oil seal (45) from cover (44) after sliding cover off hub and detaching brake cam (68). Remove and clean breather (81). Hold gear in vise, tap out cup of bearing (51). Tap cup of bearing (46) out of hub. Remove cone of bearing (51) off spindle.

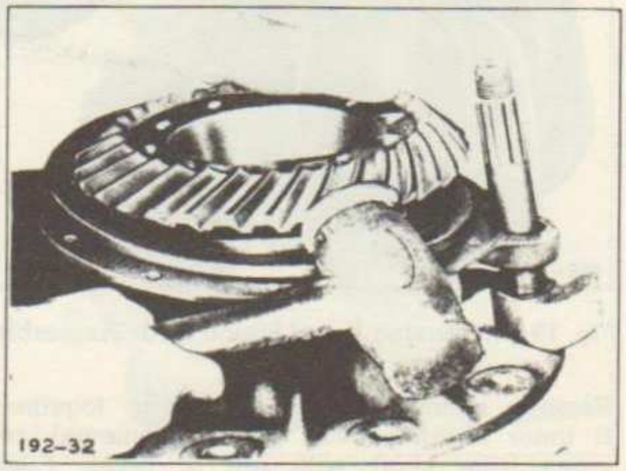


Fig. 25—Removing Gear from Wheel Hub

3rd Reduction Pinion Gear and Drive Shaft Assembly

Remove capscrews (1) and insert puller screws into tapped holes of bearing retainer (2). Carefully remove retainer, drive shaft (3) and roller bearings (4) and (11) by applying pressure evenly to avoid binding retainer pilot in housing bore. (See Figure 26).

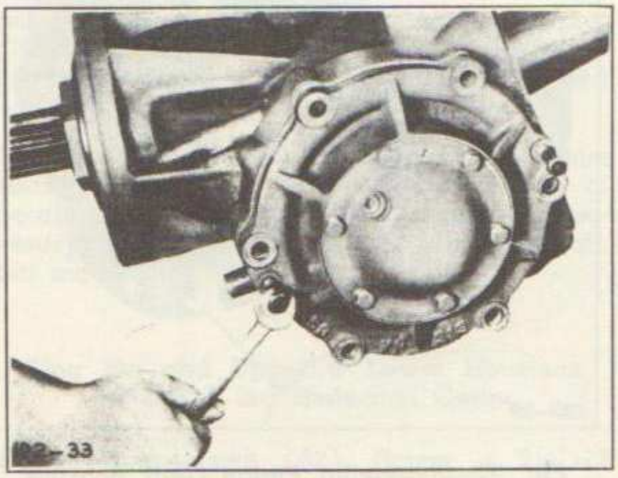


Fig. 26—Removing Lower Bearing Retainer

In withdrawing the drive shaft (3), be careful that its splined end does not damage oil seal (5). (See Figure 27). Wire shim pack (6) together.

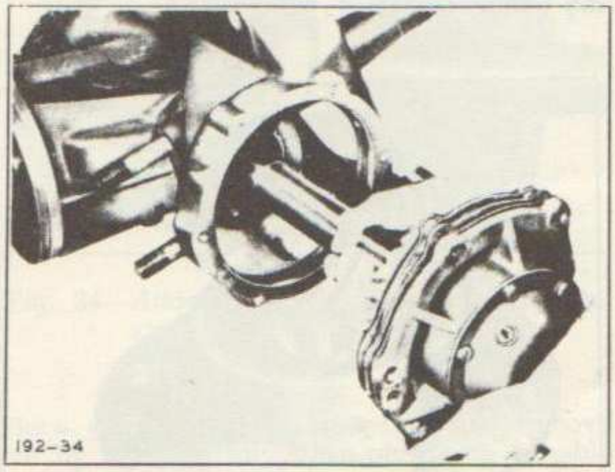


Fig. 27—Withdrawing Drive Shaft

Remove capscrews (7), detach cover (8) and gasket (90). Hold drive shaft in soft jaws of vise, turn off locknut (9) with drift and

Fig. 28—Removing Bearing Cone and Carrier

hammer or wrench, Owatonna Part No. 885. Locknut (9) has R.H. thread on R.H. Unit and L.H. thread on L.H. Unit. Remove locking washer (10).

Butt the lower end of drive shaft on a block to remove cone of bearing (11), together with retainer (2), by impact. (See Figure 28).

Slide shims (12) and spacer (13) off of shaft. Cone of bearing (4) may be wedged off with sharp, tapered drift.

Pinion gear (14) may be pressed off of drive shaft (3) only with aid of a power press, but usually these two parts are not separated. Tap cups of bearings (4) and (11) out of retainer.

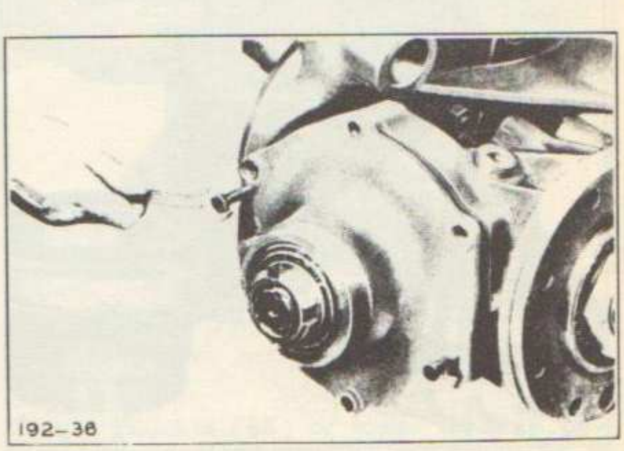


Fig. 29—Removing Retainer and Gear

2nd Reduction Bevel Gear

Remove and clean breather (80).

Turn off cover (18) with suitable wrench. Remove capscrews (15), insert puller screws into tapped holes in retainer (16), and remove retainer and gear assembly carefully by applying pressure evenly to screws. (See Figure 29). Wire shims (17) together.

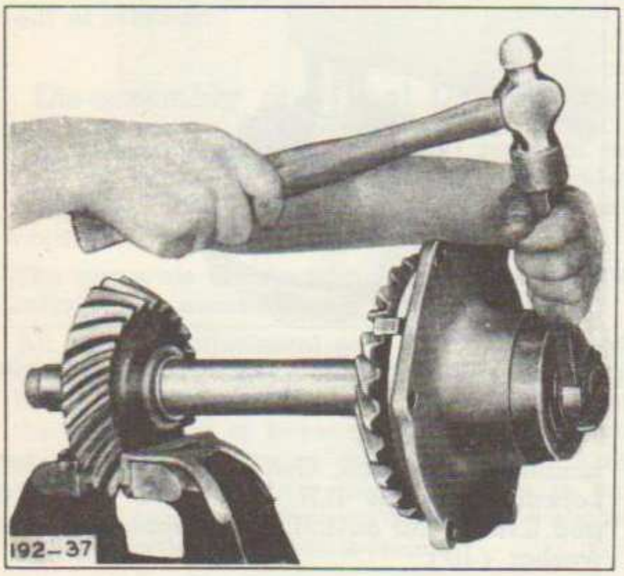


Fig. 30—Removing Bevel Gear Locknut

Grip pinion gear (14) in vise to prevent drive shaft from turning. Turn off locknut (20) with drift and hammer (See Figure 30) or wrench, Owatonna Part No. 885. Locknut (20) has L.H. thread on R.H. Unit and R.H. thread on L.H. Unit. Remove washer (21).

Fig. 31—Location of Oil Scraper and Spring

Butt upper end of drive shaft on block to remove retainer (16) by impact. Be careful not to damage oil seal (22) or lose oil scraper (23) and spring (24) as the gear separates from retainer. (See Figure 31). This operation removes cone of bearing (25), also shims (27) and spacer (27A).

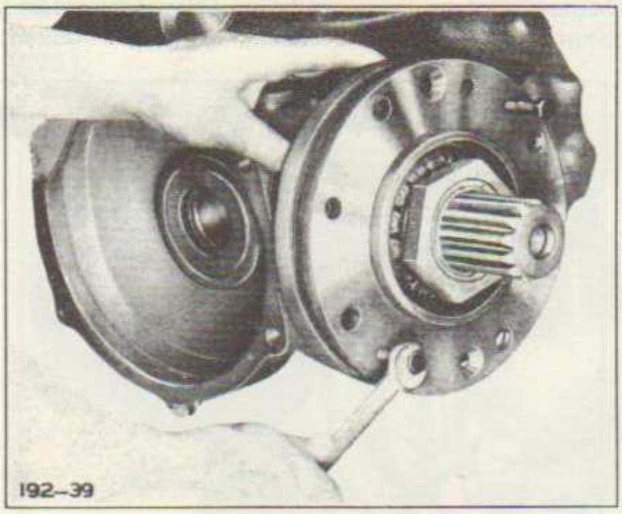


Fig. 32—Removing Pinion Gear Bearing Retainer

If necessary to remove the oil seal (22), it must be driven out, which will ruin it. Discard seal. Tap out cups of bearings (25) and (26).

With the aid of suitable tool inserted into knockout holes in gear, tap off cone of bearing (26).

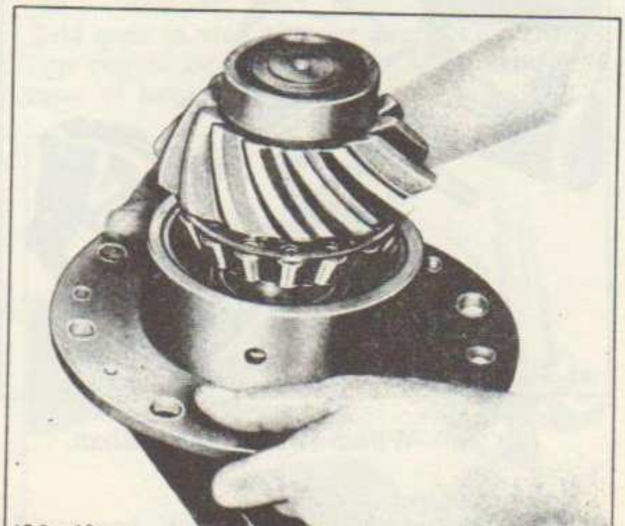


Fig. 33—Removing Retainer from Pinion Gear

2nd Reduction Pinion Gear

Remove the two countersunk screws (28) from the flange of pinion gear retainer (29). Insert two long 3/8" puller screws into retainer and remove assembly by applying pressure evenly to screws. (See Figure 32). Wire shims (30) together.

Grip pinion gear (32) in vise and turn off nut (31). This nut is L.H. on left knuckle, R.H. on right knuckle. Remove cone of bearing (33), spacer (34), shims (35) and retainer (29) from pinion shaft by impact of its splined end with a block. (See Figure 33).

Cone of bearing (36) may be removed from shaft by prying with suitable tool. Cups of bearings may be tapped out of retainer if necessary. Spigot bearing (37) remains on shaft, but may be removed by prying off.

King Pin and Upper & Lower Housings for 2nd & 3rd Reduction Gears

Remove capscrews (52). Screw a 2⅛"-12 puller plug into bottom end of the king pin (53). (See Figure 34).

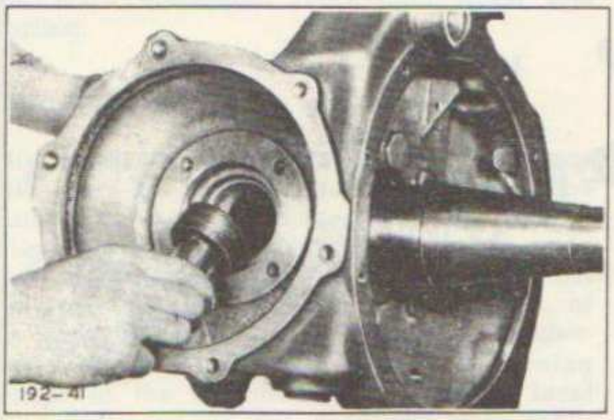


Fig. 34—Attaching Puller Plug to King Pin
(Tool—Mack Part No. 17-T-1451)

Place assembly on arbor press and remove pin by pressing on puller plug with suitable drift bar inserted thru the top of hollow king pin. (See Figure 35).

Remove housing (54) from knuckle (66) and housing (55) assembly. (See Figure 36). Remove metal grease seal spring washers (56).

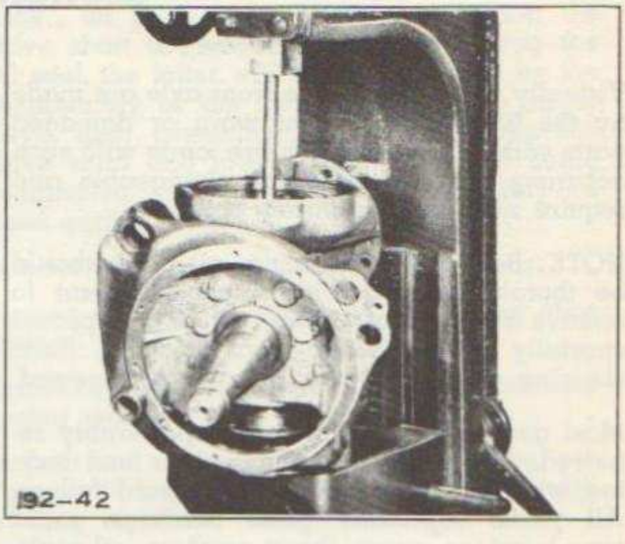


Fig. 35—Pressing out King Pi:

Remove spacers (82) and (57), thrust washers (58) and (60) and washer cups (59) and (61). Note condition of pins (62) and (63).

Invert upper housing (54) on press and press out needle bearings (64) & (65) and oil seal (5).

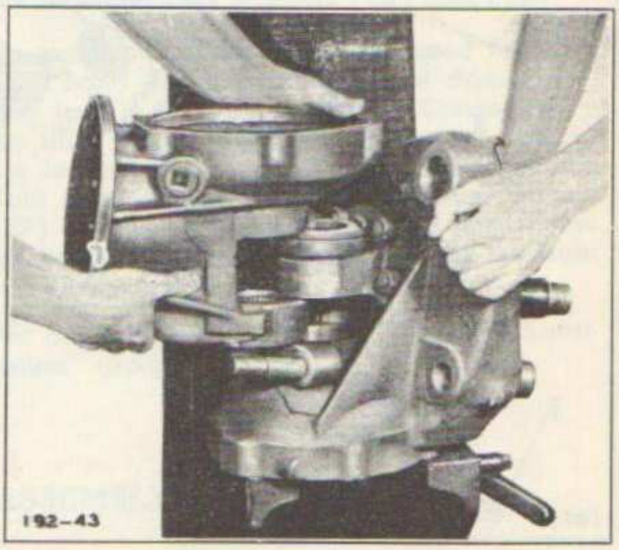


Fig. 36—Separating Housings at Knuckle

Should knuckle (66) or lower housing (55) be damaged, they may be separated by removing bolts (67) and tapping apart.

SECTION 5: REPAIRS

Virtually all repairs to the front axle are made by the REPLACEMENT of worn or damaged parts with new ones which are made with such accuracy that they are interchangeable and require no fitting or sizing operation.

NOTE: Before re-assembling, all parts should be thoroly cleaned with suitable solvent to remove all traces of dirt and oil, and inspected carefully for cracks or worn surfaces. Parts showing excessive wear should be renewed.

Most gaskets and oil seals are preferably renewed. All cotter pins, lockwashers and locking wires must be renewed to avoid failure. All parts, especially plain bearings, roller type bearings, gears, thrust washers, oil seals, splines, screw threads, etc., should be generously coated with oil. This will insure immediate lubrication of these parts and prevent seizure from first starting.

Always operate each unit slowly at first to allow lubricant to work its way to all parts.

Examine teeth on all gears carefully for nicks and galled spots. Renew gears that are noticeably nicked or scored. Small nicks may be carefully honed out. Check teeth for chipped areas or spots where case hardening is worn thru.

Inspect bearing rollers, needles and races for brinelling, pitting and deep wear.

Examine splines for scores or signs of twisting.

Examine and check thrust washers for wear.

Inspect condition of oil seals.

Inspect threads on nuts and shafts for signs of stripping.

In making repairs use a rawhide or soft hammer for dis-assembly and re-assembly work.

Keep shim packs intact when dis-assembling.

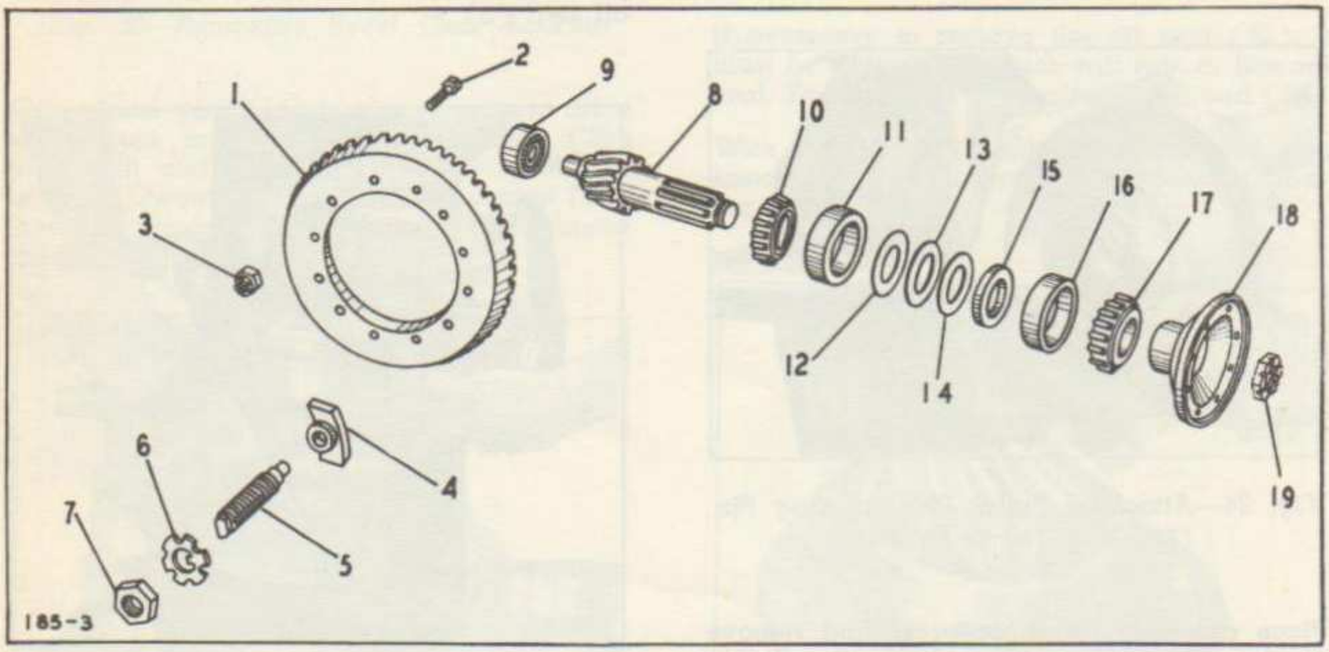


Fig. 37—Exploded View of Bevel Gears of Axle Drive Unit

1. 1st Red. Bevel Ring Gear
2. Bevel Gear Bolt
3. Gear Bolt Nut
4. Bevel Gear Shoe
5. Gear Thrust Screw
6. Screw Lockwasher
7. Thrust Screw Nut
8. 1st Red. Pinion Gear
9. Pinion Spigot Bearing
10. Bearing Cone
11. Bearing Cup
12. Shim (.020")
13. Shim (.015")
14. Shim (.002")
15. Bearing Spacer
16. Bearing Cup
17. Bearing Cone
18. Drive Shaft Flange
19. Drive Flange Nut

Axle Drive Unit

In making repairs to the differential assembly be sure that the bearing cups fit tightly in their seats and that bearing cones fit the hubs of the case tightly and do not turn on them when in operation. Be sure the bearing adjusting ring locks are in place. Draw differential case bolts down tightly.

If necessary to replace a pinion shaft bearing cup, place a flat tool against its shoulder and drive out with a hammer, being careful not to deface the bearing surface in the cage. When inserting cups be sure they are pressed tightly against the cage shoulders and are not scored or pitted.

Wheel Drive Units

If oil seal (5) must be renewed, the procedure should be the same as shown for "Installation of Gear Sub-assemblies into Housings", on page 10-31. If for any reason the drive shaft is removed without removing the oil seal, the latter will not be damaged by the re-assembly of the shaft provided the upper bevel gear assembly is removed while the drive shaft and lower pinion gear are being re-installed, and the oil seal may safely be used again.

Inspect oil scraper shoe for undue wear.

Inspect and check tension of oil scraper shoe spring.

Inspect and check tension of metal grease seal spring washers.

Inspect and check king pin for brinelling, pitting or flat spots at points of contact with bearing needles.

Inspect condition of locknuts due to staking.

Examine steering levers for signs of bending.

SECTION 6: LUBRICATION

When re-assembling the unit be sure to generously coat all parts with oil, so that they will have immediate lubrication when first starting.

(See illustration on page 10-8)

After re-assembling, fill the five gear housings with gear oil of the grade specified in the "Lubrication" group, to the levels of the filler plugs (83) and (85) in illustration on page 10-8 and (39) in Figure 5, being careful not to over-fill the housings. Also pack each of the upper bearings (25) of the second-reduction gears at re-assembly with wheel bearing grease of the specified grade, to the level (89) indicated on the diagram, and apply chassis-grease to the needle bearings (64) and (65) for the tubular king pin (53) thru fittings (87) and (88) with a hand gun, which automatically injects grease between the thrust-bearing washers (58) and (60).

As similar housings (54) are used for both right hand and left hand wheel drive units, they face in opposite directions. Consequently the filler plug (83) which is on the front of the left hand housing is on the rear of the right hand housing. Similarly, grease fittings (87) and (88) which are on the rear of the left hand housing are on the front of the right hand housing.

For other lubricating instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

In re-assembling the front axle, sub-assemblies should first be made of the several groups of parts in their respective housings and carriers. Re-assemble the parts of each sub-assembly in the reverse of their dis-assembly. All bearing adjustments should be made prior to gear adjustments and the nuts of each group should be carefully locked. The sub-assemblies are NOT re-assembled in the reverse order of their dis-assembly. The proper sequence, including the adjustments required by the re-assembly, is shown below.

Axle Drive Unit

Bevel Pinion Gear

Press bearing cone (34) on gear shaft. Place bearing spacer (32) and shims (33) on shaft.

Tap cups (31) and (35) into retainer. Assemble shaft (26) into retainer and tap bearing cone (30) into position.

Shellac and attach new gasket (28) to retainer (22). Renew felt and oil seal (37) in cover if necessary and install cover (27) on drive flange (25).

Assemble drive flange (25) with cover (27) on shaft and draw up tightly with nut (24) using 2⅛" socket wrench and handle, Snap-On Part No's. LHD-682 & L-52. Do not press cover on shoulder of retainer (22) yet as cover must revolve with drive flange during bearing adjustment.

Check bearing adjustment. No end-play at all should be allowed, nor should the adjustment be too tight. The drag should be from ¼ to ¾ pound-foot when turned by hand. Wrap a cord or tape around $4\frac{5}{16}$" diameter pilot of retainer. Attach scale to cord. The pull on scale should read 1½ to 4 pounds to keep retainer turning. (See Figure 39).

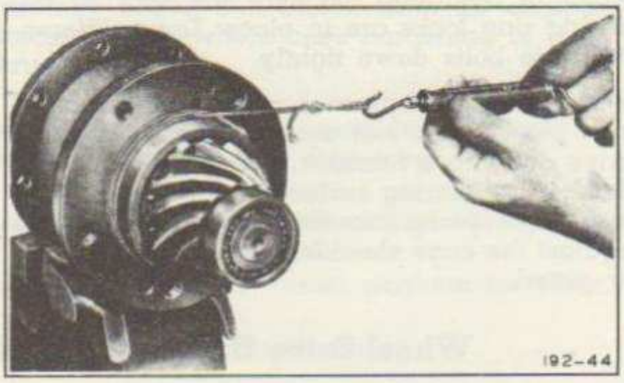


Fig. 39—Testing Bearing Adjustment

If bearing adjustment is required, remove or install shims in pack (33) as needed. Shims are furnished in thicknesses of .002, .015 and

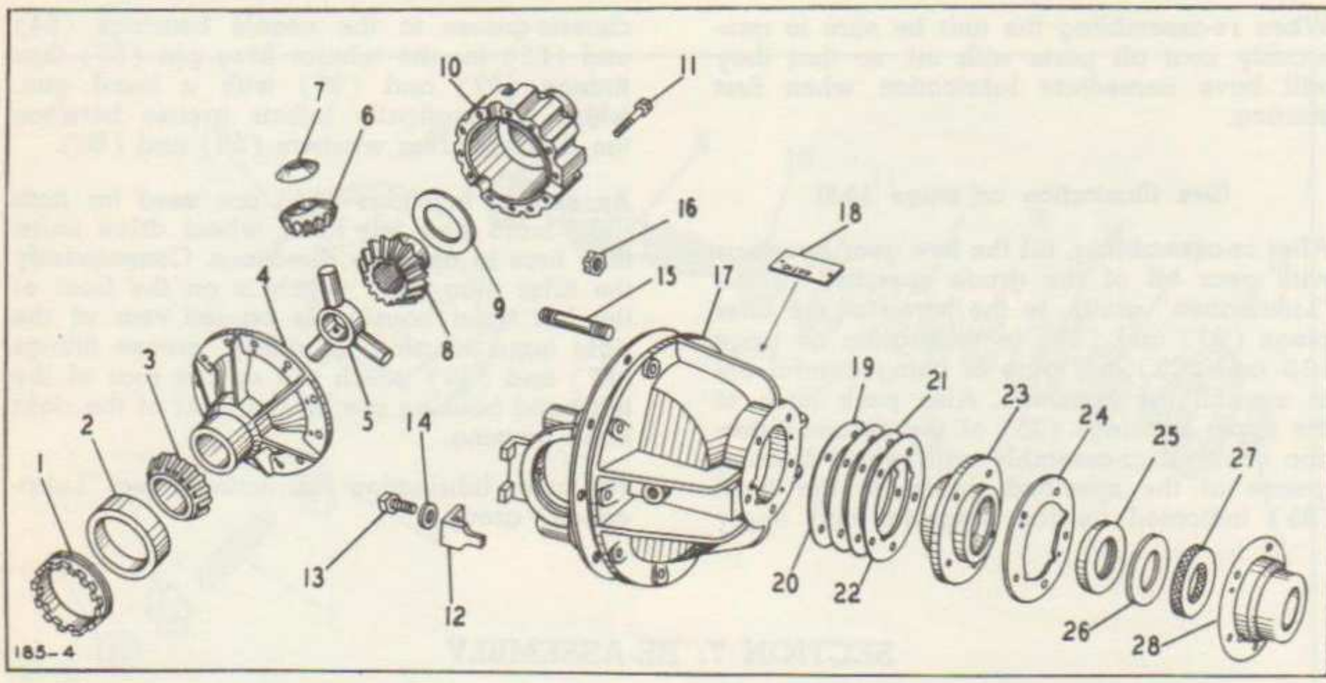


Fig. 40—Exploded View of Differential in Axle Drive Unit

1. Bearing Adjusting Nut
2. Bearing Cup
3. Bearing Cone
4. Differential Casing
5. Differential Spider
6. Pinion Gear
7. Thrust Washer
8. Side Gear
9. Thrust Washer
10. Differential Casing
11. Casing Screw
12. Adjusting Nut Lock
13. Nut Lock Screw
14. Screw Lockwasher
15. Bearing Cap Stud
16. Cap Stud Nut
17. Housing & Cap Assembly
18. Ratio & Number Plate
19. Shim (.030")
20. Shim (.018")
21. Shim (.015")
22. Shim (.012")
23. Bearing Retainer
24. Cover Gasket
25. Oil Seal
26. Oil Seal Washer
27. Oil Seal Felt
28. Pinion Bearing Cover

.020". Recheck adjustment. Install new cotter pin in nut (24).

If spigot bearing (23) was removed, press new bearing on shaft and peen shaft over bearing at three points. (See Figure 41).


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Fig. 41—Peening Shaft to Retain Bearing

Fill bearings with gear oil thru hole in retainer (22).

Place shim pack (6) on retainer (22) and use screws (21) with lockwashers to align holes. (See Figure 42).

Tap pinion assembly into carrier housing until screws can be started. Then draw assembly into place and tighten screws securely.


192-46

Fig. 42—Aligning Retainer with Carrier

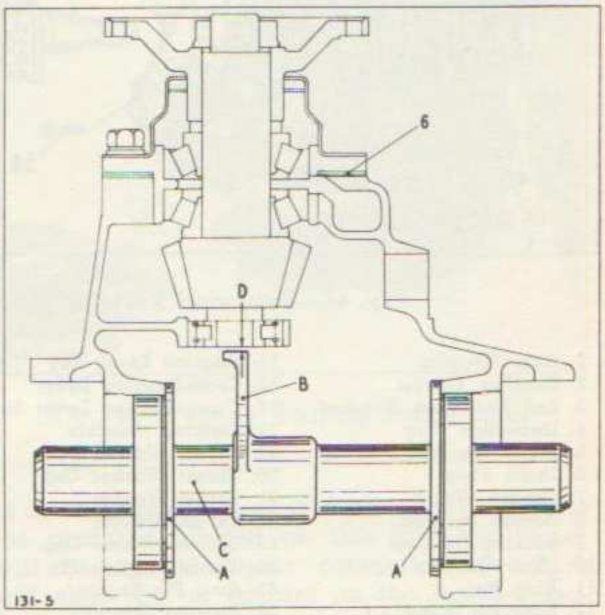
Check pinion gear for correct mounting distance. Caution: Always adjust bearings as given above before checking mounting distance.

Note: The specific mounting distance, from centerline of ring gear to end face of pinion gear, which was used in manufacture when cutting the teeth of pinion gear, is etched on its end face. The pinion gear should be set in service to this same distance by using gage tool shown in Figure 43. It consists of two plugs (A) and a gage arm (B) assembled on a tube (C). When gage arm (B) is slid along tube until opposite pinion gear face, the gap between arm and pinion gear, when measured with feeler gage, should equal the difference between the dimension etched on pinion gear face and dimension stamped on gage arm.

Make sure all contacting surfaces are free of dirt and burrs, and set complete tool into carrier housing, in place of differential assembly, so that plugs seat in bearing cup bores. Install caps and tighten nuts.

First determine correct gap (D) to obtain specific mounting distance, by subtracting dimension stamped on gage arm (B) from dimension etched on face of pinion gear (26), which varies with each gear.

Then slide gage arm (B) along tube until opposite pinion gear face, and insert feeler gage between arm and pinion face to measure actual gap (D). (See Figure 43).



131-5

Fig. 43—Adjusting Pinion Gear with Gage
(Tool—Mack Part No. 17-T-1487)

Now compare actual gap with correct gap to determine difference in total thickness of shims required at pack (6). Example:

Dimension etched on gear face	3.431
Dimension stamped on gage arm	3.417
Correct gap	.014
Actual gap (as measured by feeler)	.008
Required change in thickness of pack (6)	.006

In this case, the total thickness of shims at pack (6) should be increased by .006. When actual gap is greater than correct gap, then pack (6) should be decreased. Example:

Correct gap	.014
Actual gap (as measured by feeler)	.017
Required change in thickness of pack (6)	.003

Shims are furnished in thicknesses of .012, .015, .018 and .030". Usually one each of these shims is provided in production. To change thickness of shim pack, vary the combination of shim sizes. For instance, if pack is to be reduced .003, remove .015 shim and replace with a .012 shim, etc.

Differential

Press bearing cones (10) on casings (13) and (14). Set casings up on bearing ends, place thrust washers (20) over hubs of side gears (19) and insert into casings.

Place pinion gears (17) and thrust washers (18) on trunnions of spider (16), and position assembly on side gear of casing (13).

Place casing (14) with thrust washer and side gear on pinion gears and casing (13), making

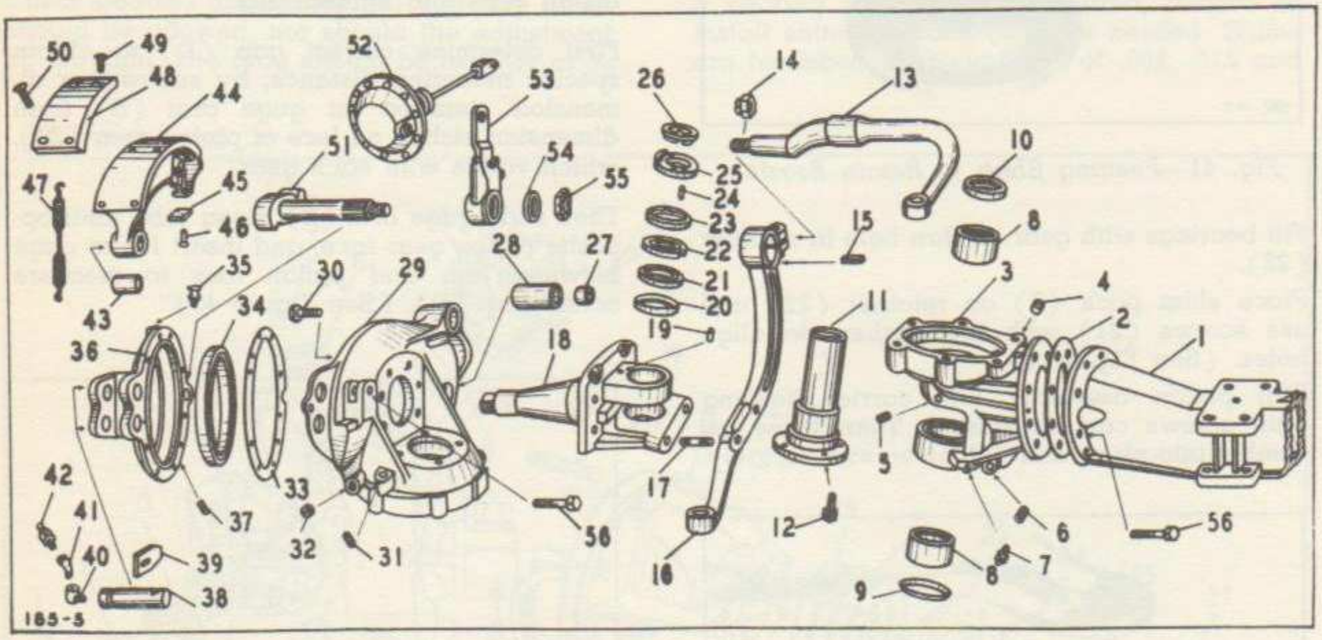


Fig. 44—Exploded View of Housings, Steering Knuckles and Brakes

1. Axle Housing
2. Housing Gasket
3. 2nd Reduction Housing
4. Inspection Plug
5. Inspection Plug
6. Drain Plug
7. Grease Fitting
8. Needle Bearing
9. Bearing Oil Seal
10. Shaft Oil Seal
11. King Pin
12. King Pin Screw
13. Steering Lever
14. Steering Lever Nut
15. Steering Lever Key
16. Cross-Steering Lever
17. Cross-Steering Lever Stud
18. Steering Knuckle
19. Thrust Washer Pin
20. Thrust Washer Cup
21. Thrust Washer
22. Thrust Washer
23. Thrust Washer Cup
24. Thrust Washer Pin
25. King Pin Spacer
26. Bearing Spacer
27. Brake Cam Bushing
28. Bushing Sleeve
29. 3rd Reduction Housing
30. Housing Cover Screw
31. Filler Plug
32. Inspection Plug
33. Housing Gasket
34. Housing Oil Seal
35. Housing Breather
36. Housing Cover
37. Pipe Plug
38. Brake Shoe Anchor Pin
39. Anchor Pin Lock Plate
40. Grease Fitting Elbow
41. Grease Fitting Elbow
42. Grease Fitting
43. Brake Shoe Bushing
44. Brake Shoe
45. Brake Shoe Wear Plate
46. Wear Plate Rivet
47. Brake Retractor Spring
48. Brake Shoe Lining
49. Shoe Lining Bolt
50. Shoe Lining Bolt
51. Brake Cam
52. Brake Chamber
53. Brake Slack Adjuster
54. Brake Cam Washer
55. Brake Cam Nut
56. Housing Screw

sure that punch-marks on casing halves match, Figure 45, and tap into position. Insert screws (15) and fasten with new locking wire.

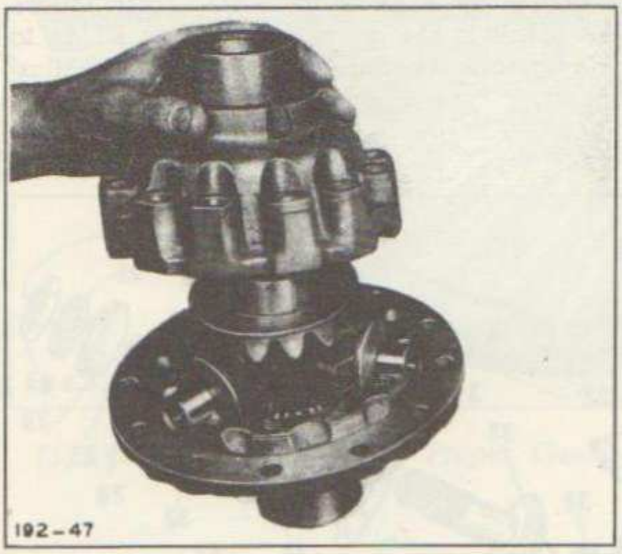


Fig. 45—Matching Casing Halves

Oil is admitted to the differential parts thru holes in the spider. When overhauled, the differential parts should be lubricated and additional oil poured into the differential case after assembly.

Prop up bevel gear (12) with teeth downward and pilot casing assembly into gear. Line up holes and tap in place with soft hammer. Install bolts (11) with nuts and new cotter pins.

Locate bearing cups (9) on cones (10) and position differential assembly into carrier pedestals a little to one side so that inner bearings (23) will clear teeth of bevel gear (12) when pinion gear assembly is later removed during differential bearing adjustment.

Place bearing adjusting nuts (5) into threads of pedestals and assemble caps (7) and nuts (4) being careful to register adjusting nut threads with cap threads. Tighten nuts (4).

Remove screws (21) and pull out bevel pinion assembly. Adjust differential bearings. No side-play at all should be allowed, nor should the adjustment be too tight. The drag should be from 3 to 3½ pound-feet when turned by hand. Wrap tape or cord around flange of casing (13) and attach an ordinary 10-pound spring scale to end of cord. The pull should range between 8½ and 9½ pounds to keep assembly turning. (See Figure 46).

If bearing adjustment is necessary, loosen cap nuts (4) a little and turn one of the adjusting nuts (5) in or out as required.

Re-install bevel pinion assembly, and tighten screws (21).

Adjust meshing of bevel gear with bevel pinion. The correct amount of back-lash is etched on the bevel gear, and usually ranges from .006 to .012. To measure back-lash, use feeler gage between the teeth of the two gears, or preferably mount a dial indicator so that the anvil rests against a tooth of the bevel gear, at the pitch line.

Adjust by means of nuts (5). Since these adjusting nuts also control the bearing adjustment, both nuts must be moved an equal number of notches when moving the bevel gear either in or out in relation to the pinion. If one nut is turned out 7 notches, then the other nut must be turned in 7 notches, etc., otherwise the bearing adjustment will be lost.

Check setting for proper tooth contact. Coat bevel gear teeth with red lead or prussian blue compound. Turn bevel pinion in same direction as when driving forward in chassis, and at the same time apply load using a bar as a brake by wedging one end of bar between carrier housing and outside diameter

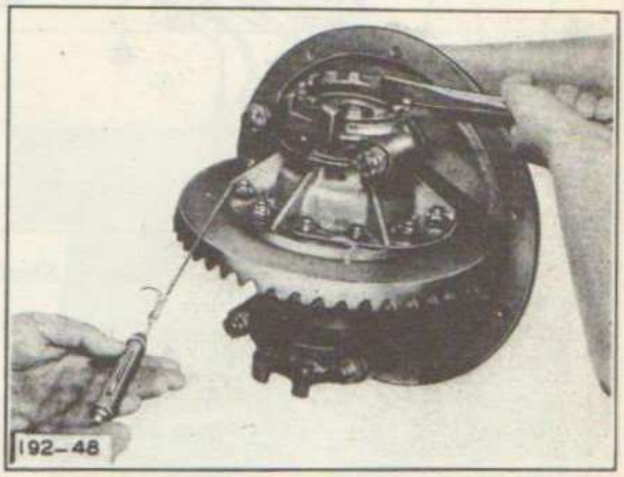


Fig. 46—Testing Bearing Adjustment

of bevel gear or differential casing. The greater the pressure exerted on this bar, the larger will become the gear contact area, which will show as an imprint on the painted surface. Enough pressure should be applied to obtain a distinct imprint.

The imprint should start near the toe and extend about 60 percent of tooth length toward the heel, as illustrated by Figure 48.

The contact area should be nearer to the toe or small end of the tooth than to the heel. This allows for deflection of parts when driving under load, as the contact then moves out toward the heel.

The imprint indicating the contact area should not be less than 60 percent of the tooth length, and should not be nearer than ⅛" to the toe end. Nor should the contact be at the bottom or at the top edge of the tooth. Tooth failure will result if the gears are not set so as to approximate the imprint shown by the illustrations.

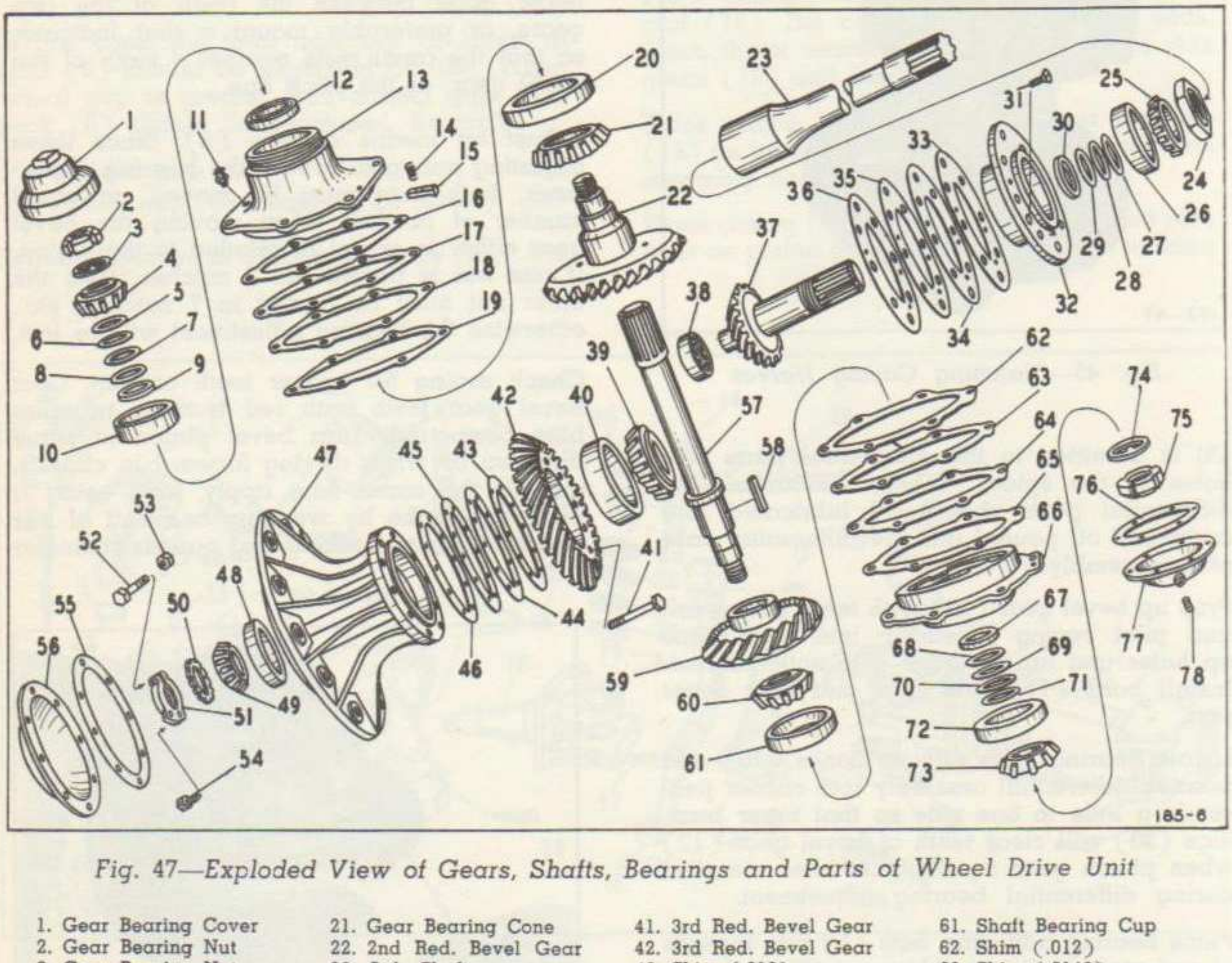


Fig. 47—Exploded View of Gears, Shafts, Bearings and Parts of Wheel Drive Unit

1. Gear Bearing Cover
2. Gear Bearing Nut
3. Gear Bearing Nut
4. Gear Bearing Cone
5. Shim (.002)
6. Shim (.005)
7. Shim (.015)
8. Shim (.020)
9. Bearing Spacer
10. 2nd Red. Bearing Cup
11. Housing Breather
12. Gear Oil Seal
13. Bearing Retainer
14. Oil Scraper Spring
15. Oil Scraper
16. Shim (.012)
17. Shim (.0149)
18. Shim (.0179)
19. Shim (.0299)
20. Gear Bearing Cup
21. Gear Bearing Cone
22. 2nd Red. Bevel Gear
23. Axle Shaft
24. Pinion Bearing Nut
25. Pinion Bearing Cone
26. Pinion Bearing Cup
27. Shim (.020)
28. Shim (.015)
29. Shim (.002)
30. Pinion Spacer
31. Retainer Screw
32. Bearing Retainer
33. Shim (.0306)
34. Shim (.0184)
35. Shim (.0153)
36. Shim (.0123)
37. 2nd Red. Pinion Gear
38. Pinion Spigot Bearing
39. Wheel Bearing Cone
40. Wheel Bearing Cup
41. 3rd Red. Bevel Gear
42. 3rd Red. Bevel Gear
43. Shim (.012)
44. Shim (.0149)
45. Shim (.0179)
46. Shim (.0299)
47. Wheel Hub
48. Wheel Bearing Cup
49. Wheel Bearing Cone
50. Adjusting Washer
51. Adjusting Nut
52. Adjusting Nut Bolt
53. Bolt Nut
54. Set Screw
55. Hub Cap Gasket
56. Hub Cap
57. Drive Shaft
58. 3rd Red. Pinion Key
59. 3rd Red. Pinion Gear
60. Shaft Bearing Cone
61. Shaft Bearing Cup
62. Shim (.012)
63. Shim (.0149)
64. Shim (.0179)
65. Shim (.0299)
66. Shaft Bearing Retainer
67. Shaft Bearing Spacer
68. Shim (.002)
69. Shim (.005)
70. Shim (.015)
71. Shim (.020)
72. Shaft Bearing Cup
73. Shaft Bearing Cone
74. Bearing Washer
75. Shaft Bearing Nut
76. Bearing Cover Gasket
77. Shaft Bearing Cover
78. Drain Plug

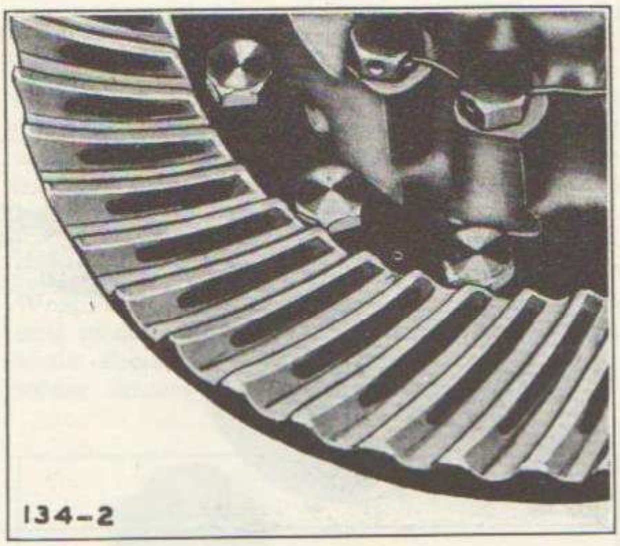


Fig. 48—Imprint Indicating Proper Gear Tooth Contact

Note: In some instances it may be necessary to make a slight readjustment of the bevel pinion from that obtained by use of the gage, in order to get the proper tooth contact. Moving the pinion in lowers the contact; moving it out raises the contact. Moving the bevel gear in brings the contact nearer the toe; moving it out brings the contact nearer the heel.

After final adjustments are made, fully tighten cap nuts (4) and install new cotter pins. Assemble adjusting nut locks (3) with screws and new locking washers. Be sure to bend ears of washer against lock and nut.

Install nut and new locking washer on thrust screw (1). Place shoe (2) on screw with oil slot at top, and turn screw in until clearance between shoe and gear is from .020 to .024". Tighten locknut securely and bend ears of washer against housing and nut.

Always make sure that all bearings and retainers are "home", and that they are tightly locked with the means provided.

Before bolting carrier (8) to axle housing (36) inspect axle shaft oil seals (38) and renew if necessary.

Wheel Drive Units

King Pin and Upper & Lower Housings

Press needle bearings (64) and (65) into housing (54). Snap metal grease seal spring washers (56) into both faces of lower jaw of housing ,at the same time hold in place spacers (82) and (57), thrust washers (58) and (60). Join jaws of knuckle (66) with upper housing (54). (See Figure 49).

Fig. 49—Joining Knuckle with Upper Housing

Preparatory assembly of these parts is made by aligning them and pressing a .007" undersize guide tube (2.493" outside diameter) into the king pin position. (See Figure 50).

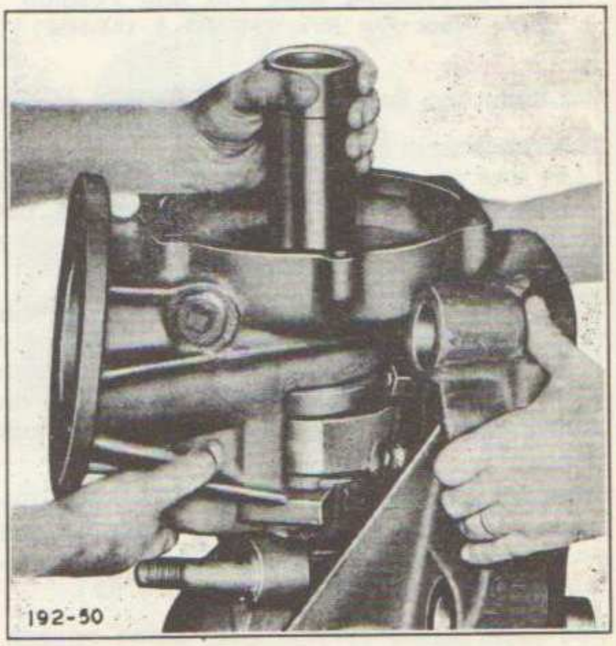


Fig. 50—Inserting Guide Tube into King Pin Position
(Tool—Mack Part No. 17-T-1461)

Now invert sub-assembly and screw four 10" x ⅜"-16 rods into tapped holes at (52). Guide king pin into position by engaging holes in its flange with the rods. Then apply pressure to 2⅛"-12 plug previously used as a puller. When the pin is inserted the guide tube will drop out. (See Figure 51).

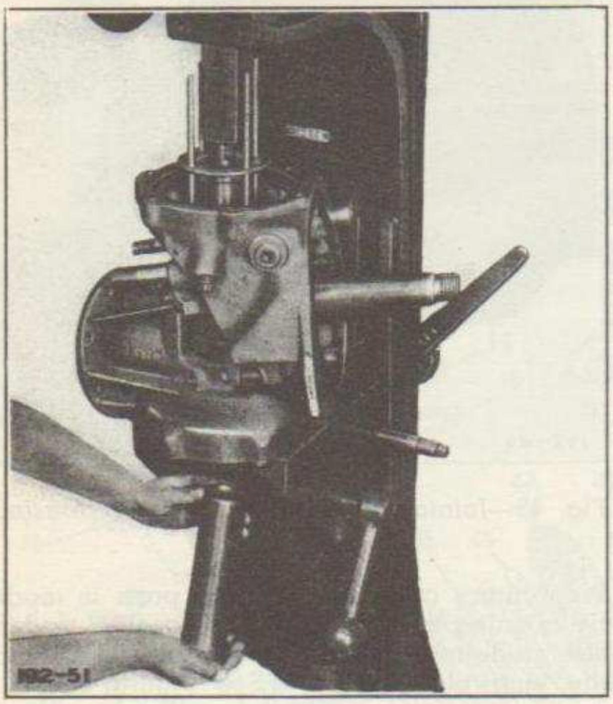


Fig. 51—Pressing King Pin into Position
(Tools—Mack Part No's. 17-T-1453 & 17-T-1451)

3rd Reduction Bevel Gear Bearing Adjustment

This adjustment should be made with the cover (44) and oil seal (45) removed and the 3rd reduction pinion gear assembly backed out of mesh so that the only drag measured by the test is due to the bearings.

Assemble shims (50) and gear (48) on hub (49) and attach with two bolts (47) only while adjusting bearings and setting tooth mesh. Complete the sub-assembly of hub on wheel spindle of knuckle (66), omitting hub cap (38).

Wrap tape or cord around brake drum pilot studs and attach spring scale to cord. The pull on scale to keep hub turning should give reading of 3 to 4 pounds. (See Figure 52).

Adjust by means of nut (41) using wrench, Mack Part No. 17-AK-27. Repeat test after tightening the clamp bolt (40). This adjustment should be checked at every major overhaul. Mark position of adjusting nut (41).

Coat gear teeth with red lead or prussian blue compound.

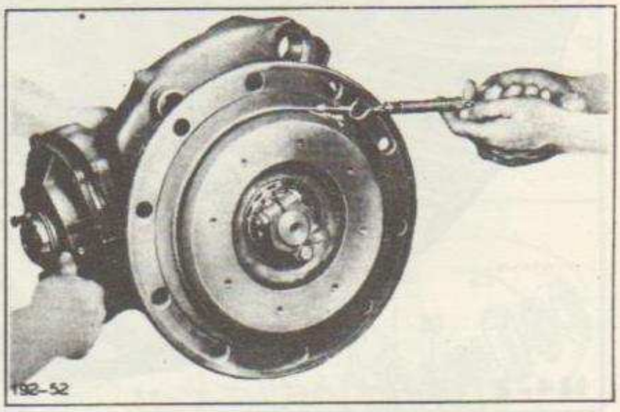


Fig. 52—Testing 3rd Reduction Bevel Gear Bearing Adjustment

3rd Reduction Pinion Gear Bearing Adjustment

Make up sub-assembly consisting of drive shaft (3), pinion (14), retainer (2), bearings (4), (11), spacer (13) shims (12), washer (10) and nut (9), using wrench, Owatonna Part No. 885.

Hold shaft in soft jaws of vise. Wrap cord around retainer pilot (7¾" dia.). Pull on scale to keep retainer turning should give reading between ½ and 2 pounds. (See Figure 53).

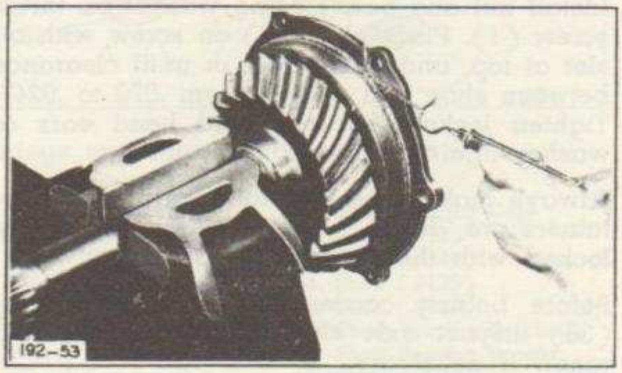


Fig. 53—Testing 3rd Reduction Pinion Gear Bearing Adjustment

Add or remove shims (12) to suit.

Lock nut (9) by staking into keyway in shaft.

Coat gear teeth with red lead or prussian blue compound.

2nd Reduction Bevel Gear Bearing Adjustment

Assemble these parts: gear (19), retainer (16), bearings (25) and (26), spacer (26), shims (27), washer (21) and locknut (20), using wrench, Owatonna Part No. 885. While making this adjustment, omit new oil seal (22) but broken-in seal may be left in place.

Hold gear in soft jaws of vise.

Wrap cord around retainer pilot as shown and attach spring scale to cord. The pull on scale should be ½ to 2 pounds to keep retainer turning. (See Figure 54).

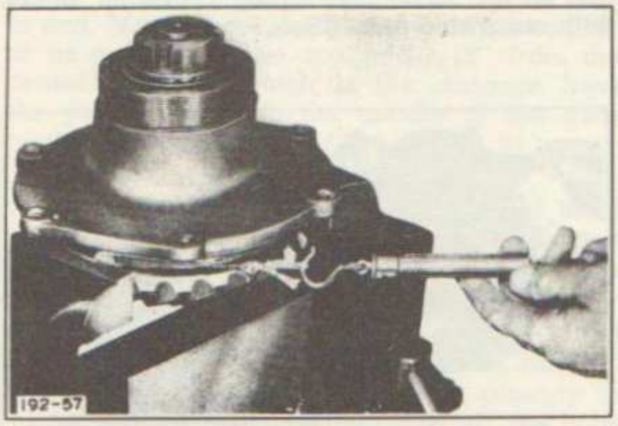


Fig. 54—Testing 2nd Reduction Bevel Gear Bearing Adjustment

Add or remove shims (27) as required.

Separate gear and retainer. Add oil scraper, spring and new oil seal if used as replacement. Stake locknut (20) and screw on retainer cover (18).

Coat gear teeth with red lead or prussian blue.

2nd Reduction Pinion Gear Bearing Adjustment

Assemble these parts; pinion (32), retainer (29), bearings (33) (36), spacer (34), shims (35) and nut (31), using wrench, J. H. Williams & Co. part No. 18A.

Hold pinion in soft jaws of vise.

Wrap cord around retainer pilot and attach spring scale to tape. The pull on scale should read ¾ to 2¾ pounds to keep retainer turning. (See Figure 55).

Add or remove shims (35) as required.

Stake nut (31) into keyway in shaft.

Coat gear teeth with red lead or prussian blue.

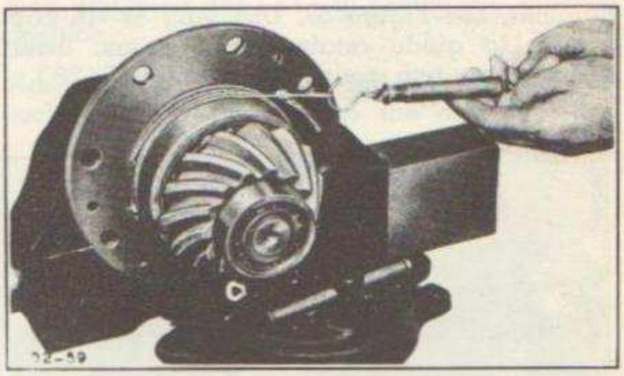


Fig. 55—Testing 2nd Reduction Pinion Gear Bearing Adjustment

Installation of Gear Sub-assemblies into Housings

Start pinion gear (14) and drive shaft (3) into position and hold loosely preferably by two bearing retainer capscrews (1). Then slip oil seal (5) on the drive shaft and tap into position. Install bevel gear (19), shims (17) and parts into housing (54), and tighten with two bearing retainer screws (15), see Figure 56.

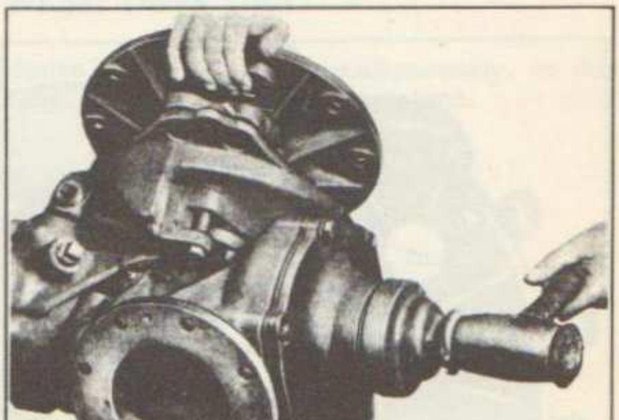


Fig. 56—Placing 2nd Reduction Bevel Gear Sub-assembly in Housing

Complete the assembly of pinion gear (14) and drive shaft by tightening down the capscrews (1). Tap pinion (32) and parts into position by striking end of pinion shaft with lead hammer, see Figure 57. Use long ⅜"-16 capscrews to guide retainer and shims; insert and tighten two countersunk screws (28).

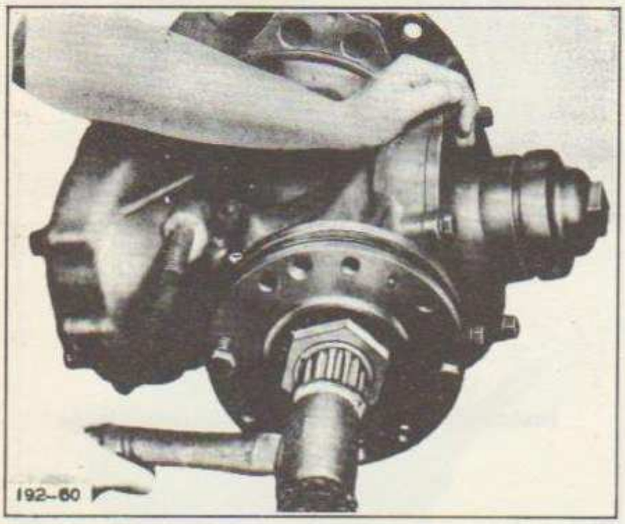


Fig. 57—Placing 2nd Reduction Pinion Gear Sub-assembly in Housing

3rd Reduction Bevel Gear Set Mesh Adjustment

Check mounting of bevel gear and pinion for proper mesh. A mounting gage need not be used to do this. The gears can be correctly mounted by providing the necessary backlash and ideal tooth contact for a given setting. Refer to procedure outlined for axle drive unit ring gear tooth contact.

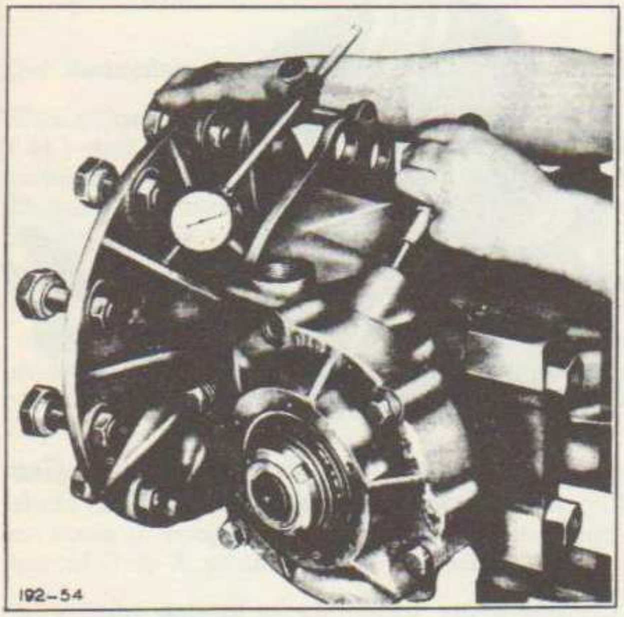


Fig. 58—Checking Backlash of 3rd Reduction Gear Set with Dial Indicator
(Tool—Federal Stock No. 41-I-100)

Check backlash by locking lower bevel pinion with screw driver inserted thru inspection hole then mount dial indicator to measure movement of wheel hub at point approximating center of gear at pitch line (See Figure 58).

Adjust shims (6) or (50) to provide .012"-.016" backlash, and check tooth contact.

Attach special sleeve as shown, tapped with 1⅜"-12 thread, to upper pinion shank. Apply load to teeth by turning wheel hub with bar, and at the same time apply brake on sleeve with strap and bar. (See Figure 59).

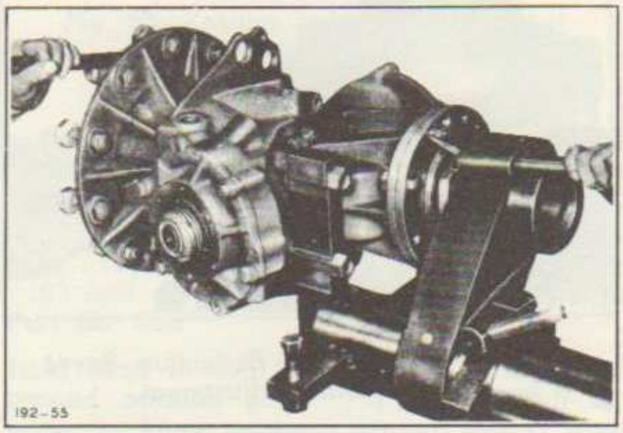


Fig. 59—Applying Load to 3rd Reduction Gears

Turn wheel hub in both directions, to load both driving and coasting sides of teeth. Remove plug (84) and examine mesh thru inspection hole or preferably withdraw gears to note nature of tooth contact. (See Figure 60).

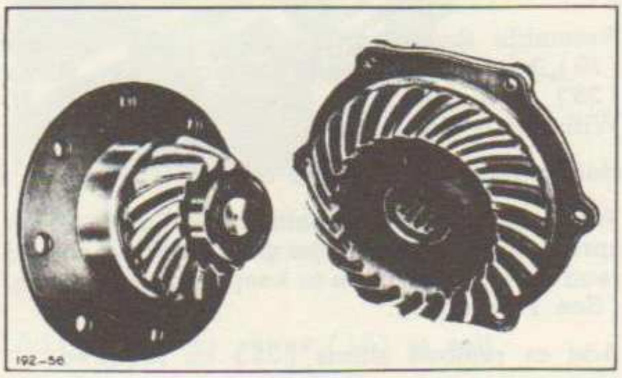


Fig. 60—3rd Reduction Gears Removed to Note Imprint due to Tooth Contact

To vary tooth contact between pinion (14) and gear (48) add or remove shims (6) and (50).

2nd Reduction Bevel Gear Set Mesh Adjustment

Check tooth backlash and tooth contact previously outlined for 3rd reduction bevel gear set.

Check backlash with dial indicator, making contact with small arm attached to pinion spline shaft by bolt screwed into tapped hole in end. Mount indicator so that point of contact of its anvil with the arm is 2-1/16" from the center of shaft, which is the distance from the pinion center to the middle of the gear teeth at the pitch line. (See Figure 61).

Adjust to get .012"-.016" backlash, and ideal tooth contact as outlined for 3rd reduction gear set, by varying shims (17) and (30).

Remove wheel hub, and separate gear (48) and hub; then assemble cover (44), oil seal (45) and brake cam (68), if not already in place. Tighten gear to hub with all the bolts (47). Install hub assembly, and tighten and lock adjusting nut (41) to previously marked position.

Add all capscrews, etc. and tighten; then attach wheel drive units to the axle housing.

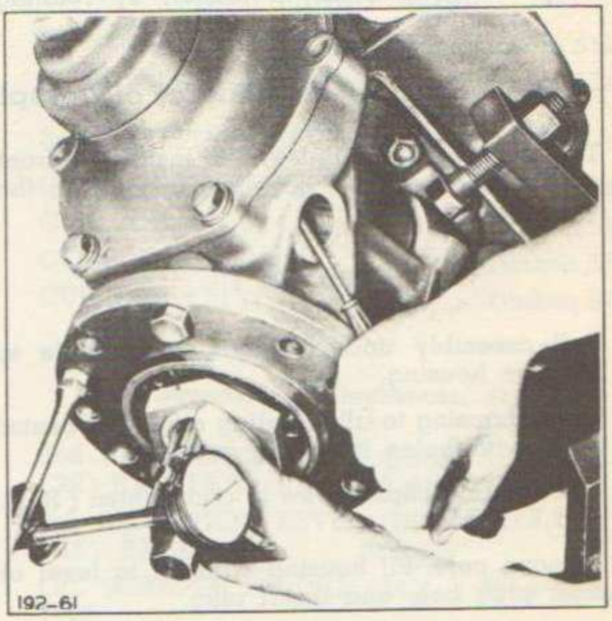


Fig. 61—Checking Backlash of 2nd Reduction Gear Set with Dial Indicator
(*Tool—Federal Stock No. 41-I-100*)

Installation of Either Wheel Drive Unit

Three men may be employed to install either unit in a short time. All are to perform the duties listed for them simultaneously, so that they will finish at the same time.

Men No's. 1, 2, and 3

Wrap sling about wheel drive housing and raise to position with hoist. Insert long bar thru sling and over front spring to guide housing into place. Be sure that the oil drain hole in the flange gasket registers with the holes in the flanges. With two or three of the flange bolts as guides draw the flanges together, being careful not to damage either the oil seal or the spline.

Man No. 1 and Man No. 2

Insert the other flange bolts and set their nuts up tightly. (After one day's running, they should be checked for tightness).

Man No. 3

Remove sling.
Connect drag link to steering lever.
Connect air line at brake chamber.

Man No. 1

Connect tie rod to cross-steering levers.

Man No. 2 and Man No. 3

Install Wheel.

It is good practice after a complete re-assembly, to spread some type of sealing compound around the outside edges of the shim packs to insure against oil leakage.

While filling with lubricant it is desirable to keep the gear trains in motion by rotating the wheel hub, thus working oil into the bearings before the load is applied. This also permits the correct amount of oil to be added to each housing.

Fill upper compartment at filler plug (83) and lower compartment at filler plug (85).

Installation of Complete Front Axle on Chassis

Two men may be employed to install the front axle in a short time. Both are to perform the duties listed for them simultaneously, so that they will finish at the same time.

Man No. 1

Roll assembly under chassis, using pole to balance housing.

Guide housing to align spring clips and center bolts with holes in spring perches.

Insert spring clips. Screw in and tighten (R. H. and L. H.).

Remove pole, fill housing with oil to level of filler plug hole and insert plug.

Assist Man No. 2 to connect drag link by turning steering wheel.

Man No. 2

Assist Man No. 1 by guiding wheels.

Lower hoist supporting front of chassis while Man No. 1 aligns axle assembly.

Remove slings and hoist. Connect brake air line (R. H. and L. H.).

Connect propeller shaft.

Connect drag link.

SECTION 8: SPECIFICATIONS

MAKE .... Mack
MODEL FA-49
TYPE .... Triple Reduction, All-Gear Drive
EFFECTIVE OVERALL RATIO 9.02

Axle Drive Unit

(Reference Numbers apply to Figure 7)

MODEL CR-51
TYPE .... Single Reduction
RATIO 3.92
REDUCTION GEARS .... Spiral Bevel
DIFFERENTIAL GEARS .... Straight Bevel

Bearings

1st REDUCTION PINION:
OUTER CONES (30) & (34) .... Timken 53177
OUTER CUPS (31) & (35) .... Timken 53375
INNER (23) .... Hyatt U-1305-TAM

DIFFERENTIAL CASING:
CONES (10) .... Timken 3984
CUPS (9) .... Timken 3920

Dimensions, Clearances, etc.

1st REDUCTION BEVEL GEAR SET (12) & (26) ADJUSTMENT .... .006-.012" Backlash

BEVEL GEAR (12) RADIAL RUN-OUT Not over .002"

BEVEL GEAR (12) BOLTING FACE RUN-OUT .... Not over .002"

SIDE GEAR (19) HUB & CASING (13) & (14) CLEARANCE .... .005-.007"

SIDE GEAR THRUST WASHER (20) THICKNESS, NEW .... .059-.062"

PINION GEAR THRUST WASHER (18) THICKNESS, NEW .... .045-.047"

SPIDER (16) & PINION (17) CLEARANCE .003-.006"

AXLE SHAFT DIAMETER AT DIFFERENTIAL END 1.749-1.750"

AXLE SHAFT SPLINES 17 (involute)

AXLE SHAFT RUN-OUT Not over .015"

Wheel Drive Units
(Reference Numbers apply to Figure 8)

Bearings, etc.

OUTER CONES FOR (33) & (36) Timken 66225

OUTER CUPS FOR (33) & (36) Timken 66462

INNER (37) Hyatt U-1306-TAM

2nd REDUCTION BEVEL GEAR:

UPPER CONE FOR (25) Timken 49162

UPPER CUP FOR (25) Timken 49368

LOWER CONE FOR (26) Timken 495A

LOWER CUP FOR (26) Timken 493

KING PIN:

NEEDLE BEARINGS (64) & (65) Bantam 405228

DIAMETER AT BEARINGS 2.5005-2.5000"

THRUST BEARING WASHER (58) & (60) THICKNESS .438-.437"

SPACER (57) THICKNESS .250-.248"

3rd REDUCTION PINION GEAR:

CONES FOR (4) & (11) Timken 55175

CUPS FOR (4) & (11) Timken 55437

3rd REDUCTION BEVEL GEAR:

CONE FOR (46) Timken 528A

CUP FOR (46) Timken 522

CONE FOR (51) Timken 5760

CUP FOR (51) Timken 5735

Dimensions, Clearances, etc.

2nd REDUCTION BEVEL GEAR SET (19) & (32) BACKLASH .012-.016"

3rd REDUCTION BEVEL GEAR SET (14) & (48) BACKLASH .012-.016"

OIL SCRAPER SPRING (24) Free Length 1½"

OIL SCRAPER SPRING (24) POUNDS PRESSURE @ 7/16" LENGTH 1 to 1½

GREASE SEAL WASHER (56) FREE HEIGHT .100"

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
*41-I-100	Indicator, Test, Universal, Dial Type		
17-T-1487	Gage, Pinion Mounting		Mack Mfg. Corp.
17-T-1451	Plug Threaded, King Pin Remover and Installer		Mack Mfg. Corp.
17-AK-27	Wrench, Front Wheel Bearing Adjusting	$ 5.25	Mack Mfg. Corp.
17-T-1461	Tube, Guide, Housing Aligner for Inserting King Pin		Mack Mfg. Corp.
17-T-1453	Studs, Guide, for Inserting King Pin (set of four)	5.20	Mack Mfg. Corp.
LDH-682	Wrench, Socket, 2⅛" flats	3.60	Snap-On-Tools
L-52	Handle, Socket Wrench	3.60	Snap-On-Tools
18A	Wrench, Open End, 3⅜" flats	29.50	J. H. Williams & Co.
885	Wrench, Spanner, Bevel Gear and Pinion Locknuts		Owatonna Tool Co.

*Federal Stock Number

GROUP 11: REAR AXLE

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Dual Rear Axles

Two rear axle drive units are combined in a structure comprising the springs and a trunnion mounting for the rear of the chassis. The two axle units are attached to opposite ends of two heavy, leaf springs by rubber Shock Insulators retained in housings on the lower side of the axle housings. By maintaining the parallel relation of the axles, the springs serve as radius arms. To restrain the turning effort of the axle housings, two torque rods, with a ball socket at each end, connect the tops of the axle carriers to the cross member of the chassis frame midway between the two axles. This arrangement of springs and torque rods forms a parallelogram on each side of the central cross member.

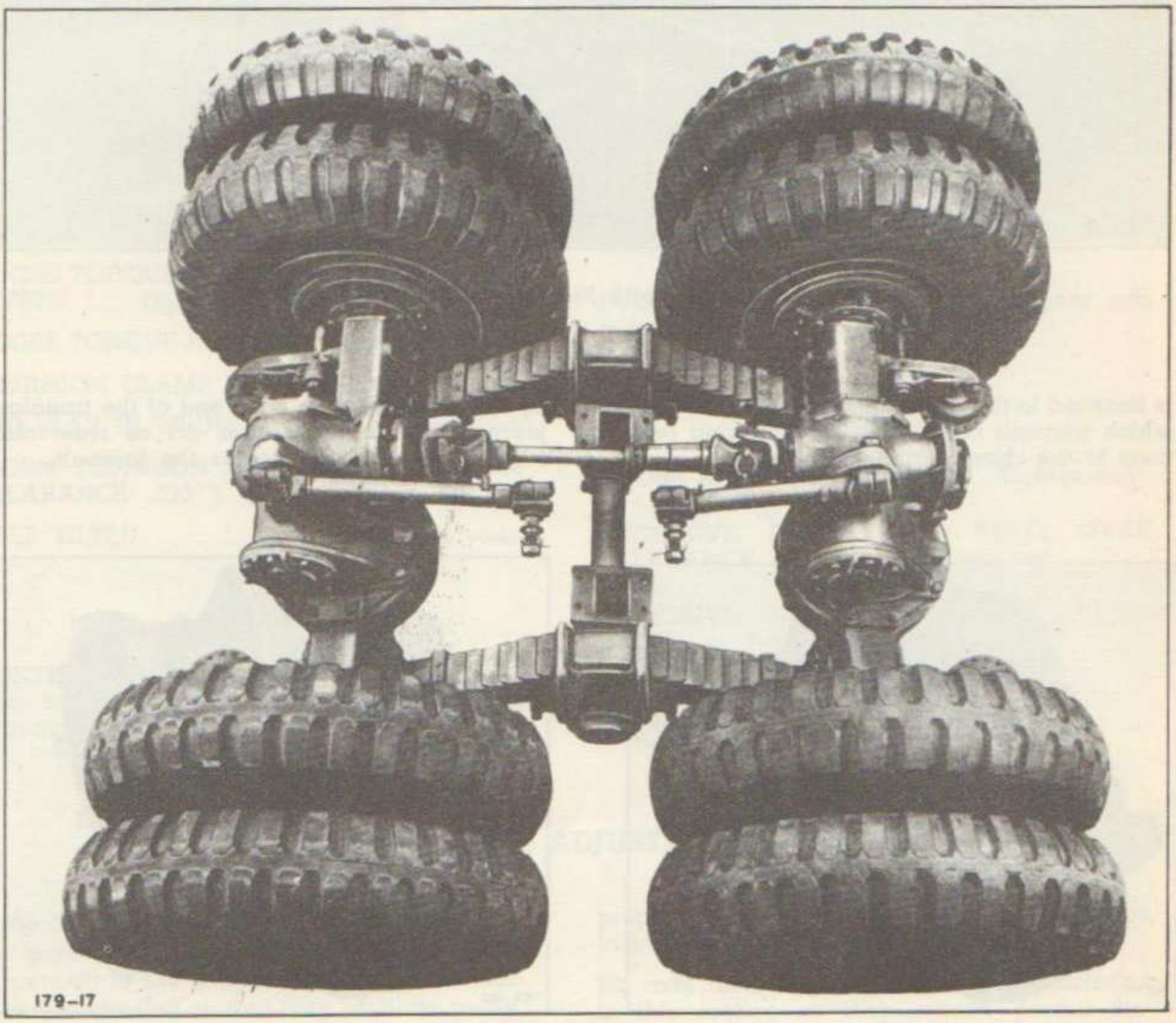

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Fig. 1—View of Dual Rear Axles

The springs oscillate on a trunnion tube, allowing the forward and the rear axle units to roll over obstructions freely. The trunnion journals are pivoted on the trunnion tube which is fastened to the frame by two heavy brackets which transmit the driving and braking reactions to the chassis frame.

The trunnion journals, which are also the spring seats, consist of steel castings lined with bronze bushings which turn upon the trunnion tube. The lateral thrust is taken by thrust washers on each end of the trunnion journal. The trunnion caps act as reservoirs for the oil which lubricates the journals.

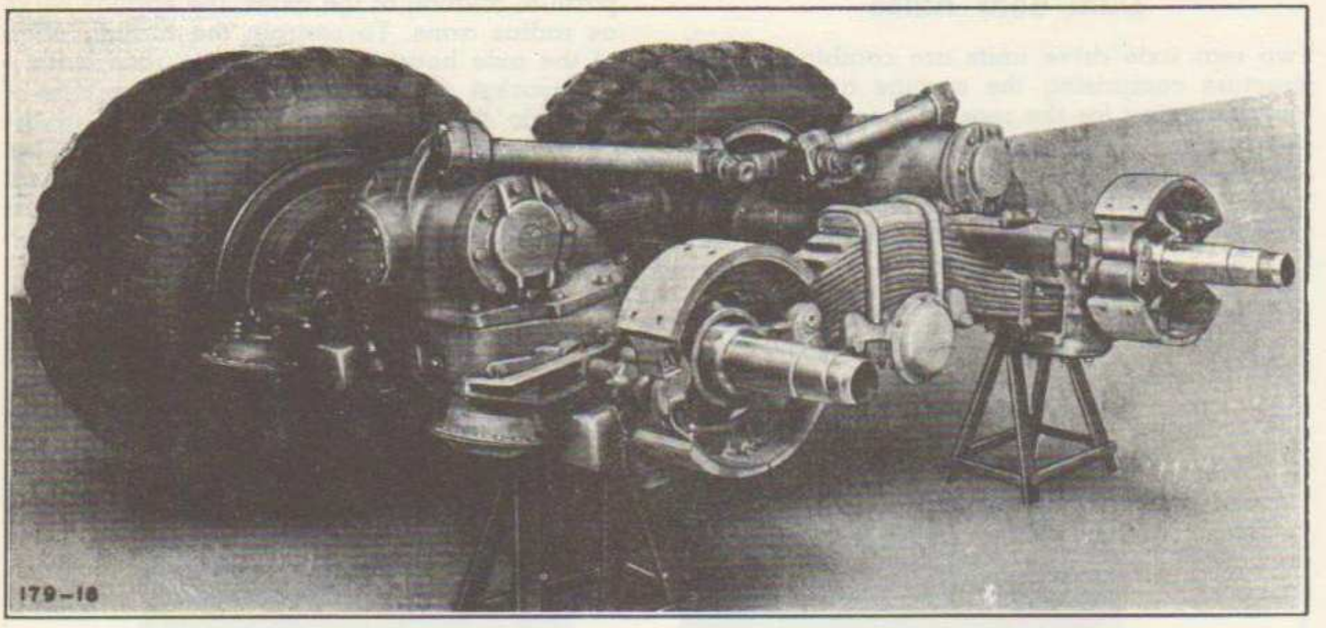

Fig. 2—View of Axles with Right Hand Wheels Removed

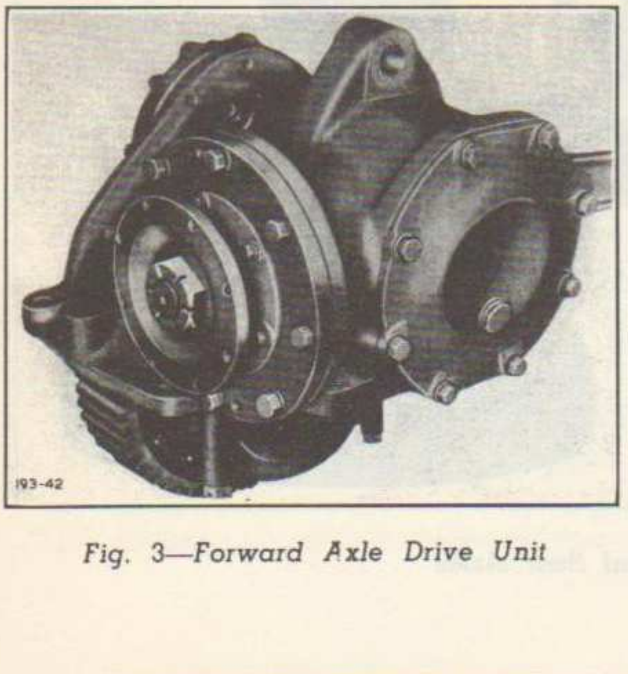

Fig. 3—Forward Axle Drive Unit

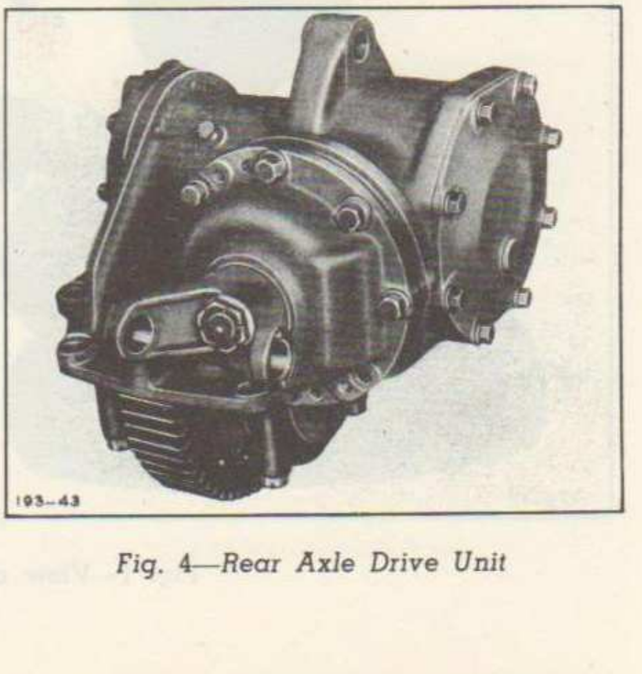

Fig. 4—Rear Axle Drive Unit

Axle Drive Units

The rear axle drive consists of forward and rear units. They are of double reduction type, and each employs a pair of spiral-bevel gears for the first reduction and a pair of spur gears for the second reduction. Each unit consists essentially of three groups: the bevel pinion, spur pinion, and differential assemblies.

The entire mechanism of each unit is contained in a carrier housing which is mounted on the axle banjo. The axle shafts are of full-floating construction and are thereby relieved of all stress excepting that required to drive the wheels.

The thru-shaft in the forward unit carries the bevel pinion for this unit and also transmits power to the rear unit thru a short propeller shaft.

With the exception of the rear bearing on the straddle-mounted bevel pinion of the forward unit, the bearings are of tapered roller type and are adjustable.

Each unit employs a differential of the power-divider type. It consists of a driving member, to which the spur gear is bolted, and two driven members, each of which have internal splines to receive the axle shafts. A series of plungers operate in holes in the driving member and ride on cam surfaces of the driven members. This provides a power-dividing action between the two wheels, as in a bevel gear differential but with the added advantage of apportioning the torque between the right and left sides in favor of the wheels having better traction.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Excessive Noise

LOOSE TORQUE ROD BRACKET BOLTS AND RIVETS .... Tighten.

LOOSE TORQUE ROD BALL STUDS Tighten.

TRUNNION CLAMP BOLTS LOOSE Tighten.

END PLAY IN TRUNNION .... Adjust.

WORN TRUNNION BUSHINGS (MAXIMUM CLEARANCE .025") .... Renew.

AXLE TILTED .... Check torque rods.

Axle Noise

CONTINUOUS HUM .... Re-adjust wheel bearings, bevel pinion bearings and spur pinion bearings.

COASTING HUM .... Inspect pinion, and bevel gear to pinion adjustment.

PULLING HUM .... Inspect bevel gear and bevel gear to pinion adjustment.

Backlash

LOOSE AXLE SHAFT FLANGE .... Tighten nuts.

EXCESSIVE PINION AND BEVEL GEAR CLEARANCE .... Adjust as per text.

EXCESSIVE AXLE SHAFT SPLINE CLEARANCE .... Renew worn parts.

EXCESSIVE OR UNEQUAL TIRE WEAR .... Check all radius rods.

SECTION 3: ADJUSTMENTS

Aside from keeping all of the dual rear axle unit parts tight, the only part which requires adjustment is the trunnion. The trunnion journals are adjusted so that they oscillate freely, but with no end play. The end play is taken up by turning the inner adjusting nut to the proper position, then replacing the D type lockwasher and the lock nut.

No axle drive unit adjustments are included in this section as they require partial disassembling. See "Section 7: Re-assembly" and "Section 8: Specifications."

SECTION 4: DIS-ASSEMBLY

Removing Dual Rear Axle Units from Chassis

Four men may be employed to advantage to remove the dual rear axle units from the chassis in short time. The duties of each man are listed below.

Men No. 1 and No. 2 Working Under Vehicle

Working together remove nuts from eight body-bound bolts attaching trunnion journal to trunnion bracket on both left and right hand sides.

Assist men No. 3 and No. 4 in rolling unit out.

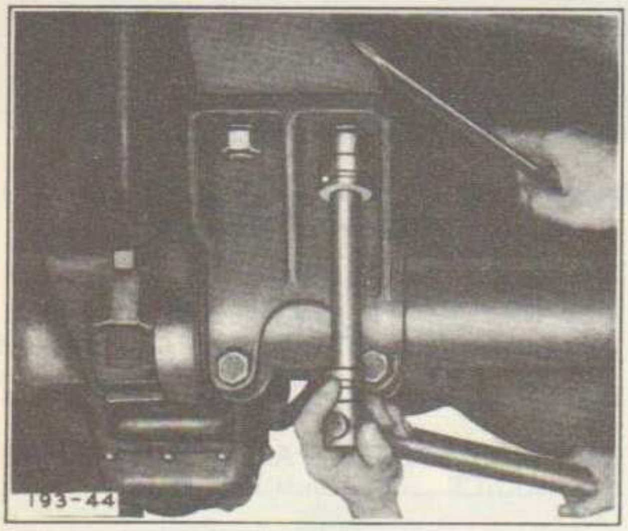

Fig. 5—Removing Trunnion Bracket Bolts

Man No. 3

Hook up chain sling from truck to hoist.

Remove right hand splash apron.

Disconnect air line at "Y" connection at forward axle unit.

Disconnect front torque rod ball socket cap.

Disconnect propeller shaft at forward axle unit.

Assist Men No. 1, No. 2, and No. 4 in rolling unit away from chassis.

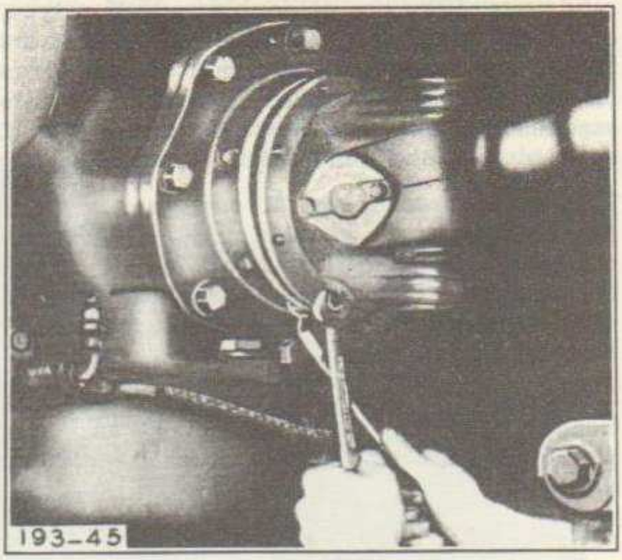

Fig. 6—Removing Propeller Shaft from Forward Axle Unit

Man No. 4

Remove left hand splash apron.

Disconnect air line at "Y" connection at rear axle unit.

Disconnect rear torque rod ball socket cap.

Assist Men No. 1, No. 2 and No. 3 in rolling unit away from chassis.

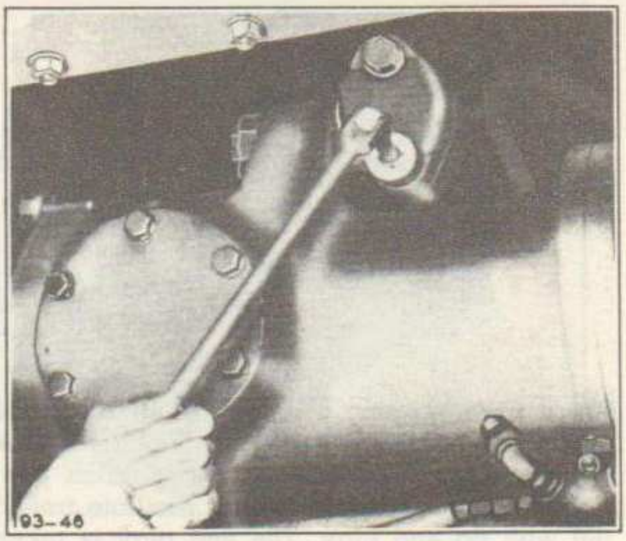

Fig. 7—Removing Torque Rod Ball Socket Cap

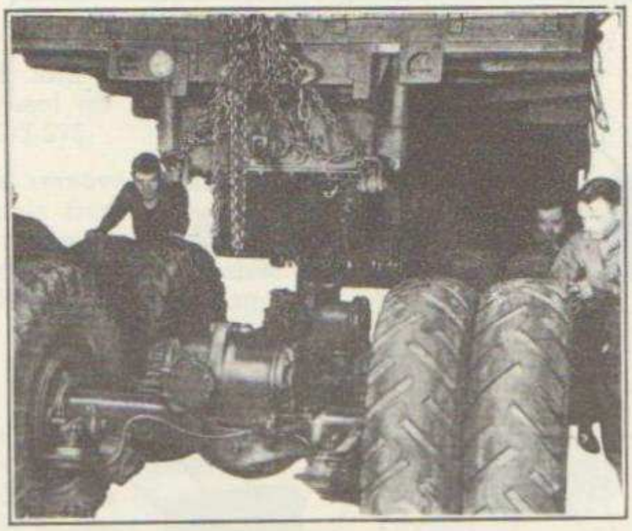

Fig. 8—Removing Rear Axle Unit from Under the Chassis

Dis-assembly of Dual Rear Axles

Remove propeller shaft between forward and rear axle units. To do this, remove bearing caps and needle bearings from one yoke at each end, then slip yokes apart.

Remove torque rod ball on carrier housing.

Axle Units

Remove hub caps and pull out axle shafts.

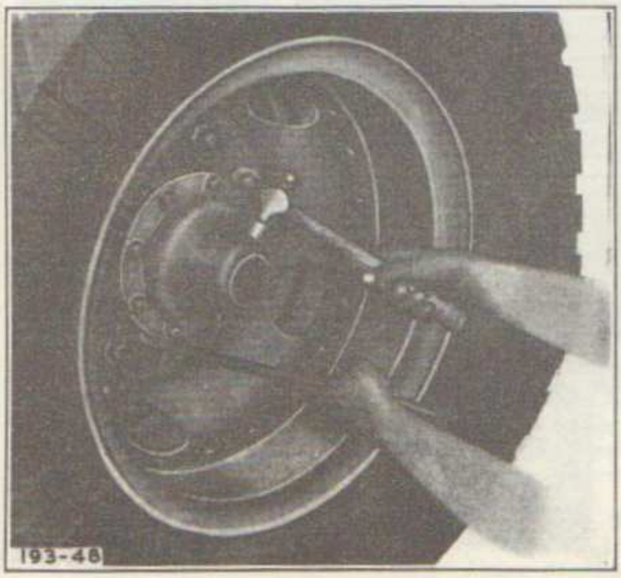

Fig. 9—Removing Hub Cap

Drain oil from axle housing and remove carriers.

Fig. 10—Removing Carrier

Springs

Remove rubber "Shock Insulator" blocks at spring ends. To do this, block up springs from floor, supporting them close to housings enclosing rubber blocks, then take out four capscrews from each housing cap.

Separate axle units from springs by taking jacks from under spring ends.

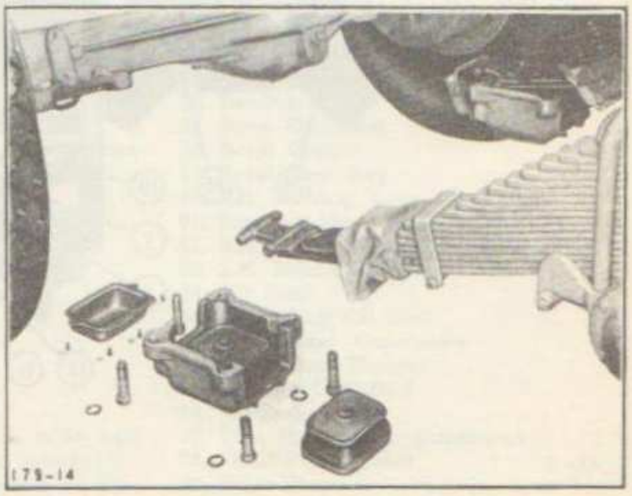

Fig. 11—Axle Unit Separated from Springs

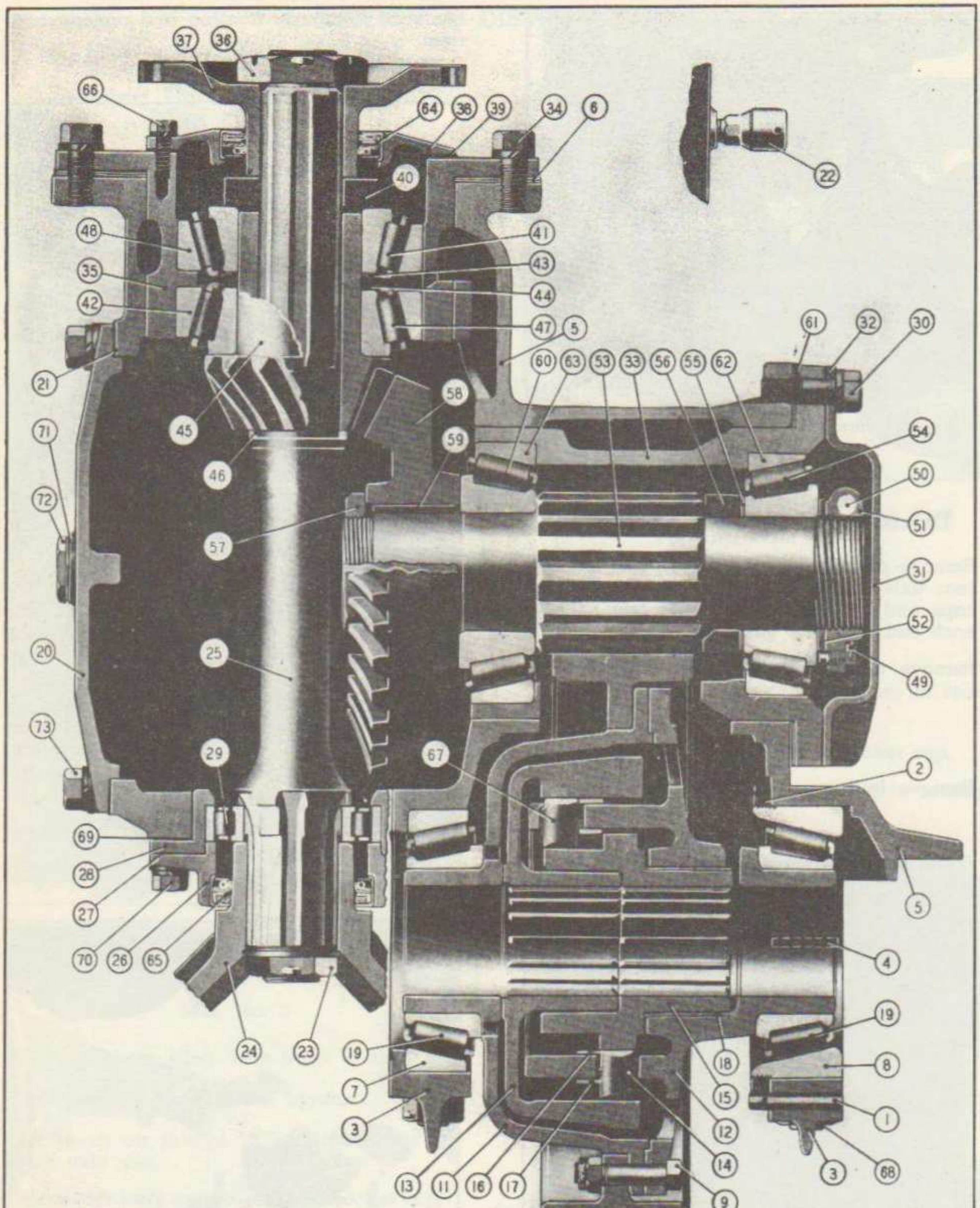

Fig. 12—Sectional View of Forward Axle Drive Unit.

Wheels

Jack up axle until tires clear ground. Take off lock nut, washer and inner nut and slide wheel off axle. Use wrench, Mack Part No. 17-T-275.

To remove bearing cone and leather grease seals from wheels, take out oil slinger lock rings with screw driver, place block of brass or hard wood against bearing cone and tap all around with hammer.

Trunnion

Remove trunnion journal hub cap, hexagonal lock nut, washer and circular inner nut at both ends as shown by Figure 4 in "Group 16: Springs."

Slide trunnion journal assembly off of trunnion tube.

Loosen spring clamp side bolts on trunnion journal and remove spring clips and springs.

Brake Shoes

Disconnect slack adjuster from brake-chamber push rod.

Remove slack adjuster from brake camshaft and slide cam out.

Remove lock nut from between anchor pins at dust shield and slip lock plate from pins.

Pull anchor pins out. Pins are tapped for a ½"—20 puller. If pulling tool is not available, remove dust shield and drive pins out from back.

Dis-assembly of Forward Axle Drive Unit

(See Figure 12)

Note: Certain parts can be inspected without dis-assembling, and these items need not be taken apart unless they require renewal.

Staked locknuts are to be turned off, shearing the staked part of nut in keyway.

With carrier unit out of axle housing, and blocked up on floor platform or held in assembly stand, commence dis-assembly by locking differential and turning off rear flange nut (23).

Fig. 13—Removing Rear Flange Nut
(Tools—Snap-On-Tool Part No's. L-643 & L-53)

1. Adjusting Nut Lockpin
2. Adjusting Nut
3. Differential Bearing Caps
4. Bearing Cup Lockwasher
5. Carrier Housing
6. Retainer Shim Pack
7. Differential Bearing L.H. Cup
8. Differential Bearing R.H. Cup
9. Spur Gear Bolt
10. Spur Gear
11. Differential Casing
12. Differential Cage Assembly
13. Differential Outer Cam
14. Differential Plunger
15. Differential Inner Cam
16. Differential Inner Ring
17. Differential Outer Ring
18. Cam Bushing
19. Differential Bearing
20. Bevel Gear Compartment Cover
21. Cover Gasket
22. Housing Breather
23. Rear Flange Nut
24. Rear Drive Flange Yoke
25. Thru Shaft
26. Thru Shaft Cover
27. Cover Gasket
28. Thru Shaft Rear Ret.
29. Thru Shaft Bearing
30. Cover Capscrews
31. Spur Shaft Brg. Cover
32. Cover Gasket
33. Bearing Retainer
34. Bevel Pinion Retainer Capscrews
35. Bevel Pinion Retainer
36. Forward Flange Nut
37. Forward Drive Flange
38. Pinion Retainer Cover
39. Cover Gasket
40. Brg. Retaining Spacer
41. Pinion Bearing Cone
42. Pinion Bearing Cup
43. Brg. Shim Pack
44. Bearing Spacer
45. Bevel Pinion
46. Spacer (not used with ratio axle furnished with this vehicle)
47. Pinion Bearing Cone
48. Pinion Bearing Cup
49. Bearing Nut Setscrew
50. Bearing Nut Bolt
51. Bearing Adjusting Nut
52. Bearing Nut Lockwasher
53. Spur Pinion Shaft
54. R.H. Bearing Cone
55. Bearing Shim Pack
56. Bearing Spacer
57. Bevel Gear Nut
58. Bevel Gear
59. Bevel Gear Key
60. L.H. Bearing Cone
61. Retainer Shim Pack
62. R.H. Bearing Cup
63. L.H. Bearing Cup
64. Oil Seal
65. Thru Shaft Oil Seal
66. Ret. Cover Capscrews
67. Differential Plunger
68. Bearing Cap Stud
69. Retainer Gasket
70. Thru Shaft Cover Capscrews
71. Filler Plug Gasket
72. Filler Plug
73. Bevel Gear Cover Capscrews

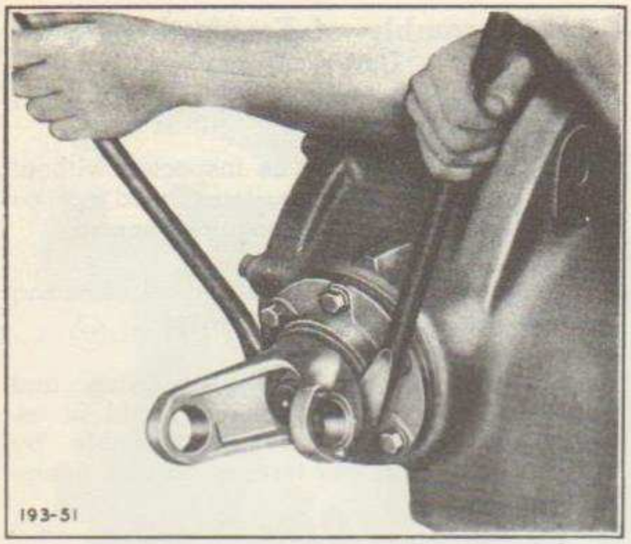

Fig. 14—Removing Rear Drive Flange Yoke

With aid of pinch bars, pry off rear drive flange yoke (24).

Remove bevel gear cover capscrews (73), then detach bevel gear compartment cover (20) and gasket (21). Filler plug (72) and gasket (71) need not be removed. Remove capscrews (30), spur shaft cover (31) and gasket (32).

Detach capscrews (70) then remove thru shaft cover (26) with aid of drift and hammer. Remove gasket (27). Tap thru shaft oil seal (65) out of cover.

Fig. 15—Removing Thru Shaft Cover

(See Figure 16)

Insert puller screws into tapped holes in rear retainer (28), then remove retainer and bearing (29) by applying pressure evenly to these screws to avoid binding retainer in housing bore. Drive outer race of bearing (29) out of retainer. Remove gasket (69).

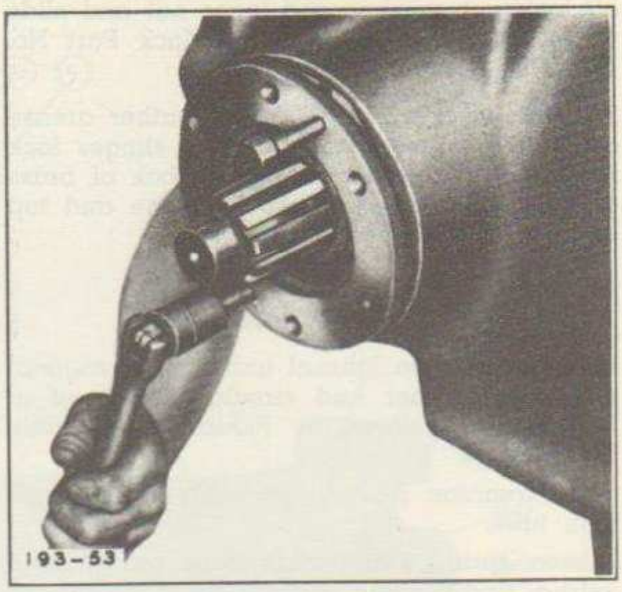

Fig. 16—Removing Thru Shaft Rear Retainer

Bevel Pinion

Take out bevel pinion retainer capscrews (34). Insert puller screws into tapped holes in retainer (35) and then take-up evenly on these screws, removing bevel pinion (45) and thru shaft (25) parts together. Wire shims (6) together.

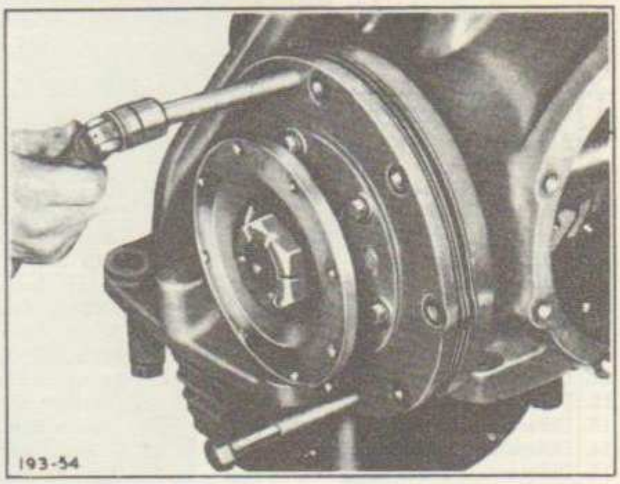

Fig. 17—Removing Bevel Pinion and Thru Shaft

(See Figure 18)

Hold forward drive flange (37) in vise with aid of strap and turn off drive flange nut (36) with socket wrench.

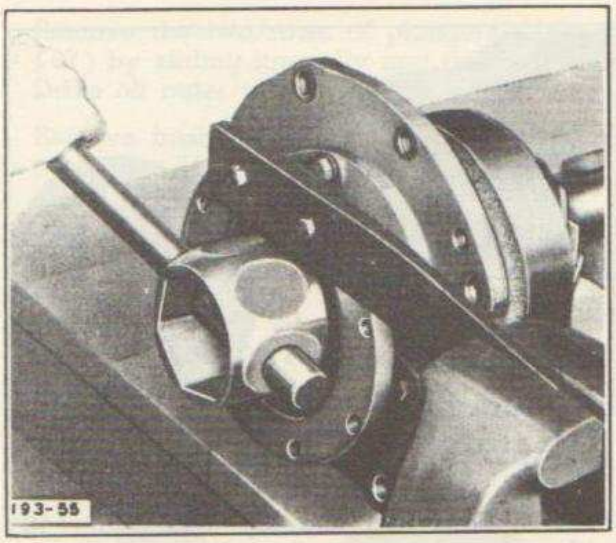

Fig. 18—Removing Forward Drive Flange Nut
(Tools—Snap-On Part No's. L-883 & L-53)

Place assembly in press with bevel pinion retainer (35) blocked up (teeth of pinion downward). Press thru shaft (25) out of forward drive flange (37) and continue operation until bevel pinion (45) and thru shaft (25) are pressed out of pinion retainer (35).

Remove bearing shim pack (43) and wire together. Then remove bearing spacer (44).

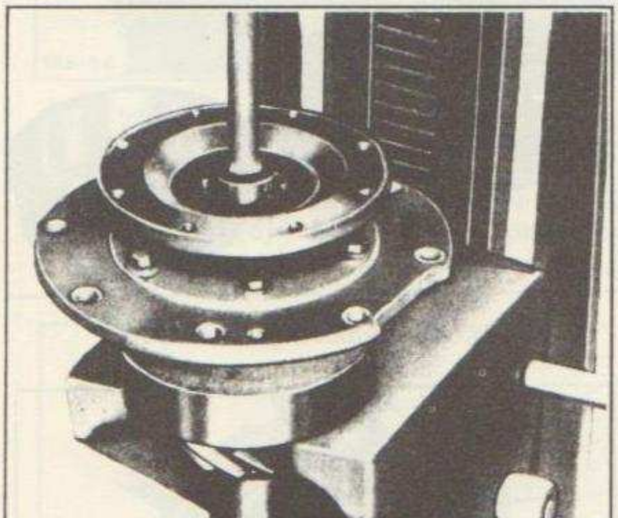

Fig. 19—Pressing Thru Shaft out of Forward Drive Flange and Pinion Retainer

(See Figure 20)

Place assembly in press with bevel pinion (45) blocked up and press out thru shaft (25). Drive cone of inner bearing (47) off bevel pinion (45).

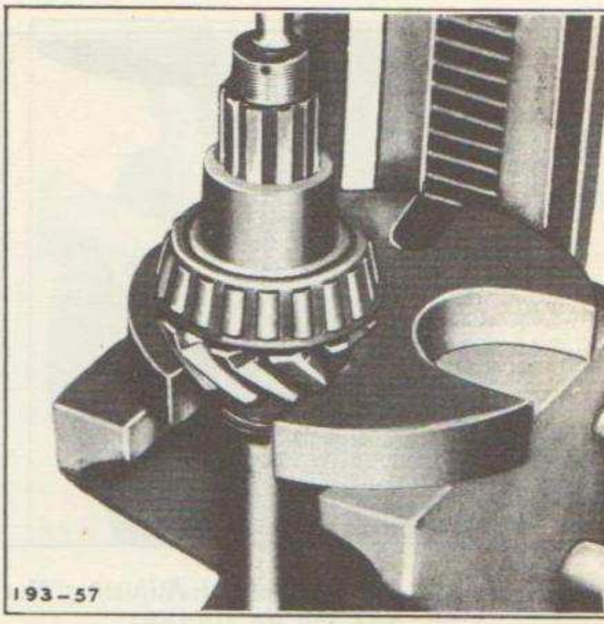

Fig. 20—Pressing Thru Shaft out of Pinion

Detach cover capscrews (66), pinion retainer cover (38) and gasket (39). Lift out bearing retaining spacer (40) and outer bearing cone (41). Tap oil seal (64) out of cover and with aid of drift, drive bearing cups (42) and (48) out of retainer.

Differential

Loosen bearing cap stud nuts slightly and remove adjusting nut lockpin (1) after taking cotter pin out.

Mark with prick punch position of adjusting nut (2) in relation to lockpin (1).

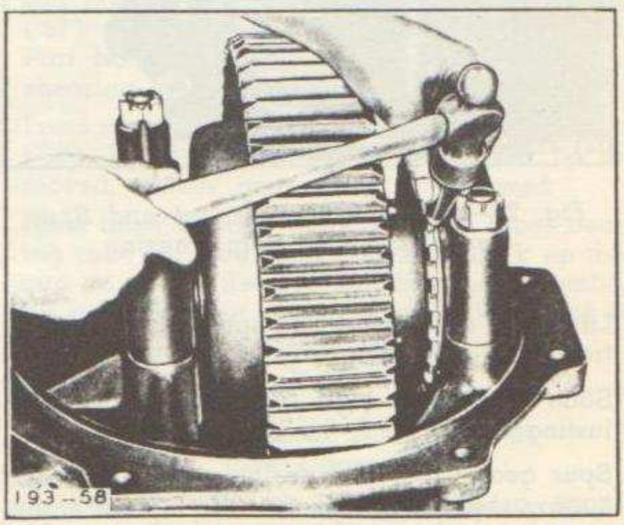

Fig. 21—Marking Differential Adjusting Nut

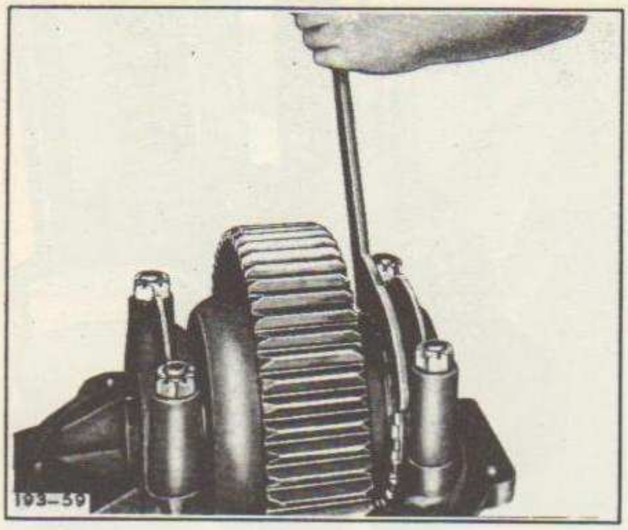

Fig. 22—Easing Off Differential Adjusting Nut
(Tool—Mack Part No. 17-T-1509)

Using spanner wrench illustrated, ease off adjusting nut (2) about one turn.

Punch mark mating bearing caps (3) and pedestals. Then remove bearing cap stud nuts, and bearing caps (3). Before removing bearing cup lockwasher (4), chalk mark the cup having the slot that engages the lock.

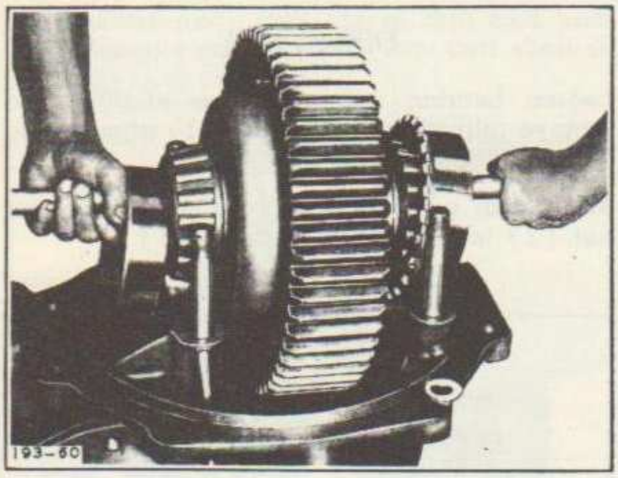

Fig. 23—Removing Differential and Spur Gear Assembly from Housing

Lift entire differential and spur gear assembly from carrier housing (5).

Slide off bearing cups (7) and (8) with adjusting nut (2).

Spur gear (10), and casing cover (11) and cage assembly (12) are line reamed and turned together making matched assembly. Punch mark casing halves to match some point on spur gear.

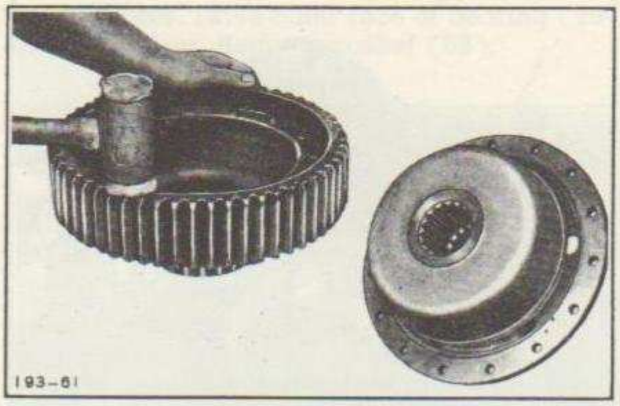

Fig. 24—Removing Spur Gear from Housing

Remove bolts (9) and tap spur gear (10) with soft hammer to free it from pilot of casing (11).

Lift off outer cam (13). Arrange position of the two rows of plungers (14) and (67) in cage assembly (12) and remove inner cam (15).

Collapse inner ring (16) and then remove with aid of screw drivers.

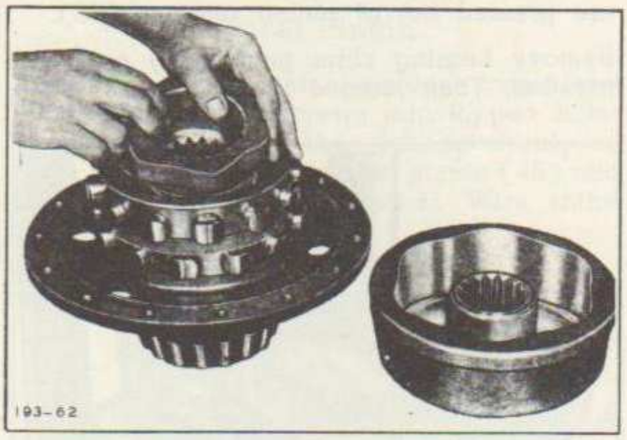

Fig. 25—Removing Inner Cam

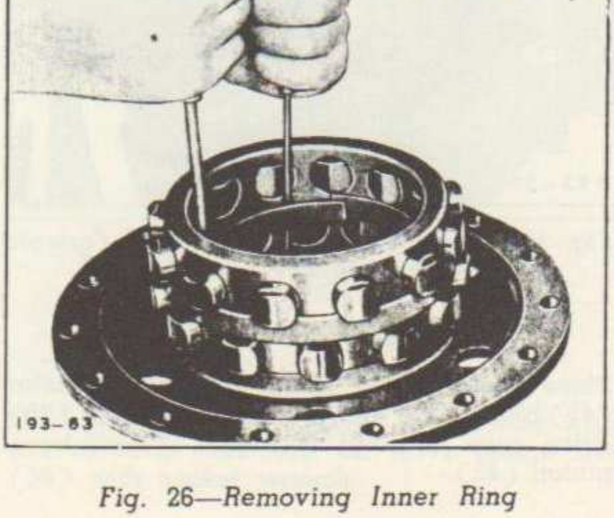

Fig. 26—Removing Inner Ring

Remove the two rows of plungers (14) and (67) by sliding inwardly and then lifting out. Drive off outer ring (17).

Remove bushing (18) from differential cage assembly (12) if worn.

Drive cones of differential bearing (19) off casing (11) and cage assembly (12) with aid of a drift inserted thru knock-out holes.

Spur Pinion Shaft

Remove spur pinion bearing adjusting nut setscrew (49) and then take out pinch bolt (50).

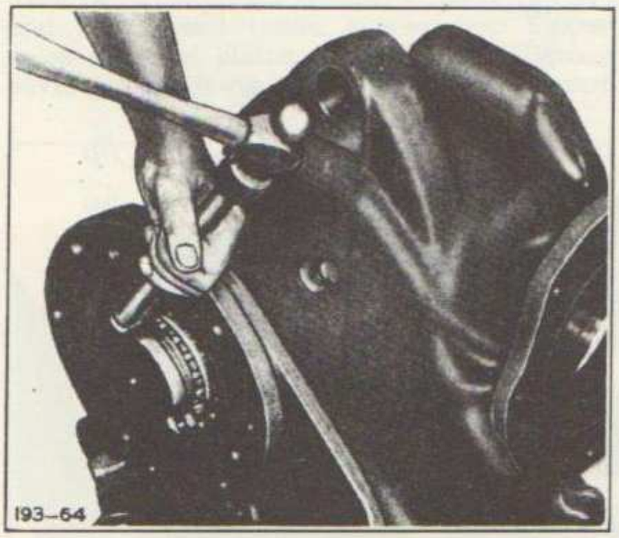

Fig. 27—Removing Bearing Adjusting Nut

Wedge bevel gear (58) and remove bearing adjusting nut (51) by reversing pinch bolt (50) in hole and using head as base for

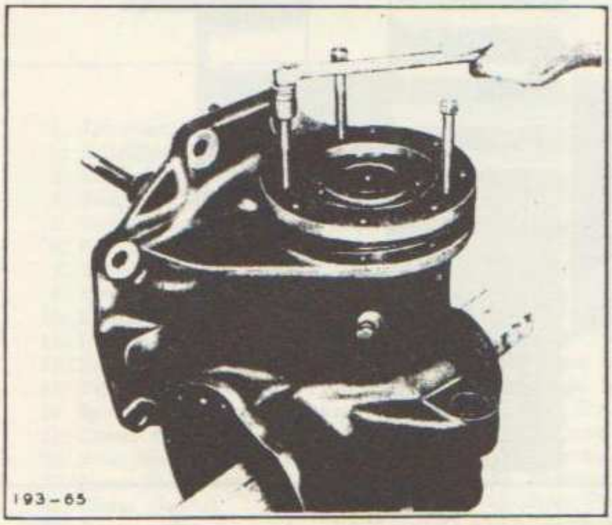

Fig. 28—Removing Bearing Retainer

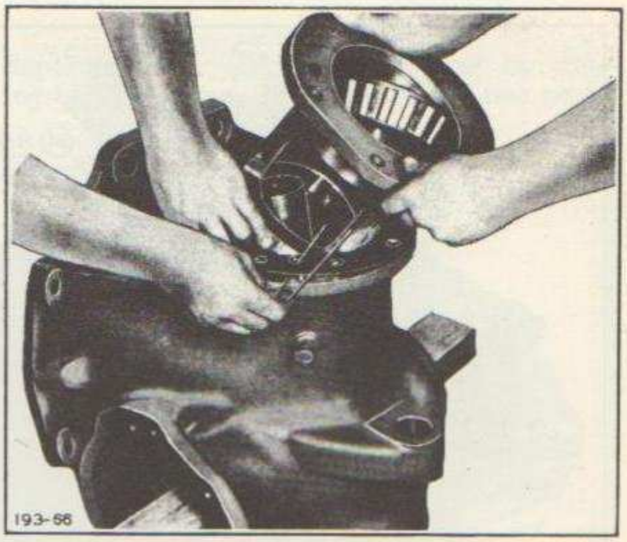

Fig. 29—Removing Retainer out of Housing

supporting drift. After nut (51) is removed, take off lock washer (52).

Block up bevel gear (58) with wood block in case and insert puller screws into tapped holes in bearing retainer (33).

Then remove retainer and parts out of housing by applying pressure evenly to these screws. This action will remove outer bearing cone (54) from spur pinion shaft (53). Wire bearing retainer shim pack (61) and then lift off bearing spacer (56) and shim pack (55).

Drive outer bearing cup (62) and inner bearing cup (63) out of bearing retainer (33) with aid of drift.

Lift spur pinion shaft (53) and bevel gear (58) out of case thru bevel gear opening.

Hold spur pinion shaft (53) by spur teeth in soft jaws of vise and remove bevel gear nut (57) with 3⅜" open-end wrench, Miller Tool Part No. DD-432, having ample leverage for shearing off the spot staked in keyway.

Press spur pinion shaft (53) out of bevel gear (58). Bevel gear key (59) need not be removed, unless gear (59) is removed.

Mate inner bearing cup (63) with inner bearing cone (60) on shaft and then block up this cup on press. Remove full bearing assembly by pressing spur pinion shaft (53) out of it.

Clean housing breather (22).

Rear Unit of Axle Drive
(See Figure 30)

With carrier out of axle housing, drain oil out of bevel gear compartment by removing drain plug.

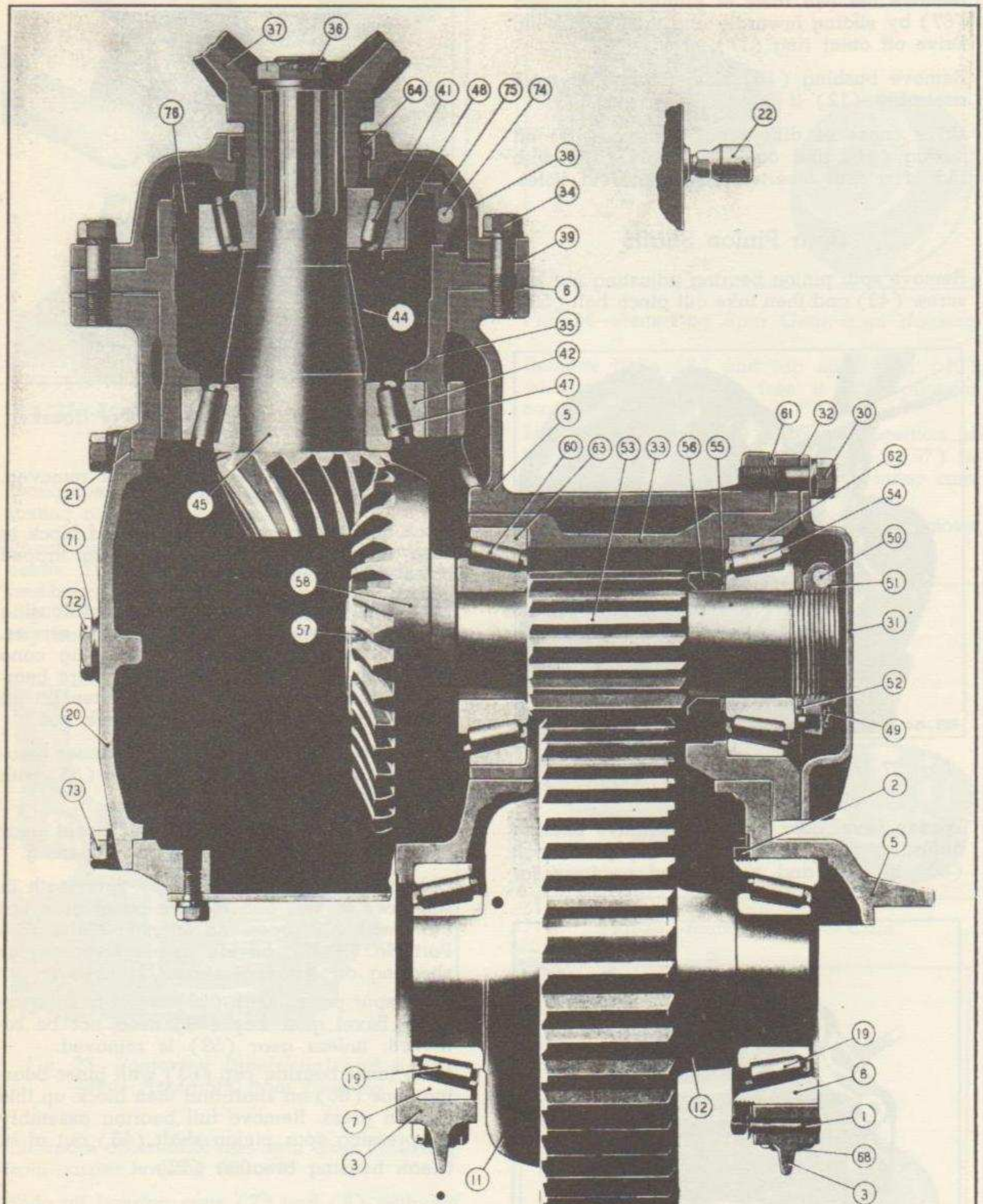

Fig. 30—Sectional View of Rear Axle Drive Unit

(See Figures 13 and 14)

Brace carrier and lock differential. Then remove drive yoke nut (36) and with aid of pinch bars pry off drive flange yoke (37).

Remove capscrews (73), bevel gear compartment cover (20) and gasket (21). Filler plug (72) and gasket (71) need not be removed. Remove capscrews (30), spur shaft cover (31) and gasket (32). Remove rear cover and gasket.

Bevel Pinion

Remove bevel pinion retainer capscrews (34) and then insert puller screws into tapped holes of bevel pinion retainer (35). Remove bevel pinion assembly by applying pressure

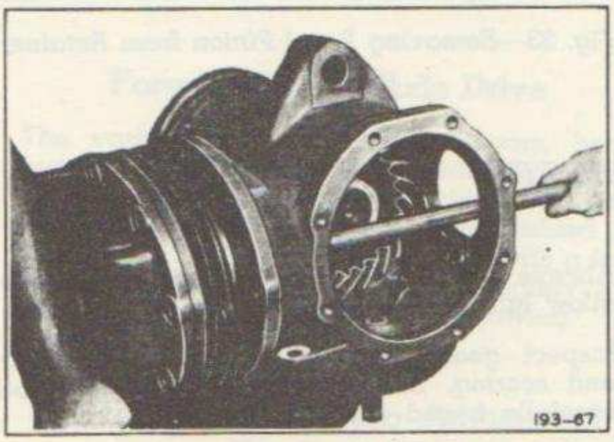

Fig. 31—Removing Bevel Pinion Assembly

evenly to these screws to avoid binding retainer in housing bore. Assist removal by prodding with a bar. Wire retainer shim pack (6) together.

Separate cover (38) from retainer by driving chisel between flanges of these two parts.

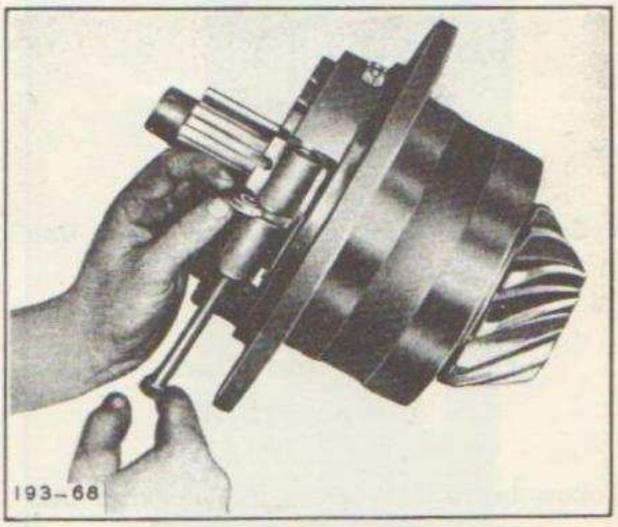

Fig. 32—Removing Bearing Lock Bolt and Lock

Tap out oil seal (64). Take out pinch bolt (74) and lock (75).

Note: Position of bearing adjusting cup (76) is to be marked in relation to lock if bearings are re-used.

(See Figure 33)

Block up retainer in press, press pinion (45) and parts out of retainer. This action will remove bearing cone (41) and spacer (44).

Drive bearing cone (47) off pinion.

1. Adjusting Nut Lockpin
2. Adjusting Nut
3. Differential Brg. Caps
4. Bearing Cup Lockwasher
5. Carrier Housing
6. Retainer Shim Pack
7. Differential Bearing L.H. Cup
8. Differential Bearing R.H. Cup
10. Spur Gear
11. Differential Casing
12. Differential Cage Assembly
19. Differential Bearing
20. Bevel Gear Compartment Cover
21. Cover Gasket
30. Spur Shaft Cover Capscrews
31. Spur Shaft Bearing Cover
32. Cover Gasket
33. Bearing Retainer
34. Bevel Pinion Retainer Screws
35. Bevel Pinion Retainer
36. Drive Yoke Nut
37. Drive Yoke
38. Pinion Retainer Cover
39. Cover Gasket
41. Pinion Bearing Cone
42. Pinion Bearing Cup
44. Bearing Spacer
45. Bevel Pinion
47. Pinion Bearing Cone
48. Pinion Bearing Cup
49. Bearing Nut Setscrew
50. Bearing Nut Bolt
51. Bearing Adjusting Nut
52. Bearing Nut Lockwasher
53. Spur Pinion Shaft
54. R.H. Bearing Cone
55. Bearing Shim Pack
56. Bearing Spacer
57. Bevel Gear Nut
58. Bevel Gear
60. L.H. Bearing Cone
61. Retainer Shim Pack
62. R.H. Bearing Cup
63. L.H. Bearing Cup
64. Oil Seal
68. Bearing Cap Stud
71. Filler Plug Gasket
72. Filler Plug
73. Bevel Gear Compartment Cover Capscrews
74. Bearing Lock Bolt
75. Front Bearing Lock
76. Bearing Adjusting Cup

Turn adjusting cup (76) out of retainer. Drive bearing cup (48) out of adjusting cup. Drive pinion bearing cup (42) out of retainer.

Differential

(See page 11-9)

Follow instructions given for "Forward Unit".

Spur Pinion Shaft

(See page 11-11)

Follow instructions given for "Forward Unit".

Fig. 33—Removing Bevel Pinion from Retainer

SECTION 5: REPAIRS

Virtually all repairs to the rear axle are made by the REPLACEMENT of worn or damaged parts with new ones which are made with such accuracy that they are interchangeable and require no fitting or sizing operation.

NOTE: Before re-assembling, all parts should be thoroly cleaned with suitable solvent to remove all traces of dirt and oil, and inspected carefully for cracks or worn surfaces. Parts showing excessive wear should be renewed.

Most gaskets and oil seals are preferably renewed. All cotter pins, lockwashers and locking wires must be renewed to avoid failure. All parts, especially plain ball and roller type bearings, gears, thrust washers, oil seals, splines, screw threads, etc., should be generously coated with oil. This will insure immediate lubrication of these parts and prevent seizure from first starting.

Always operate the unit slowly at first to allow lubricant to work its way to all parts.

Inspect gear teeth for brinelling, chipping and scoring. Small nicks in gears may be carefully honed out.

The bearing races and rollers should be checked for pitting and deep wear.

Inspect splines of pinion for signs of twisting.

Inspect threads on nuts and shafts for signs of stripping.

Inspect and check thrust washers for wear.

Inspect condition of oil seals.

Inspect and check power-divider differential cam surfaces for signs of scoring and wear.

Inspect and check the power-divider plunger working surfaces for wear.

SECTION 6: LUBRICATION

When re-assembling the unit be sure to generously coat all parts with oil, so that they will have immediate lubrication when first starting. No other lubrication is required during re-assembly. For other lubricating instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

Note: Before re-assembly, all parts should be thoroly cleaned with suitable solvent to remove all traces of dirt, and oil, and inspected carefully for cracks or worn surfaces. Parts showing excessive wear should be renewed. Most gaskets and oil seals are preferably renewed. All cotter pins, locking washers and locking wires must be renewed to avoid failure. All parts, especially plain bearings, ball and roller type bearings, gears, thrust washers, oil seals, splines, screw threads, etc., should be generously coated with oil. This will insure immediate lubrication of these parts and prevent seizure when first starting.

Always operate the unit slowly at first to allow lubricant to work its way to all parts.

Forward Unit of Axle Drive

The various sub-assemblies of gears, bearings and housings should be made first, checking bearing adjustments and locking nuts very carefully. The entire unit is re-assembled in the reverse manner of dis-assembly with a few minor exceptions which involve mainly the adjustments as noted in the following.

Bevel Pinion Bearing Adjustment

(See Figure 34)

Make sub-assembly of the following parts: bevel pinion (45), thru shaft (25), bevel pinion retainer (35), pinion bearings (41) and (47), bearing spacer (44), shims (43), bearing retainer spacer (40), forward drive flange (37) and drive flange nut (36). Install in press holding pinion between bed and ram of press.

(See Figure 35)

Make bearing adjustment while holding parts in position with press. No end-play at all should be allowed, nor should the adjustment be too tight. The drag should be ¾ to 1½ pound-feet when turned by hand. Wrap cord around 7½" diameter retainer pilot and attach scale to cord. Pull on scale should read from 2½ to 5 pounds to keep retainer turning.

If adjustment is required, add or remove shims in pack (43) as needed. Shims are furnished in thicknesses of .002, .005, .015, and .020. Recheck adjustment.

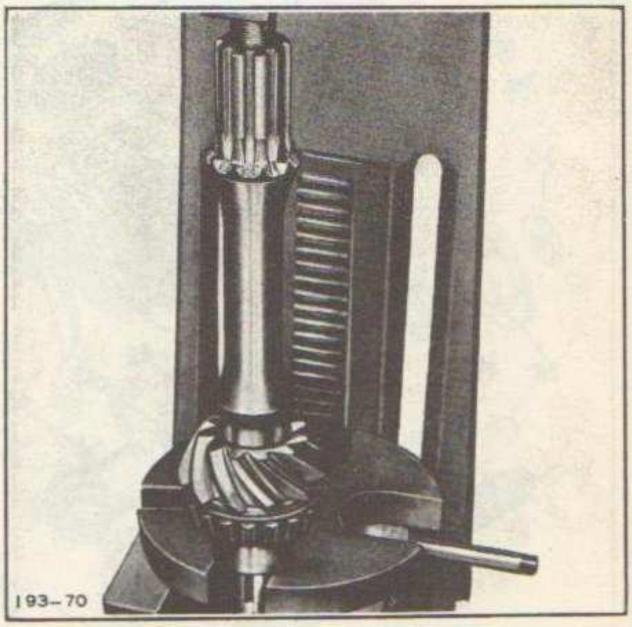

Fig. 34—Pressing Pinion and Bearing on Thru Shaft

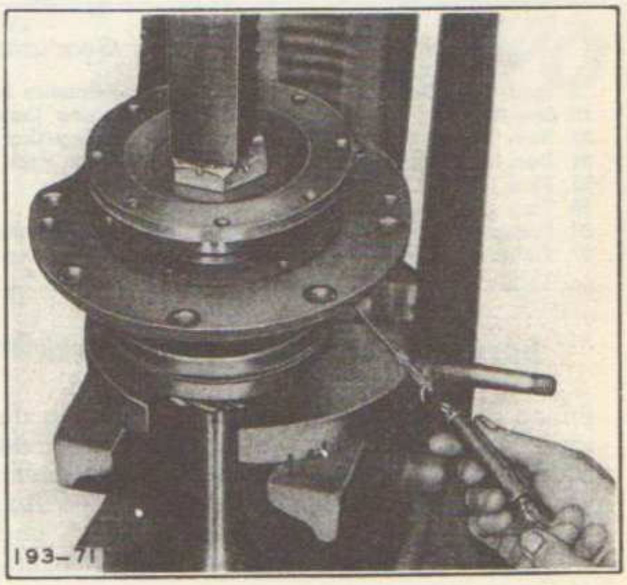

Fig. 35—Testing Bevel Pinion Bearing Adjustment

Install oil seal (64), cover gasket (39) and pinion retainer cover (38). Re-install forward drive flange (37) and then draw up forward flange nut (36) tight. Lock nut with new cotter.

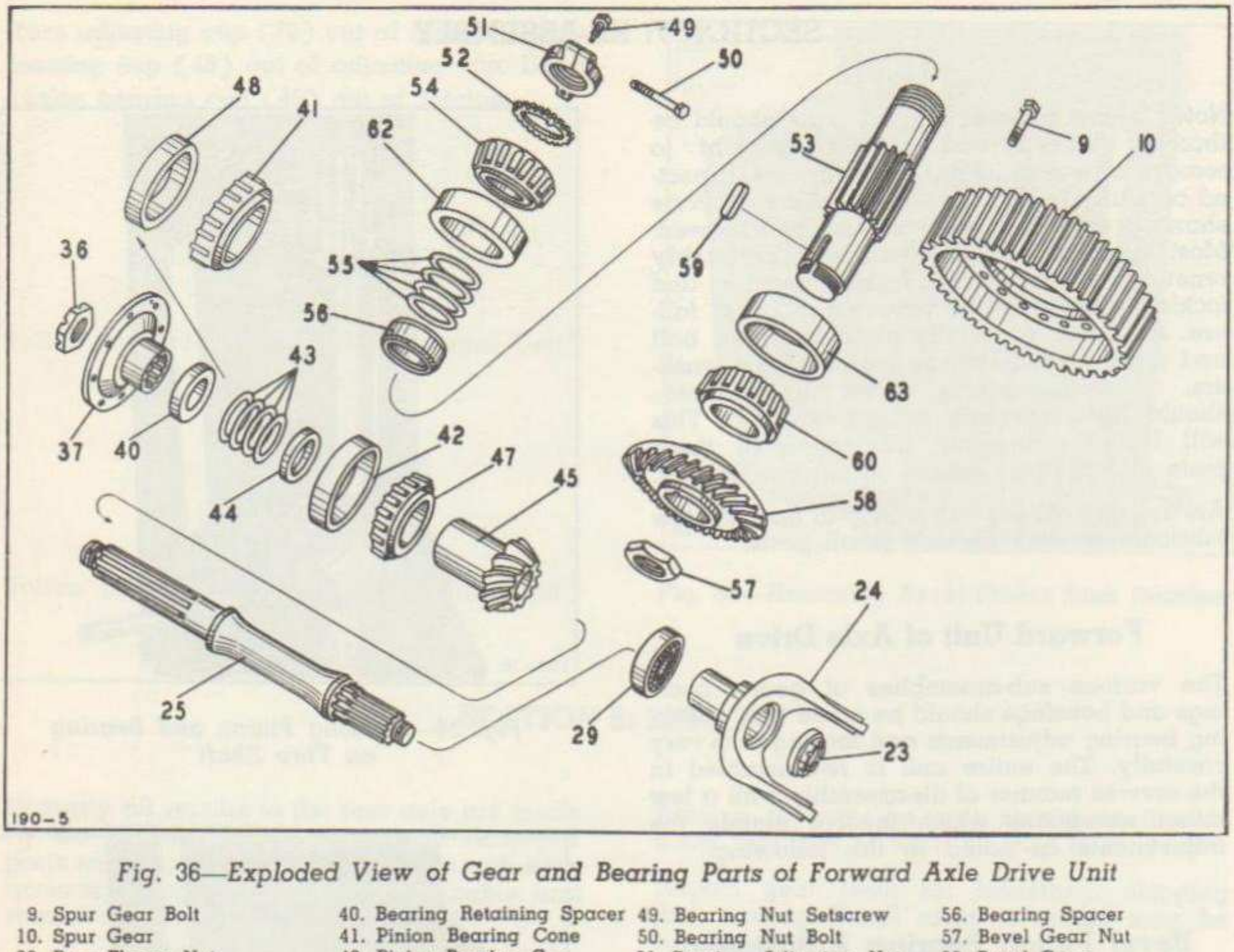

Fig. 36—Exploded View of Gear and Bearing Parts of Forward Axle Drive Unit

9. Spur Gear Bolt
10. Spur Gear
23. Rear Flange Nut
24. Rear Drive Flange Yoke
25. Thru Shaft
29. Thru Shaft Bearing
36. Forward Flange Nut
37. Forward Drive Flange
40. Bearing Retaining Spacer
41. Pinion Bearing Cone
42. Pinion Bearing Cup
43. Bearing Shim Pack
44. Bearing Spacer
45. Bevel Pinion
47. Pinion Bearing Cone
48. Pinion Bearing Cup
49. Bearing Nut Setscrew
50. Bearing Nut Bolt
51. Bearing Adjusting Nut
52. Bearing Nut Lockwasher
53. Spur Pinion Shaft
54. R.H. Bearing Cone
55. Bearing Shim Pack
56. Bearing Spacer
57. Bevel Gear Nut
58. Bevel Gear
59. Bevel Gear Key
60. L.H. Bearing Cone
62. R.H. Bearing Cup
63. L.H. Bearing Cup

Bevel Pinion Gear Adjustment

Pinion gear mesh adjustment or mounting distance in both axles is obtained in both axles by means of shims (6) located between pinion retainer (35) and carrier housing (5). Adding to or reducing thickness of the shim pack will obviously effect a change in the meshing of the gears.

(See Figure No's. 37 and 40)

Make sure all contacting surfaces are free of dirt and burrs, and set complete bevel pinion setting gage tool into carrier housing in place of spur pinion assembly with plugs (A) seating in bearing retainer bores as shown in the illustration.

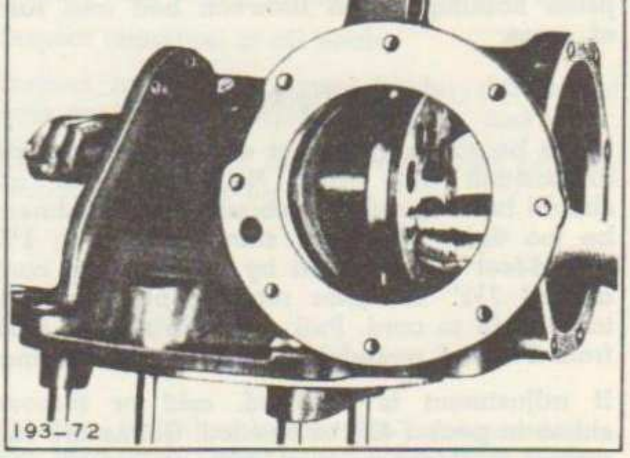

Fig. 37—Installing Bevel Pinion Setting Gage
(Tool—Mack Part No. 17-T-1508)

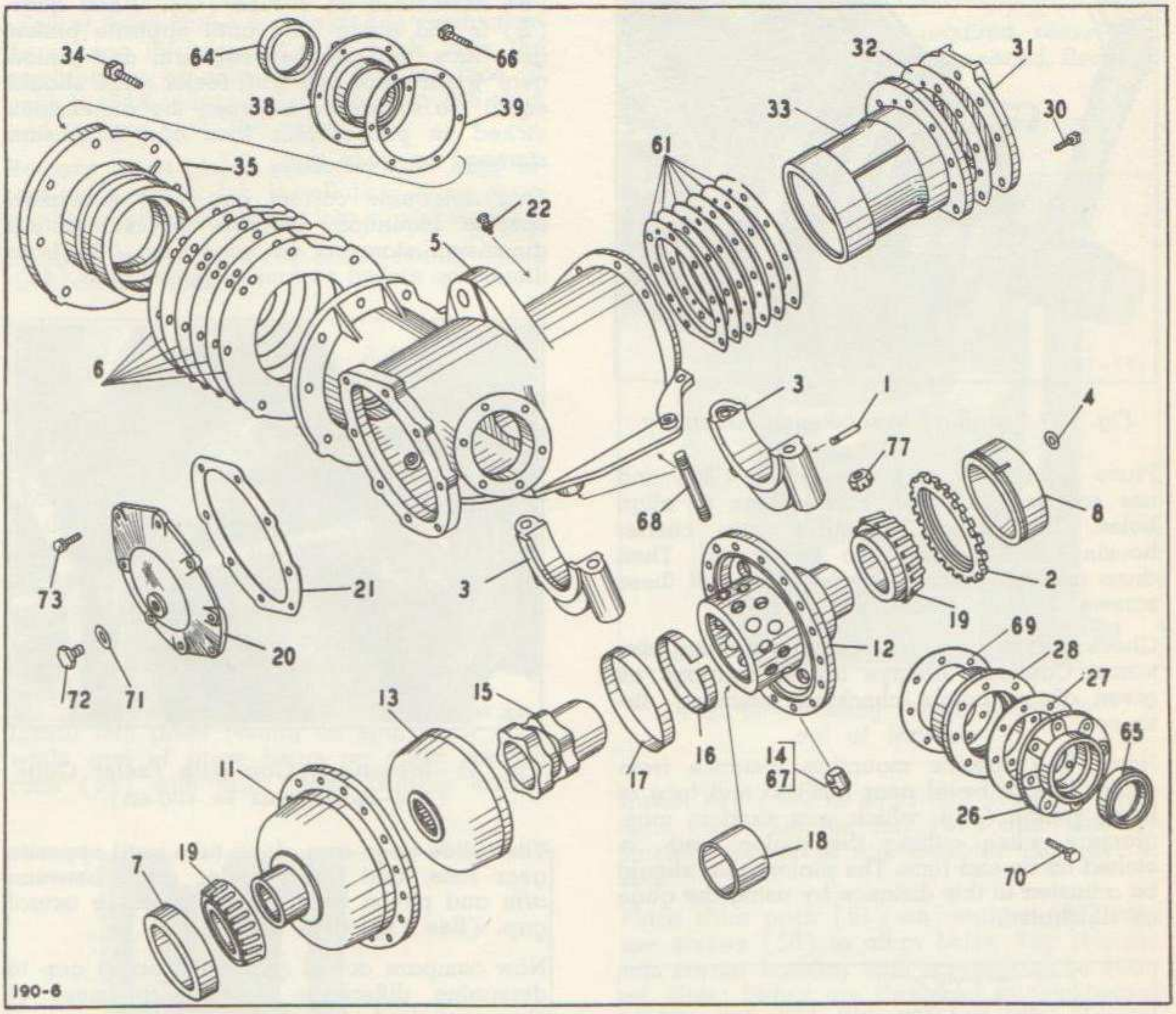

Fig. 38—Exploded View of Housing and Carrier Parts of Forward Axle Drive Unit

1. Adjusting Nut Lockpin
2. Adjusting Nut
3. Differential Bearing Caps
4. Bearing Cup Lockwasher
5. Carrier Housing
6. Retainer Shim Pack
7. Diff. Bearing L.H. Cup
8. Diff. Bearing R.H. Cup
11. Differential Casing
12. Differential Cage Assembly
13. Differential Outer Cam
14. Differential Plunger
15. Differential Inner Cam
16. Differential Inner Ring
17. Differential Outer Ring
18. Cam Bushing
19. Differential Bearing
20. Bevel Gear Compartment Cover
21. Cover Gasket
22. Housing Breather
26. Thru Shaft Cover
27. Cover Gasket
28. Thru Shaft Rear Retainer
30. Cover Capscrew
31. Spur Shaft Bearing Cover
32. Cover Gasket
33. Bearing Retainer
34. Bevel Pinion Retainer Screws
35. Bevel Pinion Retainer
38. Pinion Retainer Cover
39. Cover Gasket
61. Bearing Retainer Shim Pack
64. Oil Seal
65. Thru Shaft Oil Seal
66. Retainer Cover Capscrews
67. Differential Plunger
68. Bearing Cap Stud
69. Retainer Gasket
70. Thru Shaft Cover Capscrews
71. Filler Plug Gasket
72. Filler Plug
73. Bevel Gear Cover Capscrews
77. Bearing Cap Stud Nut

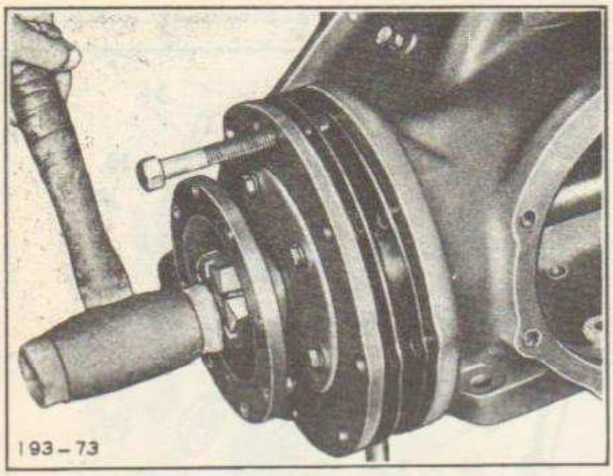

Fig. 39—Installing Bevel Pinion Assembly

Place shim pack (6) on retainer (35) and use screws (34) with lockwashers to align holes. Tap pinion assembly into carrier housing until screws can be started. Then draw assembly into place by means of these screws. Tighten screws securely.

Check pinion gear for correct mounting distance. Caution: Always adjust bearings as given above before checking mounting distance.

Note: The specific mounting distance from center line of bevel gear (58) to end face of bevel pinion (45), which was used in manufacture when cutting the pinion teeth, is etched on its end face. The pinion gear should be adjusted to this distance by using the gage as illustrated.

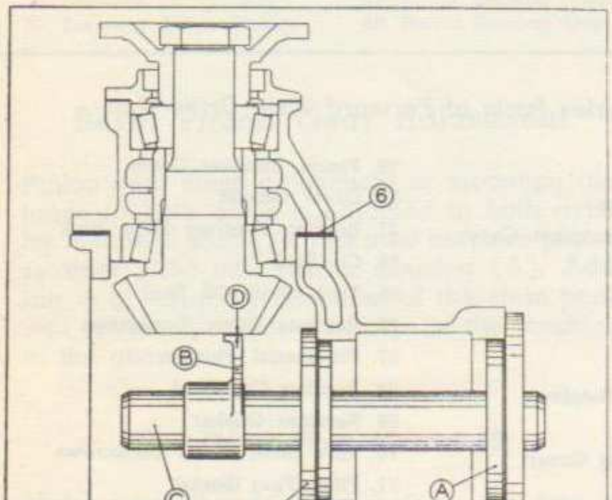

Fig. 40—Bevel Pinion Setting Gage in Position
(Tool—Mack Part No. 17-T-1508)

It consists of two plugs (A) and a gage arm (B) assembled on a tube (C). When gage (B) is slid along tube until opposite pinion gear face, the gap between arm and pinion gear when measured with feeler gage should equal the difference between the dimensions etched on pinion gear face and dimension stamped on gage arm.

First determine correct gap (D) to obtain specific mounting distance, by subtracting dimension stamped on gage arm (B) from dimension etched on face of pinion gear (45).

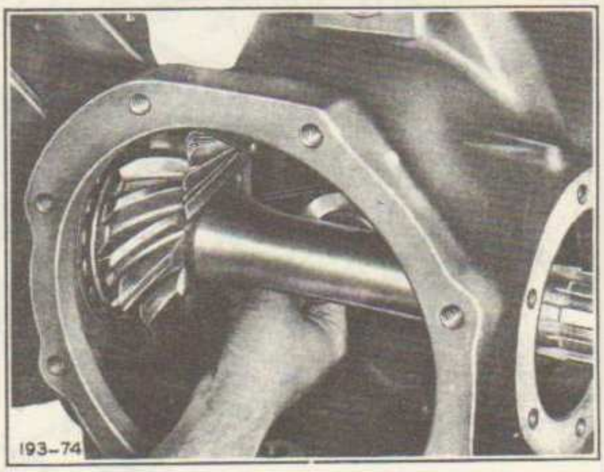

Fig. 41—Measuring Gap with Feeler Gage
(Tool—Federal Stock No. 41-G-400)

Then slide gage arm along tube until opposite gear face, and insert feeler gage between arm and pinion gear face to measure actual gap. (See Fig. 40 & 41.)

Now compare actual gap with correct gap to determine difference in total thickness of shims required at pack (6). Example:

(Forward Unit only)

Dimension etched on gear face	3.467
Dimension stamped on gage arm	3.448
Correct gap	.019
Actual gap (as measured by feeler)	.011
Required change in thickness of pack (6)	.008

In this case, the total thickness of shims at pack (6) should be increased by .008. When actual gap is greater than correct gap, then pack (6) should be decreased. Example:

Correct gap	.019
Actual gap (as measured by feeler)	.020
Required change in thickness of pack (6)	.001

Shims are furnished in thicknesses of .003, .005, .008, .016, .031 and .062. Usually one each of these shims is provided in production. To change thickness of shim pack, vary the combination of shim sizes. For instance, if pack is to be reduced .003, remove a .008 shim and replace with .005 shim, etc.

Remove bevel pinion assembly and keep intact with shims for installation after re-assembly of spur pinion unit into carrier housing.

Remove complete bevel-pinion-setting gage from carrier housing.

Spur Pinion Bearing Adjustment

Press bearing cone (60) on shaft (53).

Place bearing spacer (56) on shaft with inner chamfer against gear teeth. Follow with shims (55) having at least .015" thickness of shims at this setting. Shims are furnished in thicknesses of .005, .008, .010 and .031".

Press bearing cups (62) and (63) into retainer (33). Position retainer assembly over spur pinion shaft locating on cone (60). Tap cone (54) into position and seat bearings by tapping retainer flange with soft hammer.

Install into press resting on spur shaft (53) while ram of press bears on outer bearing cone (54) with drift. Make bearing adjustment. No end-play at all should be allowed nor should the adjustment be too tight. The drag should be from ¾ to 1 pound-foot when turned by hand. Wrap cord around retainer 7" diameter pilot. Attach scale to cord. The pull on scale should range between 2½ and 3½ pounds to keep retainer turning.

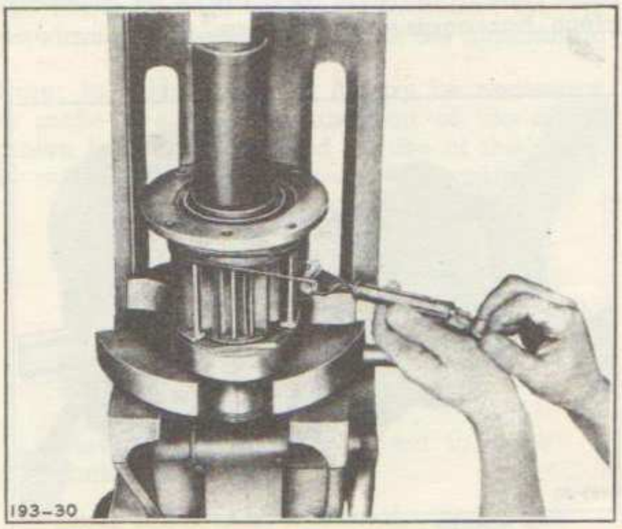

Fig. 42—Checking Spur Pinion Bearing Adjustment

If bearing adjustment is required, remove or install shims in pack (55) as needed. Recheck adjustment.

Separate pinion and retainer assemblies.

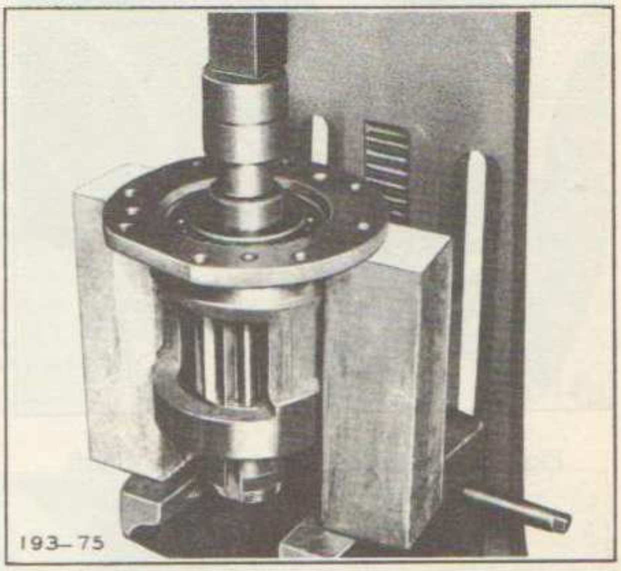

Fig. 43—Pressing Pinion Assembly out of Retainer

Install key (59) in shaft and press on bevel gear (58). Tighten nut (57) and lock by staking portion of nut shoulder into slot in shaft.

Place shim pack (61) on retainer (33) and use screws (30) to align holes. Tap retainer into carrier housing until screws can be started. Note: Shims are furnished in thicknesses of .003, .005, .008, .016, .031 and .062". Usually one each of these shims are provided.

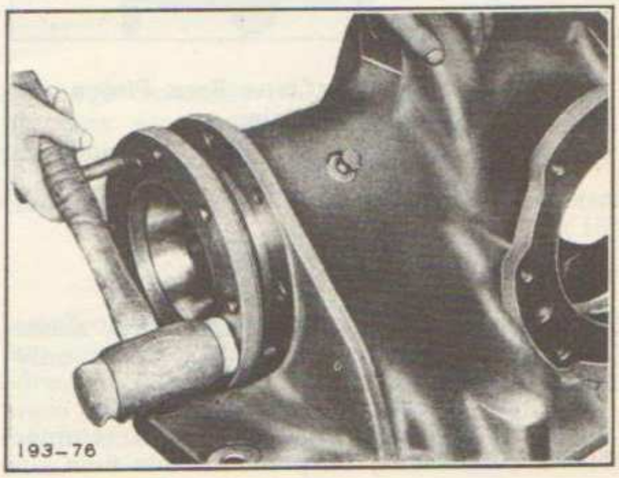

Fig. 44—Installing Retainer in Housing

Install spur pinion shaft and bevel gear assembly thru bevel gear compartment.

Fig. 45—Installing Spur Pinion Shaft and Bevel Gear Assembly

Back up bevel gear end of pinion shaft and tap bearing cone (54) into place.

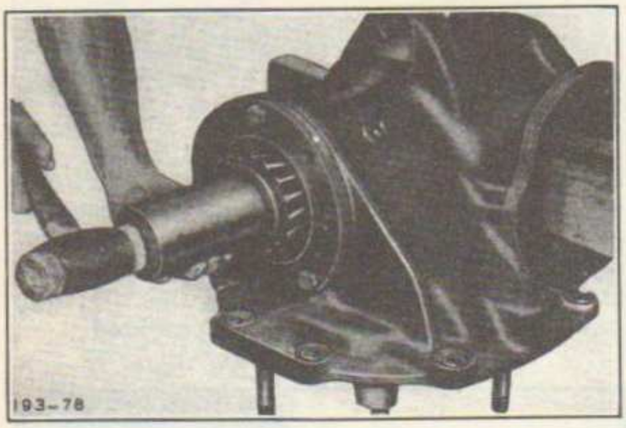

Fig. 46—Installing Outer Spur Pinion Shaft Bearing

Install locking washer (52) and tighten nut (51).

(See Figure 47)

Re-install bevel pinion assembly with shims (6) intact. Tighten screws (34), using only two at this time.

Complete tightening of spur pinion retainer screws (30), using only two at this time.

Fig. 47—Installing Bevel Pinion Assembly

Bevel Gear Mesh Adjustment

Adjust meshing of bevel gear with bevel pinion. The correct amount of back-lash is etched on the bevel gear, and usually ranges from .006 to .012. To measure back-lash, use feeler gage between the teeth of the two gears, or preferably mount a dial indicator so that the anvil rests against a tooth of the bevel gear, at the pitch line.

Adjust by means of shims (61).

Check setting for proper tooth contact. Paint bevel gear teeth with red lead or prussian blue. Turn bevel pinion in same direction as when driving forward in chassis, and at the same time apply load as a brake by pressing pinch bar against bevel gear.

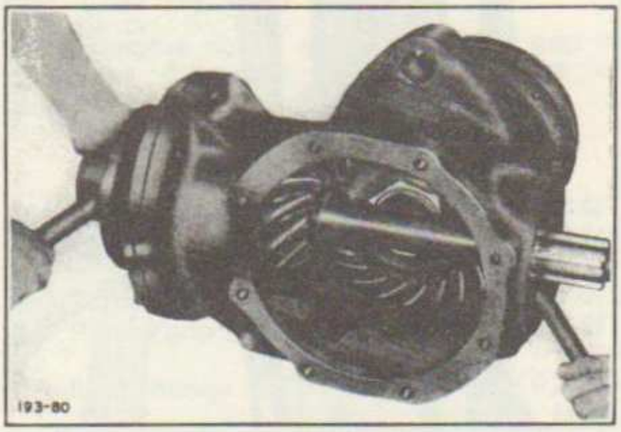

Fig. 48—Applying Pressure to Bevel Gears

The greater the pressure exerted on this beam, the larger will become the gear contact area, which will show as an imprint on the paint surface. Enough pressure should be applied to obtain a distinct imprint.

The imprint should start near the toe and extend about 60 percent of tooth length toward the heel, as shown by Figure 49.

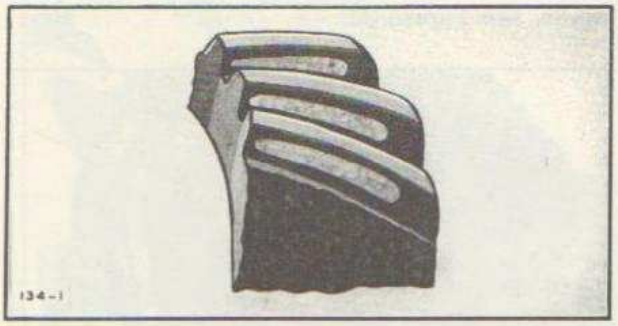
134-1

Fig. 49—Proper Gear Tooth Contact

It should be noted that the contact area must show nearer to the toe or small end of the tooth than to the heel or large end. This allows for the deflection which occurs when driving under load, thereby causing the contact to move out toward the heel.

The contact area or imprint should not be less than 60 percent of the tooth length and should not be nearer than 1/8" to the toe end. Neither should the contact be at the bottom nor top edge of the tooth. Tooth failure will result if the gears are not set so as to obtain the approximate impression shown in the illustration.

Note: In some instances it may be necessary to make a slight re-adjustment of the bevel pinion from that obtained by use of the gage, in order to get the proper tooth contact.

The Four Steps Used When Adjusting Spiral Gears Are:

Move pinion in toward gear to lower contact area.

Move pinion out from gear to raise contact area.

Move bevel gear away from pinion to lengthen contact from toe toward heel.

Move bevel gear in toward pinion to lengthen contact from heel toward toe.

Be sure that all bearings and retainers are home, and that they are tightly locked with the means provided.

After final tooth adjustment is made, remove bevel pinion assembly out of housing. Also, loosen spur shaft nut (51) about a turn so that while the differential bearing adjustment is being made, little if any of the drag of the spur shaft with which the bull gear mates, will enter into the differential bearing reading.

Differential

Note: The power-divider parts are first trial-assembled dry (without lubricant) and tested for smooth operation.

Press bearing cone (19) on cage assembly (12) and install bushing (18) if previously removed.


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Fig. 50—Installing Outer Ring

Set cage assembly (12) on end, insert three plungers equally spaced in bottom row to position outer ring (17) as it is driven on.

(See Figure 51)

Install all plungers (14) and (67) from inside into operating holes with mark "out" facing outwardly. Push all plungers outward, compress and locate inner ring (16). Move plungers in and out, replace for looser fit if any stick.

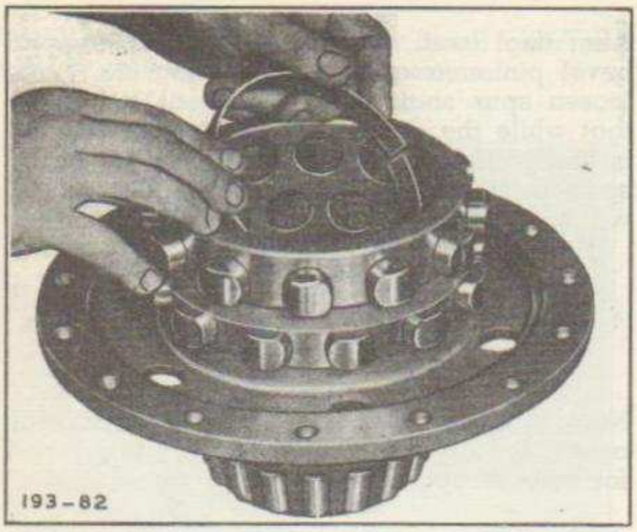


Fig. 51—Installing Inner Ring

Push plungers outward. Insert inner cam (15) into operating position. Push plungers inward. Drop outer cam (13) over plungers.

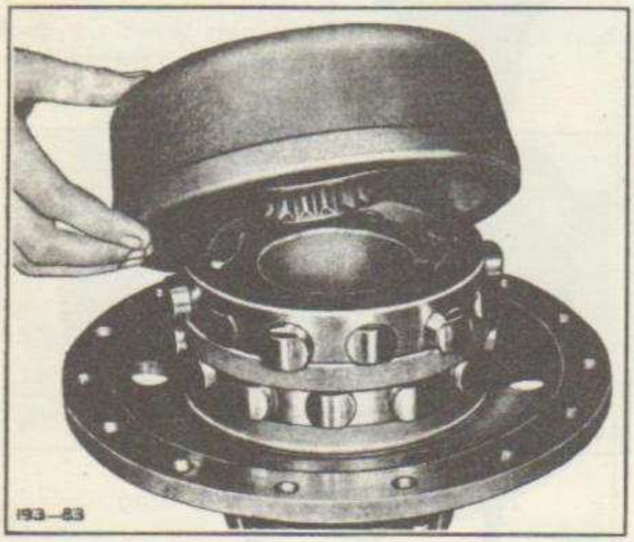


Fig. 52—Installing Outer Cam

Hold cage assembly (12) firmly with aid of axle shaft if possible, then rotate outer cam (13) back and forth with both hands to see if cams and plungers move freely but snugly. If not, select another outer or inner cam which will give the desired action.

Take assembly apart, oil all parts generously and re-assemble. Locate spur gear (10) on casing (11), making sure that punch-marks on casings line up with noted position of gear. Install bolts (9) with nuts against gear flange. Tighten nuts and lock with new cotter pins

Screw adjusting nut (2) on bearing cup (8) a few threads, and locate bearing cups (7) and (8) on cones (19), making sure to have casing (11) and cup (7) on bevel gear compartment side.

Drop differential assembly into carrier pedestals, see Figure 23.

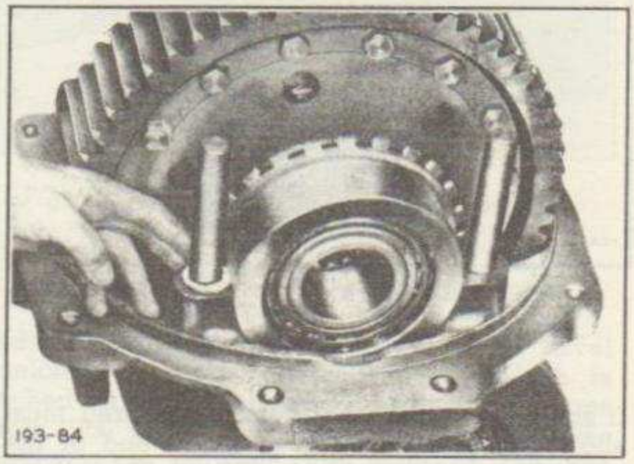


Fig. 53—Positioning Bearing Cup Lockwasher

Locate cup lock (4). Install pedestal caps (3). Set nuts (68) up snug, but not tight.

Adjust differential bearings. Attach spring scale to bracket held on spur gear (10), so that scale pulls at a distance of one foot from center of differential. The bearing drag should register as a 7 to 8 pound pull on the scale to keep differential and parts turning while meshing with loose spur pinion.

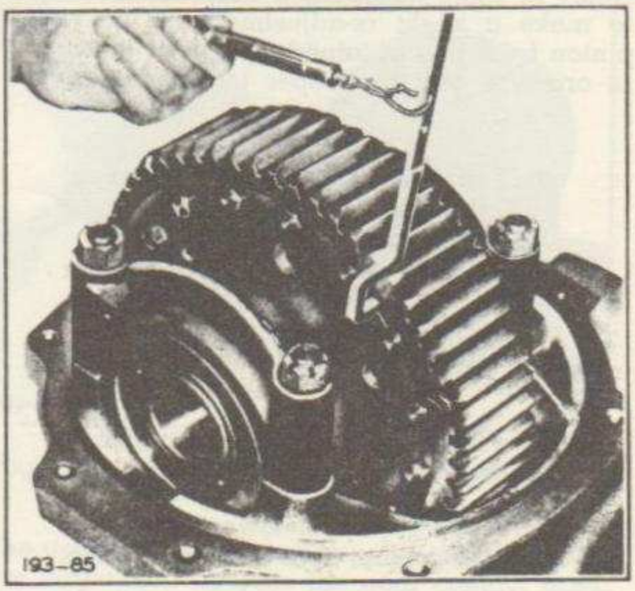


Fig. 54—Checking Differential Bearing Adjustment
(Tool—Mack Part No. 17-T-1507)

To adjust new bearings, tighten or loosen adjusting nut (2) to suit, tapping caps or spur gear to "settle" parts.

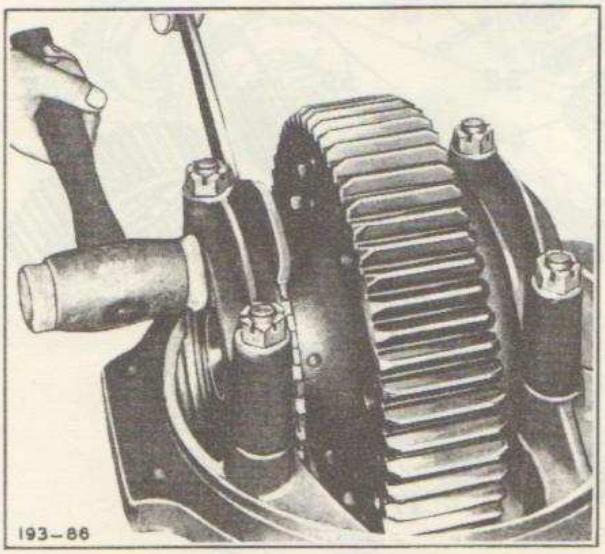


Fig. 55—*Adjusting Differential Bearings*
(Tool—Mack Part No. 17-T-1509)

Tighten and lock pedestal cap nuts. Install lockpin (1) with cotter. Align tapped hole of spur shaft nut (51) with a slot of locking

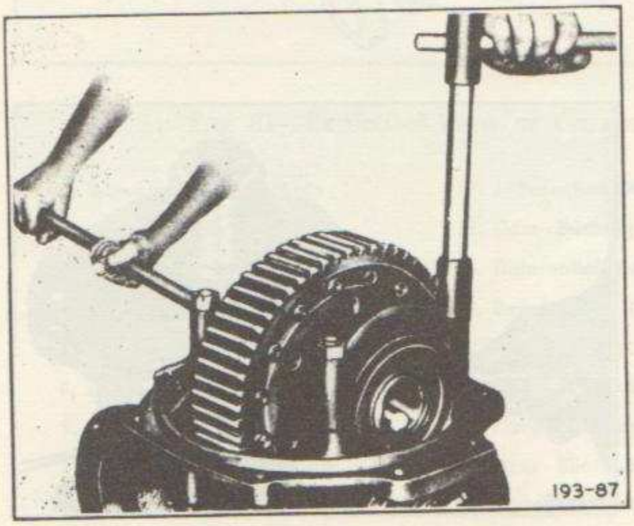


Fig. 56—*Tightening Differential Caps*

washer (52) and install screw (49). Assemble clamp bolt (50) and tighten nut. Lock screw (49) and nut at (50) with new wire.

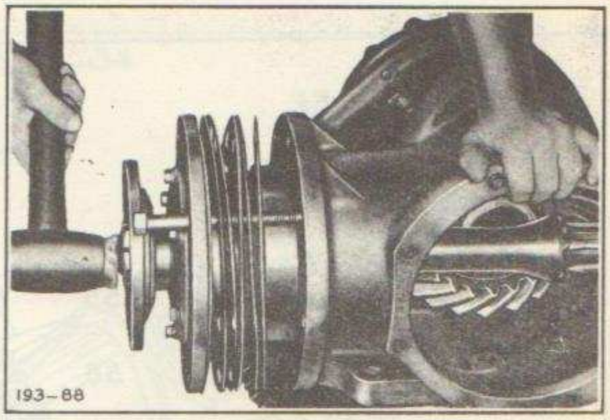


Fig. 57—*Re-installing Bevel Pinion Assembly*

(See Figure 57)

Re-install bevel pinion assembly.

Tap thru shaft rear bearing retainer (28) into case. Drive in bearing. Add cover (26).

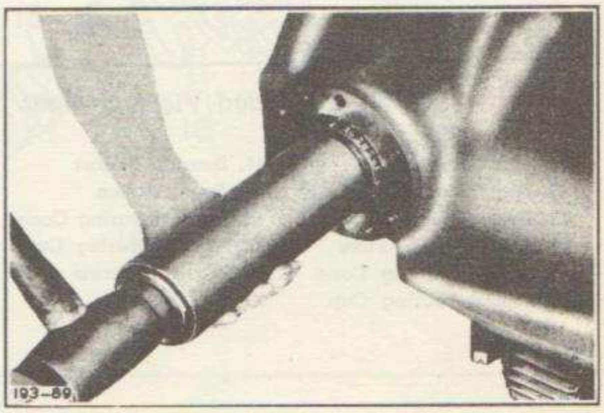


Fig. 58—*Installing Thru Shaft Rear Bearing*

Drive drive yoke (24) into position. Turn on yoke nut (23) tightly. Lock with new cotter pin.

Add remaining covers.

Rear Unit of Axle Drive

Bevel Pinion Bearing Adjustment

Tap cup (42) into retainer (35). Tap cup (48) into adjusting nut (76). Press cone (47) on pinion (45). Install retainer over pinion, add spacer (44). Screw adjusting cup (76) into retainer full depth of thread. Install into press, press bearing cone (41) on pinion shaft against spacer. At this stage, cone (41) and cup (48) should be in loose engagement.

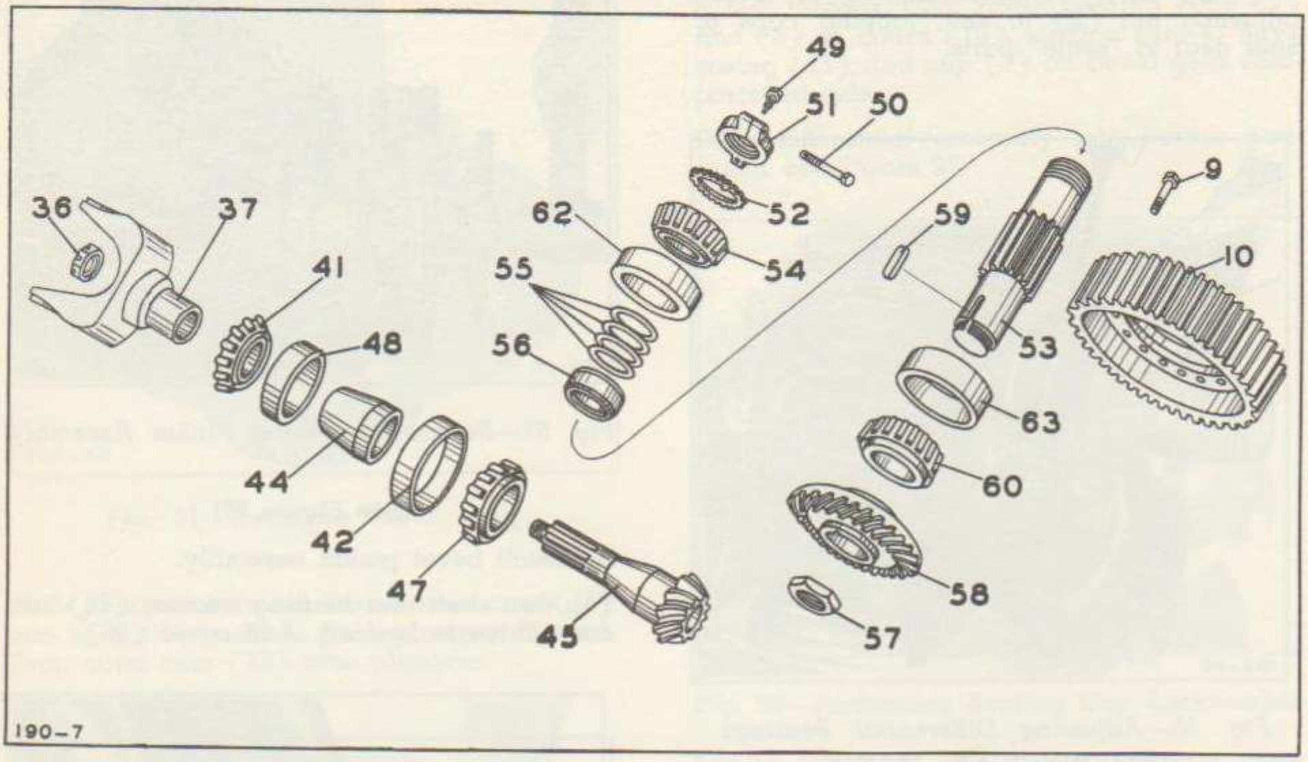


Fig. 59—Exploded View of Gear and Bearing Parts of Rear Axle Drive Unit

9. Spur Gear Bolt
10. Spur Gear
36. Drive Flange Nut
37. Drive Flange Yoke
41. Pinion Bearing Cone
42. Pinion Bearing Cup
44. Bearing Spacer
45. Bevel Pinion
47. Pinion Bearing Cone
48. Pinion Bearing Cup
49. Brg. Nut Screw
50. Brg. Nut Bolt
51. Bearing Adjustment Nut
52. Bearing Nut Lockwasher
53. Spur Pinion Shaft
54. R.H. Bearing Cone
55. Bearing Shim Pack
56. Bearing Spacer
57. Bevel Gear Nut
58. Bevel Gear
59. Bevel Gear Key
60. L.H. Bearing Cone
62. R.H. Bearing Cup
63. L.H. Bearing Cup

Locate drive yoke (37) or suitable sleeve, then draw up nut (36) tight.

(See Figure 60)

Hold pinion by teeth in soft jaws of vise. Adjust bevel pinion bearings by turning adjusting nut (76) in or out so that no end-play at all exists, nor should the adjustment be too tight. The drag should be from ¾ to 1½ pound-feet when turned by hand. Wrap a cord around 8½" diameter pilot of retainer. Attach scale to cord. Pull on scale should range between 2 and 4 pounds to keep retainer turning.

When adjustment is obtained, align nearest notch of adjusting nut with lock (75).

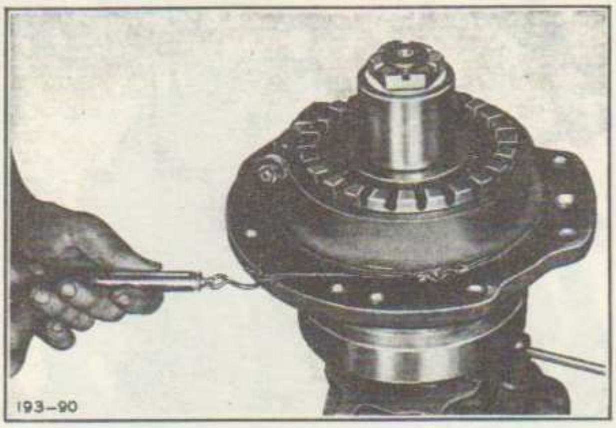


Fig. 60—Testing Bevel Pinion Bearing Adjustment

Insert lock (75) and bolt (74). Tighten nut and install new cotter pin.

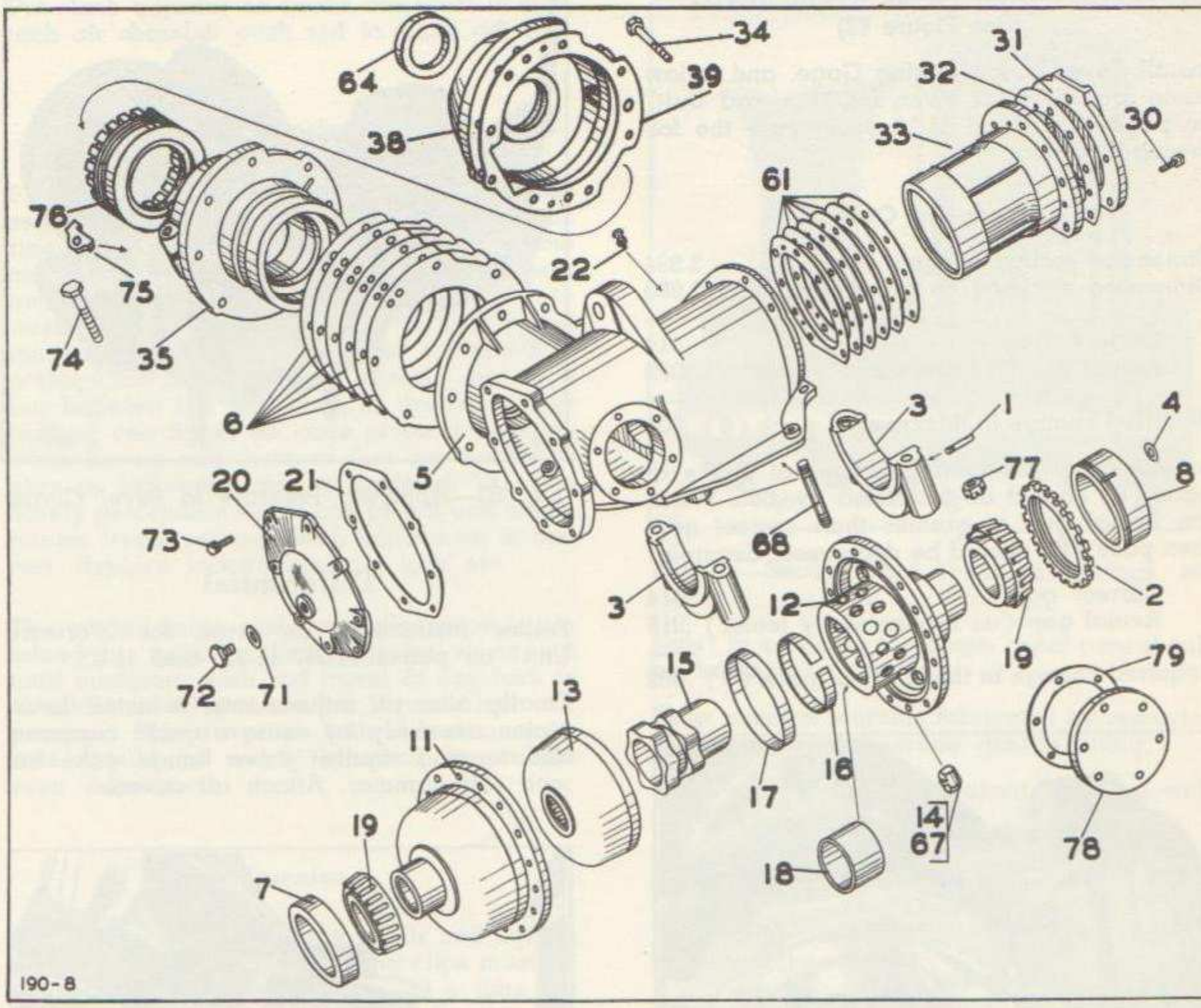


Fig. 61—Exploded View of Carrier and Housing Parts of Axle Drive Unit

1. Adjusting Nut Lockpin
2. Adjusting Nut
3. Differential Bearing Caps
4. Bearing Cup Lockwasher
5. Carrier Housing
6. Retainer Shim Pack
7. Diff. Bearing L.H. Cup
8. Diff. Bearing R.H. Cup
11. Differential Casing
12. Differential Cage Assembly
13. Differential Outer Cam
14. Differential Plunger
15. Differential Inner Cam
16. Differential Inner Ring
17. Differential Outer Ring
18. Cam Bushing
19. Differential Bearing
20. Bevel Gear Compartment Cover
21. Cover Gasket
22. Housing Breather
30. Cover Capscrew
31. Spur Shaft Bearing Cover
32. Cover Gasket
33. Bearing Retainer
34. Bevel Pinion Retainer Screws
35. Bevel Pinion Retainer
38. Pinion Retainer Cover
39. Cover Gasket
61. Bearing Retainer Shim Pack
64. Oil Seal
67. Differential Plunger
68. Bearing Cap Stud
71. Filler Plug Gasket
72. Filler Plug
73. Bevel Gear Cover Capscrew
74. Bearing Lock Bolt
75. Front Bearing Lock
76. Bearing Adjusting Cup
77. Bearing Cap Stud Nut.
78. Bevel Gear Compartment Cover
79. Cover Gasket

Bevel Pinion Gear Adjustment

(See Figure 62)

Install Bevel Pinion Setting Gage, and follow same procedure as given for "Forward Unit" on pages 11-16 and 11-18 except use the following figures:

(Rear Unit Only)

Dimension etched on gear face	2.994
Dimension stamped on gage arm	2.980
Correct Gap	.014
Actual gap (as measured by feeler)	.009
Required change in thickness of pack (6)	.005

In this case, the total thickness of shims at pack (6) should be increased by .005. When the actual gap is greater than correct gap, then pack (6) should be decreased. Example:

Correct gap	.014
Actual gap (as measured by feeler)	.016
Required change in thickness of pack (6)	.002

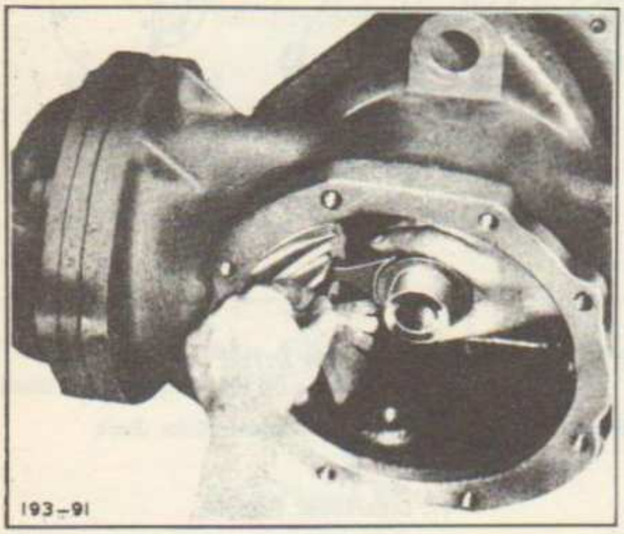


Fig. 62—Measuring Bevel Pinion Gear Setting
(Tools—Mack Part No. 17-T-1508 and Federal Stock No. 41-G-400)

Spur Pinion Shaft

Follow instructions as given for "Forward Unit" on pages 11-19 and 11-20.

Bevel Gear Mesh Adjustment

(See Figure 63)

Follow same instructions as given for the "Forward Unit" on pages 11-20 and 11-21.

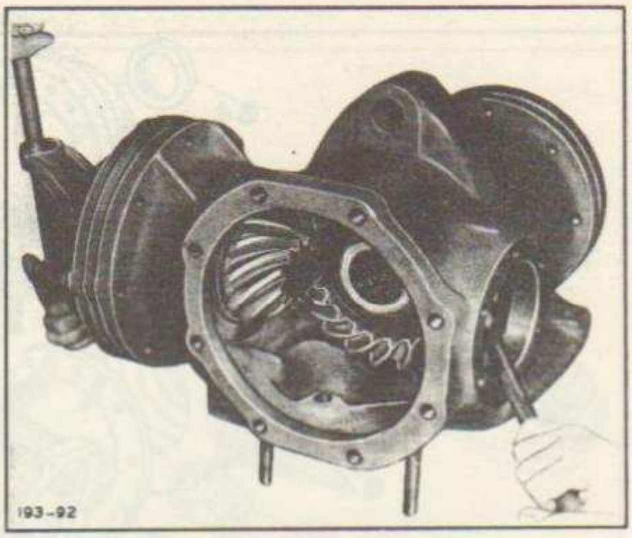


Fig. 63—Applying Pressure to Bevel Gears

Differential

Follow instructions as given for "Forward Unit" on pages 11-21, 11-22, and 11-23.

Finally after all adjustments, re-install bevel pinion assembly by using a guide capscrew and tapping against drive flange yoke nut with soft hammer. Attach all covers.

Fig. 64—Re-installing Bevel Pinion Assembly

Re-assembly of Dual Rear Axles

Brake Shoes

To replace brake shoes in simplest way, first slide cam in place, then put upper brake shoe in position and drive anchor pin home, attach tension spring to both brake shoes, move lower shoe into place and insert second lower shoe into place and insert second anchor pin. Slide anchor pin lock plate in grooves in pins and tighten lock nut.

Put slack adjuster on brake camshaft and attach air chamber push rod to slack adjuster.

Wheels

Press bearing cone, washer, leather grease seal and oil slinger in wheel. Replace lock ring and slide wheel on. Replace inner nut and adjust wheel bearings. Spin wheel slowly and turn up bearing adjusting nut with wrench, Mack Part No. 17-T-275, until wheel binds slightly. Then back nut off 1/8 to 1/6 of a turn. Test adjustment by placing end of a bar between tire and floor, at the same time holding one finger on cage of outer bearing. Work bar up and down so that any excessive play or looseness can be detected. When a barely perceptible shake can be felt and wheel rotates freely without drag, adjustment is correct. Replace lockwasher and lock nut.

The proper lining and drum clearance is obtained by rotating slack adjuster worm nut until minimum push rod travel of one inch is obtained at 60 pounds per square inch air pressure. The travel at both sides on same axle should be nearly identical to provide even adjustment.

Trunnion

Place springs on trunnion journals and tighten spring clips. The nuts on spring clips must be tightened evenly and a little at a time, so that the trunnion journal casting will not spring and cause its bushing to bind on trunnion tube. The spring clip nuts should be tightened as stated in "Group 16: Springs".

To assemble trunnion, first place trunnion tube on a stand or on horses, then put leather grease seal in place on collar at trunnion tube clamp, place steel washer on pin extending from collar and place brass washer on pin in trunnion journal. Put some oil or grease on washers so that they will stick against collar and trunnion and not slip off pins when trunnion is slid on tube. Back up grease seal so that it will be forced into recess in journal when it is slid into place, which is the next step. Put washers in place on outside end of trunnion, first the steel and then the brass one. Tighten circular adjusting nut (5) until it is tight, then back it off 1/6 turn. Replace lock washer, lock nut, gasket and hub cap. (See Fig. 65).

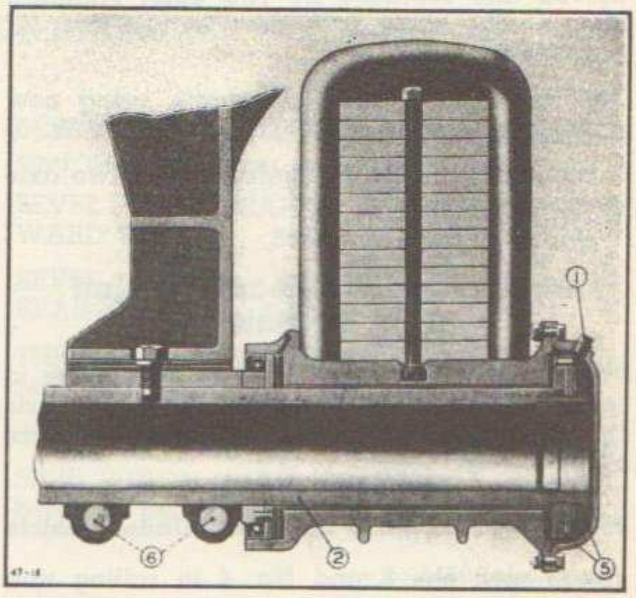


Fig. 65—Section Thru Trunnion, Springs, etc.

Note: In servicing the bogie, great care should be taken to:

Keep trunnion journals lubricated by removing plugs (1) and inserting grease fitting.

Keep wear of trunnion journal bushings within .025.

Keep trunnion journal adjusted by nut (5) to prevent end-play.

Keep bolts (6) tight to clamp saddles on trunnion tube.

Keep torque rod ball studs and torque rod bracket bolts tight.

Keep spring seat clamps and spring clips tight.

Axle Units

Set both forward and rear units down on tires and roll to springs. Place upper rubber blocks on forward ends of springs and insert blocks in housings on axles.

Jack up ends of spring by placing jacks near ends so that upper rubbers will be forced into housings and have clearance for lower rubber blocks and caps to be assembled. When assembling caps to housings, it may be necessary to use two extra-long cap screws on each cap as pilots to bring them close enough to housing for standard-length screws to reach the threads. After two standard screws are tight, the long screws are to be removed and replaced by two other standard screws. The same procedure is followed for rear axle.

Replace carriers and axle shafts, using new gaskets shellaced to housing and wheels.

Install center propeller shaft between two axle carriers.

Installing Dual Rear Axle Unit In Chassis

Four men may be employed to advantage to install the dual rear axle unit in the chassis in short time. The duties of each man are listed below.

Man No. 1 and No. 2 Working Under Vehicle

Assist men No. 3 and No. 4 in rolling unit under chassis.

Working together, guide left hand trunnion bracket bolts thru saddles on trunnion tube and then attach and tighten both left hand and right hand trunnion bracket bolts.

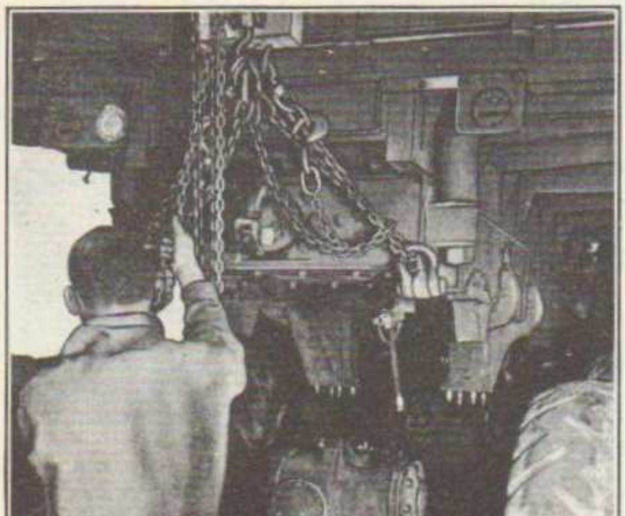


Fig. 66—Lowering Chassis

Man No. 3

Assist Men No. 1, No. 2 and No. 4 in rolling unit under chassis.

Lower chassis and remove chain sling.

Connect air line at "Y" connection at forward axle unit.

Connect front torque rod ball socket cap.

Connect propeller shaft at forward axle unit.

Man No. 4

Assist Men No. 1, No. 2, and No. 3 in rolling unit under chassis.

Guide right hand trunnion bracket bolts thru saddles on trunnion tube during lowering of chassis by Man No. 3.

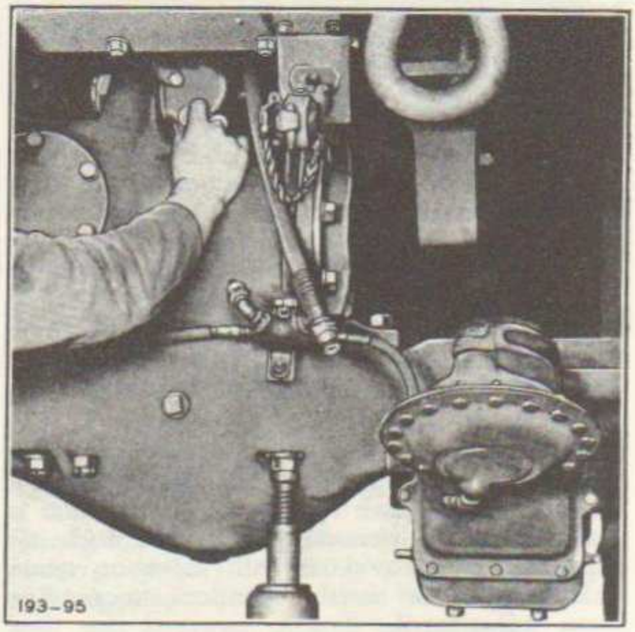


Fig. 67—Installing Rear Torque Rod Ball Socket Cap

Place jack under rear unit to align rear torque rod ball socket cap, and then connect.

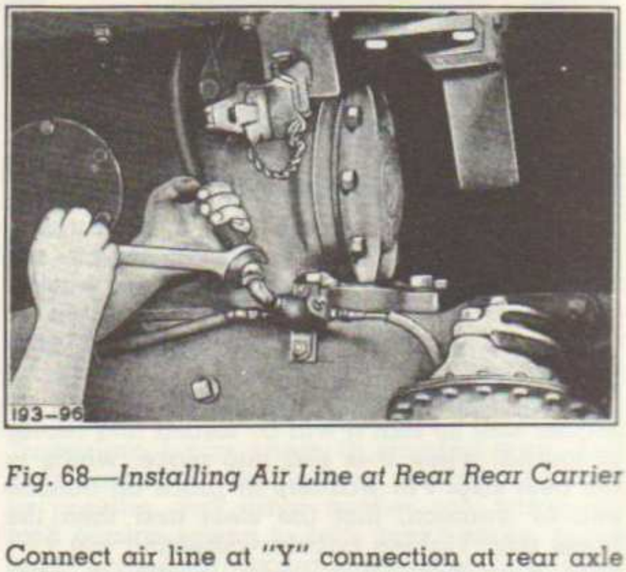


Fig. 68—Installing Air Line at Rear Rear Carrier

Connect air line at "Y" connection at rear axle unit.

Install splash aprons, both left and right hand.

SECTION 8: SPECIFICATIONS

MAKE .... Mack

MODEL, FORWARD UNIT CR-38

REAR UNIT CR-39

DRIVE .... Double Reduction

GEARING .... Spiral-bevel and spur

RATIO .... 9.02 to 1

Dimensions, Clearances, etc.

DIFFERENTIAL CASING RUN-OUT .... Not over .002

DIFFERENTIAL DRIVING CAGE BUSHING REAM DIAMETER 3.500-3.498

DIFFERENTIAL INNER (MALE) CAM AND DRIVING CAGE BUSHING CLEARANCE .007-.010

DIFFERENTIAL PLUNGERS AND DRIVING CAGE CLEARANCE .... .0015-.0035

DIAMETER ACROSS WORKING SURFACES OF INNER (MALE) CAM (MEASURED ON OPPOSITE SURFACES OF TWO LOBES, SEPARATED BY A THIRD LOBE) 4.7283-4.7273

DIAMETER ACROSS WORKING SURFACES OF OUTER (FEMALE) CAM (MEASURED ON OPPOSITE SURFACES OF TWO RECESSES SEPARATED BY A THIRD RECESS) 7.105-7.102

DIAMETER ACROSS WORKING SURFACES OF PLUNGERS (MEASURED DIAGONALLY ACROSS PLUNGER ENDS, TOUCHING CONVEX CURVATURE ON ONE END AND CONCAVE CURVATURE ON THE OTHER END) 1.184-1.182

TRUNNION BUSHING REAM 3.999-4.001

TRUNNION SHAFT BUSHING CLEARANCE Not over .025

TRUNNION JOURNAL ENDS .... Adjust for no end play

TORQUE RODS, FRONT AND REAR Fixed length

AXLE SHAFT DIAMETER AT DIFFERENTIAL END 2.622-2.628

AXLE SHAFT SPLINES .... 17 (involute)

AXLE SHAFT RUN-OUT .... Not over .015

BEVEL PINION ADJUSTMENT .... Shims under bevel pinion retainer.

BEVEL GEAR ADJUSTMENT .... Shims under spur pinion retainer.

BEVEL PINION BEARING ADJUSTMENT, FORWARD UNIT .... Shims between bearings

BEVEL PINION BEARING ADJUSTMENT, REAR UNIT .... Adjusting Cup

THRU SHAFT BEARINGS .... No adjustment required

DIFFERENTIAL BEARINGS .... Adjusting nut

SPUR PINION SHAFT BEARINGS .... Shims between bearings.

Bearings

BEVEL PINION, FORWARD UNIT:

OUTER CONE .... Timken 659

OUTER CUP .... Timken 652

INNER CONE .... Timken 659

INNER CUP .... Timken 652

BEVEL PINION, REAR UNIT:

OUTER CONE .... Timken 635

OUTER CUP .... Timken 632

INNER CONE .... Timken 757

INNER CUP .... Timken 752

THRU SHAFT, FORWARD UNIT .... Hyatt BU-1212Z, SKF NL-60, or SKF N-212

SPUR PINION, BOTH UNITS:

LEFT CONE .... Timken 762

LEFT CUP .... Timken 752

RIGHT CONE .... Timken 745A

RIGHT CUP .... Timken 742

DIFFERENTIAL, BOTH UNITS:

LEFT CONE .... Timken 766

LEFT CUP .... Timken 752

RIGHT CONE .... Timken 766

RIGHT CUP .... Timken 754W

Road Speeds

Axle Ratio—9.02 Tires 12.00-24 Engine Governed Speed—2100 R.P.M.

Fast Ratio

Gear	Trans. Ratio	Total Ratio	M.P.H.
1st	8.05	72.60	3.9
2nd	4.57	41.22	6.9
3rd	2.61	23.54	12.1
4th	1.45	13.08	21.8
5th	1.00	9.02	31.6
Rev.	8.13	73.33	3.8

Slow Ratio

Gear	Trans. Ratio	Total Ratio	M.P.H.
1st	20.13	181.57	1.6
2nd	11.42	103.00	2.8
3rd	6.53	60.90	4.8
4th	3.63	32.74	8.6
5th	2.50	22.90	12.6
Rev.	20.30	183.10	1.5

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
*41-G-400	Gage, Feeler		
17-T-1507	Bar, Differential Pre-load Scale	$ 1.50	Mack Mfg. Corp.
17-T-275	Wrench, Wheel Bearing Adjusting	7.90	Mack Mfg. Corp.
17-T-1509	Wrench, Differential Bearing Spanner		Mack Mfg. Corp.
17-T-1508	Gage, Bevel Pinion Adjusting	34.00	Mack Mfg. Corp.
DD-432	Wrench, Socket, 3⅜" flats		Miller Tool
L-643	Wrench, Socket, 2" flats	5.75	Snap-On Tool Corp.
L-883	Wrench, Socket, 2¾" flats	10.00	Snap-On Tool Corp.
L-53	Handle, Socket Wrench, 30" long	6.50	Snap-On Tool Corp.

* Federal Stock Number

GROUP 12: BRAKES

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Hand Brake
(See Figure 1)

The hand (or emergency) brake is a four-shoe, 16-inch, disk-type brake carried by a bracket attached to the rear of the transmission. The brake is operated by a hand lever in the cab thru a linkage of rods and levers.

It has two pairs of shoes, each pair being drawn together against a brake disk having a ventilating space between the two braking surfaces. Each pair of shoes is independently adjustable for equalizing the braking effort and the bracket from which they are suspended is provided with set screws for aligning the shoes so that they are parallel to the brake disk surfaces.

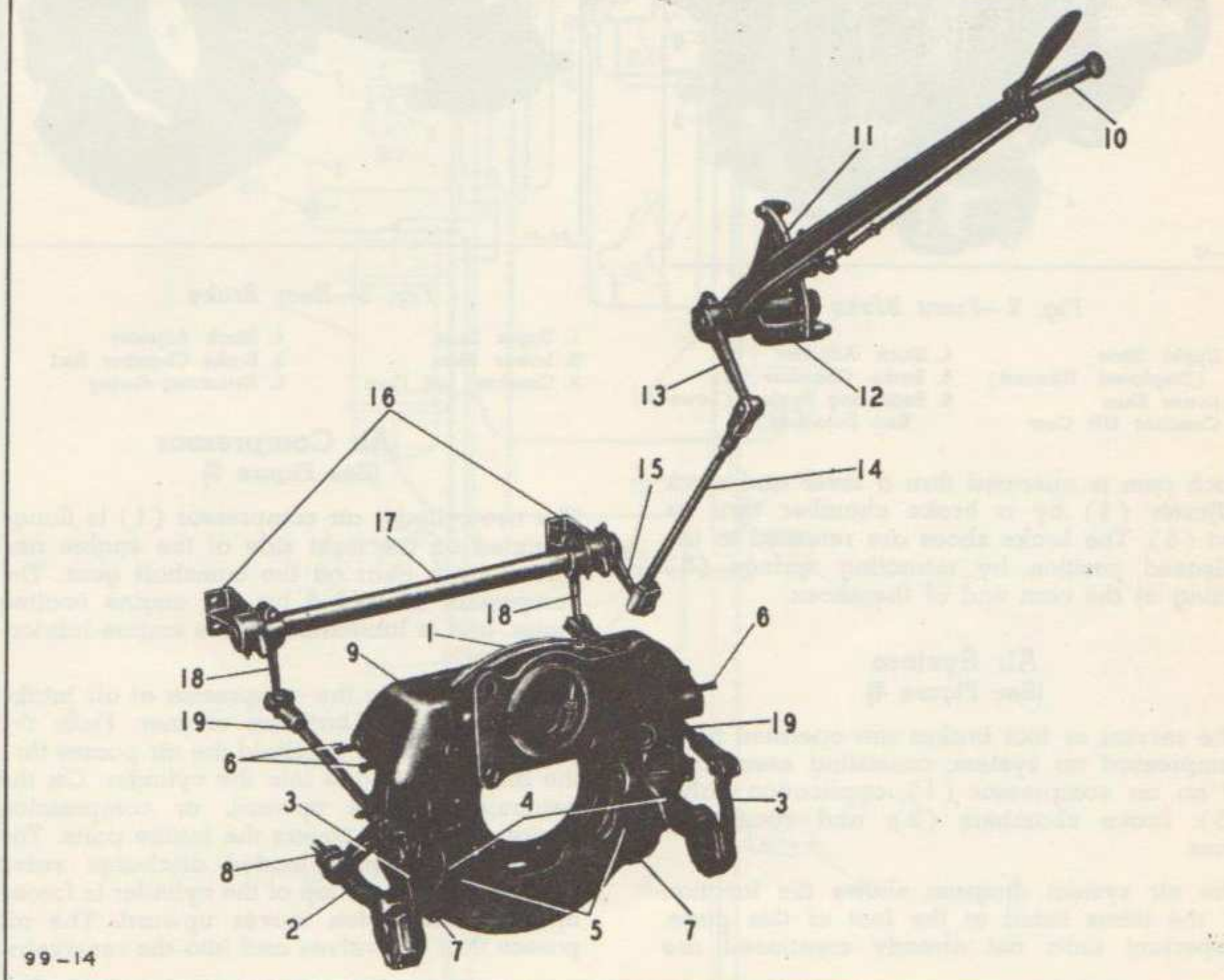


Fig. 1—Assembly of Hand Brake and Operating Linkage

1. Disk Assembly
2. Compression Spring
3. Lever
4. Lever Arm
5. Brake Shoe
6. Shoe Aligning Screw
7. Tension Spring
8. Adjusting Nut
9. Bracket
10. Brake Lever
11. Sector
12. Lever Bracket
13. Lever
14. Pull Rod
15. Lever
16. Bracket
17. Cross Shaft
18. Lever
19. Push Rod

Foot Brakes
(See Figures 2 and 3)

The foot (or service) brakes are air operated and apply on all of the six wheels. In each brake two rigid shoes (1 and 2), to which brake blocks are secured, are expanded against the internal surface of the brake drum. The shoes are anchored at one end (heel) and expanded at the other end (toe) by means of a constant lift cam (3).

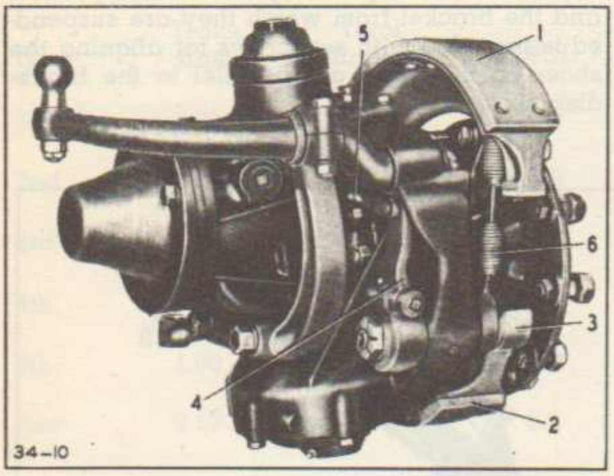


Fig. 2—Front Brake

1. Upper Shoe (Displaced Upward)
2. Lower Shoe
3. Constant Lift Cam
4. Slack Adjuster
5. Brake Chamber Rod
6. Retracting Spring (Lower End Detached)

Each cam is operated thru a lever and slack adjuster (4) by a brake chamber thru its rod (5). The brake shoes are returned to the released position by retracting springs (6) acting at the cam end of the shoes.

Air System
(See Figure 4)

The service or foot brakes are operated by a compressed air system, consisting essentially of an air compressor (1), application valve (3), brake chambers (2), and connecting lines.

The air system diagram shows the location of the items listed at the foot of this page. Important units not already mentioned are the air reservoirs (4), governor (5), relay valve (6), quick release valve (7), low pressure indicator (8), safety valve (10) and stop light switch (24).

Two shuttle-type, double check valves (20) automatically centralize control of coupled vehicles in the towing truck. One makes rear brakes of the towed truck operative thru the foot control (application) valve (3) and the other acts in conjunction with the hand control valve (25) for independent control of a trailer unit.

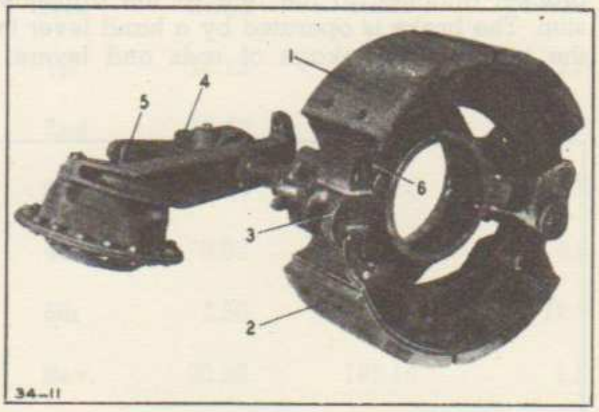


Fig. 3—Rear Brake

1. Upper Shoe
2. Lower Shoe
3. Constant Lift Cam
4. Slack Adjuster
5. Brake Chamber Rod
6. Retracting Spring

Air Compressor
(See Figure 5)

The two-cylinder air compressor (1) is flange mounted on the right side of the engine and driven by a gear off the camshaft gear. The compressor is cooled by the engine cooling water, and is lubricated by the engine lubrication system.

Air is drawn into the compressor at air intake (26), thru an oil-bath air cleaner. From the compressor intake manifold the air passes thru the intake ports and into the cylinder. On the beginning of the upward, or compression stroke, the piston covers the intake ports. The flat disk-type spring-loaded discharge valve (27) located at the top of the cylinder is forced open as the piston moves upward. The air passes thru the valves and into the reservoirs.

1. Air Compressor
2. Brake Chamber
3. Application Valve
4. Air Reservoir
5. Governor
6. Relay Valve
7. Quick Release Valve
8. Low Pressure Indicator
9. Manifold Fitting
10. Safety Valve
11. Windshield Wiper
12. Windshield Wiper Valve
13. Air Horn
14. Air Horn Relay
15. Pressure Gage
16. Single Check Valve
17. Emergency Coupling—Front
18. Service Coupling—Front
19. Air Supply Valve
20. Double Check Valve
21. Flexible Hose
22. Air Horn Air Cleaner
23. T-Fitting
24. Stop Light Switch
25. Hand Control Valve
26. Dummy Hose Couplings
27. Emergency Coupling—Rear
28. Service Coupling—Rear

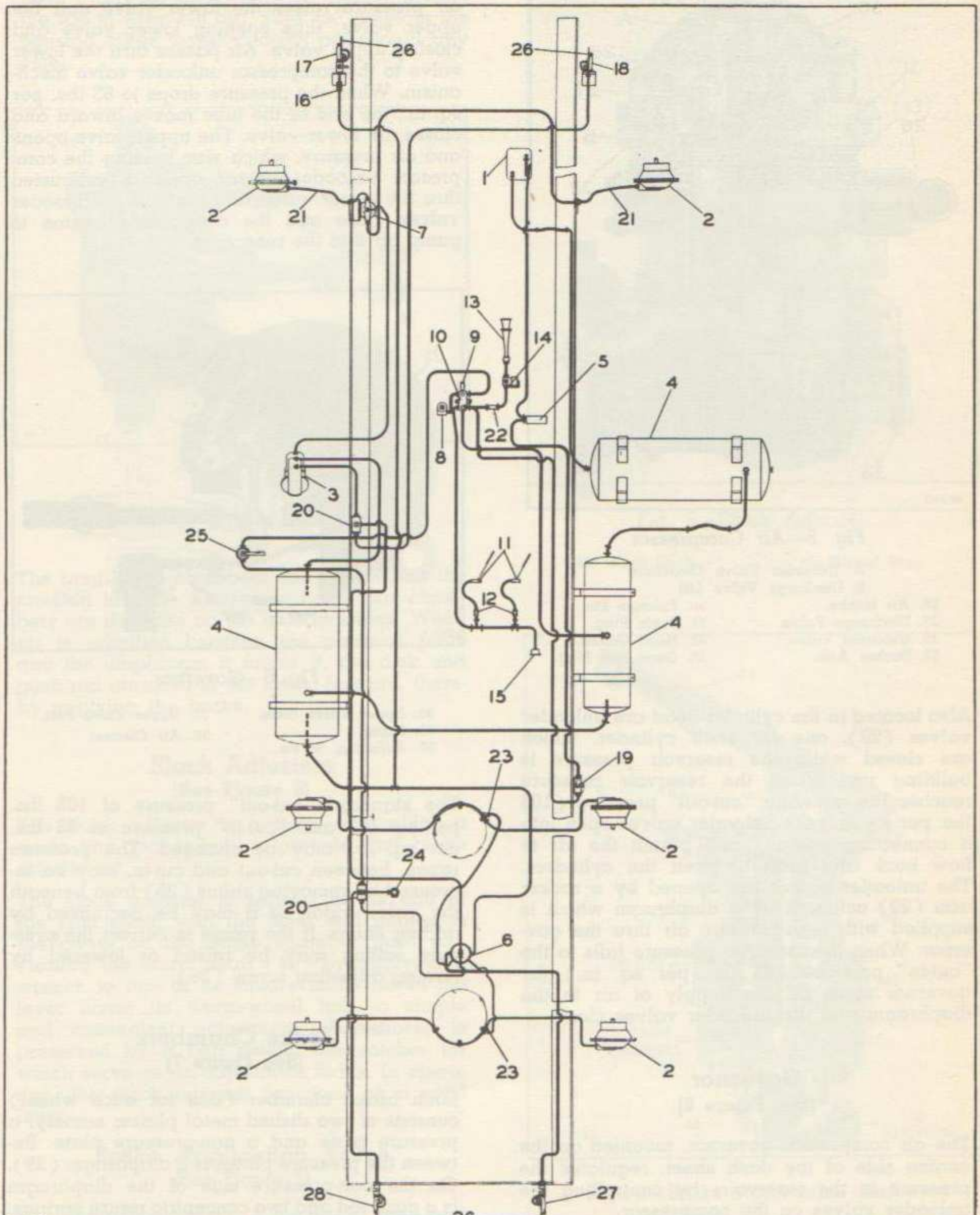


Fig. 4—Air System Diagram

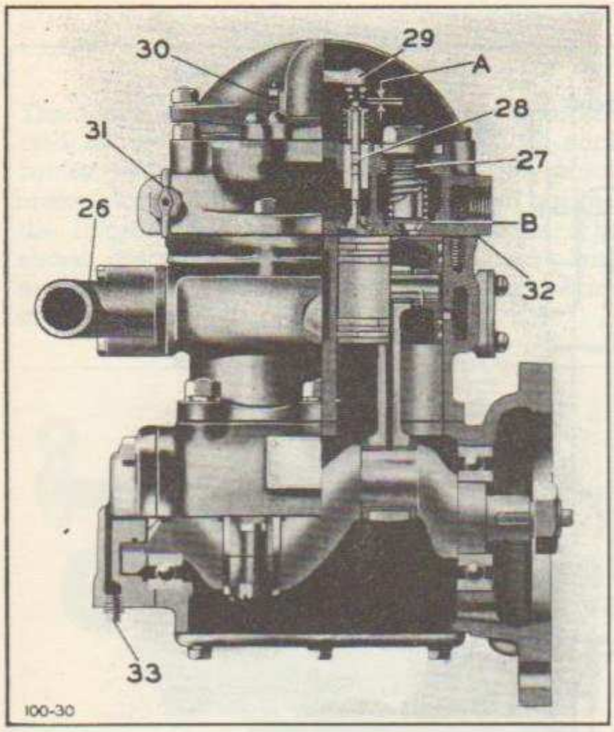


Fig. 5—Air Compressor

A. Unloader Valve Clearance
B. Discharge Valve Lift

26. Air Intake.	30. Fulcrum Pin.
27. Discharge Valve.	31. Drain Plug.
28. Unloader Valve.	32. Head Gasket.
29. Rocker Arm.	33. Gage Port Plug.

Also located in the cylinder head are unloader valves (28), one for each cylinder, which are closed while the reservoir pressure is building up. When the reservoir pressure reaches the governor "cut-out" pressure (105 lbs. per sq. in.) the unloader valves open into a connecting passage and permit the air to flow back and forth between the cylinders. The unloader valves are opened by a rocker arm (29) actuated by a diaphragm which is supplied with high-pressure air thru the governor. When the reservoir pressure falls to the "cut-in" pressure (85 lbs. per sq. in.) the governor shuts off the supply of air to the diaphragm and the unloader valves close.

Governor
(See Figure 6)

The air compressor governor, mounted on the engine side of the dash sheet, regulates the pressure in the reservoirs by controlling the unloader valves on the compressor.

As reservoir pressure builds up to 105 lbs. per sq. in., the free end of the governor tube moves outward releasing pressure on the stem (34) of the upper valve. At the same time air pressure raises the lower valve and the upper valve, thus opening lower valve and closing upper valve. Air passes thru the lower valve to the compressor unloader valve mechanism. When the pressure drops to 85 lbs. per sq. in., the end of the tube moves inward and closes the lower valve. The upper valve opens and air pressure, which was holding the compressor unloader valves open, is exhausted thru the upper valve and port (37). Unloader valves close and the compressor begins to pump air into the reservoirs.

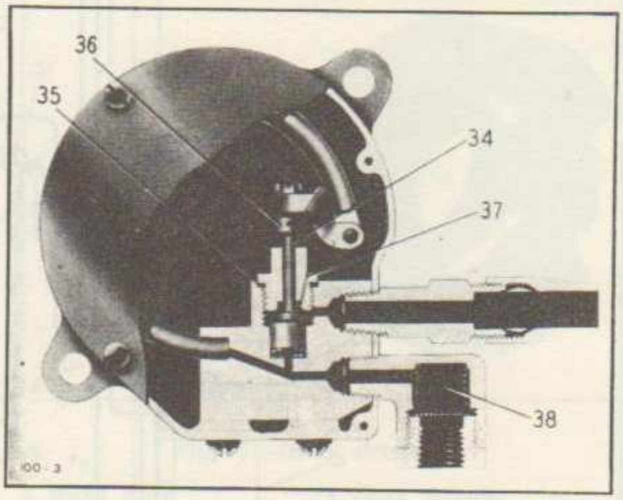


Fig. 6—Governor

34. Upper Valve Stem.	37. Upper Valve Port.
35. Shims.	38. Air Cleaner
36. Adjusting Screw.	

The standard "cut-out" pressure of 105 lbs. per sq. in., and "cut-in" pressure of 85 lbs. per sq. in., may be changed. The pressure range, between cut-out and cut-in, may be increased by removing shims (35) from beneath the valve guide or it may be decreased by adding shims. If the range is correct the pressure setting may be raised or lowered by turning adjusting screw (36).

Brake Chambers
(See Figure 7)

Each brake chamber (one for each wheel) consists of two dished metal plates; namely, a pressure plate and a non-pressure plate. Between the pressure plates is a diaphragm (39). On the non-pressure side of the diaphragm is a push rod and two concentric return springs. On the threaded forward end of the push rod is a clevis for attachment to the slack adjuster. The push rod is equipped with rubber boot (41). Some units do not have the boot but have a scraper ring which fits closely around the rod to keep out dirt. Four 1/8" holes in the housing allow water to drain out should any enter.

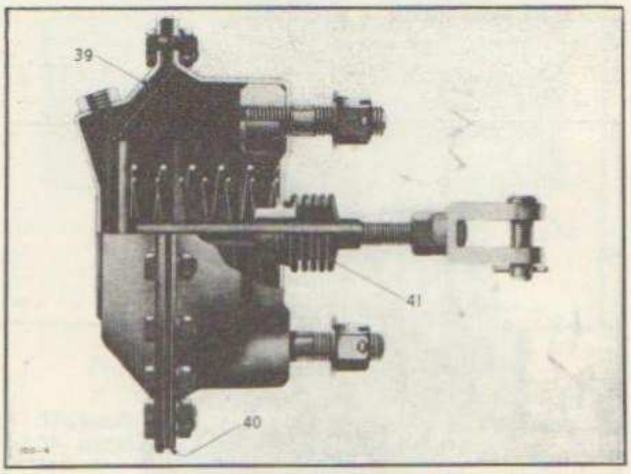


Fig. 7—Brake Chamber

39. Diaphragm. 40. Edge of Diaphragm 41. Rubber Boot.

The front brake chambers are mounted on the steering knuckle flanges and the rear chambers are mounted on the axle housings. When air is admitted between the pressure plate and the diaphragm it forces it, the disk and push rod attached to the latter, forward, thereby applying the brake.

Slack Adjusters
(See Figure 8)

The slack adjuster is a lever into which a worm and gear is built to provide easy brake adjustment.

The slack adjuster is splined to the end of the cam shaft, with the lever end pinned to the clevis on the brake chamber push rod. Turning the worm shaft (42) by applying a wrench to one of its square ends moves the lever about its worm-wheel hub—a simple and convenient adjustment. Adjustment is preserved by a ball detent, the notches for which serve as an adjustment index. In operation, the slack adjuster functions as a solid lever.

Brake Application Valve
(See Figure 9)

The application valve is the pedal type and is mounted on the floor board. This valve controls the air pressure to the brake chambers. The valve is graduated, which means that the

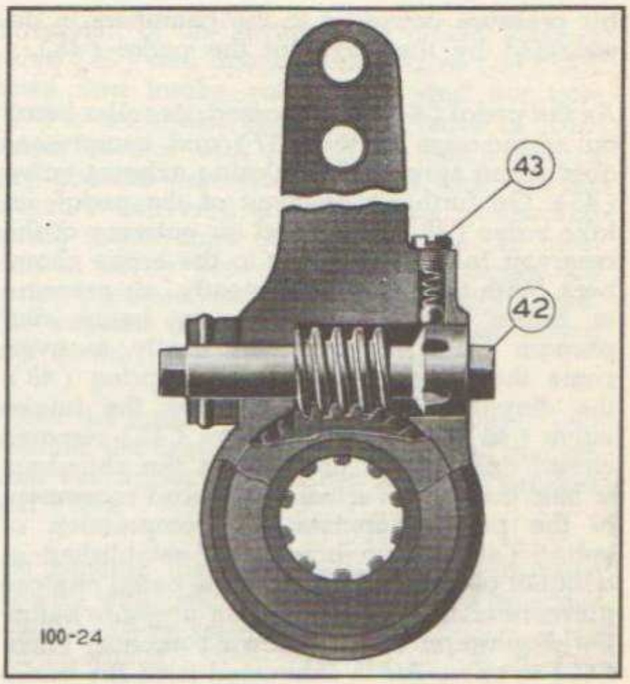


Fig. 8—Slack Adjuster

42. Worm Shaft 43. Slotted Plug

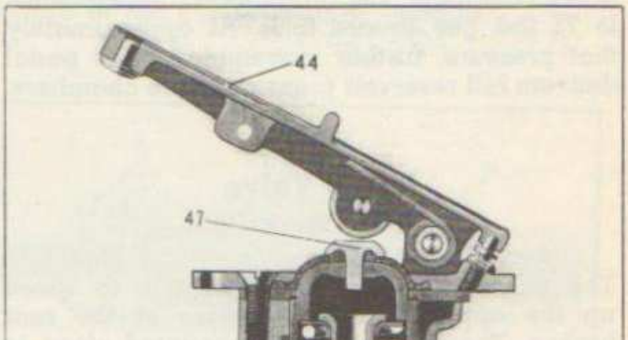


Fig. 9—Brake Application Valve

44. Operating Pedal
45. Exhaust Valve
46. Intake Valve
47. Spring-cage Button
48. Graduating Spring
50. Diaphragm

air pressure delivered to the chambers is determined by the travel of the pedal (44).

As the pedal (44) is depressed, its roller bears on spring-cage button (47) and compresses graduating spring (48), closing exhaust valve (45). On further movement of the pedal, intake valve (46) opens and air entering at the reservoir lead passes thru to the brake chambers. With the pedal held steady, air pressure in brake chambers and cavity below diaphragm (50) increases sufficiently to overcome the force exerted by the spring (48), the diaphragm rises and closes the intake valve (46); the exhaust valve (45) remains closed and the air pressure in the chambers is held constant. Further downward movement of the pedal increases the compression of spring (48) and a balance is established at a higher pressure. Release of the pedal reduces pressure of spring (48) and air pressure below the diaphragm lifts it, allowing exhaust valve (45) to open. Air is exhausted from the brake chambers until a lower balance of air and spring pressures is reached.

The valve is preloaded so that the first opening of the valve immediately admits air, at approximately 5 lbs. per square inch pressure, to the brake chambers. The graduation range extends to 75 lbs. per square inch. At approximately that pressure, further movement of the pedal delivers full reservoir pressure to the chambers.

Relay Valve

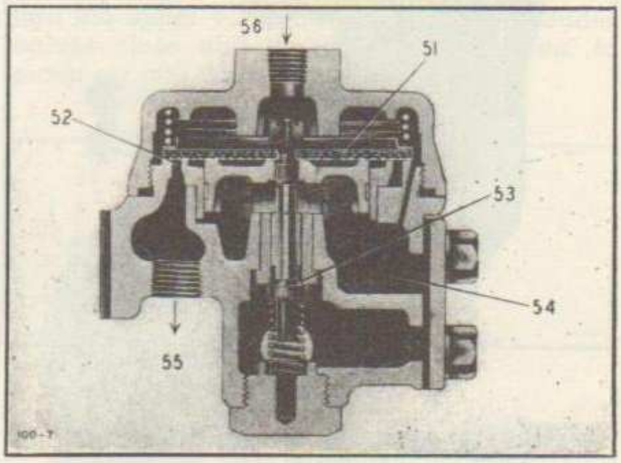
(See Figure 10)

The purpose of the relay valve is to speed up the application and release of the rear brakes. The relay valve is mounted close to the rear brake chambers and air from the reservoir goes to these chambers thru the relay valve.

The relay valve control port (56) is connected to the application valve. Air under pressure from the application valve forces diaphragm (51) downward, closing exhaust port (52) and opening intake valve (53). Air under pressure, from the reservoir, flows thru a port into the lower chamber, thru the intake valve (53) into cavity (54) and out thru ports which are not shown, to the rear brake chambers.

When the pressure in cavity (54) balances the pressure above diaphragm (51), delivered by the application valve, the diaphragm lifts and closes intake valve (53). Exhaust port (52) remains closed.

If the pressure above the diaphragm (51) is decreased by action of the application valve, the diaphragm lifts further, opening exhaust port (52) and exhausting air from the brake chambers thru cavity (54) until a lower balance of pressures is reached.



Relay 10—Relay Valve

51. Diaphragm.
52. Exhaust Port.
53. Intake Valve.
54. Cavity.
55. Exhaust Opening.
56. Control Port.

The relay valve maintains the same air pressure in the rear brake chambers as delivered to it by the application valve.

Quick Release Valve

(See Figure 11)

The purpose of the quick release valve is to speed up the release of air from the front brake chambers after a brake application.

Air from the application valve enters port (57) and forces center portion of diaphragm (58) against exhaust port seat (59), sealing it. At the same time, the edge of diaphragm is forced downward and air passes out the two side ports to the brake chambers.

When the application valve is released, the pressure above diaphragm (58) drops and air from the brake chambers flows into the central cavity, pushes the diaphragm up against the intake port seat (60) and passes out thru exhaust port (61).

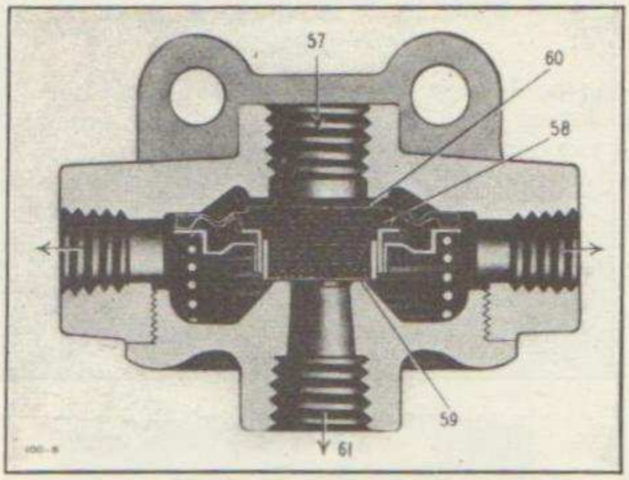


Fig. 11—Quick Release Valve

57. Intake Port
58. Diaphragm
59. Exhaust Port Seat
60. Intake Port Seat
61. Exhaust Port

Trailer Hand Control Valve
(See Figure 12)

The trailer hand control valve, mounted on the steering column, is used to apply the brakes on a towed vehicle independently of the truck brakes.

As valve lever (62) is turned, spring cage (63) is forced downward by mating cams on spring cage (63) and cover (64). Downward movement of the spring cage closes exhaust valve (66) and opens intake valve (68). Air flows thru intake valve (68) and out port (67) to the trailer brakes. This valve is graduated, so that with the handle (62) held in any position between "off" and "on" the air pressure delivered depends upon graduating spring inside cage (63). When the air pressure in cavity beneath piston overcomes the spring pressure, the intake valve (68) closes. The exhaust valve (66) also remains closed and the air pressure remains constant.

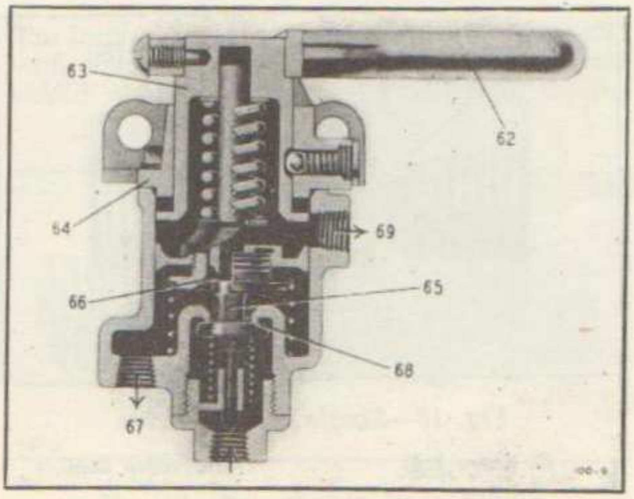


Fig. 12—Trailer Hand Control Valve

62. Valve Lever
63. Spring Cage
64. Cover
65. Exhaust Valve Assembly
66. Exhaust Valve
67. Brake Chamber Line Port
68. Intake Valve
69. Exhaust Port

When the handle (62) is moved toward "off" position, the exhaust valve (66) opens and air from the trailer line passes out thru exhaust port (69).

Just beneath the piston is a piston cup (not shown) which seals the lower cavity from the exhaust cavity above.

Safety Valve
(See Figure 13)

The safety valve protects the air system against excessive pressure in the event of a failure of the compressor to "unload".

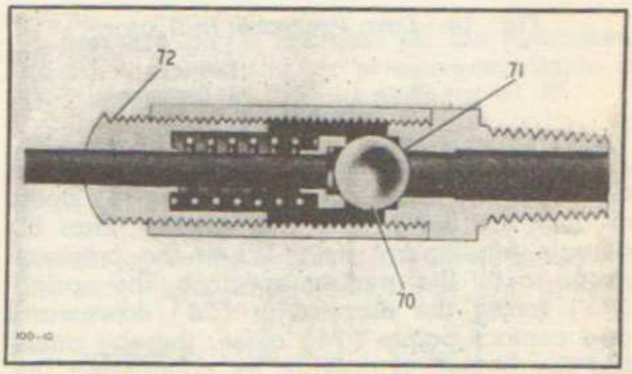


Fig. 13—Safety Valve

70. Spring-Loaded Ball
71. Ball Seat
72. Adjusting Screw

The valve is connected to the reservoirs. If the pressure rises to 150 pounds per square inch, the spring-loaded ball (70) is lifted from seat (71) allowing air to escape to atmosphere. When the pressure drops below 150 pounds per square inch, the spring forces the ball back on the seat, preventing any further exhaust.

Low Pressure Indicator
(See Figure 14)

The low pressure indicator operates a buzzer in the cab to warn the driver whenever the air pressure in the reservoir drops below 60 pounds per square inch.

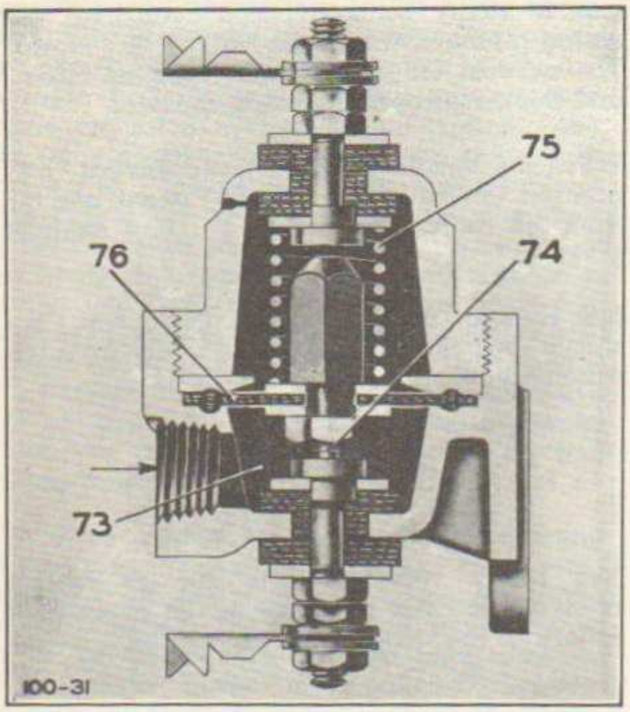


Fig. 14—Low Pressure Indicator

73. Cavity
74. Contact Points
75. Spring
76. Diaphragm

Air pressure in cavity (73), connected to the air reservoir, holds contact points (74) open as long as the pressure is greater than 60 pounds per square inch. When the pressure drops to 60 lbs. per square inch, the spring (75) forces the diaphragm (76) downward and contact points (74) close, thereby causing the buzzer to operate by completing the circuit between the terminals of the indicator, thru the spring (75) and the washers at its ends. The buzzer is connected across the ignition switch so that with the ignition "off" the buzzer does not operate.

Air Supply Valve
(See Figure 15)

An air supply valve, for use in inflation of tires, is provided in the line between the governor and the reservoir. The valve has a threaded boss (77) on which the inflating hose

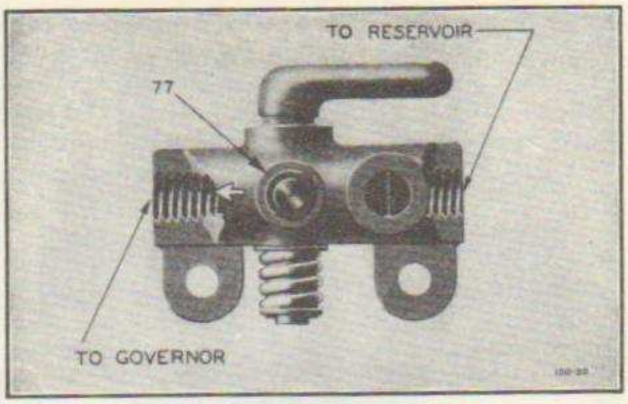


Fig. 15—Air Supply Valve

77. Tire Hose Connection

fitting is screwed. When not in use, the threads on the boss are protected by a removable cap.

When the handle is turned for tire inflation, the valve cuts off the governor and allows the compressor to build up reservoir pressure to safety valve setting of 150 lbs. per sq. in.

Single Check Valve
(See Figure 16)

A single check valve is placed in the line to the front emergency coupling to prevent loss of air in the truck reservoirs in the event of a breakaway while being towed by another vehicle.

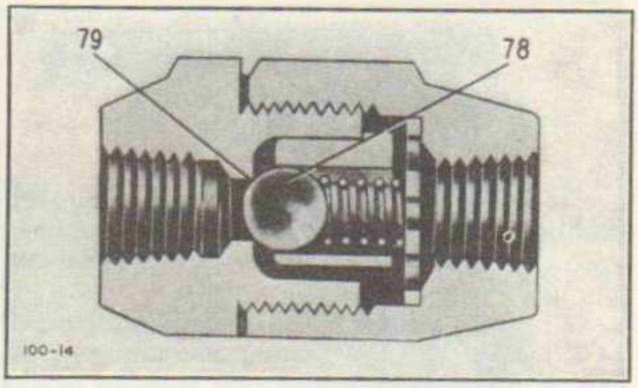


Fig. 16—Single Check Valve

78. Valve Ball
79. Valve Seat

Air pressure from the towing vehicle lifts ball (78) from seat (79) and passes to the reservoirs of the towed truck. When the pressure drops the spring forces the ball back on the seat to prevent back flow of air.

Double Check Valve
(See Figure 17)

Two double check valves are used. One permits the rear brakes of the truck to be operated from a towing vehicle. The other permits operation of the brakes of a towed vehicle independently of the truck brakes.

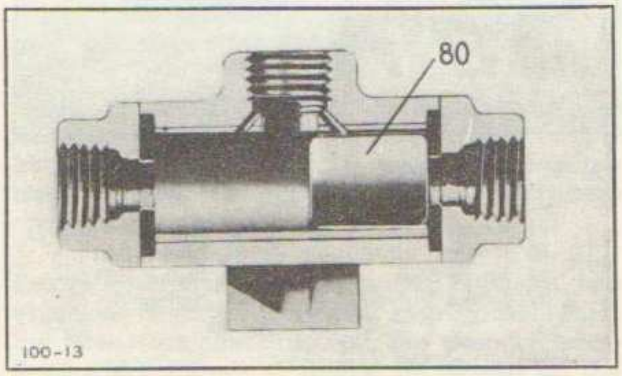


Fig. 17—Double Check Valve

80. Shuttle

Air entering either end of the valve causes shuttle (80) to seat against rubber washer, sealing the opposite end and allowing air to flow out the side connection.

Air Lines and Hose
(See Figures 4 and 18)

The brake lines are of seamless copper tubing, with the exception of the lines to the windshield wipers which are welded steel tubing.

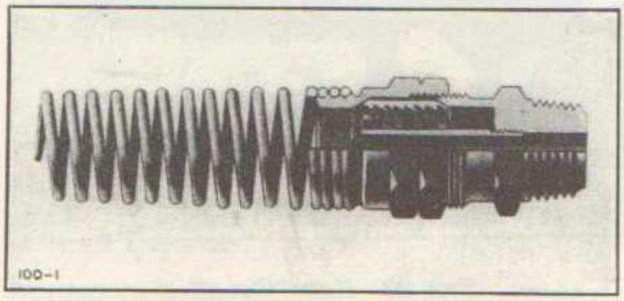


Fig. 18—Detachable Hose Fitting

Flexible rubber hose with detachable fittings, is used between the frame connectors and the front brake chambers, and between the relay valve and the rear brake chambers.

Reservoirs and Drain Cocks
(See Figure 4)

Three air reservoirs are included in the equipment. At the bottom of each reservoir is a drain cock which should be opened daily to drain condensation which accumluates there.

The reservoirs are made from steel sheet, formed and welded into cylindrical tanks.

Air Pressure Gage
(See Figure 19)

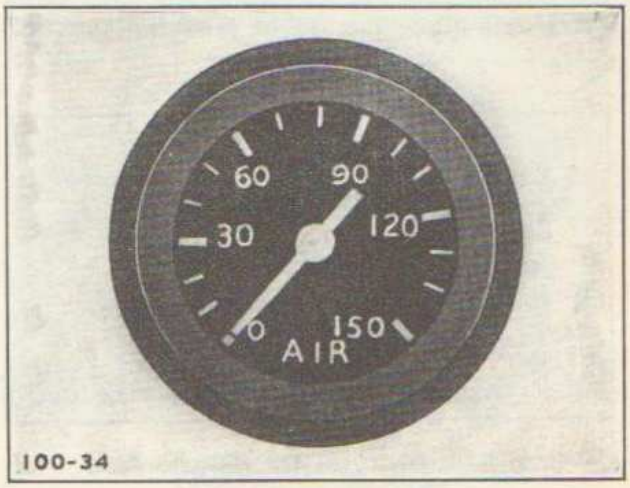


Fig. 19—Air Pressure Gage

A pressure gage, mounted on the instrument board, indicates the air pressure available in the reservoirs for brake operation.

Stop Light Switch
(See Figure 20)

An air operated switch is provided to operate the stop light when the brakes are applied.

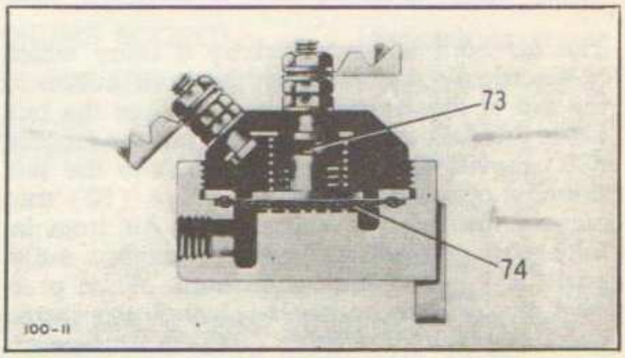


Fig. 20—Stop Light Switch

73. Contacts 74. Diaphragm

An air pressure of 5 lbs. per sq. in. lifts diaphragm (74) and closes contacts (73), thus causing the stop light to glow.

Air Horn

(See Figure 21)

A two-tone air horn is mounted on the hood side of the dash sheet.

Air entering the horn thru port (81) causes the diaphragms (82) to move off their seats (83) and allow the air to pass out thru the bells (84), causing the diaphragm (82) to vibrate. The vibration can be controlled to some extent by the tension on springs (85).

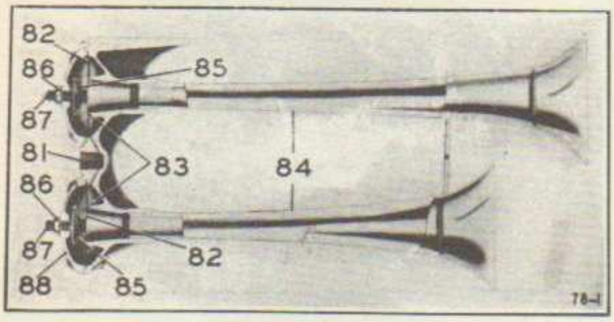


Fig. 21—Air Horn

81. Port
82. Diaphragm
83. Seat
84. Bell
85. Spring
86. Locknut
87. Stud
88. Cover

Air Horn Valve

(See Figure 22)

The air horn is controlled by a relay which is electrically actuated by the horn button at the top of the steering column. When the button is pressed, the armature (89) of the magnet (90) moves the valve stem (91) to the left, thereby opening the intake valve (92) and closing the exhaust valve (93). Air from intake port (94) flows to the horn thru outlet port (95) and operates the horn. When pressure on the horn button is relieved, the spring (96) closes intake valve (92) and opens exhaust valve (93). Any air leaking by the intake valve passes out thru exhaust port (97) instead of blowing the horn.

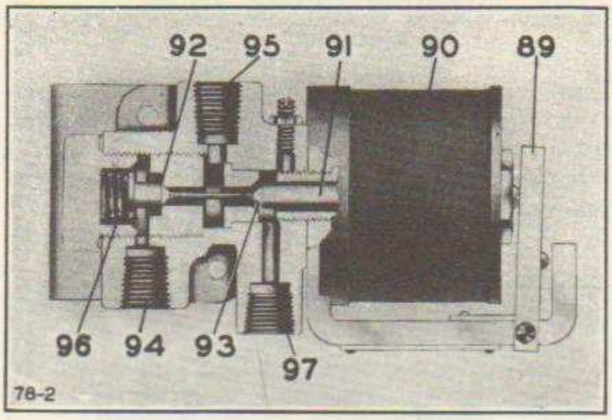


Fig. 22—Air Horn Valve

89. Armature
90. Magnet
91. Valve Stem
92. Intake Valve
93. Exhaust Valve
94. Intake Port
95. Outlet Port
96. Spring
97. Exhaust Port

A line air cleaner (22), Figure 4, is provided to protect the air horn from dirt and moisture.

Trailer Connections

(See Figures 4, 23 and 24)

Trailer connections are provided at both front and rear of the truck. When towing a gun equipped with air brakes, connect the hoses on the gun to the rear hose couplings (27) and 28), Figure 4, on the truck.

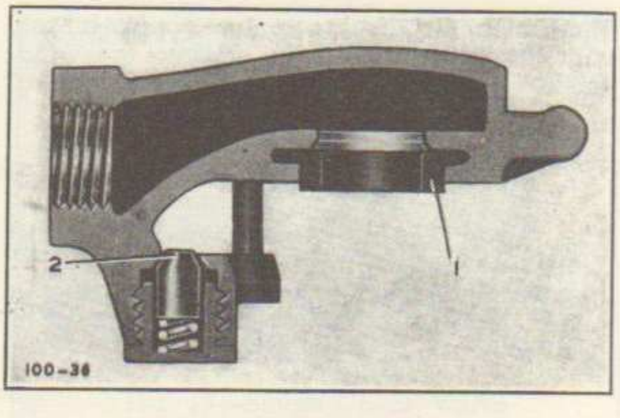


Fig. 23—Hose Coupling

1. Seal
2. Spring Lock

When towing another truck equipped with front trailer connections, attach jumper hoses between the hose couplings on the two vehicles.

Each truck carries one jumper hose in the tool compartment.

One connection at each end of the vehicle is marked SERVICE (18) and (28), Figure 4, and the other marked EMERGENCY (17) and (27), Figure 4. Always connect the service lines of the two vehicles together and the emergency lines together. When this is done, the hoses will be crossed; right rear to left front and left rear to right front.

Open the stop cocks at connections where hoses have been coupled. The trailing vehicle brakes will now operate when the leading truck brakes are applied. (There is no stop cock on the front service line).

Before disconnecting the hoses between two vehicles, always close the stop cocks. After the hoses are disconnected, the dummy couplings (26), Figure 4, should be placed on the hose couplings. The dummy coupling for the front service coupling is provided with a small bleed hole to prevent double check valve from becoming pressure bound.

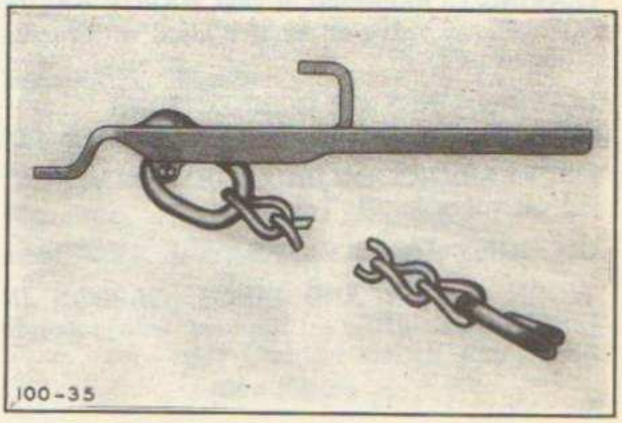


Fig. 24—Dummy Coupling

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Ineffective Brakes

GREASE ON LINING .... Renew lining.

LINING WORN TO RIVET HEADS .... Renew lining.

DRUMS SCORED OR OUT OF ROUND .... Refinish or renew.

EXCESSIVE CLEARANCE .... Decrease stroke of slack adjuster.

PARTIAL LINING CONTACT WITH DRUMS .... Repair or renew sprung shoes or bent anchor pins.

Dragging Brakes

LACK OF CLEARANCE .... Increase stroke of slack adjuster.

DRUMS OUT-OF-ROUND .... Refinish or renew.

LOOSE WHEEL BEARINGS .... Adjust bearings.

WEAK RETRACTING SPRINGS .... Renew springs.

SEIZED OR BINDING LINKAGE .... Adjust and lubricate.

Grabbing Brakes

GRIT ON LINING .... Renew lining

LOOSE LINING .... Tighten rivets or renew lining.

SPRING U-BOLTS LOOSE OR BROKEN .... Tighten or renew.

DRUMS SCORED OR CRACKED .... Refinish or renew.

Noisy Brakes

GRIT ON LINING .... Clean or renew lining.

DRUMS SCORED .... Refinish or renew

LOOSE LINING RIVETS .... Tighten or renew.

SHOES, ANCHOR PINS OR PLATES DISTORTED .... Straighten or renew.

Ineffective Air System

LOW BRAKE LINE PRESSURE .... Adjust pressure thru brake application valve.

BRAKE CHAMBER DIAPHRAGM LEAKING .... Renew diaphragm.

Slow Pressure Build Up in Reservoirs

LEAKING APPLICATION OR BRAKE VALVE .... Clean valves or replace with reconditioned unit.

LEAKING COMPRESSOR DISCHARGE VALVE .... Clean valve or replace head with reconditioned unit.

LEAKING LINES OR CONNECTIONS .... Renew tubing and fittings or tighten fittings.

NO CLEARANCE ON UNLOADER VALVES .... Adjust valve to .010" clearance.

CLOGGED AIR CLEANER .... Clean.

WORN PISTON AND RINGS, CARBON IN DISCHARGE LINE .... Replace with reconditioned unit.

Quick Loss of Reservoir Pressure When Engine is Stopped

WORN AND LEAKING COMPRESSOR DISCHARGE VALVES .... Clean valves or replace head with reconditioned unit.

TUBING OR CONNECTIONS LEAKING .... Renew tubing or tighten fittings.

LEAKING VALVES .... Clean or renew unit.

LEAKING GOVERNOR .... Clean or renew unit.

Compressor Not Unloading

BROKEN UNLOADER DIAPHRAGM .... Install new diaphragm.

TOO MUCH CLEARANCE ON UNLOADER VALVES .... Adjust to .010" clearance.

Compressor Not Unloading (Cont'd.)

RESTRICTION IN LINE FROM GOVERNOR TO UNLOADER .... Replace tubing or clean.

GOVERNOR NOT OPERATING .... Replace with reconditioned unit.

Slow Brake Application

LOW BRAKE LINE PRESSURE (BRAKE VALVE TO CHAMBERS) .... Adjust pressure thru valve.

BRAKE CHAMBER PUSH ROD TRAVEL EXCESSIVE .... Adjust brakes.

RESTRICTION IN LINE .... Clean or renew tubing or hose.

LEAKING BRAKE CHAMBER DIAPHRAGM .... Renew diaphragm.

BRAKE LINING OR DRUM CONDITION .... Renew or recondition.

LEAKING BRAKE VALVE DIAPHRAGM .... Renew diaphragm or complete unit.

Slow Brake Release

BRAKE VALVE LEVER NOT RETURNING FULLY TO STOP .... Adjust operating rod.

BINDING CAM OR CAM SHAFTS .... Lubricate and align properly.

BRAKE CHAMBER PUSH ROD TRAVEL EXCESSIVE .... Adjust brakes.

RESTRICTION IN TUBING OR HOSE .... Clean or renew.

IMPROPER SEATING OF VALVES .... Clean or replace with a reconditioned unit.

SECTION 3: ADJUSTMENTS

Hand Brake
(See Figure 25)

Tighten nut (8) so that spring (2) exerts enough pressure to bring lever (3) to stop solidly against lever arm (4).

Insert .020" shim between front shoe lining and disk (1).

Adjust nut (8) so that rear lining has .020" clearance with disk (1).

See that tension spring (7), attached to lower ends of each pair of shoes (5), are in place, then adjust screws (6) so that linings are parallel with disks.

Remove shims.

Be sure that hand lever is in full-release position; then adjust pull rod to proper length and make final connections.

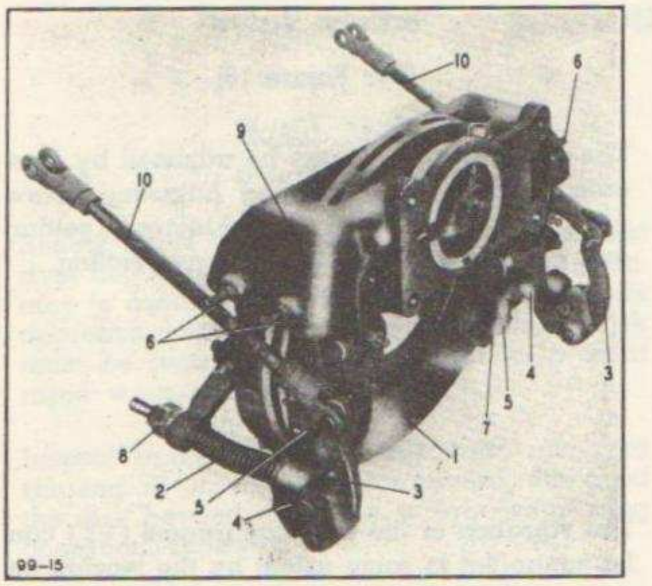


Fig. 25—Hand Brake

1. Disk Assembly
2. Compression Spring
3. Lever
4. Lever Arm
5. Brake Shoe
6. Shoe Aligning Screw
7. Tension Spring
8. Adjusting Nut
9. Bracket
10. Push Rod

Foot Brakes
(See Figure 26)

Brakes are adjusted at the brake chamber (5) by turning worm shaft (42) on the slack adjuster (4). The following brake chamber push-rod strokes should be used.

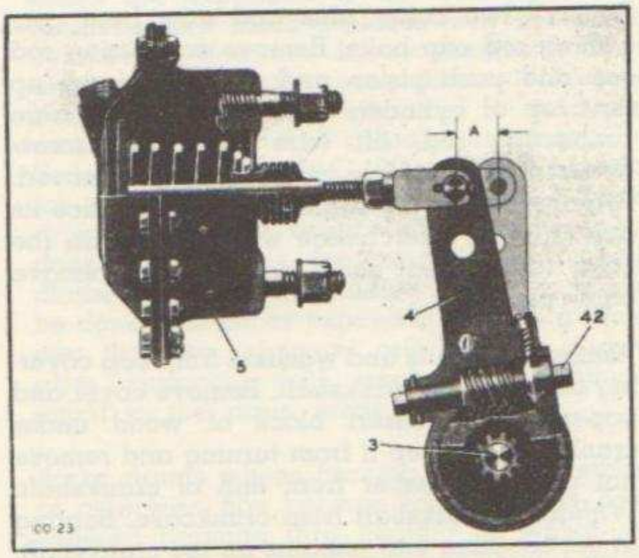


Fig. 26—Brake Chamber and Slack Adjuster for Foot Brake

Front Brake Chamber	Stroke (A)
Minimum Adjustment	¾" to ⅞"
Readjust at	1⅜"
Maximum	1¾"

Rear Brake Chamber	Stroke (A)
Minimum Adjustment	⅞" to 1"
Readjust at	1¾"
Maximum	2¼"

See "Slack Adjusters" in this section.

Air Compressor
(See Figure 5)

If the compressor has been removed from the engine for any reason, it should be reinstalled as follows: Bring No. 1 piston in engine to upper dead center. At this position, turn compressor over by means of the coupling until the notch in the compressor coupling coincides with the notch in the compressor mounting flange, then remount on engine. This special phasing adjustment minimizes vibration.

Unloader valve clearance (A) should be .010" minimum to .015" maximum. Check every 6,000 miles.

Discharge valve lift (B) should be .042" minimum to .075" maximum. Check every 6,000 miles.

Governor
(See Figure 6)

The standard "cut-out" pressure of 105 lbs. per sq. in., and "cut-in" pressure of 85 lbs. per sq. in., may be changed. The pressure range, between cut-out and cut-in, may be increased by removing shims (35) from beneath valve guide, or it may be decreased by adding shims. If the range is correct the pressure setting may be raised or lowered by turning adjusting screw (36).

A. Stroke
3. Brake Cam
4. Slack Adjuster Lever
5. Brake Chamber
42. Worm Shaft

Slack Adjusters
(See Figure 26)

To adjust brakes, turn worm shaft (42) until block lining is brought firmly, but not excessively tight, against brake drum and then turn shaft back three notches. This will provide sufficient clearance to prevent dragging brakes. However, final adjustments should be such that strokes at air chambers are within limits specified, see "Foot Brakes" in this section.

Brake Application Valve
(See Figure 9)

Movement of the upper end of the pedal, before contacting the button, should be about ½ inch. This is equivalent to 1/16 inch clearance between the pedal roller and the spring-cage button (47). Adjustment is made with the stud and lock nut at the lower end of the pedal.

Safety Valve
(See Figure 13)

The pressure setting may be adjusted by loosening lock nut and turning adjusting screw (72). Turn screw clockwise to increase setting and counter-clockwise to decrease setting.

Air Horn
(See Figure 21)

The vibration of the two diaphragms (82) can be controlled to some extent by the tension on springs (85). This can be adjusted by backing off locknuts (86) and screwing studs (87) in or out. When adjustment is correct, retighten the locknuts.

SECTION 4: DIS-ASSEMBLY

Air Compressor
(See Figure 5)

Remove two nuts and washers from cover. Remove cover and cover felt. Remove two cotter pins from fulcrum pin (30) and remove pin. Remove rocker arm (29) and spring. Remove diaphragm plate cap. Remove five screws and lock washers from diaphragm cover and remove cover. Remove diaphragm plate. Invert compressor and spill out diaphragm.

Remove six cylinder head stud nuts and remove cylinder head and gasket.

Compress spring of unloader valve (28) and remove locking washers. Remove valve spring and unloader valve (28) from cylinder head. Repeat same procedure to remove other unloader valve (28).

Remove spring guide of discharge valve (27) from cylinder head. Remove discharge valve spring and spill out discharge valve disc. Repeat same procedure to remove other discharge valve (27).

Remove six screws and lockwashers from crankcase cover. Remove crankcase cover and gasket.

Insert a block of wood between crankshaft and crankcase to prevent crankshaft from turning when loosening nut which secures coupling to crankshaft. Remove nut and lockwasher. Remove coupling with a gear puller. Remove coupling key.

Remove two cotter pins and nuts from connecting rod cap bolts. Remove connecting rod cap and push piston and connecting rod up thru top of cylinder. To remove piston from connecting rod, lift wire lock with screw driver. The wrist pin may then be removed. After removing the connecting rod, replace its cap to avoid interchange with the cap on the other rod. Repeat same procedure to remove other piston.

Remove four nuts and washers from cap covering outer end of crankshaft. Remove cover and paper gasket. Insert block of wood under crankshaft to keep it from turning and remove nut and lockwasher from end of crankshaft. Withdraw crankshaft from crankcase. Bearing at the coupling end remains on the crankshaft. The bearing at the outer end remains on crankshaft.

SECTION 5: REPAIRS

Hand Brake

(See Figure 1)

Renew brake blocks before wear is such that rivet heads bear against disk. It is false economy to continue blocks in service when rivets approach contact with disk, for a scored disk must be removed and resurfaced to prevent rapid wear of new blocks.

Inspect brake disk for smoothness and true running. If scoring or heating has damaged the disk beyond repair by a light resurfacing operation, renew it.

Renew excessively worn, or deformed parts; obviously, any broken ones.

Foot Brakes

(See Figures 2 and 3)

Renew brake blocks before there is danger that their bolt fastenings will come into contact with brake drums and score them. Tho the blocks are thick and will render long service, timely renewal is nonetheless important—and an economy, for drums which have been permitted to become scored must be resurfaced to prevent rapid wear of new blocks.

When correct brake blocks are installed, and shoes are expanded to the braking surface diameter, the block surfaces will be closely cylindrical. However, for maximum accuracy of contact and for peak brake efficiency, brake blocks should be ground to exact size and concentricity with a brake lining grinder, Federal Stock No. 400-G-100, a portable device for attachment to the wheel spindle. If brake drums are to be resurfaced, this should be done before shoes are ground so that exact diameter is known. Grinding of blocks should be done with shoes expanded to such a diameter that the minimum grinding for a complete surfacing will result in a diameter equal to the drum measurement.

Brake drums whose braking surface is scored or otherwise has become rough, which have suffered damage thru heating or which are out of round or do not run true should be resurfaced or renewed depending upon their condition.

Drums should not be refinished to diameters greater than those specified as maximum, see "Section 8: Specifications", "Front Brake Drums" and "Rear Brake Drums". When using brake drum lathe, Federal Stock No. 40-L-15, remove only enough material to produce a smooth and true surface.

Renew excessively worn, or deformed parts; obviously, any broken ones. Check brakes for freedom of action. If hard action cannot be remedied by cleaning and lubrication, seek parts whose condition is responsible and if they cannot be restored to full efficiency, renew them.

Air System

(See Figure 4)

Instructions relating to repairs of the component parts of the air brake system for operating the foot brake follow, under the headings relating to those parts.

Air leakage should be checked daily by running the engine until the reservoir is at the cut-out pressure of about 105 lbs. Major leaks can be located by ear. Test of the engine system, including tubing and fittings, should be made with the brake pedal blocked in the full open position. If no leaks can be heard, but pressure drops several pounds in a few minutes, the various accessories and connections should be tested with soap suds to determine places where air is escaping.

During operation the air pressure will normally fluctuate between 85 and 105 pounds per square inch. If, however, the pressure falls below 60 pounds per square inch, the buzzer will operate and the driver should stop the truck and locate the failure.

Air Compressor

(See Figure 5)

Renew oil in air cleaner at (26).

Disconnect discharge lines and remove carbon accumulation if necessary every 12,000 miles.

Remove discharge valve cap nuts and check for excessive accumulation of carbon every 12,000 miles, if necessary, remove cylinder head and scrape off the carbon.

When replacing the cylinder head use a new cylinder head gasket.

When mounting compressor use new gaskets for the mounting flange and also the discharge fitting flange.

Check oil pressure every 12,000 miles by installing gage in oil line at (33). Pressure should be not less than 5 lbs. per sq. in. at idling speed nor less than 15 lbs. per sq. in. at governed engine speed.

When draining the radiator, drain cock (31) in the side of the compressor head must be open.

Governor

(See Figure 6)

Remove air strainer (38) every 6,000 miles or semi-annually and clean with kerosene.

Lubricate upper valve stem (34) every 6,000 miles or semi-annually with a few drops of penetrating oil.

Every 12,000 miles allow governor to cut out and check upper valve for leakage by covering port (37) with soap suds. Allow governor to cut in and test lower valve for leakage by covering port (37) with soap suds.

Leakage of a 3-inch soap bubble in 3 seconds is permissible. Leakage is caused either by dirt on the valve seat or by excessive valve wear. If caused by dirt the leakage can be remedied by cleaning both the valve and seat and then regrinding the valve slightly with grade 1000 grinding compound. If the leakage is caused by valve wear the governor should be replaced by a reconditioned unit.

Brake Chambers

(See Figure 7)

Check for leakage at edges (40) of diaphragm every 12,000 miles or annually. To detect leakage apply the brakes and cover the edges of the diaphragm and clamping bolts and nuts with soap suds.

No leakage is permissible. Tighten nuts uniformly until leakage is eliminated. Be careful not to tighten to such a degree that the edges (40) of the diaphragm bulge at the flanges.

Slack Adjusters

(See Figure 8)

In operation, slack adjusters should function as solid levers. Any different action calls for renewal of parts or of complete unit as condition indicates. If slack adjuster will not hold its adjustment renew parts or complete unit.

Remove plug (42), install grease fitting and fill with grease—every 6,000 miles or semi-annually. Be sure ball and spring are in place before re-installing plug (42).

Brake Application Valve

(See Figure 9)

Every 12,000 miles check with a test gage the maximum pressure at the application valve. If the pressure is not within 5 lbs. per sq. in. of the reading of the air gage on the instrument board, check the pedal adjustment and the valves.

Leakage of intake valve (46) can be detected by covering the exhaust port with soap suds. This test should be made with the brake released. Leakage of the exhaust valve (45) can be detected by covering the exhaust port with soap suds. This test should be made with the brakes applied.

Leakage should not exceed a 3-inch bubble in 3 seconds.

Leakage is caused either by dirt between the valve and its seat or by valve seat wear. If due to the latter cause the worn valve should be replaced by a reconditioned unit.

Fill oil cup at top of valve, under treadle, every 1,000 miles or monthly.

Relay Valve

(See Figure 10)

To check for leakage of intake valve (53) cover exhaust opening (55) with soap suds. This test should be made with the brakes released.

To check for leakage at exhaust port (52), apply brakes and cover exhaust opening (55) with the soap suds. A 3-inch bubble in 3 seconds is permissible leakage.

If leakage is caused by dirt, cleaning the valve (53) and its seat or diaphragm (51) and its seat at port (52) will stop the leakage. If it is due to worn valve, valve seat or diaphragm, replace with a reconditioned relay valve.

Quick Release Valve

(See Figure 11)

To check for leaks apply brakes and cover exhaust port (61) with soap suds. A 3-inch bubble in 3 seconds is permissible. Clean the valve and if leak persists replace diaphragm (58). If the trouble is due to a worn exhaust seat, replace the valve with a reconditioned unit.

Trailer Hand Control Valve

(See Figure 12)

Leakage of intake valve (68) may be detected by covering exhaust port (69) with soap suds with the lever (62) in full "off" position. With the lever (62) in full "on" position, leakage of the exhaust valve (66) or piston cup (not shown may be detected by covering port (69) with soap suds. The piston cup is just beneath piston.

Safety Valve

(See Figure 13)

Once a year the safety valve should be dismantled, thoroly cleaned and reset to blow off at 150 lbs. per sq. in.

Low Pressure Indicator

(See Figure 14)

To correct corrosion or pitting at the contact points, a fine file may be used to refinish them. An operating pressure as low as 54 or as high as 66 lbs. per sq. in. is permissible.

Air Supply Valve

(See Figure 15)

If leakage exceeds that indicated by a 3-inch bubble in 3 seconds the valve should be cleaned.

If the leakage is not corrected the key and seat should be lapped with grinding compound.

Single Check Valve

(See Figure 16)

Dismantle, clean thoroly and re-assemble. If leakage persists, refinish ball seat (78).

Double Check Valve

(See Figure 17)

The shuttle (80) must slide freely in the housing. If the shuttle sticks, valve should be taken apart, cleaned and oiled.

Air Lines and Hose

(See Figures 4 and 18)

If the springs on the hose fittings are broken they should be replaced for the protection of the hose against sharp bending.

Reservoirs and Drain Cocks

(See Figure 4)

All reservoirs should be drained daily by opening their drain cocks.

Air Pressure Gage

(See Figure 19)

As the gage mechanism is enclosed in a sealed case it is not adapted for adjustments in the field. If the pressure readings differ by more than 4 lbs. with the readings of an accurate test gage the service gage should be replaced by a reconditioned one.

Stop Light Switch

(See Figure 20)

The contact points (73) may become corroded and pitted. A fine file may be used to refinish the points.

Air Horn

(See Figure 21)

If the horn does not blow properly the cause is usually dirt on the seat (83). Before removing covers (88) loosen locknuts (86) and turn studs (87) part way out. Clean diaphragm (82), body and seat. Replace covers and adjust spring pressure on diaphragm.

Air Horn Valve
(See Figure 22)

Leaks at the intake valve (92) or exhaust valve (93) are usually caused by dirt and can be corrected by dis-assembling and cleaning valves.

Every 12,000 miles or annually remove air cleaner; wash the curled hair with kerosene and replace.

Trailer Connections
(See Figure 23)

The rubber seals in the couplings should be renewed annually, or whenever an air leak is heard during the daily leakage test.

PERIODIC LIST OF PREVENTIVE MAINTENANCE OPERATIONS FOR AIR BRAKE SYSTEM

Daily

Air Reservoirs
(*See Figure* 4)

Drain three reservoirs (4) by opening their drain cocks.

Every 1,000 Miles or Monthly

Brake Application Valve
(*See Figure* 9)

Add oil to cup at top, under treadle.

Every 6,000 Miles or Semi-Annually

Air Compressor
(*See Figure* 5)

Check rocker arm (29) for freedom of movement. Oil fulcrum pin (30) of rocker arm (29).
Check clearance (A) of unloader valves (28).
Check lift (B) of discharge valve (27).

Governor
(*See Figure* 6)

Oil upper valve stem (34).
Clean air strainer (38).

Every 12,000 Miles or Annually

Air Compressor
(*See Figure* 5)

Check gasket between compressor and engine for oil leaks.
Check oil pressure at gage port plug (33).
Check condition of discharge valve (27) at seats.
Inspect unloader diaphragm.
Remove carbon from discharge line.
Check for accumulation of carbon in cylinder head, chambers, valves and springs. If necessary, remove cylinder head and scrape off.

Governor
(*See Figure* 6)

Check cut-in and cut-out setting.

Brake Chambers
(*See Figure* 7)

Test for air leaks.

Slack Adjusters
(*See Figure* 8)

Remove pipe plug (43) and fill with grease.

Note: Requires temporary installation of grease fitting.

Brake Application Valve
(*See Figure* 9)

Check air pressure with test gage.

Relay Valve
(*See Figure* 10)

Test for air leaks.

Quick Release Valve
(*See Figure* 11)

Test for air leaks.

Trailer Hand Control Valve
(*See Figure* 12)

Test for air leaks.

Safety Valve
(*See Figure* 13)

Clean and reset.

Low Pressure Indicator
(*See Figure* 14)

Check condition of contact points (74).

Air Supply Valve
(*See Figure* 15)

Test for air leaks.

Single Check Valve
(*See Figure* 16)

Test for air leaks and operation.

Double Check Valve
(*See Figure* 17)

Test for air leaks and operation.

Air Lines and Hose
(*See Figures* 4 *and* 18)

Check condition.

Reservoirs and Drain Cocks
(*See Figure* 4)

Inspect for air leaks.

Air Pressure Gage
(*See Figure* 19)

If suspected of false indication, test with gage.

Stop Light Switch
(*See Figure* 20)

Check condition of contact points.

Air Horn
(*See Figure* 21)

If performance is faulty, clean and adjust; see also Air Horn Valve.

Air Horn Valve
(*See Figure* 22)

Test for air leaks and operation.

Remove and clean air cleaner (22), **Figure 4.**

Trailer Connections
(*See Figure* 23)

Renew rubber seals in couplings.

SECTION 6: LUBRICATION

None of the valves, or other units of the braking system having moving parts, require dis-assembly at regular intervals for the purpose of lubrication. When such units are taken apart for adjustment or repair, their valve stems and other sliding or turning parts should be sparingly coated with light oil to avoid sticking and wear.

For other lubrication instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

Air Compressor
(See Figure 5)

To re-assemble the compressor, reverse the dis-assembly operations. When replacing caps on connecting rods, be sure that marks on rods and caps coincide.

The driving coupling has a press fit on the crankshaft and should be applied with a press.

When re-assembling compressor it is always best to replace all gaskets with new ones.

Before installing gaskets under the head, the crankcase cover and the cap at the end of the crankshaft, scrape all surfaces so that no pieces of the old gaskets remain and the faces are smooth.

When tightening nuts on ends of crankshaft, insert a block of wood under it to prevent turning. Be sure to clean the cylinder head thoroly to avoid air leaks where the diaphragm seats on it. Also be sure to replace cap on diaphragm plate, so that no dust can reach the diaphragm.

The compressor is lubricated from the auxiliary drive shaft, there being no external oil lines. Oil is delivered by the main oil pressure line of the engine to the auxiliary shaft rear bearing, and thence thru a hole in the center of this shaft to the center of the compressor crankshaft, the connection being made by a spacer, the ends of which engage the two shafts. This spacer must not be omitted when re-assembling the compressor. Holes in the compressor crankshaft distribute oil to the main bearings, connecting-rod bearings, and to the wrist pins. Excess oil overflows back into the engine crankcase.

SECTION 8: SPECIFICATIONS

Hand Brake

MAKE	American Chain & Cable Co.
TYPE	16", 4-shoe disk (Model 65D)
LOCATION	Rear of transmission
LINING AREA (SQ. IN.)	122
LINING TYPE	Molded block
LENGTH	12½"
WIDTH	3"
THICKNESS	¼"

Foot Brakes

MAKE	Mack
ACTUATION	Westinghouse air

(Front)

SIZE	17¼" x 4" x ¾"
LINING AREA (SQ. IN.)	284
LINING TYPE	Molded Block
LENGTH, EACH (TWO BLOCKS)	8⅞"
WIDTH	4"
THICKNESS	¾"

(Rear)

SIZE	17¼" x 6" x ¾"
LINING AREA (SQ. IN.)	852
LINING TYPE	Molded block
LENGTH, EACH (TWO BLOCKS)	8⅞"
WIDTH	6"
THICKNESS	¾"

Brake Drums

MAKE	Mack
TYPE	Cast
MATERIAL	Iron

Front Brake Drums

NOMINAL DIAMETER (BRAKING SURFACE)	17¼"
MAXIMUM DIAMETER (REGRINDING LIMITS)	17½"

Rear Brake Drums

NOMINAL DIAMETER (BRAKING SURFACE)	17¼"
MAXIMUM DIAMETER (REGRINDING LIMITS)	17½"

Air Compressor

MAKE	Westinghouse
MODEL	2UE7-¼ FW
TYPE	Water cooled
CAPACITY at 1250 R.P.M.	7¼ cu. ft. per minute
GOVERNOR (CUT-IN) FOR COMPRESSOR SET AT	85 lbs.
LUBRICATION	From engine

Air Reservoirs

NO. OF TANKS 3
TANK SIZE, SMALL (1) .... 7" x 24"
TANK SIZE, LARGE (2) .... 9½" x 27"

Front Brake Chambers

MAKE .... Westinghouse
SIZE .... 6"
MINIMUM STROKE .... ¾" to ⅞"
MAXIMUM STROKE .... 1¾"
MAXIMUM RECOMMENDED STROKE .... 1⅜"

Rear Brake Chambers

MAKE .... Westinghouse
SIZE .... 9"
MINIMUM STROKE .... ⅞" to 1"
MAXIMUM STROKE .... 2¼"
MAXIMUM RECOMMENDED STROKE .... 1¾"

Front Slack Adjusters

SIZE .... 6⅛"

Rear Slack Adjusters

SIZE .... 6½"

Application Valve

MAKE .... Westinghouse
TYPE .... D

Trailer Hand Control Valve

MAKE .... Westinghouse
TYPE 215304

Air Horn

MAKE .... Westinghouse
TYPE 217869

Air Horn Valve

MAKE .... Westinghouse
No. 216959

Trailer Hose Assembly

No. PROVIDED 1
LENGTH .... 162½"

Trailer Air Connections

MAKE .... Westinghouse
TYPE .... Self-locking and quickly detachable
NO. PROVIDED .... 2 at rear

SECTION 9: TOOLS

As all dis-assembling, adjustments and re-assembling can be accomplished with the standard tool equipment furnished with the truck or with tools included in mechanic's kits, and as repairs are usually made by the RENEWAL of worn or broken parts, the only special tools required are those of the machine type for surfacing brake blocks and refinishing brake drums.

Part No.	Description
*40-G-100	Grinder, Brake Lining; Universal, Portable Type
*40-L-15	Lathe, Brake Drum; Electric, Heavy Duty

**Federal Stock Number*

GROUP 13: WHEELS

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

The wheels are of the ventilated disk type, attached to the hub by ten studs.

The single front and dual rear wheels are of the same size and design, thereby providing for the interchange of wheels complete with tires to compensate for their unequal wear. The inner rear wheels are attached by long stud nuts or sleeves which have internal threads to fit the studs in the wheel hubs and are also threaded externally to fit the outer nuts which are screwed on them to retain the outer wheels. Similar double nuts are provided for the single front wheels studs, but only the long nuts are utilized for retaining the wheels, the outer nuts being screwed down until they jam at the bottom of the threads so that they do not come off due to vibration.

Both front and rear wheels are carried on two opposed, fully adjustable, tapered roller bearings. Correct lubrication and adjustment will prolong the life of these bearings.

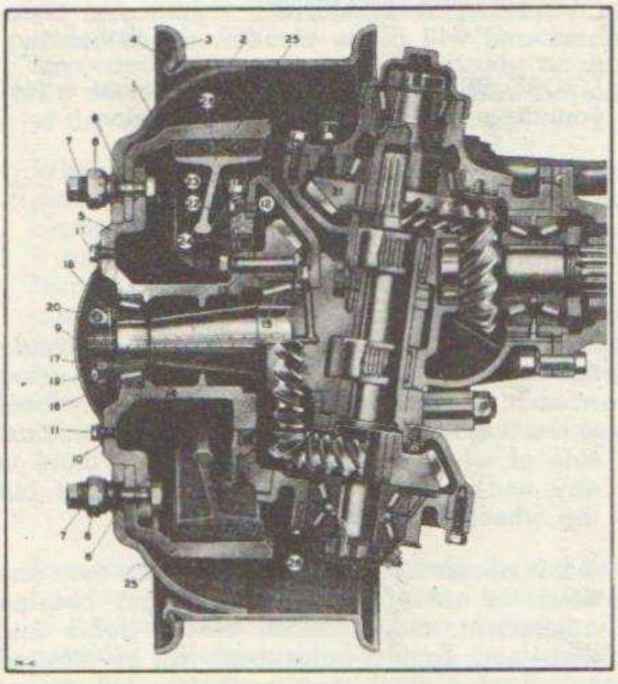


Fig. 1—Sectional View of Front Wheel

1. Wheel Disk
2. Wheel Rim
3. Side Ring
4. Locking Ring
5. Wheel Hub
6. Wheel Stud
7. Wheel Stud Nut
8. Outer Nut
9. Wheel Hub Cover
10. Hub Cover Gasket
11. Hub Cover Capscrew
12. 3rd Red. Bevel Gear
13. Gear Bolt
14. Steering Knuckle
15. Inner Hub Bearing
16. Outer Hub Bearing
17. Adjusting Nut
18. Adjusting Nut Washer
19. Adjusting Nut Lock Screw
20. Adjusting Nut Clamp Bolt
21. Lower Housing
22. Housing Cover
23. Breather
24. Oil Seal
25. Brake Drum
26. Brake Shoe

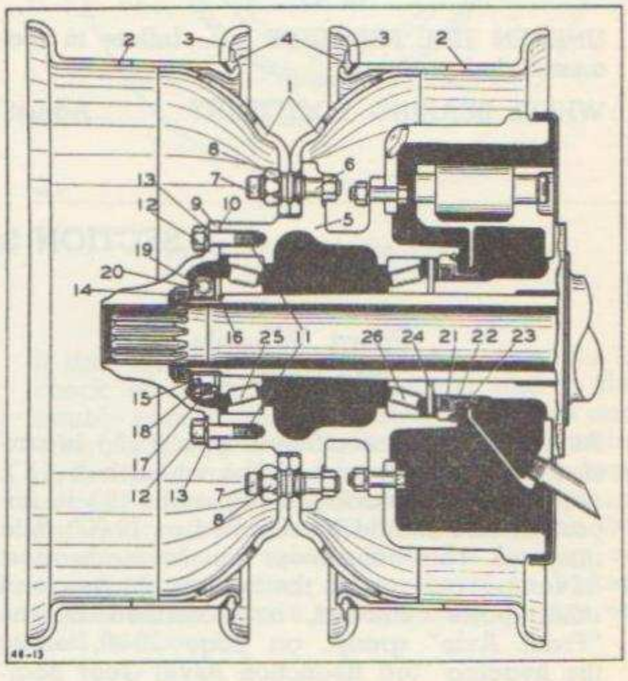


Fig. 2—Sectional View of Rear Wheel

1. Wheel Disk
2. Wheel Rim
3. Side Ring
4. Locking Ring
5. Wheel Hub
6. Wheel Stud
7. Wheel Stud Nut
8. Outer Nut
9. Drive Flange
10. Drive Flange Gasket
11. Drive Flange Stud
12. Flange Stud Nut
13. Nut Lockwasher
14. Outer Oil Seal
15. Adjusting Nut
16. Adjusting Nut Washer
17. Adjusting Nut Lock Screw
18. Screw Lock Wire
19. Adjusting Nut Clamp Bolt
20. Clamp Bolt Nut
21. Inner Oil Seal
22. Oil Seal Retainer
23. Retainer Snap Ring
24. Washer
25. Outer Hub Bearing
26. Inner Hub Bearing

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Shimmy

TIRES WORN UNEVENLY OR IMPROPERLY INFLATED........Match tires or inflate to recommended pressure. If uneven tire wear persists investigate wheel alignment settings and check for sprung axles.

TIRE AND WHEEL ASSEMBLY OUT OF BALANCE........Remove wheel, tire and hub assembly and balance statically on a balancing fixture.

BENT RIM OR WHEEL........Straighten or replace and remount correctly.

Wander

UNEVEN TIRE PRESSURE........Inflate to recommended pressure.

WHEEL BEARING TOO TIGHT........Adjust.

Excessive Tire Wear

IMPROPERLY INFLATED TIRES........Inflate to recommended pressure.

TIRE AND WHEEL ASSEMBLY OUT OF BALANCE........Remove wheel, tire and hub assembly and balance statically on a balancing fixture.

BENT RIM OR WHEEL........Straighten or replace and remount correctly.

GRABBING BRAKES........Adjust brakes.

Wheel Bearings

OVERHEATED BEARINGS........Indicates tightness and will cause wander, adjust bearing.

LOOSE BEARINGS........Will cause wheel pounding and shimmy, adjust bearing.

SECTION 3: ADJUSTMENTS

Front Wheels
(See Figure 1)

As the 3rd reduction bevel gear (12) is carried on the inner end of the wheel hub (5), adjustment of bearings (15) and (16) is important and should be checked at 18,000 mile intervals. This adjustment can be made most advantageously with the wheels, brakes and other parts removed, as described in the "Front Axle" group, on page 10-30, under the heading "3rd Reduction Bevel Gear Bearing Adjustment," and illustrated by Figure 52. To adjust the bearings on either side without removing the wheel, the following procedure should be followed:

Place jack under axle housing and raise wheel off the ground. The brakes must be fully released and free from dragging on brake drums or the adjustment of these bearings cannot be properly checked. Remove capscrews (11) and wheel hub cover (9), taking care not to damage gasket (10). Remove lock wire, adjusting nut clamp bolt (20) and adjusting nut lock screw (19). Turn adjusting nut (17) right hand one notch of adjusting nut washer (18) to tighten bearings, using wrench, Mack Part No. 17-AK-27. Turn wheel to test the drag of bearings. Then press against side of wheel to determine whether there is any end-play. No end-play should exist but the wheel should turn freely.

If it is necessary to turn the nut more than one notch in order to effect the proper bearing adjustment, the backlash of the gears and their tooth contact adjustment will be affected to a degree which requires their re-adjustment as described in the "Front Axle" group, on page 10-32, under the heading "3rd Reduction Bevel Gear Set Mesh Adjustment".

When the correct bearing adjustment is attained, replace and tighten clamp bolt (20). As the tightening of this bolt on the split nut may tighten the bearing adjustment, a final test should be made before inserting the lock screw (19) and securing it and the nut on bolt (20) with a lock wire.

Replace gasket (10) and attach hub cover (9) with capscrews (11).

Rear Wheels
(See Figure 2)

To adjust any one of the four sets of wheel bearings, place a jack under the axle housing back of the bearings to be adjusted and raise the wheel off the ground. The brakes must be fully released and free from dragging on brake drums in order to check the wheel bearing adjustment.

Remove nuts (12) and lockwashers (13) from studs (11) and remove drive flange (9) and oil seal (14), taking care not to damage it or gasket (10). Withdraw axle shaft. Remove lock wire from nut (20) and lock screw (17) and remove adjusting nut clamp bolt (19) and screw (17). Spin the wheel slowly and tighten the adjusting nut (15) with wrench, Mack Part No. 17-T-275, until the bearings bind slightly. Then back off the adjusting nut (15) two to three notches of the adjusting nut washer (16), in order to provide an end-play of .002" to .005", which can be measured by placing a dial indicator against the wheel hub and pressing against the side of the wheel.

When the correct adjustment is attained, replace lock screw (17) and adjusting nut clamp bolt (19), tighten nut (20) and secure it and also screw (17) with lock wire (18). Inspect outer oil seal (14) in the drive flange and renew it if unfit for further use. Replace drive flange gasket (10), or renew it unless in perfect condition. Then put drive flange (9), lockwashers (13) and nuts (12) on studs (11) and tighten nuts to secure flange.

Tires

In mounting the dual rear wheels, they should be placed on the studs so that the valve stems of the inner and outer tires are diametrically opposite, as shown by Figure 3. In that relation both valves are accessible for inflation and the wheels are in balance.

Tires should be checked twice weekly for correct inflation pressure. Running tires a short distance with either too much or too little pressure results in wear equivalent to that of many miles of running with the correct pressure.

The variation in wearing surfaces due to different degrees of inflation is indicated by Figure 4.

See "Section 8: Specifications" for pressure to use.

Daily inspection and removal from tires and from between duals should be made of such foreign matter as nails, glass or stones. Also all missing valve caps must be replaced. It is important that valve caps be replaced on the stems after inflation operation to insure a positive operating valve core.

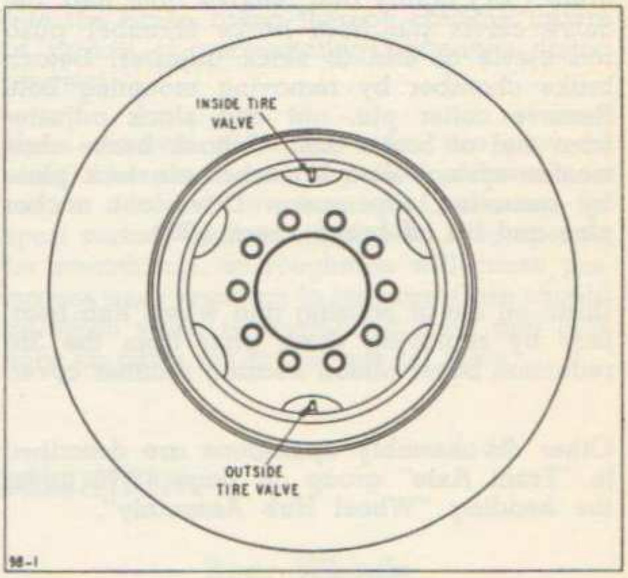


Fig. 3—Tire Valve Location

If tires wear unevenly it will be advisable to check wheel alignment settings, and if the trouble persists, to check for sprung axles and other parts affecting alignment. Better tire mileage will be obtained by interchanging tires to compensate for slight unevenness of wear. For safety always install the new tires on the front wheels. If vehicle is to be laid up or stored for some time, frame should be jacked up so as to remove weight from springs as well as tires.

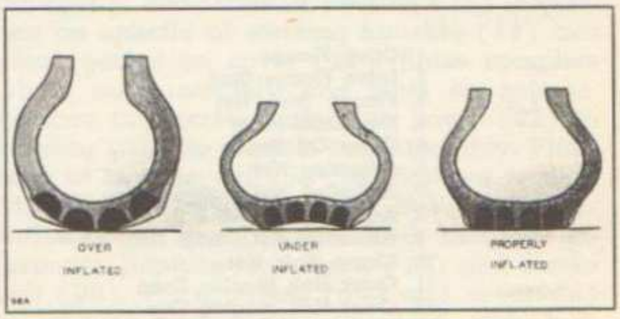


Fig. 4—Tire Inflation Diagram

SECTION 4: DIS-ASSEMBLY

Front Wheels

(See Figure 1)

Remove wheel stud nuts (7). Tap wheel rim (2) lightly and remove from hub. Tap brake drum (25) lightly and remove from hub. Remove clevis pin from brake chamber push rod clevis at end of slack adjuster. Detach brake chamber by removing mounting bolt. Remove cotter pin, nut and slack adjuster from end of brake cam. Unhook brake shoe tension spring. Detach anchor pin lock plate by removing cap screw. Drive out anchor pins and lift off brake shoes (26).

Drain oil out of housing and wheel hub bearings by removing drain plug from the 3rd reduction bevel pinion bearing retainer cover.

Other dis-assembly operations are described in "Front Axle" group on page 10-18 under the heading "Wheel Hub Assembly".

Rear Wheels

(See Figure 2)

With rear axle on jack, remove drive flange nuts (12) and lock washers (13). Tap drive flange between the stud bosses to break seal between flange (9) and gasket (10), being careful not to damage oil seal (14). Remove lock wire (18), loosen lock screw (17) and bearing adjusting nut clamp bolt nut (20) on bolt (19). Remove adjusting nut (15) and bearing adjusting nut washer (16). Remove axle shaft from axle housing. Slide the wheel, brake drum and hub assembly from the spindle. Care should be taken that outer bearing (25) does not fall from spindle when pulling off the complete wheel assembly. Do not let wheel assembly fall on spindle or oil seal (21) will be damaged. Remove the inner oil seal retainer snap ring (23) and oil seal retainer (22), oil seal (21) and washer (24). Inner bearing (26) can now be removed. Cups of bearings (25) and (26) should be removed only when renewal is necessary.

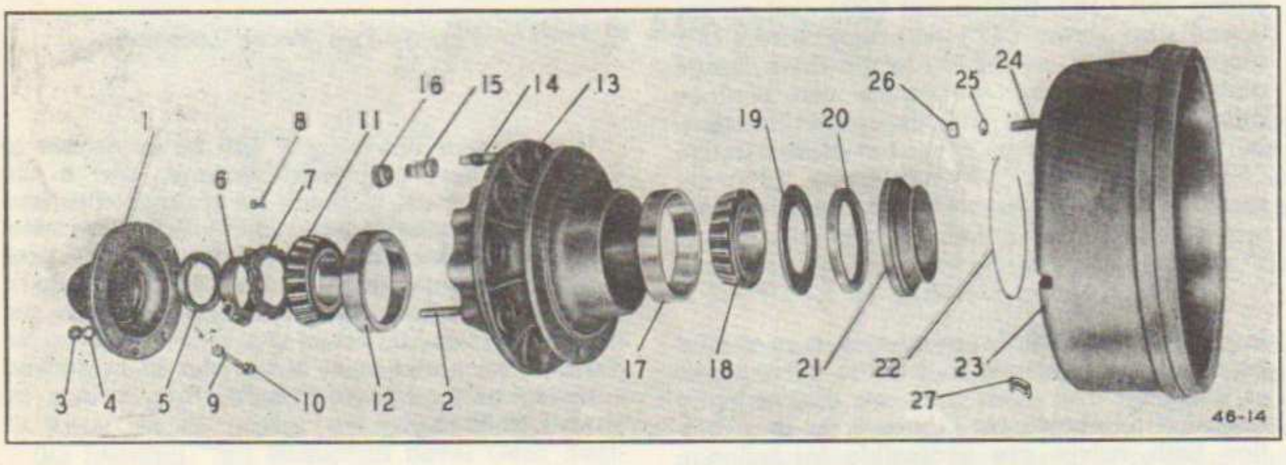


Fig. 5—Exploded View of Rear Wheel Hub, Bearing Parts, Drive Flange and Brake Drum

1. Drive Flange
2. Drive Flange Stud
3. Flange Stud Nut
4. Nut Lockwasher
5. Outer Oil Seal
6. Adjusting Nut
7. Adjusting Nut Washer
8. Adjusting Nut Lock Screw
9. Adjusting Nut Clamp Bolt
10. Clamp Bolt Nut
11. Outer Hub Bearing Cone
12. Outer Hub Bearing Cup
13. Wheel Hub
14. Wheel Stud
15. Wheel Stud Nut
16. Outer Nut
17. Inner Hub Bearing Cup
18. Inner Hub Bearing Cone
19. Washer
20. Inner Oil Seal
21. Inner Oil Seal
22. Retainer Snap Ring
23. Brake Drum
24. Brake Drum Bolt
25. Brake Drum Nut
26. Nut Lockwasher
27. Inspection Hole Cover

SECTION 5: REPAIRS

Wheels

Wheels often become out of balance due to hitting curbs and from other accidents. This will cause tramp and shimmy, especially in front wheels.

It is important that the wheel assembly be considered as a unit, which includes hub, drum, tire and tube, and complete assembly be removed and properly balanced. It can be balanced statically on a balancing fixture.

Brake drum bolting face must be absolutely true with relation to bearing bore. When assembling drum to wheel be sure surfaces are free from dirt or chips. After drum is bolted to wheel, check must be made to see if drum runs true. Drum can be bored while assembled to wheel on a drum boring lathe.

Oil Seals

The oil seals should be periodically inspected and renewed if undue wear is apparent. If the seals are allowed to remain when worn out, the lubricant will leak past the seal and get into the brake lining thereby causing failure of brakes or necessitating premature lining renewal.

Upon removal of wheel hubs, use new oil seals when re-assembling. Soak oil seals in engine oil for a few hours before using. Inspect surface against which seal is to operate for smoothness, as roughness will cause premature wear resulting in leakage. Care should be taken when re-assembling front and rear hubs on axles not to damage oil seals.

SECTION 6: LUBRICATION

Front Wheels

The front wheel bearings are lubricated by a continuous flow of gear oil carried by gears from the lower oil reservoir, see page 10-9 of "Front Axle" group. Note especially that these bearings are NOT lubricated with wheel bearing grease as in the case of the rear wheel bearings. For all other lubrication points of the wheel drive units, see the "Lubrication" group of this manual.

Rear Wheels

The rear wheel bearings should be lubricated with wheel bearing grease as specified in the "Lubrication" group. Remove wheel hubs and wash all old grease thoroly from all parts including bearing rollers. Fill hub cavity about half-full only, not more, of new grease; then repack bearing cones either by hand or preferably with a grease packing tool. See "Lubrication" group for seasonal type of grease to use.

SECTION 7: RE-ASSEMBLY

Front Wheels
(See Figure 1)

Attach breather (23) to housing cover (22). Press cup of bearing (16) into hub (5) providing it is necessary to make renewal. Renew oil seal (24) if the old seal is defective. Attach brake actuating cam to housing cover (22) and slide cover on hub. Attach bevel gear (12) and shims to hub (5), and tighten securely with bolts (13). Press cup of bearing (15) in bevel gear in the event a renewal is necessary. Slide cone of bearing (15) in position on spindle of steering knuckle (14) and place gasket on cover (22). Raise complete wheel hub assembly and slide on spindle. Replace cap screws attaching cover (22) to housing (21), to support hub assembly. Place cone of bearing (16) in cup. Replace washer (18) and adjusting nut (17). See "Section 3: Adjustments" for proper wheel bearing adjustment. Replace lock screw (19) and clamp bolt (20). Place gasket (10) and cover (9) in position and secure in place with lock washers and capscrews (11). Seat brake shoes

(26) in position and secure with anchor pins. Attach anchor pin lock plate and capscrew. Connect brake shoe tension spring; shoes are now in correct operating position. Place slack adjuster on brake cam end and secure with nut and cotter pin. Attach brake chamber to housing using mounting bolt. Secure clevis attached to brake chamber rod to slack adjuster arm. Place brake drum (25) and wheel (1) in position on hub studs. Tighten securely with wheel stud nuts (7). Replace drain plug in lower bevel pinion bearing retainer and refill to level with proper oil. See "Lubrication" group for grade of oil to be used.

Rear Wheels and Hub

(See Figure 2)

NOTE: Check bearings for sufficient grease and repack them if necessary. See "Lubrication" group for type of wheel bearing grease to use.

Press new cups for bearings (25) and (26) into hub, providing it is necessary to renew them. Follow in succession with the cone of inner bearing (26), oil seal washer (24), oil seal (21), oil seal retainer (22) and oil seal retainer snap ring (23). Raise hub, drum and wheel assembly to position and slide onto spindle taking care not to damage oil seal or bearing. Place outer bearing (25) on spindle, put on bearing adjusting washer (16) and bearing adjusting nut (15). See "Section 3: Adjustments". Tighten bearing adjusting nut clamp screw nut (20). Place axle shaft in axle housing and place drive flange gasket (10) and drive flange (9), taking care not to damage oil seal (14). Place lock washers (13) on drive flange studs (11) and tighten down flange with flange stud nuts (12).

SECTION 8: SPECIFICATIONS

Wheels

MAKE	Budd Wheel Co.
TYPE WHEELS	Disk
TYPE RIMS	R
WHEEL SIZE	24" x 9-10"
BOLT CIRCLE	13.189"
OFFSET	6¾"

Locking Rings

SIZE	24" x 9-10"
TYPE	R

Wheel Studs

NUMBER FOR EACH WHEEL	10
THREAD SIZE	¾"-16

Bearings

MAKE	Timken
TYPE	Tapered roller
FRONT WHEEL, INNER	Cup 5735, Cone 5760
FRONT WHEEL, OUTER	Cup 522, Cone 528A
REAR WHEEL, INNER	Cup 772, Cone 780
REAR WHEEL, OUTER	Cup 772, Cone 776

Tires and Tubes

TYPE	Pneumatic, balloon, 14-ply
SIZE	12.00-24"
AIR PRESSURE	Front: 80 lbs. Rear: 65 lbs.

Tube Valve Stems

TYPE	Right-Angle Offset, T.R.78F/12

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
17-AK-27	Wrench, Front Wheel Bearing Adjusting	$5.25	Mack Mfg. Corp.
17-T-275	Wrench, Rear Wheel Bearing Adjusting	7.90	Mack Mfg. Corp.

GROUP 14: STEERING

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Steering Gear

The steering gear is the roller mounted twin-lever type of cam and lever design. The cam is integrally welded to the steering wheel tube, and is mounted between two ball bearings which are adjustable by means of shims between the housing and upper plate.

Two studs, mounted in tapered roller bearings in the lever shaft, engage the cam thread with a rolling contact. Clearance between these studs and the cam can be quickly and accurately adjusted by means of a screw and lock nut which are easily accessible on the side cover. Also, the stud roller bearing units in the lever shaft are adjustable. The operating action of the gear is extremely simple. Turning the steering tube by means of the steering wheel, rolls the tapered studs of the lever staft thru the groove of the cam thus rotating the lever shaft and providing angular movement of the steering arm. Two studs engage the same for normal straight-ahead driving thus reducing the unit pressure where most of the steering action occurs. As the steering action moves into the limit of turning range one of the studs disengages the cam (moves out the end of the groove) and the other stud moves into the position (above the cam axis) at which the effective leverage increases greatly.

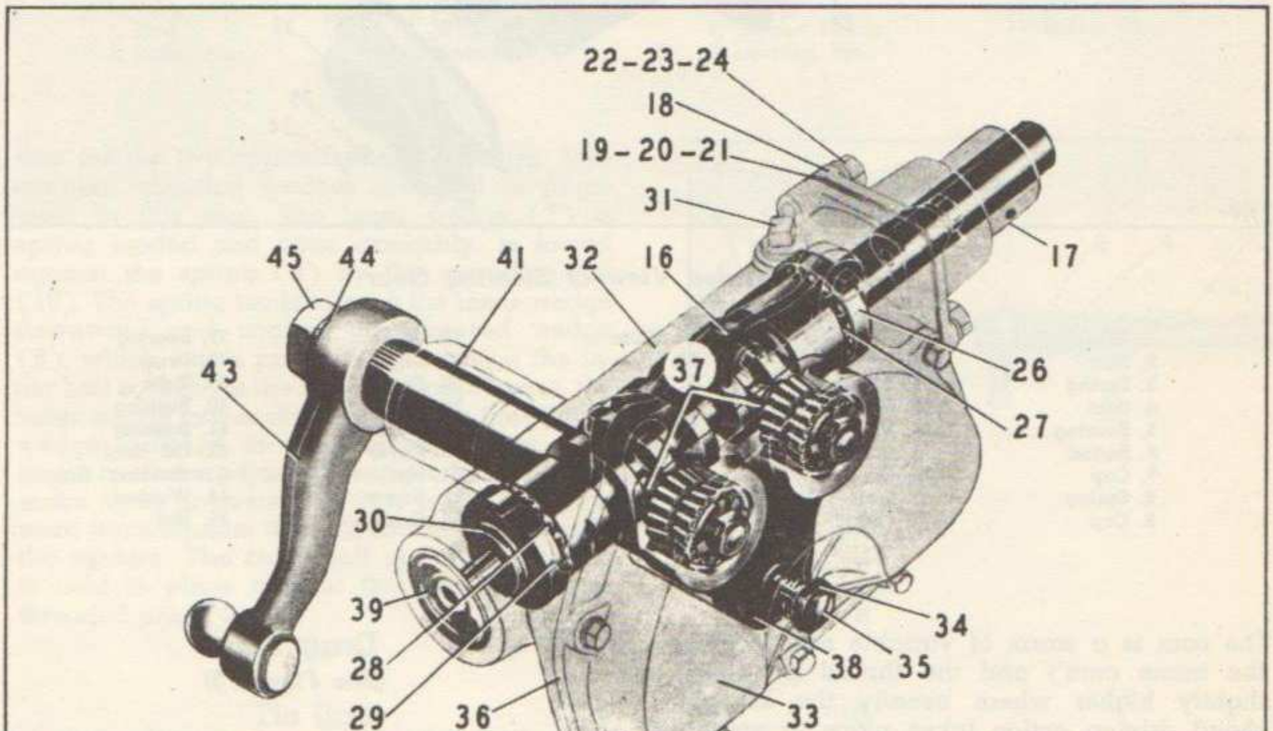


Fig. 1—Phantom View of Steering Gear

16. Cam	22. Stud	29. Cup	34. Nut	39. Tube
17. Jacket	23. Nut	30. Ring	35. Screw	41. Bushing
18. Cover Plate	24. Washer	31. Plug	36. Gasket	43. Steering Arm
19. Shim	26. Cup	32. Housing	37. Bearing	44. Lockwasher
20. Shim	27. Bearing	33. Cover	38. Lever	45. Nut
21. Shim	28. Bearing			

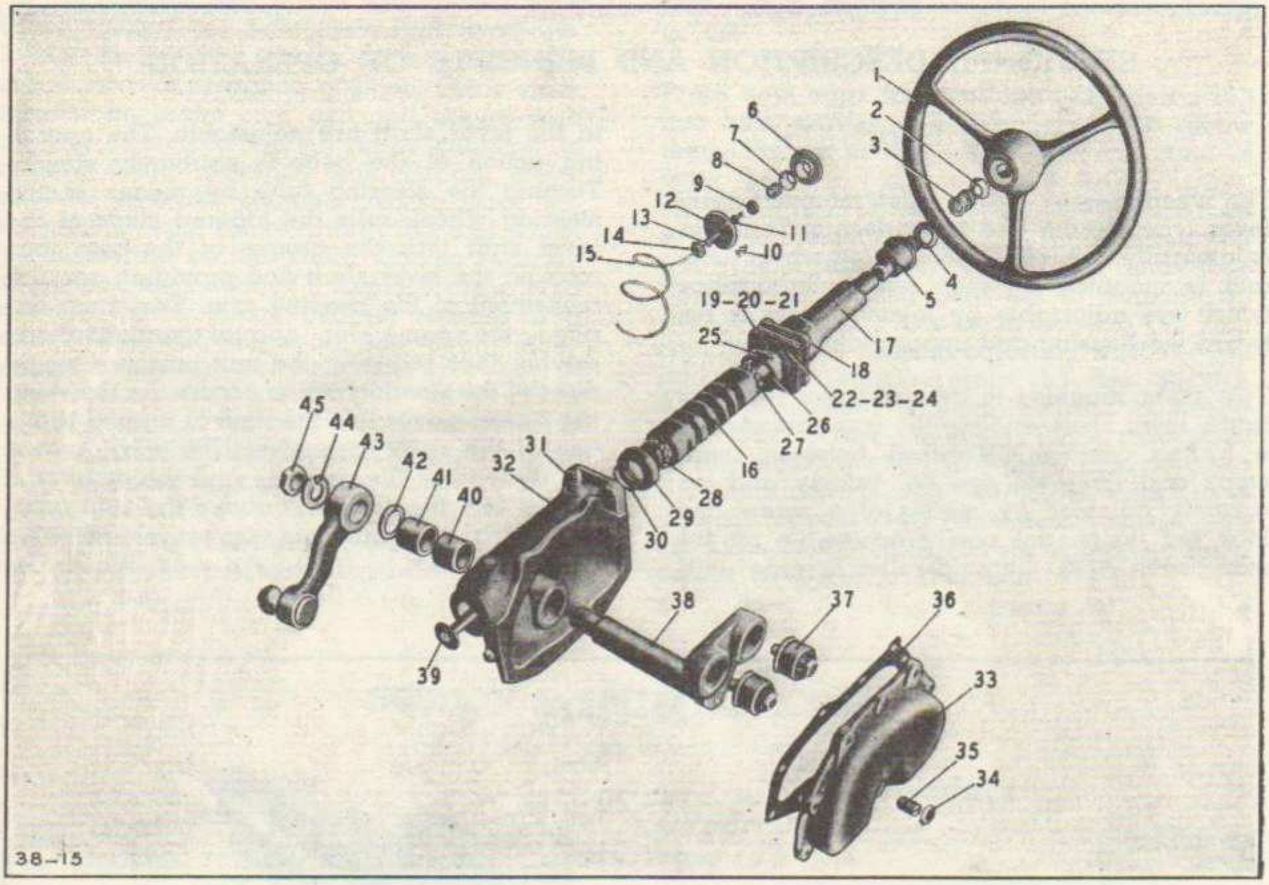


Fig. 2—Exploded View of Steering Gear

1. Wheel	10. Screw	19. Shim	28. Bearing	37. Bearing
2. Nut	11. Ferrule	20. Shim	29. Cup	38. Lever
3. Spring	12. Segment	21. Shim	30. Ring	39. Tube
4. Seat	13. Spring	22. Stud	31. Plug	40. Bushing
5. Bearing	14. Washer	23. Nut	32. Housing	41. Bushing
6. Button	15. Cable	24. Washer	33. Cover	42. Oil Seal
7. Cup	16. Cam	25. Ring	34. Nut	43. Steering Arm
8. Spring	17. Jacket Tube	26. Cup	35. Screw	44. Washer
9. Cap	18. Cover	27. Bearing	36. Gasket	45. Nut

The cam is a worm of variable ratio (hence the name cam) and the thread is ground slightly higher where usually the straight-ahead driving action takes place to provide closer adjustment of the clearance between the studs and the cam at that point of steering action.

The lever shaft is mounted in two bronze bushings. An oil seal is provided on the shaft at the outer end.

An anti-friction bearing is used in the upper end of the jacket tube to support the upper end of the wheel tube.

Drag Link
(See Figure 3)

The drag link is of seamless tubing with ball and socket ends. The wear adjustment for the ball and sockets is automatic, a spring loaded opposed wedge system maintains a constant pressure on the ball studs. The construction of the take-up feature is shown in the illustration on next page.

Both ends of the drag link are identical except for the location of the lubricating fittings. In each end is a fixed plug (11) which acts as a

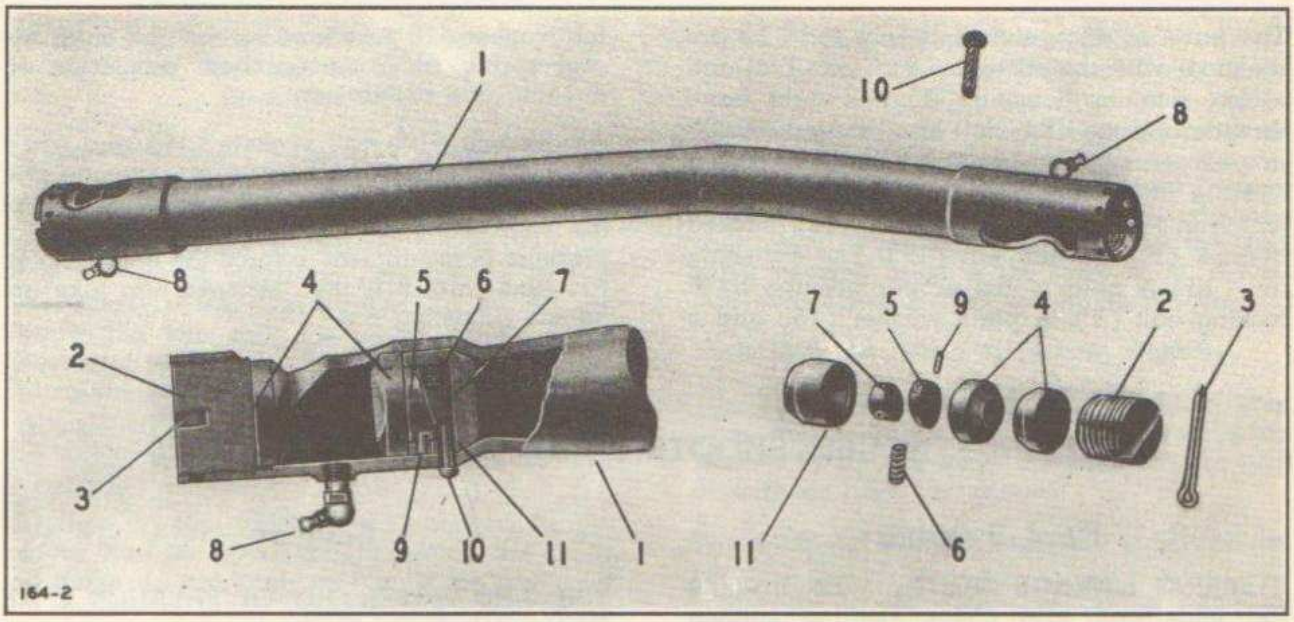


Fig. 3—Sectional and Exploded Views of Drag Link

1. Tube
2. Plug
3. Cotter Pin
4. Socket
5. Wedge
6. Spring
7. Wedge
8. Grease Fitting
9. Locating Pin
10. Adjusting Pin
11. Socket Plug

seat for the two opposed sliding wedges. Two circular adjusting wedges are held in alignment in this seat. The inner wedge (7) is spring loaded and upon assembly, is forced against the spring (6) by the extruding pin (10). The spring tends to push the inner wedge downward and against the opposed wedge (5), which exerts pressure outward on the inner ball socket. As the ball and socket wear, the inner wedge moves down and forces the sliding wedge outward to take up the wear. The angle on these adjusting wedges is such as to make them irreversible; that is, a large inward force against the ball socket will not shift the wedges. The outer half of the ball socket is held in place against the ball stud by a threaded plug (2).

Tie Rod

(See Figure 4)

The tie rod is of the conventional spring-loaded, ball-and-socket type which requires very little adjustment to compensate for wear. The right hand tie-rod end is tapped with a right hand thread and the left hand end is tapped with a left hand thread. This arrangement makes it possible to adjust the toe-in without removing the ends from the cross-steering levers.

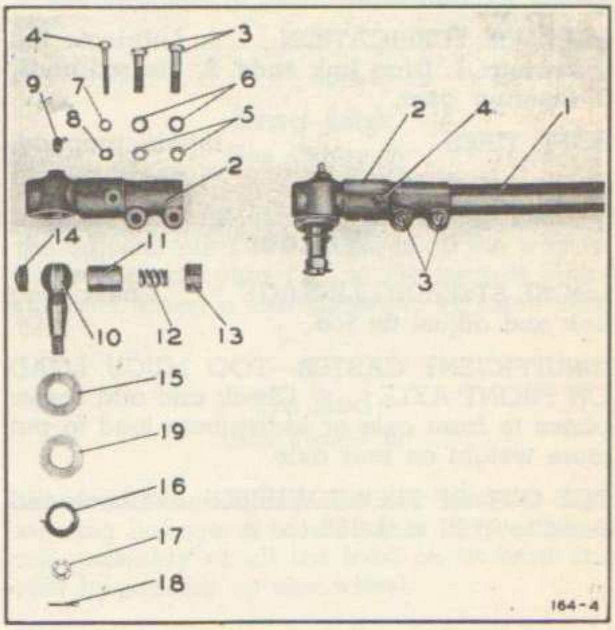


Fig. 4—Exploded View of Tie Rod

1. Tie Rod
2. Ball & Socket Retainer
3. Clamp Bolt
4. Lock Bolt
5. Clamp Bolt Nut
6. Lockwasher
7. Lock Bolt Lockwasher
8. Lock Bolt Nut
9. Grease Fitting
10. Ball Stud
11. Inner Socket
12. Spring
13. Adjusting Nut
14. Outer Socket
15. Washer
16. Seal Spring
17. Ball Shaft Nut
18. Cotter Pin
19. Felt Washer

The parts of each end of the tie rod (1) are identical with the exception that one ball and socket retainer housing (2) has right hand threads and the other left hand threads. Within each retainer housing (2) is an outer socket (14), a ball (10), and an inner socket (11) which is positioned by a spring (12) backed against an adjusting nut (13). The adjusting nut (13) is held in the proper position by a locking bolt (4). A plain washer (15) and a felt washer (19) retained on the ball shaft by seal spring (16) prevent both admission of dirt and loss of lubricant.

As the ball (10) and sockets (11) and (14) wear, the spring (16) exerts pressure on the inner socket (11) and forces it outward. When the wear becomes excessive and the spring pressure is insufficient to force the inner socket (11) outward, it is then necessary to take up on the adjusting nut (13).

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Hard Steering

STEERING LINKAGE TIGHT........Readjust tie rod ends and also check steering column bushing.

STEERING COLUMN SPRUNG........Loosen steering column bracket and shim into correct alignment.

STEERING COLUMN BRACKET CLAMP TOO TIGHT........Loosen.

LACK OF LUBRICATION........Lubricate the following: 1. Drag link ends. 2. Tie rod ends. 3. Steering gear.

SOFT TIRES........Inflate properly.

Wander

LOOSE STEERING LINKAGE........Check drag link and adjust tie rod.

INSUFFICIENT CASTER—TOO MUCH LOAD ON FRONT AXLE........Check and add caster plates to front axle or redistribute load to put more weight on rear axle.

TOE OUT OF FRONT WHEELS........Check and reset to 1/8" to 3/16" toe-in.

Shimmy

TIRE AND WHEEL OUT OF BALANCE........Test and balance.

LOOSE STEERING LINKAGE........Check and adjust.

WORN KING PIN........Check and renew.

WORN STEERING GEAR........Check and adjust.

Drag Link

(See Figure 3)

LOOSE BALL STUDS—PIN (10) PROJECTS ¼" FROM TUBE........Tighten plug (2) and tap in pin (10).

Tie Rod

(See Figure 4)

BALL STUDS LOOSE IN TIE ROD ENDS
Remove ends and tighten. Adjust toe in.

INCORRECT TOE IN—BENT TIE ROD
Remove tie rod and straighten, cold. Adjust toe in.

SECTION 3: ADJUSTMENTS

Steering Gear

When making adjustments it is advisable to free the gear of all load by disconnecting the drag link from the steering arm and loosening the steering column support bracket in cab.

If the ball thrust bearings on the cam must be adjusted, make this adjustment before making the adjustment for minimum backlash of tapered studs in cam groove.

Adjustment of Ball Thrust Bearings on Cam (See Figure 1)

Adjust to a barely perceptible drag but allow the steering wheel to turn freely. The drag may be from one to two pounds pull.

Before making this adjustment, loosen the housing side cover adjusting screw (35) to free the studs in the cam groove. To adjust, unscrew the four nuts (23) and move up the housing upper cover (18) to permit the removal of shims (19, 20 and 21).

Remove one or more thin shims as required. In order to remove or to add shims cut thru one side.

Tighten all four nuts (23). Caution:—As the cover must be drawn snugly against the shims to make a tight joint, care must be taken not to remove too many shims, which would cause the ball races to be dented by excessive pressure.

Remove or add shims, or do both to get the necessary combination to obtain the correct adjustment and a tight assembly.

Adjustment for Minimum Backlash of Tapered Studs in Cam Groove

Adjust so that a very slight drag is felt thru the mid-position when turning the steering wheel slowly from one extreme position to the other.

Backlash of the studs in the cam groove shows up as end play of the lever shaft, also as backlash at the steering wheel and at the ball stud on steering arm.

The groove is purposely cut shallower in the mid-position range of stud travel to provide close adjustment where the straight-ahead-driving action takes place. It also makes this close adjustment possible after normal wear occurs without causing a bind elsewhere.

Adjust at the mid-position of stud travel only and not at positions off straight-ahead. Backlash at these turn positions is not objectionable. In making adjustments, the sequence shown below should be followed:

Tighten side cover adjusting screw (35) until the adjustment is correct, then tighten the lock nut (34) and then give the gear a final test.

Secure the gear at all points loosened prior to making the adjustment.

Check tightness of mounting bracket bolts and nuts, steering gear arm on lever shaft and the nut and lock washer (44).

Adjustment of Stud-Roller Bearing Units

The roller bearings should be preloaded at all times. Each stud should turn with a drag of 5 to 11 pound-inches. New replacement bearing units should be set tighter than when adjusting used units. When necessary to adjust the stud-roller bearing units in the lever shaft, the instructions listed below should be followed:

Straighten out prong of locking washer.

Tighten nut as required, while holding stud from turning, either by spanner wrench on washer or by clamping the stud. Do not nick or burr the bearing surface.

Tap each end of the stud lightly to test adjustment.

Lock each adjusting nut by bending up the prong of the locking washer which is at a right angle with one of its flat sides. If a used washer is utilized, cut off the prong previously employed, to avoid the danger of its breaking due to repeated bending.

Wash bearings in kerosene and make a final test.

Drag Link
(See Figure 3)

Tighten plug (2) and at the same time tap the adjuster pin (10) until it is all the way in. Then back off plug (2) to the nearest cotter pin hole. Insert a new cotter pin (3) and lock.

Tie Rod
(See Figure 4)

When making adjustments for loose or tight steering linkage, it is advisable to free the tie rod assembly of all the load on at least one side by jacking up one wheel.

To adjust for wear of the ball studs and sockets, loosen clamp bolts (3) and screw tie rod (1) out of ball and socket retainers (2). Remove the lock bolts (4) and tighten the adjusting nuts (13) until they compress the socket spring solid. Then back the nuts (13) off one slot and replace the lock bolts (4).

Caution: After this adjustment always check toe-in.

SECTION 4: DIS-ASSEMBLY

Steering Gear
(See Figure 2)

Before removing the steering arm (43), preparatory to removing the steering gear from the chassis, note the marks on the face of the steering arm hub and the end of the steering arm shaft, to facilitate re-assembly of the arm on the shaft in the same position. Do not hammer off arm without support against end of shaft. Use arm puller if possible. If necessary to remove arm with hammer or wedge, light blows are more effective.

Remove horn button from steering wheel by gripping button with downward pressure of fingers and twisting either right or left. Unscrew three screws to remove base plate and cable assembly. Remove wheel nut, steering wheel, and upper bearing spring and seat.

Loosen lock nut (34) and unscrew adjusting screw (35) a few turns.

Remove side cover screws and lock washers, and remove side cover. This will permit removal of lever shaft.

Remove upper cover plate stud nut (23) and lockwashers (24).

Remove upper cover plate with jacket tube and cam and wheel tube assembly from housing.

Drag Link
(See Figure 3)

Remove the plug (2) and the outer socket (4). Then the ball stud may be taken out. Pull out the adjusting pin (10), which is driven into the inner wedge (7). Then tap the end of the link with a block of wood and the recessed plug (11) will slide out with the wedges (5) and (7).

Tie Rod
(See Figure 4)

To take tie rod end apart, follow the adjustment procedure, see "Section 3: Adjustments"; but instead of tightening the adjusting nuts (13), remove them. Then the socket springs (12), the inner (11) and outer sockets (14) and the ball stud (10) will fall out.

SECTION 5: REPAIRS

Steering Gear

NOTE: Before re-assembling, all parts should be thoroughly cleaned with suitable solvent to remove all traces of dirt and oil, and inspected carefully for cracks or worn surfaces. Parts showing excessive wear should be renewed. Most gaskets and oil seals are preferably renewed. All cotter pins, lock washers and locking wires must be renewed to avoid failure. All parts especially plain bearings, ball and roller type bearings, gears, thrust washers, oil seals, splines, screw threads, etc., should be generously coated with oil. This will insure immediate lubrication of these parts and prevent seizure when first starting.

Inspect cam threads for brinelling from abnormally heavy blows, chipping and scoring, also the ball races on the ends of the cam and the separate ball cup for brinelling, pitting and deep wear. Cam thread is copper plated for initial service. Disregard worn-off condition.

Inspect upper end of wheel tube for bearing wear.

Inspect lever shaft at all bearing points for wear, also splines for twisted condition and for wear from a loose steering arm, also threads for stripping.

Inspect studs on lever shaft for flat spots or chipping. Disregard small flat spots if satisfactory adjustment can be obtained.

Inspect adjustment of stud roller bearing units in lever shaft. If unit feels unduly rough, disassemble by removing nut and pressing stud out of cone to inspect cone and cups.

Inspect lever shaft bushings in housing for scoring.

Inspect fit of lever shaft in bushings.

Inspect the bearing in top end of jacket tube.

Inspect condition of oil seal in housing.

Inspect steering arm ball stud for wear.

SECTION 6: LUBRICATION

Steering Gear

When re-assembling the unit be sure to generously coat all parts with oil, so that they will have immediate lubrication when first starting.

No other lubrication is required during re-assembly.

For other lubricating instructions, see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

Steering Gear

Assemble cam, wheel tube and bearing assembly, seating the lower bearing ball cup solidly in the housing.

With adjusting shims in place on top of housing, assemble upper cover plate and jacket tube assembly and adjust cam bearings.

Place lever shaft and stud roller bearing unit assembly in the housing, first making sure there are no burrs to damage the bushings. Check fit of shaft in bushings. With gasket in place assemble side cover and make adjustment for minimum backlash of studs in cam groove.

Assemble upper bearing spring and spring seat, steering wheel, and wheel nut. Assemble horn button parts and cable in reverse order of removal.

Steering Gear Mounting

Steering gear bracket is flanged and integral with the steering gear housing. It is attached to the outside of the frame by three body-bound bolts.

The upper rear bolt is fastened to an angle attached to the top flange of the side rail. These three mounting bolts are set in the rear bracket and side rail at a slight angle. Bevel washers have been supplied to provide a square seat for the nuts.

To avoid misalignment of the steering column, when installing the steering gear, it is important that the three bevel washers are in their correct position before tightening the bolts. Proceed as follows:

Insert bolts in steering gear mounting bracket but do not tighten.

Insert and tighten bolts on steering column bracket.

See that all bevel washers are in correct position, then tighten mounting bolts.

Steering Column Alignment

With all supporting brackets clamped tight, turn steering wheel to see if any stiffness exists. If so, the gear is adjusted too tight or the steering column is out of alignment. The steering column must not be sprung in any direction.

Steering Gear Correction With Front Wheels

The steering gear should be in its mid-position When the wheels are in the straight-ahead position. To check, turn the front wheels to the right as far as possible, then rotate the wheel in the opposite direction as far as possible and note the total number of turns. Turn the wheel back just one-half of this total movement, thus placing the gear in mid-position, at which point the front wheels should be in the straight-ahead position. If not, it may be necessary to remove the steering arm and shift it one spline on the shaft.

Drag Link
(See Figure 3)

Replace the recessed plug (11), making sure that the hole for the adjusting pin, (10) lines up with the hole in the tube. Insert the spring loaded wedge (7) with the thin edge toward the pin and the spring in the cavity at the other end. The square face of the wedge should rest against the end of the seat. Then place the adjusting pin (10) thru the hole in the tube and tap it into the hole in the wedge (7). The sliding wedge (5) is assembled with the slot over the locating pin (9) and the square face against the recessed plug (11). The threaded plug (2) is screwed in about three-quarters of the way and both halves of the sockets (4) are put in place thru the ball stud opening. The end is then slipped over the ball stud and the plug screwed in until snug. Then tighten the plug and at the same time tap the adjuster pin (10) until it is all the way in. Then back off the plug (2) to the nearest cotter pin hole. Insert a new cotter pin (3) and lock.

Tie Rod
(See Figure 4)

Place the outer socket (14) in position; then insert the ball stud (10) in the retainer (2). Slide the inner socket (11) in from the open end. The spring (12) is then put in place and the nut (13) tightened against it. Then the end is adjusted, see "Section 3: Adjustments".

SECTION 8: SPECIFICATIONS

Steering Gear

TYPE .... Roller Mounted Twin-Lever (Cam and Lever Design)

GEAR RATIO .... Straight-Ahead Driving 23 to 1, Parking 27 to 1.

MAKE .... Ross

MODEL T-74

CAM THRUST BEARINGS .... 1 to 2 pounds pull on rim of 22" diameter wheel.

BACKLASH OF TAPERED STUDS IN CAM GROOVE .... Very slight drag over tightest spot.

STUD-ROLLER BEARING UNITS .... 5 to 11 lb.-in. torque.

WHEEL TUBE BEARING .... Spring tension of ball type, no adjustment on roller type.

CLEARANCE BETWEEN LEVER SHAFT AND BUSHINGS .... .0005" to .003".

Steering Gear Bearings

CAM .... Ball.
STUD-ROLLER BEARING UNITS .... Tapered Roller.
LEVER SHAFT .... Bushings.
WHEEL TUBE .... Roller.

Steering Wheel

DIAMETER .... 22"

Drag Link

TYPE .... Sliding Wedge take up.
ADJUSTMENT .... Threaded plug.
WEAR TAKE UP .... Automatic.
TUBE .... Seamless steel.

Tie Rod

TYPE .... Seamless Steel Tube.
WEAR TAKE UP .... Adjustment Nut.

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
C-410	Puller, Steering Arm	$8.75	Miller Tool Mfg. Co.

GROUP 15: FRAME

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Frame
(See Figure 7)

The chief structural member of the chassis, the frame, is composed of two parallel side rails kept in alignment by a series of properly spaced alligator, box and channel type cross members. The side rails are heat treated alloy steel pressed channels.

Draw Bar and Pintle Hook
(See Figures 1 and 6)

The pintle hook is attached to the rear cross member of the frame. For towing guns there is an extra heavy universal type draw bar which is strictly interchangeable with the pintle and may be quickly installed in the pintle hook housing. The arrangement consists of a cast steel housing rigidly connected to an

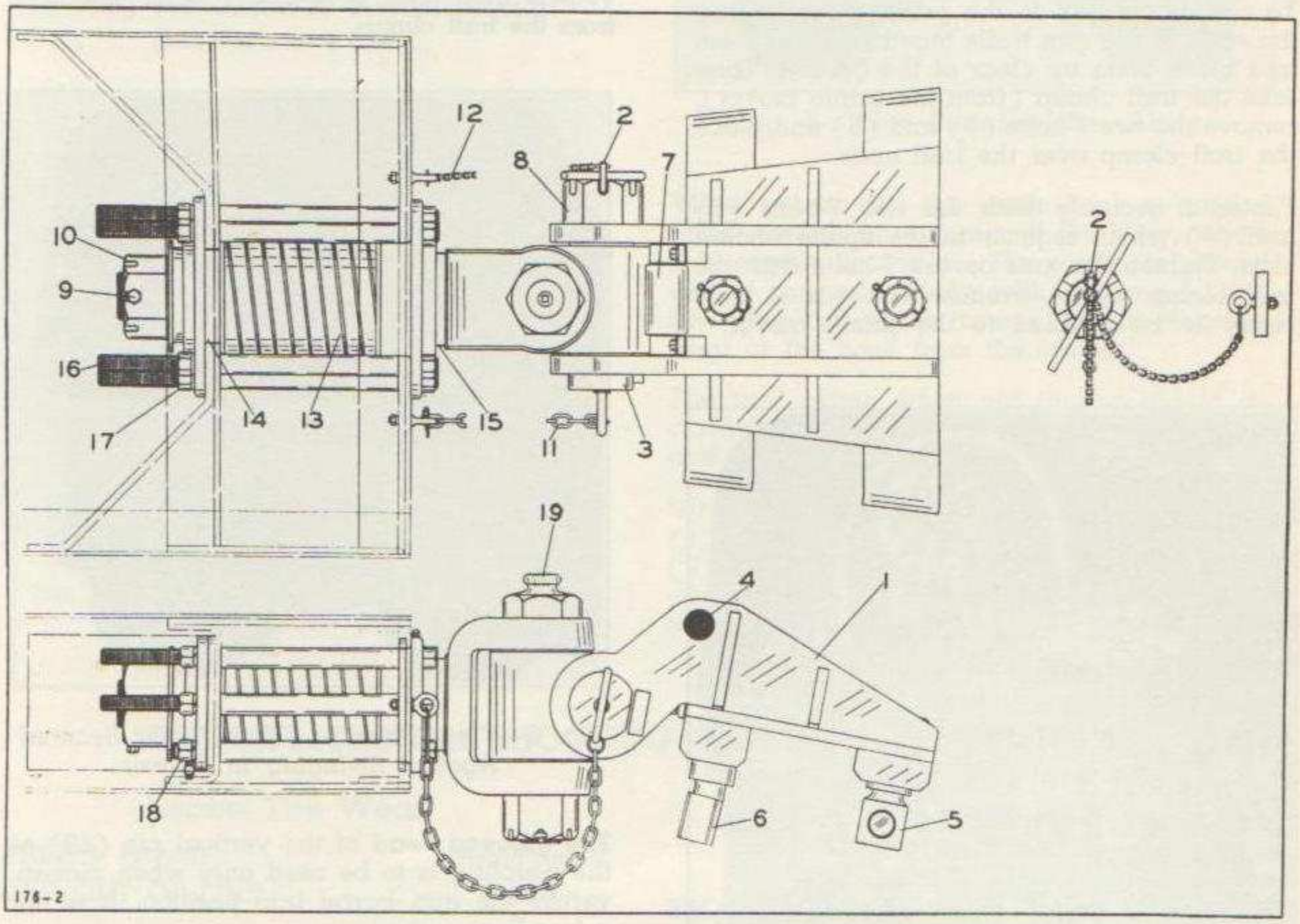


Fig. 1—Draw Bar

1. Trail Clamp
2. Lock Pin
3. Cross Pin
4. Trail Clamp Lifting Eye
5. Trail Clamp T-Bolt
6. Trail Clamp T-Bolt
7. Aligning Roller
8. Cross Pin Nut
9. Lock Bolt
10. Pintle Nut
11. Cross Pin Chain
12. Lock Pin Chain
13. Spring
14. Front Sleeve
15. Rear Sleeve
16. Studs, long
17. Stud Nuts
18. Stud Nuts
19. Grooved Vertical Pin

extra heavy cross member at the rear of the frame. The housing contains a spring which cushions the shock loads on the pintle hook or draw bar and allows 5/8" movement fore and aft from the neutral position. The arrangement is made so that the pintle or the draw bar can be quickly and easily interchanged without affecting the spring. The pintle hook and draw bar parts are heat treated drop forgings.

Operation of Draw Bar

(See Figures 1 and 2)

The draw bar was designed to tow the M-1 type gun carriage and has a towing attachment or trail clamp (1) made especially for this carriage.

To couple the gun to the prime mover, bring the ends of the gun trails together, raise them and block them up clear of the ground. Then take the trail clamp (from the prime mover), remove the two T-bolts (5) and (6) and place the trail clamp over the trail ends.

Fasten it securely with the two T-bolts (5) and (6) which register in the spade anchor slots. Tighten the nuts on the T-bolts with the trail clamp socket wrench. The gun is now ready to be coupled to the prime mover.

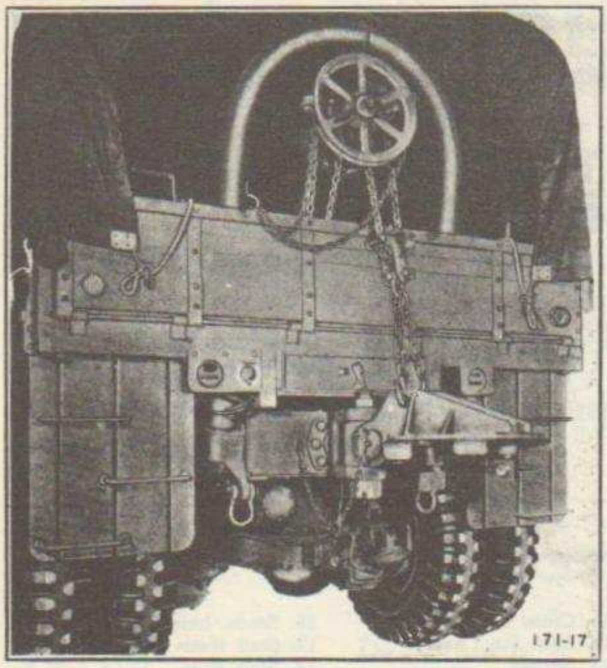


Fig. 2—View Showing Chain Hoist Supporting Draw Bar

Back the prime mover to the gun so that the coupling is directly over the trail clamp. Then remove the cross pin (3) from the draw bar after taking the L-shaped lock pin (2) from the end and removing the nut. Insert the chain hoist hooks in the lifting eyes (4) of the trail clamp and raise it up to the coupling, guiding it so that the side plates straddle the draw bar block. When the trail clamp is at the coupling, a roller (7) automatically aligns the coupling with the trail clamp so that the cross pin can be inserted easily. The cross pin nut (8), with the handle on it, should be run up until it is snug; it is not necessary that it be jammed tight. The handle must be vertical or it will strike the coupling on a short turn. Replace the lock pin (2) and the safety hook. Remove hooks of the chain hoist from the towing attachment and anchor the chain hoist to the lifting arch. **Never move the coupled vehicle until hoist hooks have been detached from the trail clamp.**

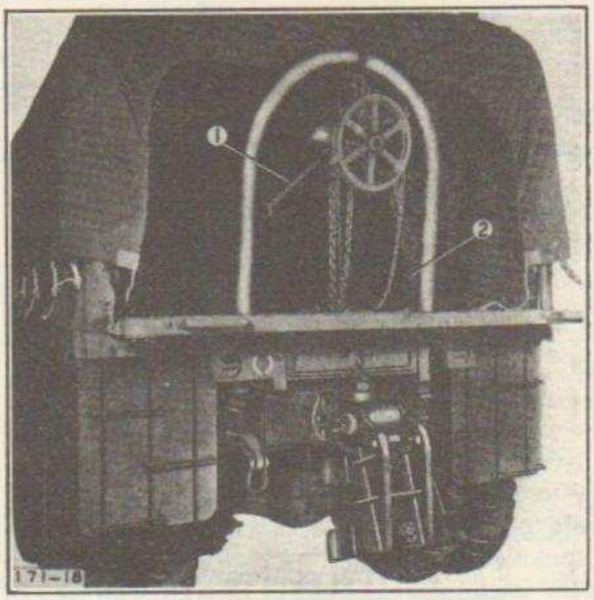


Fig. 3—View Showing Chain Hoist Secured Against Swinging in Transit

The grooved head of the vertical pin (19) of the coupling is to be used only when maneuvering the gun barrel into position. It is not a tow line anchor.

To uncouple the gun, the procedure is reversed. The first step is to attach the chain hoist to the towing attachment to relieve the load on the cross pin. Remove the pin and lower the trails to rest on blocking keeping them clear of the ground. Then remove the T-bolts and the trail clamp from the trails. Replace all the nuts on the bolts and place the towing attachment in the prime mover body. The trail clamp when not in use should be carried inside the body and not left attached to the draw bar.

(See Figure 3)

The hoist is secured to the lifting arch to prevent it from swinging while the truck is in motion. To fasten the hoist to the arch, place the hook on the end of the short piece of chain (1) which is attached to the left leg of the arch, over one of the spacer bolts behind the chain wheel of the hoist. Then anchor the hoist hook (2) to the ring on the front side of the right leg of the arch and draw the block snug with the hoisting chain. Place the extra chain in the body.

Towing Accessories Arrangement

(See Figures 4 and 5)

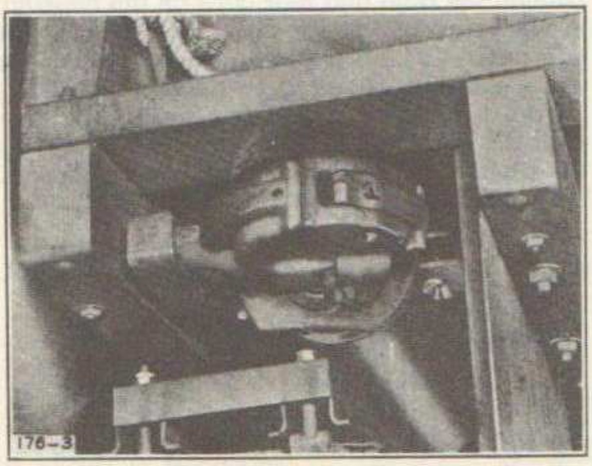


Fig. 4—View Showing Pintle Hook in Carrier Under Body

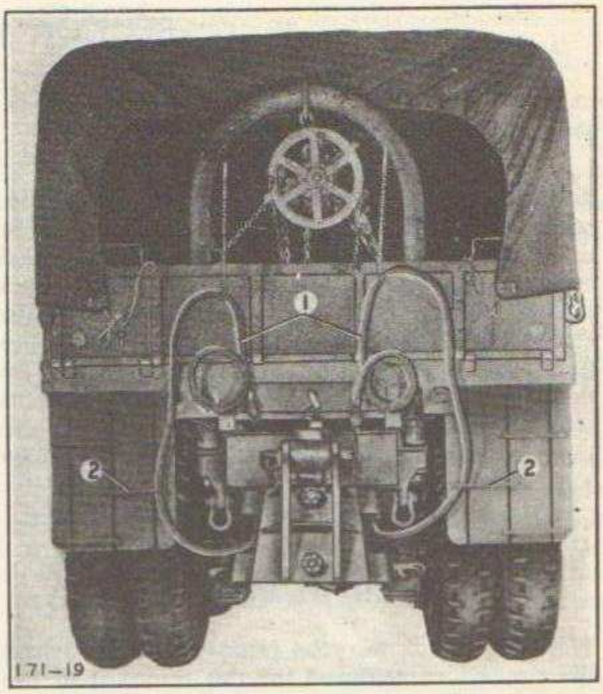


Fig. 5—View Showing Hose Lines

When not in use, the pintle hook is carried under the left front corner of the body, where it is readily accessible. The carrier is rugged and of convenient form with a clamp having two wing nuts which insures against dislodgement of the hook from the carrier.

The trail clamp when not in use should be carried inside the body or left on the gun trails and not attached to the draw bar.

When a vehicle is towed, the air hose lines (1) should be threaded thru the middle steps (2) on the rear splash aprons of the body; otherwise they may become tangled with the towing member and be cut or torn loose.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Excess Tire Wear

SPRUNG FRAME .... Straighten.

AXLE OUT OF LINE .... Align.

Failure of Rear Wheels to Track With Front Wheels

SPRUNG FRAME .... Straighten and align.

RELATIVE MOTION BETWEEN SIDE RAILS .... Tighten rivets or drive new hot rivets.

Draw Bar or Pintle Hook Loose in Housing

BROKEN SPRING .... Renew

Draw Bar or Pintle Hook Stuck in Housing

BENT SHANK .... Renew

SECTION 4: DIS-ASSEMBLY

Draw Bar
(See Figure 1)

To interchange the draw bar and the pintle, remove the small lock bolt (9) in the large nut (10) on the shank of the draw bar and cross, then remove the large nut. Disconnect the pin chain (11) and the lock pin chain (12). The draw bar will then slide out of the rear end. A chain hoist or two men should be used to remove the draw bar because it weighs about 150 pounds. The pintle hook may be pushed into the housing and the large nut and lock bolt put in place.

Pintle Hook
(See Figure 6)

The pintle hook may be removed by following the procedure outlined for the removal of the draw bar. The stem of the pintle hook is much smaller in diameter than the stem of the draw bar, so that two adapters (1) and (2) are necessary to make the pintle hook and the draw bar fit the same housing. The pintle hook may be removed from the adapters by taking out the lock pin (3) and unscrewing the stem from the adapter (1).

To dis-assemble the latch, remove the cotter pin and nut and pull out the pintle lock bolt (4) which will allow the removal of the pintle lock (5) with the pintle latch (6) assembled. The latch can be taken apart by removing the lock screw (7) and driving out the pintle latch pivot pin (8). The latch spring (9) can now be taken from the machined slot in the latch.

(See Figure 1)

To facilitate the removal of the spring (13) and the sleeves (14) and (15) after the pintle or draw bar has been taken out of the housing, three extra inches of thread have been left on the rear end of four of the studs (16) holding the front and rear caps on the housing. When removing the spring, first remove the two nuts (18) on the short studs at the rear of the housing. Then loosen the four nuts (17) on the long studs just a few turns at a time until the spring is free. Remove the nuts from the studs and take out the spring and sleeves.

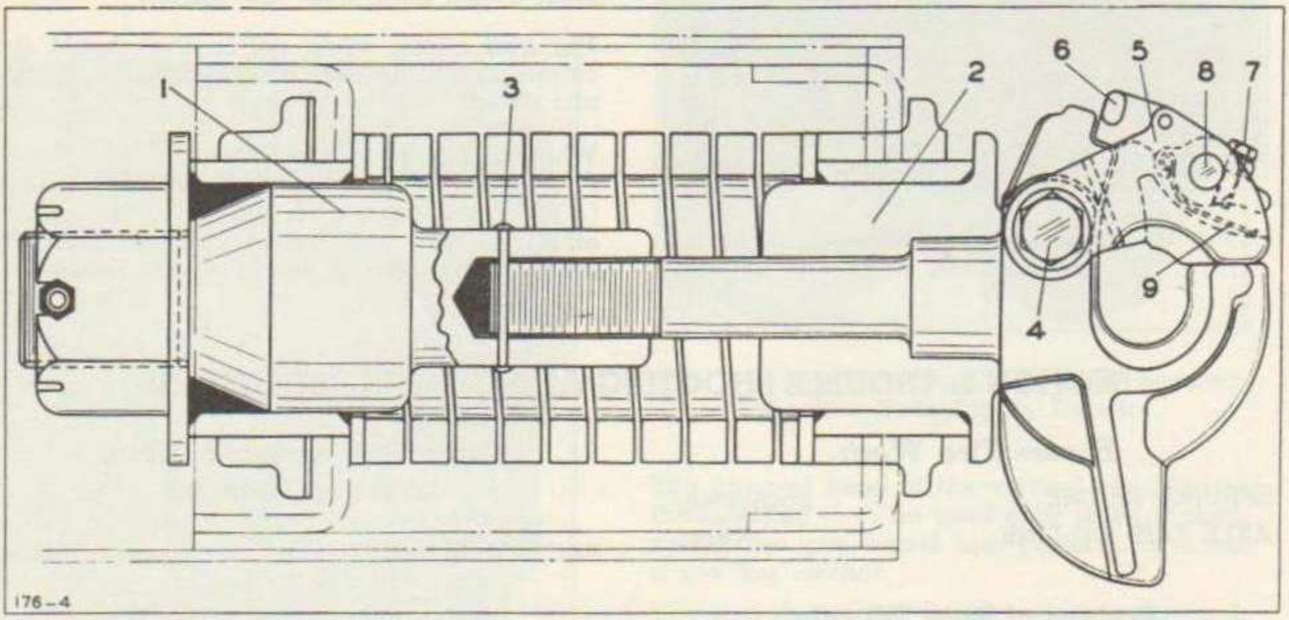


Fig. 6—Pintle Hook

1. Pintle Hook Adapter, front
2. Pintle Hook Adapter, rear
3. Lock Pin
4. Lock Bolt
5. Pintle Hook Lock
6. Pintle Hook Latch
7. Latch Lock Screw
8. Latch Pivot Pin
9. Latch Spring

SECTION 5: REPAIRS.

Frame
(See Figure 7)

The frame requires very little attention. Occasionally, the rivets and bolts should be checked for tightness. After any exceptionally hard abuse or accident, the frame should be checked for proper alignment. Sprung frames usually cause abnormally high stresses and excessive wear in the running gear and other parts.

The frame alignment may be checked by placing the chassis on a level floor and fastening pieces of paper to the floor under each point of measurement (M) and the center line intersections with the cross and diagonal lines (U), (V), (X), (Y), (Z), (Z'), then projecting the reference points (M) from the frame down to the floor.

Check the frame widths front and rear, and locate points (U) and (V) halfway between the marks at the front and rear.

Measure the diagonals (A), (B), (C), and (C') and mark their intersection points (X), (Y), (Z) and (Z') on the layout.

Lay out the center line thru the four intersections (X), (Y), (Z) and (Z'). If the frame is true, the center line will come within ⅛ inch of passing thru the points (U), (V), (X), (Y), (Z) and (Z'). Variations of more than ⅛ inch indicate misalignment.

If the frame is sprung, locate the true center line by passing a line thru the intersection of two sets of diagonals and the center point of one end of the frame. For a true center line it must pass thru two of the points and be not

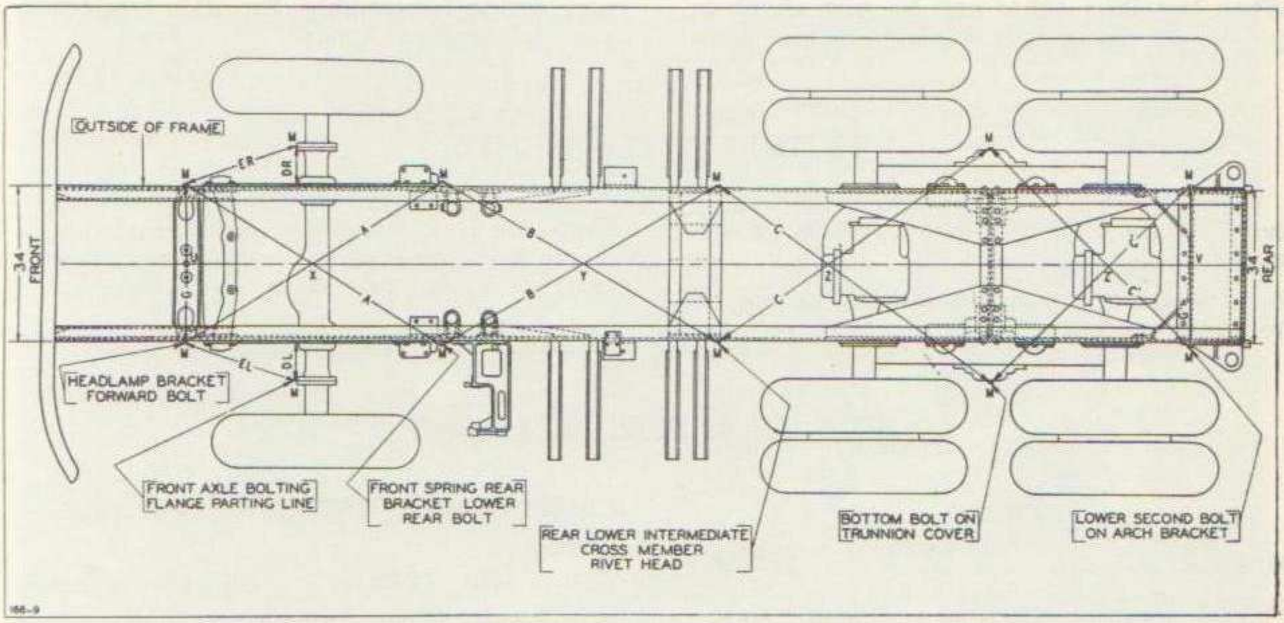


Fig. 7—Frame Alignment Diagram

The measurement points may be located on the paper by dropping a plumb bob from the reference points (M) indicated in the illustration shown above. These points must be accurately located with respect to the frame or the check will not be dependable.

After all of the points have been carefully placed on the layout, the vehicle should be moved and the procedure outlined below followed:

more than ⅛ inch from the third. The center line may be marked by locating the ends of a chalk line on the floor and snapping it. The damaged section may be isolated by comparing the lengths of the equal pairs of diagonals and noting the variation of the intersections from the center line. The lengths of each pair of diagonals should not vary by more than ⅛ inch, and they should intersect within ⅛ inch of the center line.

If the frame requires straightening, all work should be done cold. The side rails are heat treated and, if the damage is severe enough to necessitate heating to make the repairs, the member should be renewed. After any straightening and aligning, all cross member rivets should be checked for tightness.

The front axle alignment should be checked after properly straightening the frame. The front axle is square with the frame and is centrally located if (ER) equals (EL) and (DR) equals (DL). The front axle is out of square if (DR) equals (DL) and (ER) does not equal (EL).

Draw Bar and Pintle Hook

(See Figures 1 and 6)

Both the pintle hook and draw bar are simple units, composed of a few sturdy parts and even the severest service rarely makes repairs necessary. Worn or broken parts, even minor ones, should be renewed. Do not continue unit in operation with broken draft spring. Parts which have become deformed should be renewed.

SECTION 6: LUBRICATION

Draw Bar and Pintle Hook

When installing either unit be sure shank is generously coated with lubricant so that there will be sufficient lubrication for heavy pulling. Paint the shank with fluid gear lubricant prior to installation. No other lubrication is necessary during re-assembly. For other lubrication see "Lubrication" group.

SECTION 7: RE-ASSEMBLY

In re-assembly reverse the procedure for dis-assembly.

Parts intended to permit movement should be free from binding.

There are no adjustments; parts in good condition will produce a correct assembly with draft spring compressed to proper length.

SECTION 8: SPECIFICATIONS

Frame

WHEELBASE .... 127"-58"

FRAME WIDTH .... 34"

NO. OF CROSS MEMBERS 5

SIDE RAIL MATERIAL .... Chrome-manganese steel, heat treated.

CROSS MEMBER MATERIAL .... Plain carbon steel.

SIDE RAILS, TYPE .... Pressed channel

SIDE RAILS, SIZE .... 7½" x 3" x ¼", forward section, 11½" x 3" x ¼", rear section

6" drop, 140" from front end of frame to rear tangent line of drop.

SECTION 9: TOOLS

As all dis-assembling and re-assembling can be accomplished with the standard tool equipment furnished with the truck or with tools included in mechanics' kits, and as repairs are usually made by the RENEWAL of worn or broken parts, no special tools are required. Frame alignment work usually requires devised means for applying jacks.

GROUP 16: SPRINGS

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Front Springs

The front springs are semi-elliptic, the two long top leaves having an eye at each end for attachment to the chassis frame. The rear eye oscillates on a pin carried by a bracket attached directly to the chassis frame. The front eye oscillates on a similar pin carried by a pair of shackles having another pin at its upper end which oscillates in a bracket attached to the frame. The shackles swing to a small degree to permit the slight change in the length of the spring due to their flexure.

Bronze bushings are pressed into the spring eyes and the forward brackets. The eyes in the rear brackets and those on each end of the shackles are slotted and have pinch-bolts for clamping them on the pins. These bolts pass thru notches in the ends of the pins, thereby preventing the pins from turning.

Rear Springs

Two inverted leaf springs carry the load on the rear axles, equalize the load between the front and rear axles of the rear axle structure, and act as radius rods in maintaining the position of the axles. Each spring is mounted at its center on a trunnion journal which oscillates about a transverse trunnion tube rigidly attached to the frame by two brackets.

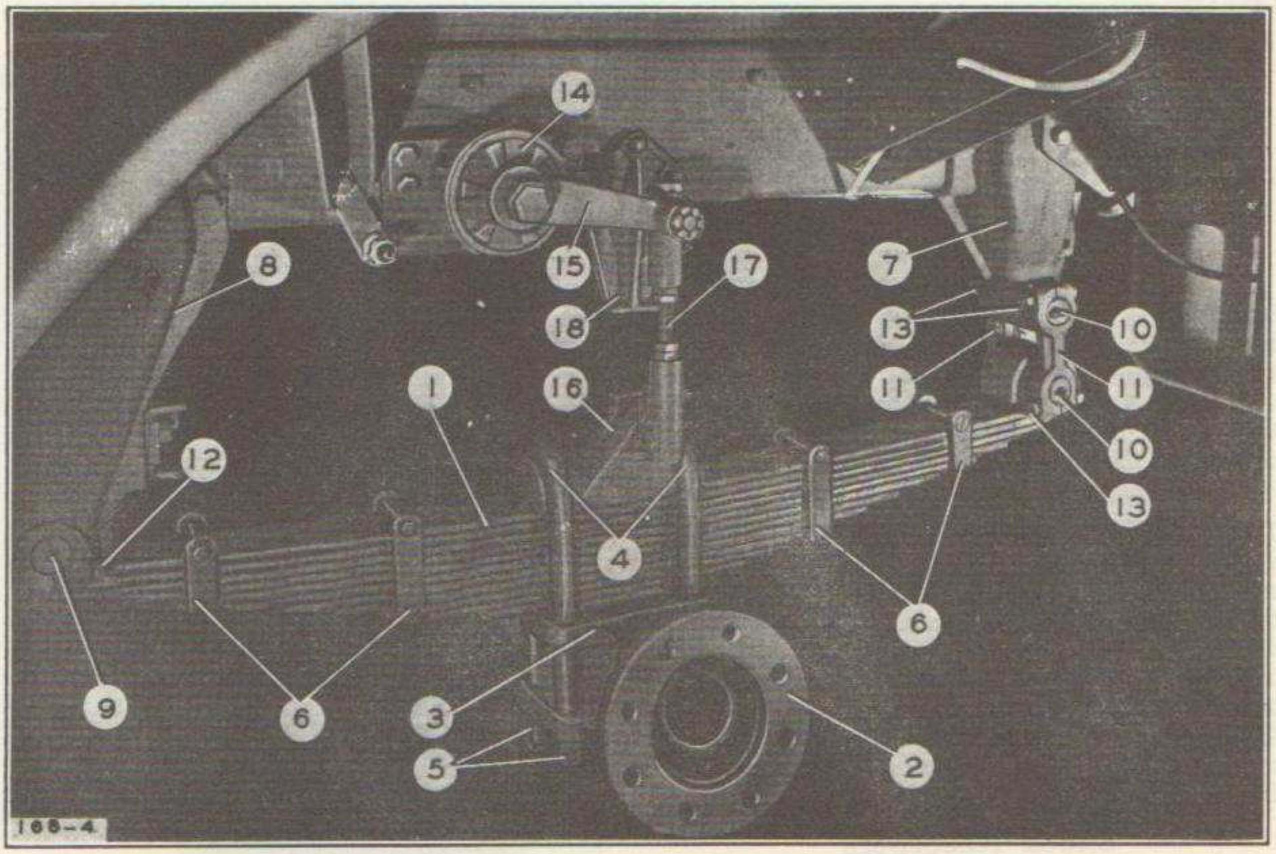


Fig. 1—Right Side View of Front Spring

1. Front Spring
2. Axle Housing
3. Spring Perch
4. Spring Clip
5. Spring Clip Nut
6. Rebound Clip
7. Spring Bracket, Front
8. Spring Bracket, Rear
9. Rear Bracket Pin
10. Shackle Pin
11. Shackle
12. Bracket Pinch-Bolt
13. Shackle Pinch-Bolt
14. Shock Absorber
15. Shock Absorber Arm
16. Shock Absorber Bracket
17. Shock Absorber Link
18. Frame Stop

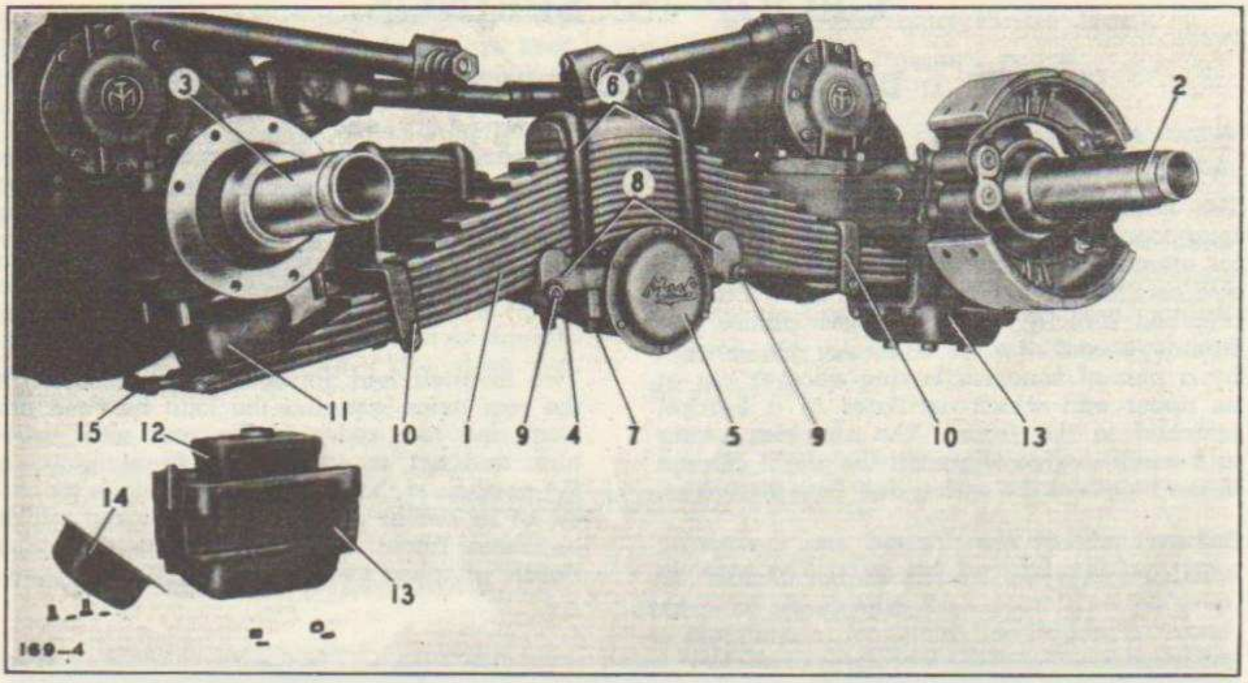


Fig. 2—Right Side View of Rear Spring

1. Rear Spring
2. Rear Axle, Forward
3. Rear Axle, Rear
4. Spring Trunnion Journal
5. Trunnion Journal Cap
6. Spring Clip
7. Spring Clip Nut
8. Spring Seat Clamp
9. Seat Clamp Nut
10. Rebound Clip
11. Rubber Shock Insulator
12. Rubber Shock Insulator
13. Shock Insulator Housing
14. Housing Cover
15. T-Bar Anchor Stop

Each spring end is retained by two large rubber shock insulator blocks, confined in a housing under the axle at the location of the usual spring pad. The flow of the rubber allows the spring ends to move sufficiently in any direction to eliminate most of the twisting and bending action at the spring ends.

To act as a safety device and to limit the relative fore-and-aft travel between the springs and the axles, T-bar anchor stops are riveted on the ends of the springs. The T-bars extend thru openings beyond the rubber block housings and engage with heavy reinforced ribs on the housings. This arrangement limits the fore-and-aft motion of the axles in relation to the frame, without restricting the twisting freedom.

Shock Absorbers

To control the action of the front springs, hydraulic shock absorbers are provided. They are mounted on the chassis frame and their arms are connected to brackets, which are clamped under the spring clips, by means of links with ball-and-socket fittings at each end, as shown by Figure 1. As each shock absorber

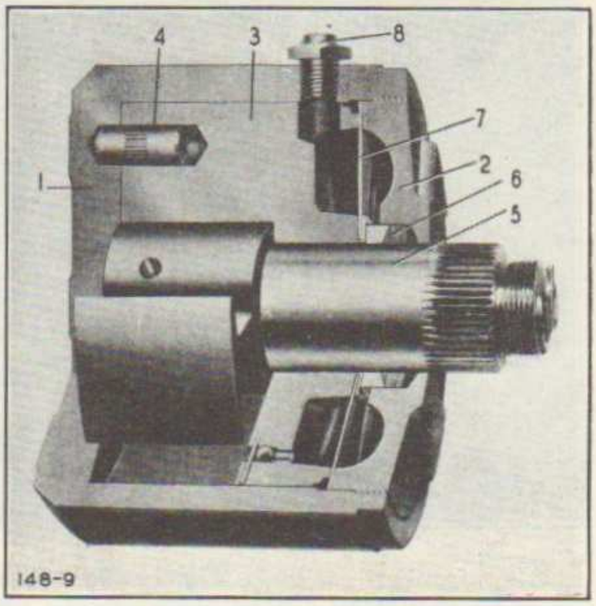


Fig. 3—Sectional View of Shock Absorber

1. Reservoir
2. Cover
3. Abutment Flange
4. Dowel Pin
5. Wingshaft
6. Wingshaft Packing
7. Packing Spring
8. Filler Plug

arm is attached to the serrated end of its wingshaft, shown by Figure 3, the spring action causes the wings on the other end of the shaft to oscillate in the chambers enclosing them, thereby forcing the fluid with which they are filled, from one chamber to another thru a port with a regulating valve which may be adjusted to control the degree of resistance to the spring action imposed by the flow of the fluid.

Ball check valves in the partitions between the chambers permit the fluid to flow freely during the upward movement of the arm, but close instantly upon its downward movement, thereby greatly increasing the resistance to its movement and checking the recoil of the spring. Because of the characteristics imparted to the shock absorbers by this method of hydraulic control, the springs yield freely when the wheels encounter obstructions, but when either or both wheels drop into holes, the movement of the axle away from the frame is retarded and excessive flexure of the springs is prevented.

Figure 5 is a longitudinal section of the shock absorber showing the construction of the central valve and ports for controlling the flow of fluid and thereby regulating the spring action.

Shock Absorber Linkage

Each link consists of a threaded stud with lock nuts for adjusting the distance between the studs of the ball-and-socket joints at each end. Each ball stud is retained between two sockets, firmly pressed against it by a coil spring and a screw plug secured by a cotter pin. A rubber dust shield in a metal cup is fitted to each stud, to close the orifice thru which it projects. The tapered end of each stud is drawn into place by a nut secured by a cotter pin.

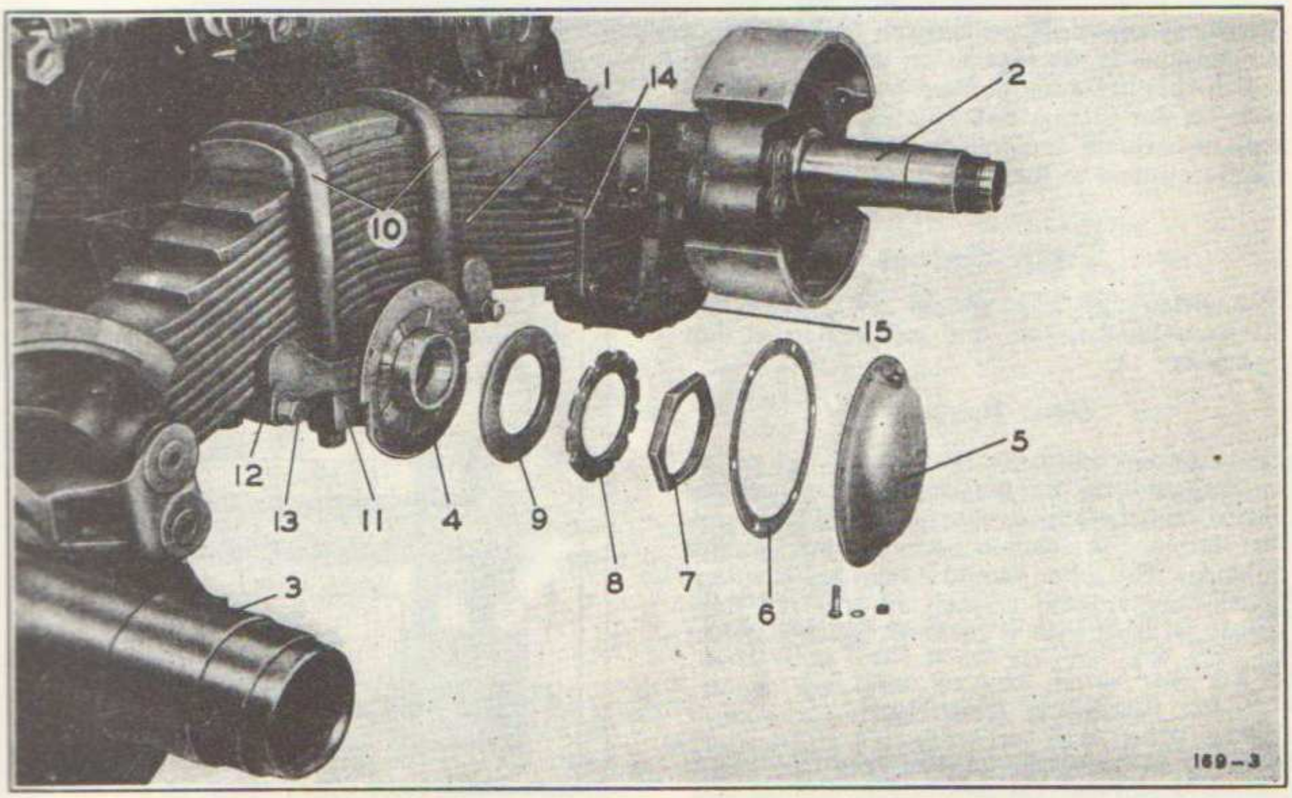


Fig. 4—Rear Spring with Trunnion Journal Retaining Parts Removed so that Spring may slide off of Trunnion

1. Rear Spring
2. Rear Axle, Forward
3. Rear Axle, Rear
4. Spring Trunnion Journal
5. Journal Hub Cap
6. Hub Cap Gasket
7. Trunnion Lock Nut
8. Trunnion Washer
9. Trunnion Nut
10. Spring Clip
11. Spring Clip Nut
12. Spring Seat Clamp
13. Seat Clamp Nut
14. Rebound Clip
15. Shock Insulator Housing

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Front Springs

Shock Absorber Bracket Strikes Frame Stop

BROKEN LEAVES .... Renew leaves

SAGGED SPRING .... Renew entire spring

Spring Breakage at Center Bolt

LOOSE CLIPS .... Renew broken leaves and tighten clips.

Excessive Noise

LOOSE BRACKETS OR SHOCK ABSORBER PARTS .... Tighten.

Rear Springs

Spring Breakage at Center Bolt

LOOSE CLIPS .... Renew broken leaves and tighten clips.

Excessive Noise

NO OIL IN TRUNNION .... Lubricate

SPRING SEAT CLAMP STUDS LOOSE .... Tighten

Shock Absorbers

Poor Riding Qualities

SHOCK ABSORBER NOT OPERATING .... Refill or renew

Spring Breakage

SHOCK ABSORBER NOT OPERATING .... Refill or renew

SECTION 3: ADJUSTMENTS

The most important adjustment of leaf spring suspensions is the tension on the spring clips, which should be maintained by tigthening the nuts on the U-bolts and checking the tension with a wrench indicating in pound-feet the torque applied to the nuts.

Front Springs

The spring clip nuts should be tightened to 800 pound-feet torque and maintained at that tightness.

Rear Springs

The clamping studs on the side of the spring seat should be tightened to 250 pound-feet torque and the spring clip nuts to 1575 pound-feet torque. They should be maintained at that tightness. The latter should be tightened with a heavy-duty striking wrench or a heavy duty socket wrench with a lever at least five feet long.

Shock Absorbers

The shock absorbers are adjusted by the manufacturer to meet the average operating conditions encountered by the vehicle. For certain requirements, it may be desirable to vary their resistance. Extremely poor roads or excessively high atmospheric temperatures may require more control and a smaller valve opening, while smooth road surfaces or very cold climates may require a wide open valve setting for the best results.

The shock absorber is adjusted by turning the valve pointer, which changes the valve setting. The valve pointer is located under the hexagonal nut on the end of the shock absorber shaft. As originally adjusted at the

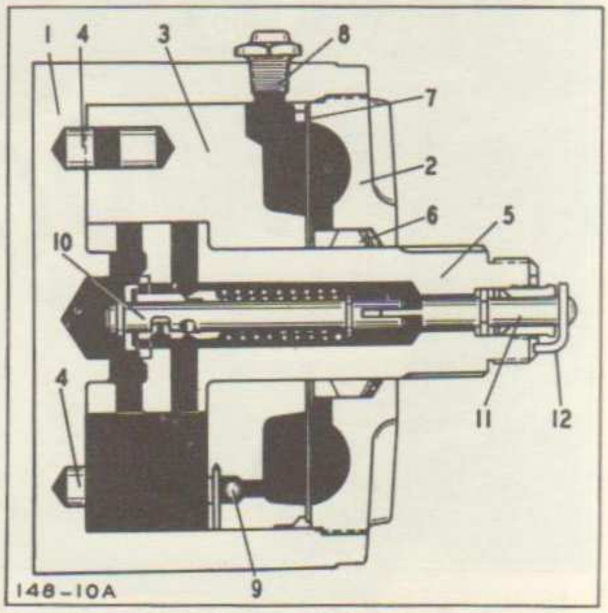


Fig. 5—Section thru Shock Absorber

1. Reservoir
2. Cover
3. Abutment Flange
4. Dowel Pin
5. Wingshaft
6. Wingshaft Packing
7. Packing Spring
8. Filler Plug
9. Ball Check Valve
10. Adjusting Valve
11. Valve Adjusting Stem
12. Valve Pointer

factory the pointer is set at the mark inscribed on the end of the shaft between the two shoulder stops. The full range of adjustment lies between the two valve stops and the pointer should never be turned beyond them.

To effect more spring control, increase the resistance by turning the pointer clockwise from the factory setting mark. This should be done in small steps, approximately 1/16" at a time.

To soften the spring action, decrease the resistance by turning the pointer counter-clockwise from the factory setting mark.

The link studs should be adjusted so that the shock absorber arms are horizontal when the truck is loaded. Their lock nuts should be kept tight to preserve this adjustment.

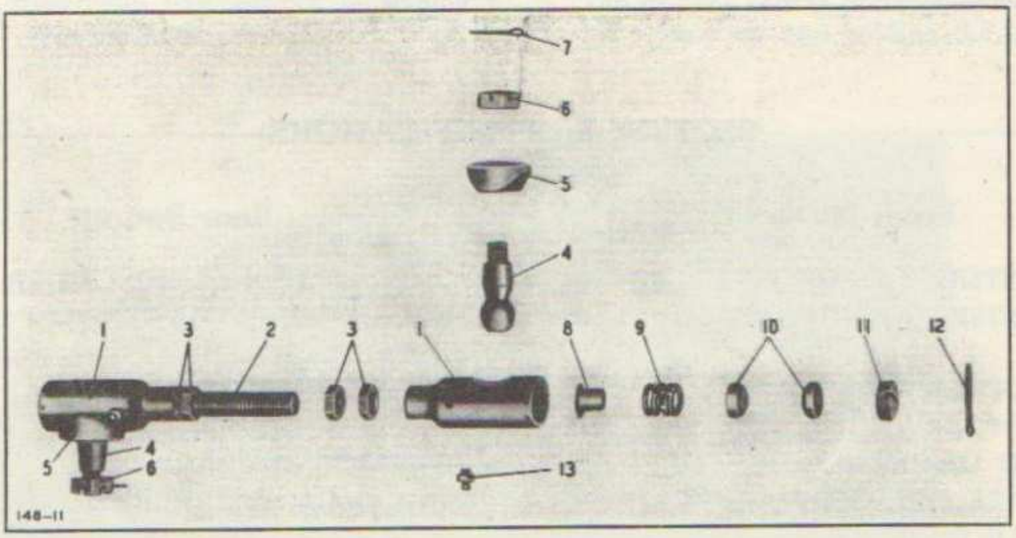


Fig. 6—Exploded View of Shock Absorber Linkage.

1. Socket Body
2. Link Stud
3. Check Nut
4. Ball Stud
5. Ball Stud Cap
6. Ball Stud Nut
7. Stud Cotter Pin
8. Spring Guide
9. Socket Spring
10. Socket
11. Screw Plug
12. Plug Cotter Pin
13. Grease Fitting

SECTION 5: REPAIRS

Springs

Replace all broken leaves. Inspect all leaves, clips, center bolt, for cracks or stripped threads and renew any found to be defective.

Shock Absorbers

Normally, the only care which the shock absorbers require is fluid inspection. This check-up should be made every 6,000 miles or semi-annually. The filler plug, which is also the fluid level indicator, is located on the upper side of the shock absorber housing. Before removing the filler plug, the top of the shock absorber, the filler plug threads, and all nearby parts, should be thoroly cleaned to prevent dirt from getting into the reservoir. Small particles of dirt in the fluid can jam the valves and ruin the shock absorber. The fluid should be level with the bottom of the filler hole on the inside.

If the fluid is below this level, Shock Absorber Fluid should be added. If the fluid is very low, it is best to disconnect the link and pump the lever several times thru its full range to remove any air which might be trapped in the chamber. After each addition of fluid, the pumping should be repeated. When the shock absorber is properly filled and operating, there will be a uniform resistance of the lever with no lost motion or rubbery feeling.

When replenishing shock absorbers when off the vehicle, it is important that they be held in the same position as when on the vehicle.

SECTION 6: LUBRICATION

Springs

When re-assembling the unit be sure to coat each side of the leaf with heavy graphite grease. No other lubrication is required during reassembly.

For other lubricating instructions, see "Lubrication" group.

Shock Absorbers

For good service and long life, the ball joints should be packed carefully with grease. Whenever the vehicle is greased, lubricant should be forced thru the fittings on the joints until it begins to seep out around the dust shields.

SECTION 8: SPECIFICATIONS

Front Springs

LOAD CENTER TO LOAD CENTER	50"
LOAD CENTER TO CENTER BOLT	25"
WIDTH	3"
NUMBER OF REBOUND CLIPS	4
NUMBER OF LEAVES	12
THICKNESS GRADING	12 @ 7/16"
TOTAL PACK THICKNESS	5¼"
SPRING CLIP DIAMETER	1"
SPRING CLIP TIGHTENING TORQUE	800 lb.-ft.
SHOCK ABSORBER BRACKET TO FRAME STOP—LOADED	2¾" minimum

Rear Springs

LOAD CENTER TO LOAD CENTER	58"
LOAD CENTER TO CENTER BOLT	29"
WIDTH	5"
NUMBER OF REBOUND CLIPS	2
NUMBER OF LEAVES	12
THICKNESS GRADING	12 @ ⅝"
TOTAL PACK THICKNESS	7½"
SPRING CLIP DIAMETER	1¼"
SPRING CLIPS TIGHTENING TORQUE	1575 lb.-ft.
SPRING SEAT CLAMP STUDS TIGHTENING TORQUE	250 lb.-ft.

Shock Absorbers

MAKE	Houde Manufacturing Corp.
MODEL	BBSB-1

SECTION 9: TOOLS

Part No.	Description	Price	Manufacturer
TQ-2003-AL	Wrench, Torque Indicating, 0 to 2000 lb.-ft.	$175.00	Snap-On Tools
LS-462	Wrench, Socket, Front Spring Clip Nut, 1-7/16" opening	2.60	Snap-On Tools
LS-583	Wrench, Socket, Rear Spring Clip Nut, 1-13/16" opening		Snap-On Tools
L-342	Wrench, Socket, Rear Spring Seat Clamp Stud Nut, 1-1/16" opening	1.05	Snap-On Tools
LA-124	Adapter, Torque Indicating Wrench to Socket	2.15	Snap-On Tools

GROUP 18: BODY & CAB

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

Cab
(See Figure 1

The Mack cab is of all-steel construction with folding windshield and canvas folding type top with side curtains.

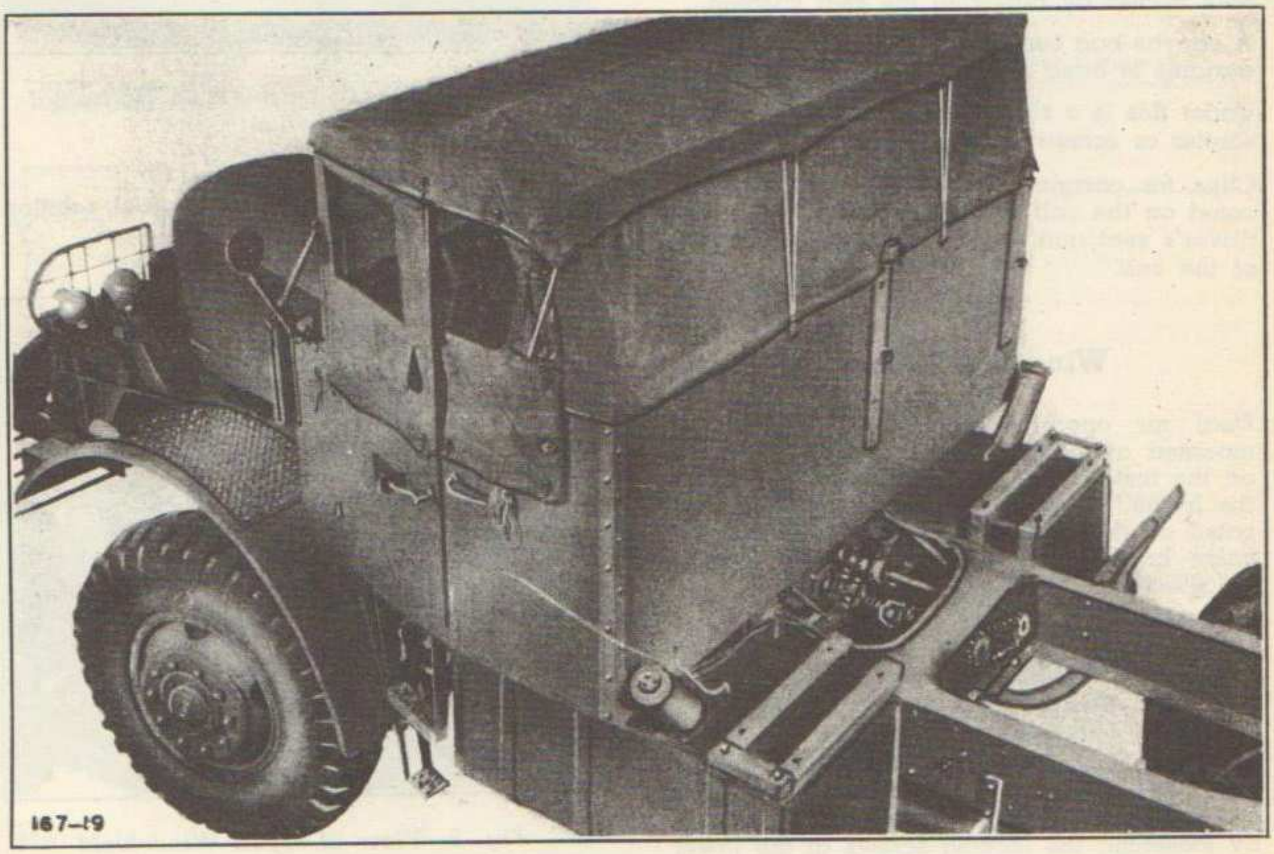


Fig. 1—View of Cab

Rear Vision

Two outside rear vision mirrors are provided one on each side of the cab. The mirrors are equipped with swivel heads which are easily replaced.

A rear cab curtain is furnished which may be rolled up and strapped to the rear bow thereby giving the driver an open rear view from the inside.

Seats and Seat Adjustment

The driver's seat is adjustable, front and rear, by pulling up and holding the handle found on the front of the seat frame just below the bottom of the cushion. This handle operates a slotted lever, which when released, becomes engaged to a fixed stop mounted on the seat box. This method permits a close adjustment of the seat for the driver.

The right hand seat cushion is hinged to swing up for access to the battery compartment which is covered by a removable lid. The right hand back cushion swings down on top of the seat cushion to make a platform for the machine gun operator. The back of the cushion is covered with a Diamondette plate to provide a non-slipping surface.

All seat and back cushions have removable covers and removable spring pads for gas decontamination.

Compartments

A tool box is provided under the driver's seat with access by removing the seat cushion.

A canvas bag container for the door and side curtains is hung in back of the driver's seat.

Under this is a shelf for carrying the radiator shutter or screen plates.

Clips for carrying the engine crank are located on the cab floor, one at the left of the driver's seat and the other at the center rear of the cab.

Windshield Wipers

Dual air operated windshield wipers are mounted at the top of the windshield frame on the inside of the cab so as to move with the frame. They are controlled by valves located on the instrument board. Screwing the valve knob in starts the wiper and controls the speed.

Windshield Operation
(See Figures 2 and 3)

The two-piece windshield is mounted in a movable framework which can be laid down flat, when the cab top curtain is untied at the back, by loosening the locking screws at the lower end of the windshield support bars. The bars slide down in slots on the sides of the cowl and are locked in position at top and bottom of the slots by the screw.

Note that the top curtain is also designed as a windshield cover, with the windshield flat, to prevent reflected glare from the glass which would be visible to aircraft.

The driver's windshield section is equipped with slotted arms and thumb screws so that it can be opened to within 15° of the horizontal position. This is locked in closed position by

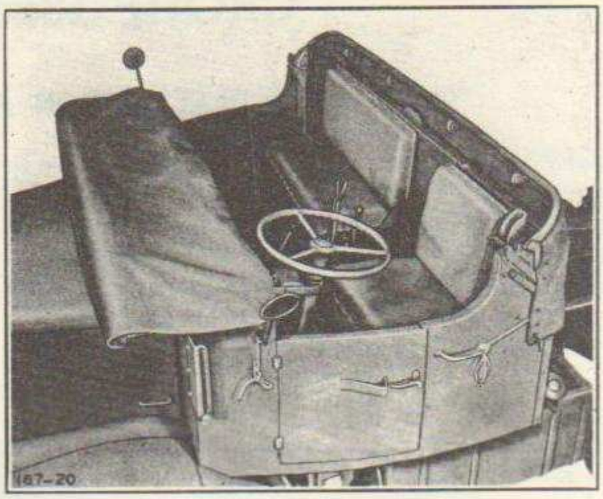


Fig. 2—View of Windshield in Horizontal Position

bringing slotted arms to the vertical position and tightening screws.

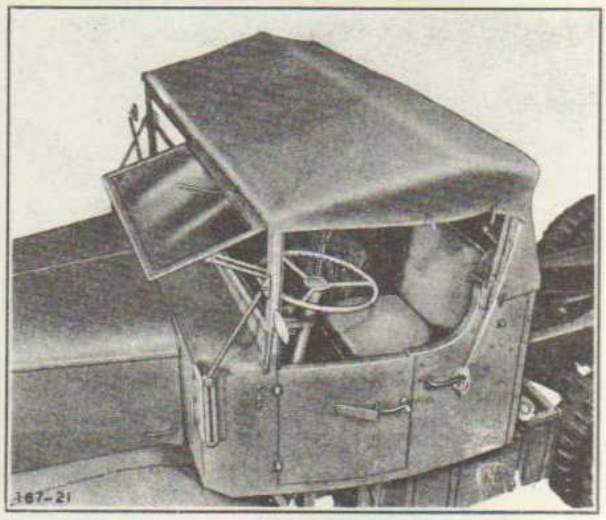


Fig. 3—View of Open Windshield

It is important in opening or closing windshield, that the two slotted arms be moved together to avoid twisting the windshield frame and breaking glass.

Cab Door Ventilation

The cab doors are provided with a long hook and eye arrangement whereby the doors can be hooked in a partly open position to increase ventilation at the cab floor level.

Exterior and Interior Finish

The entire chassis, including the body, is thoroly cleaned of dirt, scale, oil, grease and rust, and dried of surface moisture immediately prior to application of the primer coat.

The primer coat is of a rust inhibiting nature and is baked on all metal parts at temperatures ranging from 150° F. to 250° F.

The color coat consists of two spray coats of Lustreless, Coronada Tan, Synthetic Enamel, Q.M. Specifications ES-680. This enamel dries to a uniform dead flatness devoid of luster. Since the object of this finish is to definitely lessen any light reflections, compounds such as waxes, polishes, abrasives, etc., should not be used since they have a tendency to gloss up the film. Instead, the finish should be wiped with a rag saturated with safety solvent and then washed with soap and water.

Cab Mounting
(See Figure 4)

The cab is fastened to the chassis frame at four points. The left hand front corner is bolted solidly to the frame, while the right hand front corner and the two rear corners are fastened with a spring-loaded bolt as shown in the illustration.

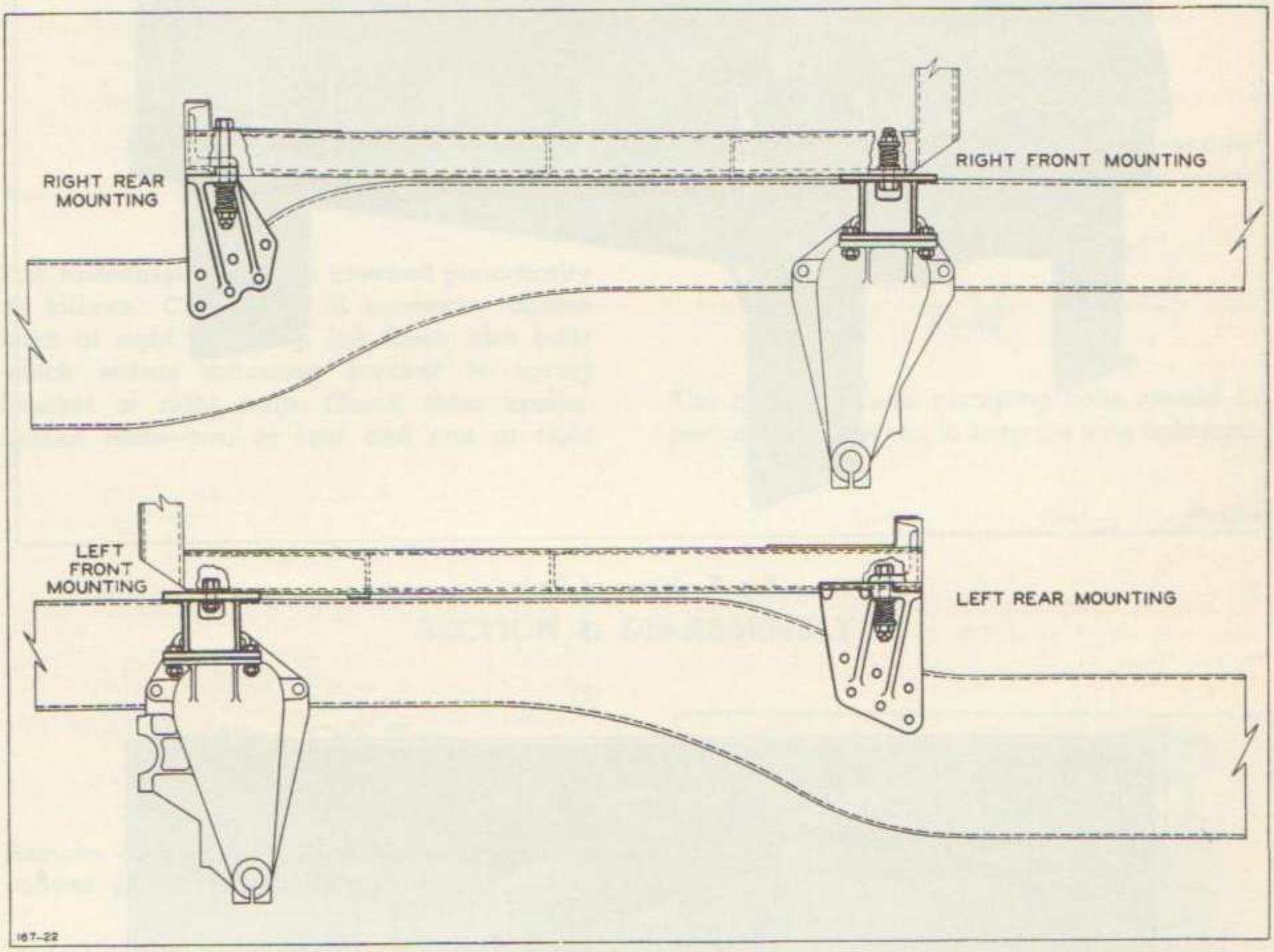


Fig. 4—Line Drawing of Cab Mounting

A removable floor plate is provided between the seats for access to a lifting hook welded to the rear cab sill at the cab center. The cross sill between the floor and toe boards can be used for front lifting slings.

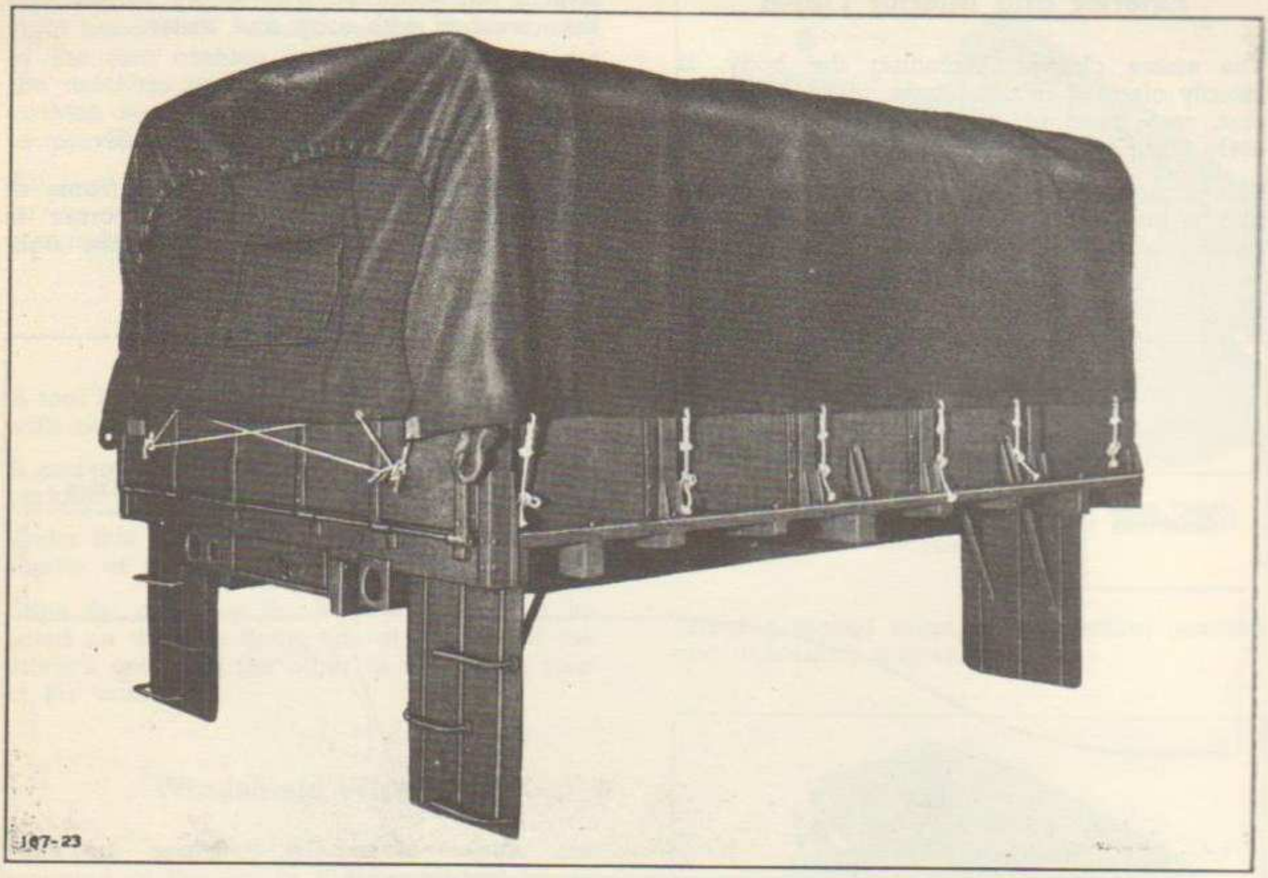


Fig. 5—View of Body

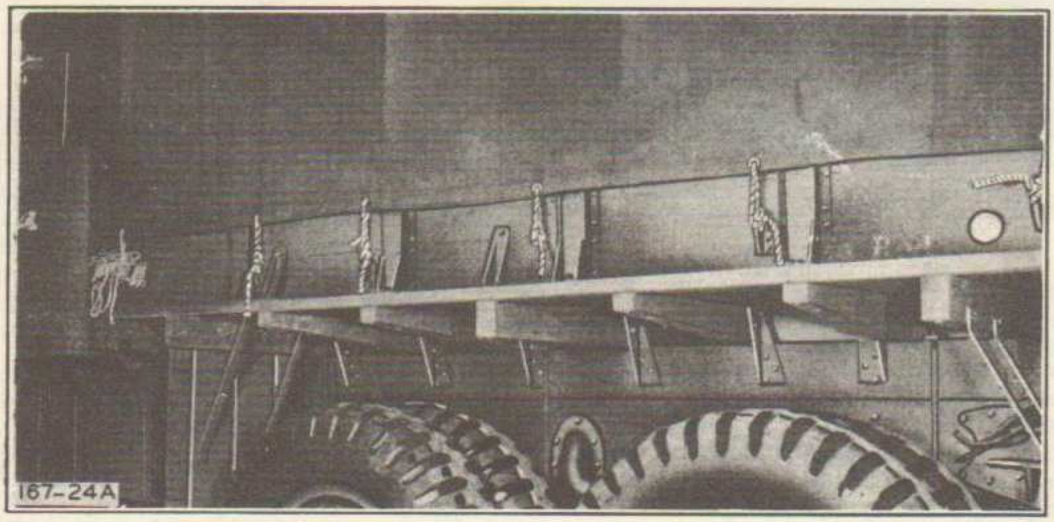


Fig. 6—View Showing Body Mounting

Body
(See Figures 5 and 6)

The body is of all-wood construction and is securely fastened to the chassis thru oak sills. Cross bars are bolted to the floor, and sills are attached to them by vertical angle clips. Two bolt-and-plate clamps and a pair of spring-loaded bolts thru a bracket, near the front, secure each sill to the chassis rail.

SECTION 3: ADJUSTMENTS

Cab
(See Figure 4)

Cab fastenings should be checked periodically as follows: Check, and if necessary tighten bolts at rigid fastening, left front; also bolts which secure mounting bracket to spring bracket at right front. Check three spring-loaded bolts—two at rear and one at right front; springs should have an assembled height of 1-11/16" and nuts should be locked with cotter pins.

Body

The body-to-chassis clamping bolts should be periodically checked to keep the nuts tightened.

SECTION 4: DIS-ASSEMBLY

Handling Cab Top
(See Figure 7)

Remove door and side curtains and store in canvas pocket behind driver's seat.

Untie top anchor rope from side grab handles, unhook loop at outside center hook and push top over rear bow. Turn in sides, roll top up and strap to top of windshield frame.

Turn bow locking latches over to inside and drop bows down, letting rear curtain fold up.

For tropical operation, the rear curtain may be rolled up and strapped to the rear bow.

Fig. 7—View of Rear Curtain Rolled Up

Removing Cab from Chassis

Four men may be employed to advantage to remove the cab from the chassis in a short time. The duties of each man are listed below. Each man is to perform the duties listed for him simultaneously with the others so that all will finish at the same time.

Man No. 1 Working in Cab

With Man No. 2, unfasten top and hand to Men No. 3 and No. 4.

Remove steering column draft pad.

Take screws out of brake treadle valve.

Remove accelerator pedal.

Assist Man No. 2 in removing toe and floor board bolts.

With Man No. 2, remove toe and floor boards from cab.

Disconnect air line clamps from floor board brace.

Work with Man No. 2 in removing tie rod nuts inside cab.

Disconnect horn button and remove wire.

Working with Man No. 2, remove steering wheel nut and remove steering wheel.

Working with Man No. 2, remove steering column bracket from dash.

Working with Man No. 2, remove steering column bracket cap from steering gear.

Working Underneath

Remove cab rear mounting bolts.

Disconnect and remove winch control clevis pin over left hand gas tank.

Working in Cab

With Man No. 2, remove magnetic switch cable clamp from frame.

All four men cooperate in positioning hoist and placing lifting cables, at two sides and rear. Assist in hoisting and removing cab.

Man No. 2 Working in Cab

With Man No. 1, unfasten top and hand to Men No. 3 and No. 4.

Remove floor mat.

With assistance of Man No. 1, remove toe and floor board bolts.

Remove gas line three-way valve stem lever.

Remove gear shift lever floor plates.

Remove clevis pin at hand brake lever.

With Man No. 1, remove toe and floor boards from cab.

Disconnect battery. Remove clamp bolt and pull extreme right hand cable thru floor of battery box.

Work with Man No. 1 in removing tie rod nuts inside cab.

Working Underneath

Remove four bolts supporting air reservoir; leave reservoir hanging.

Working in Cab

Remove three speedometer cable clamps from transmission.

Remove speedometer cable from adapter.

Working with Man No. 1, remove steering wheel nut and remove steering wheel.

Working with Man No. 1, remove steering column bracket from dash.

Working with Man No. 1, remove steering column bracket cap from steering gear.

Working Underneath

Remove cab rear mounting bolts.

Working in Cab

With Man No. 1, remove magnetic switch cable clamp from frame.

All four men co-operate in positioning hoist and placing lifting cables, at two sides and rear. Assist in hoisting and removing cab.

Man No. 3 Working at Right Side of Engine

With Man No. 4, roll up top and fasten to top of windshield.

Raise hood.

Remove radio bond from hood.

Remove hood front hinge.

Remove hood—with Man No. 4.

Remove tachometer cable from engine, radiator tie rod and exhaust manifold.

Disconnect choke wire clamp at intake manifold and valve push rod cover plate.

Disconnect choke wire at carburetor.

Disconnect foot pedal retractor spring at horn bracket.

Disconnect radio bond—cylinder head to dash sheet.

Disconnect radio bond—exhaust pipe to dash sheet.

With Man No. 4, loosen radiator tie rod nuts at radiator and remove tie rods.

Disconnect coil wire at dash sheet.

Remove ½" air line—from junction box to reservoir.

Remove ⅜" air line—from junction box to treadle valve.

Remove air governor line and clamp at governor.

Remove ⅜" air line—from air governor to tire inflation valve—and clamp.

Remove oil pressure line and clamp.

Remove cab front mounting bolts.

Remove air line—from junction block to low pressure indicator.

Remove air line—from junction block to air pressure gage.

All four men co-operate in positioning hoist and placing lifting cables, at two sides and rear. Assist in hoisting and removing cab.

Man No. 4 Working at Left Side of Engine

With Man No. 3, roll up top and fasten to top of windshield.

Raise hood.

Remove radio bond from hood.

Loosen hood rear hinge.

Remove hood—with Man No. 3.

Disconnect hand throttle.

Working Underneath

Drain water to level below thermocouple connection.

Working on Top

Disconnect thermocouple.

Disconnect viscometer.

Disconnect accelerator pedal rod.

With Man No. 3, loosen radiator tie rod nuts at radiator and remove tie rods.

Remove wire harness at junction block (16 wire connections).

Disconnect horn wire.

Working Underneath

Remove cab front mounting bolts.

Remove radio bond—from cab bracket to frame.

All four men co-operate in positioning hoist and placing cables, at two sides and rear. Assist in hoisting and removing cab.

Removing Body from Chassis

Free sills from chassis frame rails by removing nuts at top ends of sill bolts and from spring-loaded bolts at front fastenings. Place cables or slings so that body can be kept approximately level during lifting. If facilities provide insufficient lift for splash aprons to clear top of tires, remove aprons. Body removed with aprons attached must, of course, be set on blocking of a height to keep aprons clear of floor or ground.

SECTION 5: REPAIRS

Windshield Glass

Should any leaks develop between the glass and frame, it is quite often possible to stop small leaks by application of a light engine oil to the glazing tape on the inside and outside of frame at point of leakage. This will cause the glazing tape to swell up and re-establish its sealing action. If this method fails, the windshield can be reglazed with a heavier tape or a sealing compound applied with a putty knife at the place where leakage occurs.

Refinishing

Lustreless, Olive Drab, Synthetic Enamel may be applied by either the brush or spray methods. However, the spray method is more desirable because of the uniform thickness of the paint film and the more pleasing appearance obtained. If the finish on a portion of a panel is destroyed, best results are obtained if entire panel is refinished.

In repair work it is necessary to sand any feather scratches until they disappear. One coat of synthetic enamel should be all that is necessary on repair work due to the fact that the hiding power is exceptionally good; but, in such cases as require a second coat, the second coat should be applied about thirty minutes after the application of the first coat. The Lustreless, Olive Drab, Synthetic Enamel becomes dust free in about two hours, and air dries hard enough to handle in sixteen hours.

Note: Alcohol or anti-freeze solutions spilled on exterior finish should be washed off immediately or flushed off with water, as they will penetrate the finish and ultimately destroy the film.

SECTION 7: RE-ASSEMBLY

Handling Cab Top
(See Figures 8 and 9)

Raise up top bows with rear curtain attached and throw over locking latch provided on belt rail, to keep bows in upright position. Tighten the rope at the grab handles, if necessary, to make curtain taut.

Unstrap top curtain from top of windshield framework and unroll over roof bows. Pull curtain taut over rear bow, hook anchor rope into outside center hook, then pull rope tight and tie to grab handles.

Remove door and side curtains from pocket behind driver's seat. Door curtain has heavy edge on front side which should be entered into channel groove on rear of windshield framework, starting from top down. Enter curtain rods into respective holes in door top, pull curtain down and fasten at lower rear corner.

Fig. 8—View of Top Bows Raised

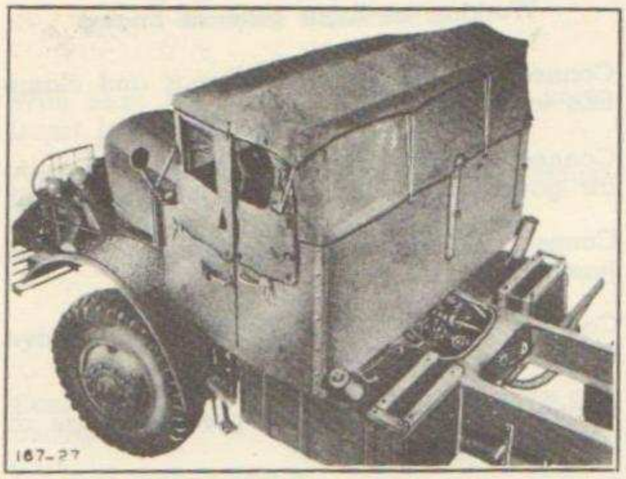


Fig. 9—View of Cab Top Complete

Assemble rear side curtain by fastening to top curtain, back curtain, and cab side.

Refer also to Figures 2 and 3.

Installing Cab on Chassis

Four men may be employed to advantage to install the cab on the chassis in a short time. The duties of each man are listed below. Each man is to perform the duties listed for him simultaneously with the others so that all will finish at the same time.

Man No. 1 Working Principally in Cab

All four men co-operate in placing lifting cables and positioning hoist. Assist in placement of cab on chassis. Note: Battery cable should be guided thru battery box floor while cab is being lowered into position.

With Man No. 2, remove cables and move hoist away.

Working Underneath

With Man No. 2, align cab mounting holes. Insert bolts and tighten.

Working in Cab

Attach steering column bracket to instrument board.

Install steering column bracket cap.

Install steering wheel and nut.

Install and connect horn button wire cable.

Fasten air line clamps to cab floor cross brace.

Working Underneath

Install clevis pin in winch control lever over left hand gas tank.

Working in Cab

With Man No. 2, connect magnetic switch cable clamp to frame.

With Man No. 2, install toe and floor boards and tighten.

Work with Man No. 2 to install treadle valve.

Install steering column draft plates.

Tighten radiator tie rod nuts—with Man No. 2.

Install floor mat.

With other three men, roll canvas top into position and fasten in place.

Man No. 2 Working Principally in Cab

All four men cooperate in placing lifting cables and positioning hoist. Assist in placement of cab on chassis. Note: Battery cable should be guided thru battery box floor while cab is being lowered into position.

With Man No. 1, remove cables and move hoist away.

With Man No. 1, align cab mounting holes. Insert bolts and tighten.

Working Underneath

Fasten air reservoir to cab sill.

Working in Cab

Install gas line three-way valve stem lever.

Assist Man No. 1 with steering wheel.

Install three tachometer cable clamps.

Install and connect tachometer cable.

Hook up hand brake rod.

Install shifter lever floor cover plates.

With Man No. 1, connect magnetic switch cable clamp to frame.

With Man No. 1, install toe and floor boards and tighten.

Working Underneath

Work with Man No. 1 to install treadle valve.

Working in Cab

Install and hook up foot accelerator pedal.

Tighten radiator tie rod nuts—with Man No. 1.

Connect all cables to battery.

With other three men, roll canvas top into position and fasten in place.

Man No. 3 Working at Right Side of Engine

All four men co-operate in placing lifting cables and positioning hoist. Assist in placement of cab on chassis. Note: Battery cable should be guided thru battery box floor while cab is being lowered into position.

Working from Top

With Man No. 3, align cab mounting holes. Insert bolts and tighten.

Working at Right Side of Engine

Connect air line at air governor and clamp line to dash sheet.

Connect air line from tire inflation valve to air governor and clamp line to dash sheet.

Connect ½" air line from air reservoir to junction block.

Connect ⅜" air line from tire inflation valve to junction block.

Connect air line from air pressure gage at junction block.

Connect air line from treadle valve to junction block.

Connect air line from low pressure indicator at junction block.

Connect coil wire to dash.

Connect radio bond — from exhaust pipe to dash.

Connect radio bond—from cylinder head to dash.

Install two carburetor choke wire clamps.

Connect choke wire at carburetor.

Connect oil pressure line to engine and clamp line.

Connect throttle retractor spring.

Install radiator tie rods, right hand and left hand—with Man No. 4.

Connect tachometer cable to engine. Clamp it to radiator tie rod and exhaust manifold.

Working with Man No. 4, install engine hood; make necessary adjustments of tie rods.

Install radio bond—from hood to dash, right-hand side.

With other three men, roll canvas top into position and fasten in place.

Man No. 4 Working at Left Side of Engine

All four men co-operate in placing lifting cables and positioning hoist. Assist in placement of cab on chassis. Note: Battery cable should be guided thru battery box floor while cab is being lowered into position.

Working Underneath

With Man No. 3, align cab mounting holes. Insert bolts and tighten.

Connect radio bond—from frame to cab mounting brackets.

Working from Top

Connect wires to junction block (16 wire connections).

Connect thermocouple.

Connect viscometer line.

Install radiator tie rods, right hand and left hand—with Man No. 3.

Connect horn wire.

Working with Man No. 3, install engine hood; make necessary adjustments of tie rods.

Install radio bond—from hood to dash, left hand side.

Connect accelerator pedal rod.

Connect hand throttle.

Add sufficient water (and anti-freeze, for cold weather operation) to fill radiator.

With the other three men, roll canvas top into position and fasten in place.

Installing Body on Chassis

Sling body so that it will handle in an approximately level position. Lower body into correct position on chassis. Secure sills to chassis frame with sill bolts and with spring-loaded bolts at the front. After several days running or a few hundred miles, check and if necessary tighten all bolts.

SECTION 8: SPECIFICATIONS

Body

MAKE .... Schantz

TYPE .... Wood Cargo

MOUNTING .... Oak Sill

Cab

MAKE .... Mack

TYPE Open steel with removable canvas top

MOUNTING Four point—L. H. front corner, solid; others, spring-loaded.

Hardware

MAKE .... C. Cowles & Co.

Windshield Wiper

MAKE .... Trico

MODEL FP679

TYPE .... Air

NUMBER PROVIDED 2

Rear View Mirrors

LOCATION .... Two outside

Windshields

TYPE .... Opening

ALIGNMENT .... Slotted Arm

Upholstery

CUSHIONS Duck covered spring construction

GROUP 19: WINCH

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

The winch is of the horizontal drum, jaw clutch type and reels both in and out by power received thru a shaft-and-chain drive from the power-take-off unit of the transfer case. It is

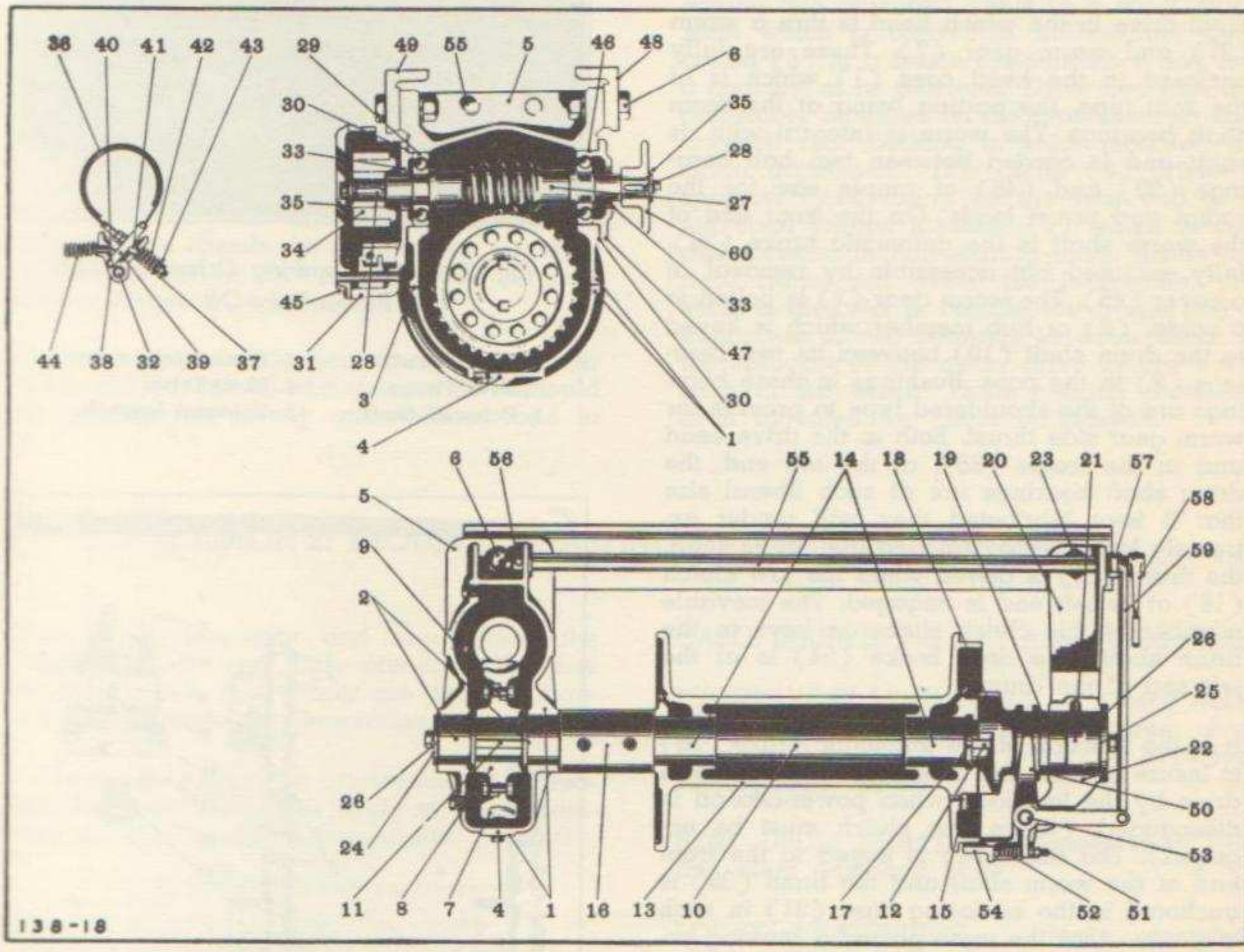


Fig. 1—Sectional Views of Winch

1. Drive Head Case
2. Bearing Bushing
3. Cover Gasket
4. Case Cover
5. Case Body
6. Pivot Bolt
7. Worm Gear Ring
8. Worm Gear Spider
9. Spider Bolt
10. Drum Shaft
11. Worm Gear Key
12. Jaw Clutch Key
13. Drum
14. Drum Bushing
15. Cable Clamp
16. Drum Spacer
17. Drum Thrust Ring
18. Sliding Jaw Clutch
19. Frame Thrust Ring
20. Frame Assembly
21. Sleeve Assembly
22. Frame Cap
23. Pivot Bolt
24. Retainer Washer
25. Retainer Washer
26. Drum Shaft Shim
27. Worm
28. Worm Shaft Key
29. Ball Bearing
30. Bearing Gasket
31. Brake Case
32. Rocker Pin
33. Oil Seal
34. Automatic Brake Disk
35. Retainer Washer
36. Automatic Brake Band
37. Check Nut (and Adj. Nut)
38. Brake Rocker
39. Band End Link
40. Link Pin
41. Adjustment Spacer
42. Brake Spring
43. Aligning Washer
44. Rocker Spring
45. Brake Case Cover
46. Ball Bearing
47. Bearing Cap
48. Base Rear Angle
49. Base Front Angle
50. Clutch Yoke
51. Spring Bolt
52. Brake Spring
53. Yoke Pin
54. Drag Brake
55. Operating Shaft
56. Shaft Collar
57. Short Lever
58. Long Lever
59. Clutch Link
60. Worm Shaft Sprocket

underslung mounted, transversely, on the chassis rails, forward of the radiator and to the rear of the bumper. The bumper is so shaped and mounted that it does not interfere with the winch line. Winch is arranged for bottom pull.

(See Figure 1)

Final drive in the winch head is thru a worm (27) and worm gear (7). These are fully enclosed in the head case (1) which is of the split type, the parting being at the drum shaft bearings. The worm is integral with its shaft and is carried between two ball bearings (29) and (46) of ample size for the radial and thrust loads. On the front end of the worm shaft is the automatic brake (36), fully enclosed but accessible by removal of a cover (45). The worm gear (7) is bolted to a spider (8) or hub member which is keyed to the drum shaft (10) between its two bearings (2) in the case. Bushings in these bearings are of the shouldered type to provide for worm gear side thrust. Both in the drive head and in the frame (20), at the left end, the drum shaft bearings are of such liberal size that if kept lubricated they will render extremely long service. Carried free on its shaft, the drum (13) is driven when the jaw clutch (18) at its left end is engaged. The movable member of this clutch slides on keys in the drum shaft. The drag brake (54) is at the left end of the drum.

It is the function of the automatic brake (36) to insure against any overhauling of the worm drive by the line load when power-take-off is disengaged. (Drum jaw clutch must be engaged). The disk (34) is keyed to the front end of the worm shaft and the band (36) is anchored in the enclosing case (31) in such a manner that the more powerful braking action is against unwinding rotation.

The sole purpose of the drag brake (54) is to prevent the drum from spinning and thereby loosening the cable on the drum when reeling off cable by hand. This brake is of the shoe type, acts on a flange integral with the drum and is applied automatically when the drum jaw clutch is disengaged. NEVER ATTEMPT TO USE IT FOR PAYING OUT CABLE UNDER LOAD, as when lowering a gun or other equipment down a grade. THE BRAKE IS NOT CAPABLE OF THIS and there was no intention to make it so, for handling load with a

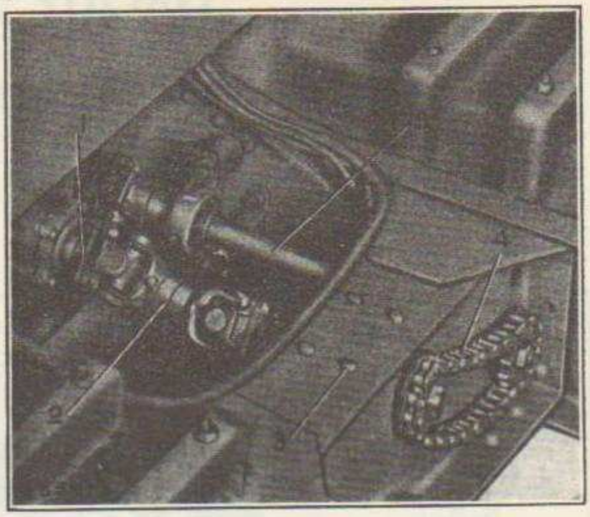


Fig. 2—View Showing Drive Rear of Power-Take-Off

1. Power-Take-Off Drive Flange
2. Universal Shaft
3. Bearing Bolt
4. Chain Drive
5. Universal Layshaft

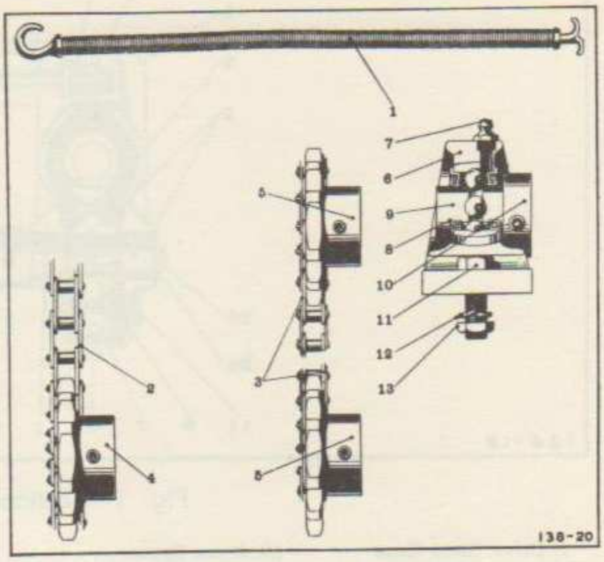


Fig. 3—View Showing Line Holder, Sprockets, Chain and Propeller Shaft Bearing

1. Line Holder
2. Chain, 37" long
3. Chain, 39" long
4. Sprocket
5. Sprocket
6. Bearing Assembly
7. Lubricating Fitting
8. Seal
9. Ball Bearing (with collar)
10. Lock Collar
11. Capscrew (Bolt)
12. Lockwasher
13. Nut

free drum is too dangerous to be attempted. When lowering a load, the power-take-off must be engaged, the truck transmission must be in gear, in reverse, and the sliding jaw clutch at the winch drum must be engaged, thus running the winch in the unwinding direction by power, under control thru the truck clutch and accelerator. This gives absolutely safe control of the load at all times, see "Winch Operation" in "Operation" group.

Power-Take-Off and Drive

(See Figures 2 and 3)

The power-take-off is built into the transfer case and may be driven thru any of the transmission speeds. Its shifter lever positions are designated as "In" and "Out" on the gear shifter diagram.

It receives its lubrication from the transfer case and if removed and re-installed it should at first be run slowly and without load to insure entrance of lubricant before it is subjected to its duty of transmitting power.

(See Figure 2)

When the winch is to be driven, power-take-off lever must be at "In" position. From the power-take-off drive flange (1) the drive is first toward the rear, thru a short shaft (2) having two universal joints to a short plane shaft which is carried in ball-bearing units bolted (3) to a frame cross-member and has a sprocket at its rear end. These bearings are adjustably mounted on the cross-member and layshaft rear bearing is shim mounted for chain adjustment. This chain (4) drives a sprocket (1.00 ratio) on the rear end of a universal jointed layshaft (5) which is carried forward in ball-bearing units, inside the right frame rail. Near the front axle, this shaft is directed to outside the frame and it terminates at two bearings between which is the sprocket of the chain drive to the worm shaft of the winch. These bearing units are shim mounted for chain adjustment.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

Due to its simplicity and ruggedness, the winch requires very little attention. The few troubles which may occur are readily diagnosed thru ordinary observation.

Only long neglect of lubrication or unreasonable overloading are likely to cause damage or wear of any consequence.

WINCH ALLOWS LOAD TO DRIFT .... Adjust automatic brake.

CABLE DRUM SPINS .... Adjust drag brake.

EXCESSIVE PLAY IN DRIVE .... Check worm bearings, worm and worm gear, drum shaft bearings, jaw clutch, all keys and keyways. Renew faulty parts.

BENT DRUM SHAFT .... Renew shaft and any other damaged parts.

LOOSE FASTENINGS .... Make complete check and tighten.

SECTION 3: ADJUSTMENTS

Automatic Brake

(See Figure 1)

Test automatic brake during operation by disengaging truck clutch and noting if winch allows its load to drift. If it does, adjust brake as follows:

Remove brake case cover (45). Note: Arrow on rocker (38) must point in direction brake drum (34) turns when winch is reeling in. Tighten nut at end of brake spring (42) one half turn and tighten check nut (37). Push adjustment spacer (41) into rocker (38) as far as it will go, backing up nut until clearance between nut and end of spacer is 1/8". Set up check nut. Test winch again and if any tendency to overhaul remains, adjust again; but never by more than a half-turn at a time. A brake which will not respond to reasonable adjustment should have its lining renewed; for lining is excessively worn or otherwise incapable of proper action.

Drag Brake
(See Figure 1)

When drag brake (54) fails to keep disk (13) from spinning (when cable is unreeled by hand) it should be adjusted for stronger application. Adjustments should not be continued when lining is worn excessively; instead renew lining.

Never attempt to adjust the brake to perform a greater duty than preventing drum spin, see "Section 1" of this group.

Chain Drives

The two chain drives should not be allowed to develop excessive slack. Adjust to take up slack but do not make chains tight. At the front drive, shim-mounted layshaft bearings are the means provided; at the rear, bearings of shaft to rear of power-take-off are adjustable sidewise and layshaft bearing is shim mounted. Chains which are slack after adjustment limits have been reached should be renewed.

Note: Worm shaft bearings are of non-adjustable type. Any looseness requires that they be renewed.

SECTION 4: DIS-ASSEMBLY

Removing Winch from Chassis

Two men should be employed to remove winch.

Remove drive chain at winch by taking out two cotter pins from a chain link and driving out link with a small drift pin.

Disconnect winch and brake control rod by removing cotter pin and withdrawing clevis pin. Disconnect air lines from trailer connections at both sides of chassis.

Fig. 4—View Showing Bumper Being Removed

Remove two bolts at each side which fasten rear ends of horizontal members of brush guards and remove screws holding air line clamps.

Fig. 5—View Showing Winch Removed

Note: Layshaft bearings and sprocket are at left in illustration.

Remove nuts from six bolts which hold bumper mounting flanges to frame on each side, place sling attached to hoist around bumper, take up slack and drive bolts out with drift pin.

Pull bumper assembly free from chassis and place to one side.

Remove remaining bolts which hold winch flanges to frame rails. There are two in front on top and four to the rear of these on each side.

Pass a sling about each end of winch frame and attach to hoist.

Remove nuts from 1¼" bolts, one on each side at rear top of winch frame, and drive bolts out with drift pin.

Lift with hoist until front angle cross-member is clear of chassis side rails and pull winch forward clear of chassis.

Disassembly of Winch

(See Figure 1)

Remove cotter pin from shift yoke pin (53) and drive pin out. This will allow removal of shift yoke (50) and drag brake (54).

Loosen set screw in collar (56) on operating shaft (55) in winch base. Slide off collar (56) and pull out shaft (55).

Remove retainer washers (24) and (25) and drum shaft shims (26) from both ends of drum shaft (10).

Loosen pivot bolts (6) in gear case (1). Remove pivot bolts (23) from end frame (20) and slide it off. Then slide off thrust ring (19) and sliding clutch (18).

Pull out clutch keys (12) and slide off drum thrust ring (17). Loosen set screws in spacer (16) and slide it off.

Remove capscrews from cover of gear case (1) and lift off cover. Drum shaft (10) with worm gear (7) and spider (8) can now be lifted out of gear case (1). Worm gear is fastened to spider with twelve ream-fit bolts and should not be taken off unless worm gear is worn or damaged. Bolts are tight and if removal is necessary they must be driven out. The spider should not be taken off shaft unless it is damaged or there is evidence that the key is allowing movement. An arbor press will probably be needed if spider is to be removed from shaft.

Remove brake case cover (45) and slide off brake band (36) with rocker (38). Rocker spring (44) will drop out of assembly. Remove capscrews and retainer washers (35) from both ends of worm shaft (27). This allows brake disk (34) and sprocket (60) to be pulled off. Lift out keys (28) from ends of worm shaft (27).

Remove capscrews that hold worm bearing cap (47) and brake case (31) to worm gear case (1) and remove cap and brake case. Tap either end of worm shaft (27) with hammer thru a wood block; worm will come out with one ball bearing, either (29) or (46). The other bearing can be tapped out separately in a similar manner. CAUTION: Note which side of each bearing is against shoulder of worm shaft. These bearings will take thrust in only one direction and if reversed at reassembly the bearing that takes the thrust of the worm will fail the first time the winch is used.

SECTION 5: REPAIRS

Clean all parts carefully in kerosene or other cleaning fluid, and blow dry with compressed air so they can be minutely inspected for evidence of excessive wear or other failure.

Bearing should be given an extremely thoro cleaning. After bearings have been soaked in kerosene, tap them lightly to dislodge any solid particles, flush them again in clean kerosene and blow dry with compressed air. Do not spin bearings with air, revolve them slowly in races with fingers as air is directed at right angles to balls. Examine races and balls for pits or flat spots and then oil each bearing assembly with clean engine oil.

Lubricant grooves and passages in bushings should be thoroly cleaned and bushings inspected for evidence of excessive wear.

Drilled lubricant passages in upper and lower gear case housing should be cleaned thoroly and inspected to be sure that passage in bushing lines up with lubrication fitting passage.

Inspect worm gear for evidence of cracked or chipped teeth or excessive wear.

Oil seals, at each end of worm shaft, should be carefully inspected and renewed if slightest evidence of wear is apparent.

See that drum shaft bushings in gear case are properly placed over the dowels.

Use great care in re-assembly of worm shaft caps with oil seals. The oil seals may easily be ruined if improperly pushed over the shoulders on the worm shaft.

See that sliding clutch keys are properly in place and seated to full depth. See that clutch freely slides on keys before proceeding with assembly of end frame. If necessary, file keys to assure easy sliding fit and oil with light oil.

Always use new cotter pins and lockwashers on any assembly.

If automatic brake has been relined, be sure that its ends are on same side of brake case as before dis-assembly and be sure it is tested and adjusted (after winch is again in position on truck) as described under "Section 3: Adjustments".

The lining used on the automatic worm brake is a special type, developed especially for this purpose. Get the proper lining. Do not substitute ordinary brake lining, as it may contain gummy material which will melt out, stick to the disk and cause jerky brake action.

SECTION 6: LUBRICATION

When re-assembling the unit be sure to generously coat all parts with oil, so that they will have immediate lubrication when first starting. No other lubrication is required during re-assembly.

For other lubricating instructions, see "Lubrication" group.

After re-installing power-take-off unit it should be run slowly and without load to insure entrance of lubricant from transfer case before subjecting it to load.

SECTION 7: RE-ASSEMBLY

Reassembly of Winch
(See Figure 1)

Place worm (27) thru opening in gear case (1). Slide on bearings (29) and 46). CAUTION: Be sure bearings are installed exactly as before removing, as these bearings will take thrust in one direction only. Tap them into place with hammer thru a block of wood.

Renew oil seals (33) in worm bearing cap (47) and brake case (31). With new gasket (30) in place, attach worm bearing cap (47) and brake case (31) on proper sides of worm gear case (1).

Insert key (28) in each end of worm shaft (27) and tap on brake disk (34) and sprocket (60). Secure with retainer washers (35) and cap screws.

With spacer (41) in place on rod, thread loose rod end of brake band (36) thru hole in rocker (38), then slide on brake spring (42) and washer (43); hold loosely in position with two nuts (37) over washer (43). Slide brake band (36) over brake disk (34) and rocker (38) over pin (32) in brake case (31). Replace rocker spring (44). Do not adjust automatic brake until winch is completely assembled. Note: There is an arrow on brake rocker (38) which must agree with direction of rotation of worm for hoisting. Check this before replacing brake case cover (45), see "Section 3: Adjustments."

If worm gear (7) has been removed from spider (8), reassemble using new ream-fit bolts. Set spider keys (11) in drum shaft (10). Press gear and spider onto shaft (10). Slide on gear case bushings (2), one over each end of shaft (10), up flush with each side of spider (8).

Set drum shaft (10) with spider (8) and gear (7) in place into gear case (1). With new gasket (3) in place set gear case cover over gear (7) and secure with cap screws.

Slide spacer (16) onto shaft (10) until it touches gear case (1), and tighten set screws. Press bushings (14) into drums (13). Slide drum (13) onto shaft (10); then drum thrust ring (17). Insert sliding clutch keys (12) in drum shaft (10); slide clutch (18) over keys. CAUTION: Be sure clutch is free to slide.

Assemble bushing (21) into end frame (20), secure with dowel. Slide thrust ring (19) onto drum shaft (10). Then slide on end frame (20). Secure with pivot bolts (23) to base angles (48) and (49). Replace shims (26) and retainer washers (24) and (25). Draw up tight with cap screws in ends of drum shaft (10). NOTE: Use drum shaft shims (26) as required. All parts on drum shaft should be snug but must not bind.

Set clutch shift yoke (50) into place and tap in pin (53). Secure with cotter pin. Slide control shaft (55) into base of winch. Slide collar (56) onto shaft at gear case end and tighten set screw. Connect control link (59) with lever arm (57) and put in cotter pin.

Installing Winch on Chassis

Two men should be employed to install winch.

Pass a sling around each end of winch, attach slings to hoist and position winch suspended in front of the chassis with drive head at right side of chassis.

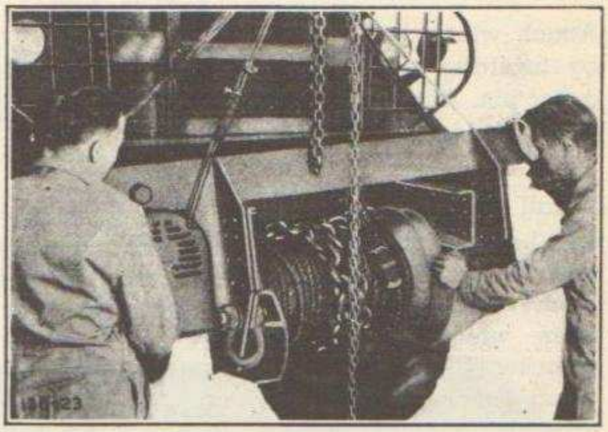


Fig. 6—Illustration of Positioning of Winch on Chassis

Lift winch until its front angle cross-member is slightly above top of chassis frame rails and push back into position.

Insert the two 1¼" bolts thru upper mounting lugs at the rear of winch. A pinch bar will be helpful in inserting left hand bolt. A hammer may used for the one on the right. Place lockwashers and nuts on bolts and tighten.

Line up flange bolt holes by using drift pins. With a drift pin in place on each side, remove slings. Install bolts, lockwashers and nuts, two at upper front and four to the rear of these on each side, leaving drift pins in place until last. Tighten nuts.

Lift bumper assembly with sling and hoist and push it into position with holds on brush guards. With bumper suspended from hoist, using drift pins to align holes, insert bolts in four holes in mounting flanges on each side. Remove sling. Install lock washers and nuts. Tighten nuts.

Insert bolts at two holes at rear of horizontal member of brush guard on each side. Install shakeproof washers and nuts and tighten nuts. Attach air line clamps to brackets with Phillips screws.

Attach winch brake and clutch control lever by inserting clevis pin and securing it with cotter pin. Attach air line to trailer connection on each side.

Install winch drive chain around sprockets, insert connecting link pins, replace link bar and put in cotter pins. If difficulty is encountered, slacken chain by loosening the four bolts which secure bearings at layshaft sprocket. Check chain adjustment after tightening bearing bolts. The chain should not be excessively slack; neither should it be too tight. Adjustment is made by removing or adding shims under bearings, see "Section 3: Adjustments."

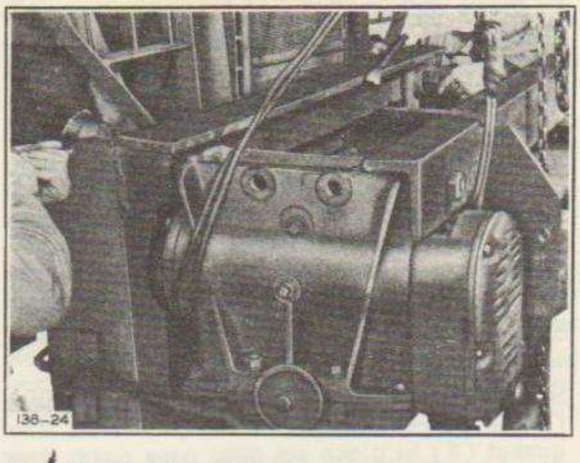


Fig. 7—Winch in Place showing Large Bolts at Rear Being Inserted

SECTION 8: SPECIFICATIONS

Winch

Make	Gar Wood
Model	Basic 5 M B
Location	Front of Chassis
Drive	Power-Take-Off built into Transfer Case

Power-Take-Off

Make	Mack
Model	Unit Built into Transfer Case
Speeds	Taken from Transmission
Drive	From Rear of Transfer Case
Control	Shift Lever in Cab

SECTION 9: TOOLS

As all dis-assembling, adjustments and re-assembling can be accomplished with the standard tool equipment furnished with the truck or with tools included in mechanics' kits, and as repairs are usually made by the RENEWAL of worn or broken parts, no special tools are required.

GROUP 20: HOIST

SECTION 1: DESCRIPTION AND PRINCIPLE OF OPERATION

For safe and quick accomplishment of coupling operations there is a chain hoist at the rear end of the truck. Its principal function is the lifting of the gun trail and the drawbar trail clamp when joining these members in towing arrangement.

The hoist is suspended from the center of a transversely mounted, arch-shaped, tubular support. This support is carried directly on the chassis frame; its verticals passing thru the body floor, just ahead of the tailgate, and into bores in large rugged brackets which are rigidly fastened to the side rails, on the outside near the end of the frame. For favorable disposition of the hoist, the support leans slightly toward the rear. Means are provided for securing the hoist from swinging when the truck is traveling. The hoist should never be used as a towing means either alone or supplementary to any towing arrangement.

Hand operated, the hoist is of the type that is widely known thru industrial use. A fully enclosed geared mechanism provides the high mechanical advantage that converts hand power into a powerful lift. The means of operation is an endless, hand chain which travels thru guides and over the link-recessed chain wheel. From a fixed attachment at the hoist, the load chain passes down thru the lifting block and up into the hoist where the lift for this double suspension is by the link-recessed load-chain wheel. The ratchet and friction elements incorporated in the hoist make it impossible for the load to overhaul the hoist; and the load chain cannot jump from the load chain wheel.

To facilitate attachment of the hoist to its load, there are a pair of short chains having heavy hooks attached to the load block by a shackle.

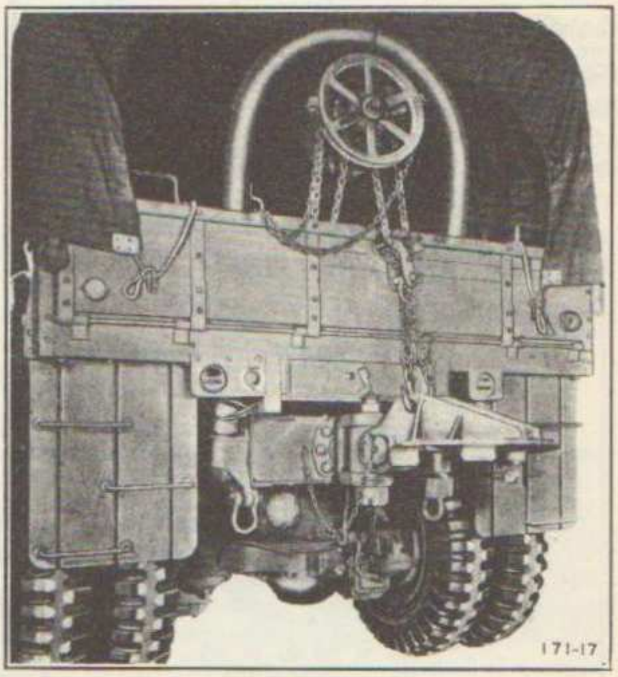


Fig. 1—View Showing Hoist Supporting Trail Clamp

Almost an unlimited length of service may be expected from the hoist for it is amply sized for the intended duty and its design and construction are conducive to long life.

SECTION 2: TROUBLE SHOOTING AND GENERAL SOLUTIONS

BROKEN OR DAMAGED CHAIN	Renew
BROKEN, DAMAGED OR WORN GEARS	Renew
BROKEN, DAMAGED OR WORN SHAFT	Renew
BROKEN OR DAMAGED CHAIN WHEELS	Renew
BROKEN, DAMAGED OR WORN BEARINGS	Renew
BROKEN PAWL AND/OR PAWL SPRING	Renew

SECTION 3: ADJUSTMENTS

There are no mechanical adjustments to be made; but regular inspection should be practised in the interest of keeping all nuts and bolts tight and to assure that all cotter pins are in place and in such condition as to provide full security.

SECTION 4: DIS-ASSEMBLY

Remove hoist from yoke by first supporting hoist, then extracting cotter pin from upper cross-head shackle bolt (19) and removing castle nut, bolt and shackle (18). Lower hoist.

Remove plug (36) from casing and drain oil before dis-assembly.

Remove load chain by removing bolts (21) and (26) to release chain end links and rotate chain wheel to disengage chain.

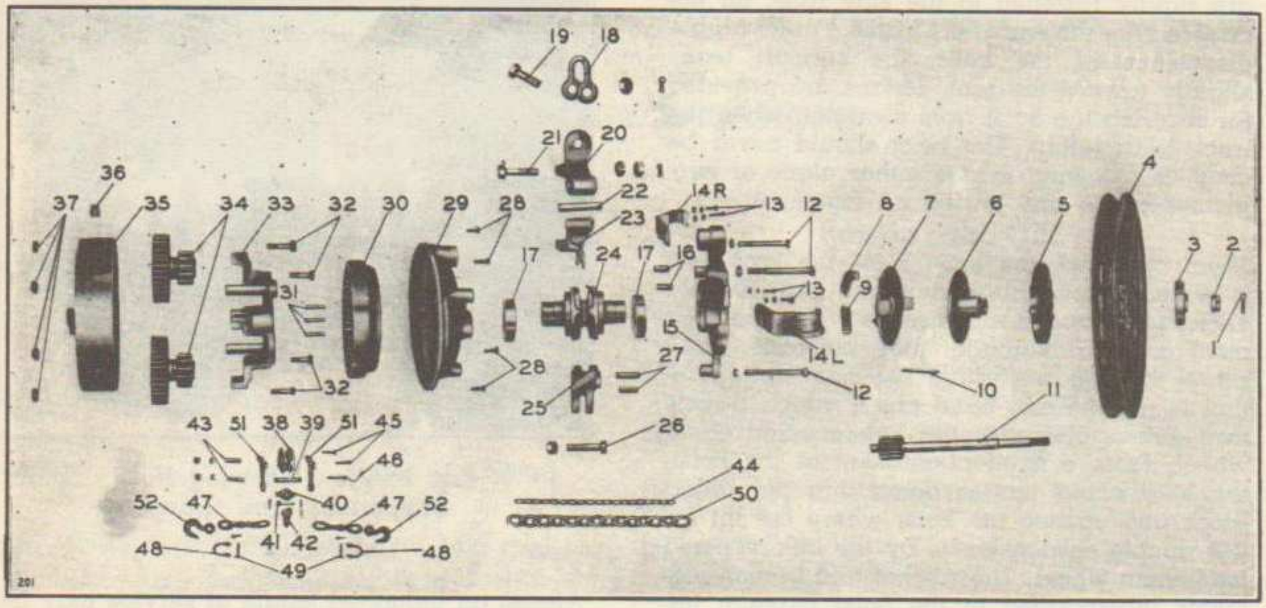


Fig. 2—Exploded View of Chain Hoist

1. Shaft Cotter Pin
2. Shaft Nut
3. Cam Cap
4. Hand-Chain Wheel
5. Brake Wheel
6. Friction Disk
7. Pawl Plate
8. Pawl
9. Pawl Spring
10. Friction Disk Key
11. Center Shaft
12. Separator Bolt
13. Guide Bolt

14R. Chain Guide (Right)

14L. Chain Guide (Left)

15. Ratchet Frame
16. Separators
17. Load-Chain Wheel Bearing
18. Shackle
19. Shackle Bolt, Nut and Cotter Pin
20. Upper Cross-head
21. Bolt, Nut and Cotter Pin
22. Cross-head Pin
23. Chain Stripper
24. Load-Chain Wheel
25. Load-Chain Guide
26. Guide Bolt and Nut
27. Guide Pins
28. Frame Screws
29. Right Hand Frame
30. Internal Gear
31. Int. Gear and Load-Chain Wheel Pins
32. Spider Bolts
33. Spider
34. Spur Wheel and Pinion
35. Casing
36. Pipe Plug
37. Spider Bolt Nut
38. Lower Block Chain Wheel
39. Wheel Axle and Cotter Pin
40. Cross-head and Cotter Pins
41. Shackle Pin and Cotter Pin
42. Block Shackle
43. Separator
44. Hand Chain
45. Separator Bolt, Nut and Washer
46. Two-speed Pin, Chain and Cotter Pin
47. Sling Leg
48. Hook Yoke
49. Yoke Pin and Cotter Pin
50. Load Chain
51. Block Frame
52. Sling Chain Hook

Place hoist so that hand-chain wheel (4) is up and remove cotter pin (1) and castle nut (2). Unscrew cam cap (3). Remove hand-chain wheel (4) and chain brake wheel (5), friction disk (6), key (10) and pawl plate (7). Pawl (8) and pawl spring (9) will then drop out. Remove chain guides (14R and 14L) by removing four nuts and bolts (13).

Take out three long bolts (12) and remove ratchet frame (15) which will free the upper cross-head (20) and pin (22), load chain guide and anchor (25) and pins (27), chain stripper (23) and pipe separators (16). Remove these parts and the outer or right hand bearing (17).

Remove four screws (28) and lift frame cover (29) with lift chain wheel (24), inner or left hand bearing (17) and inner gear (30). If dis-assembly of the last mentioned parts is necessary, remove inner gear (30) from shaft of load-chain wheel (24) by using puller or driving implement as it is pinned in place by three pins (31) driven between the gear and the shaft. The chain wheel can then be lifted out of the cover (29) and the bearing (17) removed.

Remove four nuts (37) and bolts (32) from the spider assembly and remove spider (33) from casing (35). Gears (34) will slide off shafts on spider and main shaft (11) may be removed.

Dis-assemble lower block assembly by removing cotters and nuts and bolts (45). Lower block frames (51) may then be separated and chain wheel (38) removed from shaft (39). Lower block cross-head (40) is also removed and cotters removed from shackle pins to dis-assemble chains (47) and hooks (52).

SECTION 5: REPAIRS

Repairs are made by renewal of broken or worn parts.

Note: All parts should be thoroly cleaned, using suitable solvents when necessary to remove all traces of dirt and lubricants; and inspected carefully for cracks or evidences of wear. Parts showing wear that would impair their usefulness or would have a detrimental effect upon other parts in assembly should be renewed. It is preferable to renew seals. Any questionable bolts, nuts and pins should be renewed. All cotter pins and lock-washers must be renewed for safety. All bearing and working surfaces should be generously coated with oil preparatory to re-assembly.

Renewal of gears (34) or shaft (11) may be effected without complete dis-assembly by removing only the parts from pawl plate (7) to outer end of shaft including key (10) and then taking out screws (28) to remove casing and spider assembly with shaft. See "Section 7: Re-assembly" for proper method of aligning gears when replacing.

To install a hand chain (44) it is necessary only to remove cotter pin (1) and castle nut (2). Slide the entire brake assembly with hand-chain wheel (4) on shaft (11) until hand chain can be lifted free of wheel.

Place new chain and slide assembly back into position being sure that the lugs of the pawl plate (7) are properly engaged in the recesses of the brake wheel (5). If the original relation of the lugs to the recesses has been maintained, the cam cap (3) needs no adjustment. If the position has not been kept it will be necessary to screw cam cap (3) until tight, then back off 1/32" to allow brake wheel (5) to free itself. Screw castle nut (2) against cam cap and secure with cotter pin (1).

To renew load chain, detach end links from upper cross-head (20) and chain guide (25). Rotate hand-chain wheel (4) until load chain is removed from chain wheel (24) and pull out of lower block chain wheel (38). Thread new chain over top of chain wheel (24) from right hand side rotating wheel to engage chain. Anchor end link to chain guide (25) with bolt (26) and replace nut. Thread other end of chain thru lower block wheel (38) from left hand side and attach end to upper cross head (20) by bolt (21) replacing washer, nut and cotter pin.

SECTION 6: LUBRICATION

Before reassembly, place small amounts of chassis-grease in ratchet frame (15), ratchet, and pinion gear shafts. Bearings are sealed and need no lubrication. A light coating of light oil on the unpainted parts before reassembly will minimize the tendency to rust.

SECTION 7: RE-ASSEMBLY

Place shaft (11) in recess in casing (35) and arrange gears (34) on each side over recessed holes for shafts so that punch marks on gears are in line toward center shaft. Replace spider (33) and bolt in place with bolts (32).

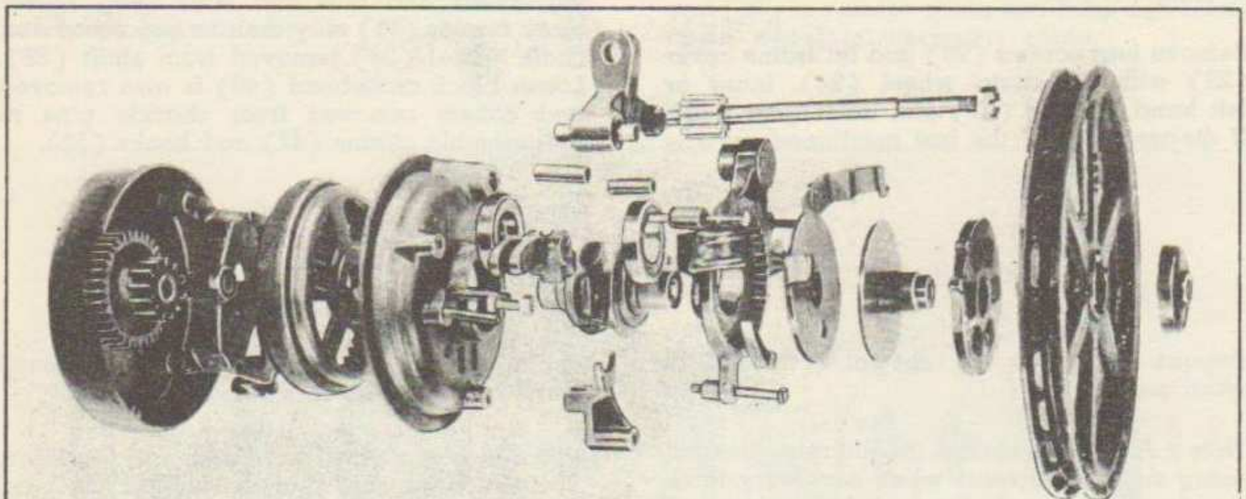


Fig. 3—View of Chain Hoist, Partially Exploded

Place left hand bearing (17) on load-chain wheel (24) shaft, and place shaft in frame (29) sliding inner gear (30) onto shaft. Drive three pins (31) into keyways provided in gear and shaft. Place this assembly over spider (33), meshing internal gear with pinion gears. Use small amount of white or red lead where casing (35) meets frame (29) to seal joint. Install screws (28) and tighten.

Place right hand bearing (17) on shaft and place pin (22) in hole provided in frame, sliding upper cross-head (20) onto pin. Install chain guide (25) with pin (27) thru hole and insert in hole beneath the guide. Position pipe separators (16) on two top bosses and lower chain stripper (23) on lower boss, place ratchet frame (15) in position, slide bolts (12) with lock washer on them thru holes, and pilot the pins (22) and (27) into position. Tighten bolts.

Put pawl spring (9) over projection on under side of pawl (8) and place in ratchet frame so pawl plate (7) may be put on with pawl pivot in hole in pawl plate. The position of the plate is with ears to right and left away from ratchet frame with hole above shaft. Drop plate into place, piloting pawl spring into hole provided in under side of plate.

Slip key (10) into keyway in shaft and slide friction disk (6) onto shaft over key. Place brake wheel (5) and hand-chain wheel (4) on shaft and screw on cam cap (3). The cam cap can be screwed tight by turning the chain wheel in the same direction so that cam surfaces will be properly seated. When tight, the cam cap should be screwed back about 1/32" and the castle nut (2) and cotter pin (1) replaced.

Place the hand chain over the chain wheel and replace the chain guides (14R and 14L) by attaching with nuts and bolts (13).

For lower block re-assembly, place cross-head (40) ends in holes in lower ends of block frames and replace cotters. Put shaft (39) thru center holes and chain wheel (38) and replace cotter pins using, for outer end, the cotter pin on end of the locking pin chain (46).

Complete the block assembly by placing bolts (45) in holes in frames installing pipe separators to maintain the space between frames. Re-assemble the chain and hook assemblies by replacing shackles, pins and cotters.

Replace load chain by method outlined under "Section 5: Repairs".

Put ½ pint universal gear oil into casing and replace plug.

Remount hoist on yoke by attaching shackle (18) thru ring on yoke to upper cross-head (20) and replacing nut and cotter pin (19).

SECTION 8: SPECIFICATIONS

MAKE .... Reading Chain and Block Corp.

CAPACITY RATING .... 3 Tons

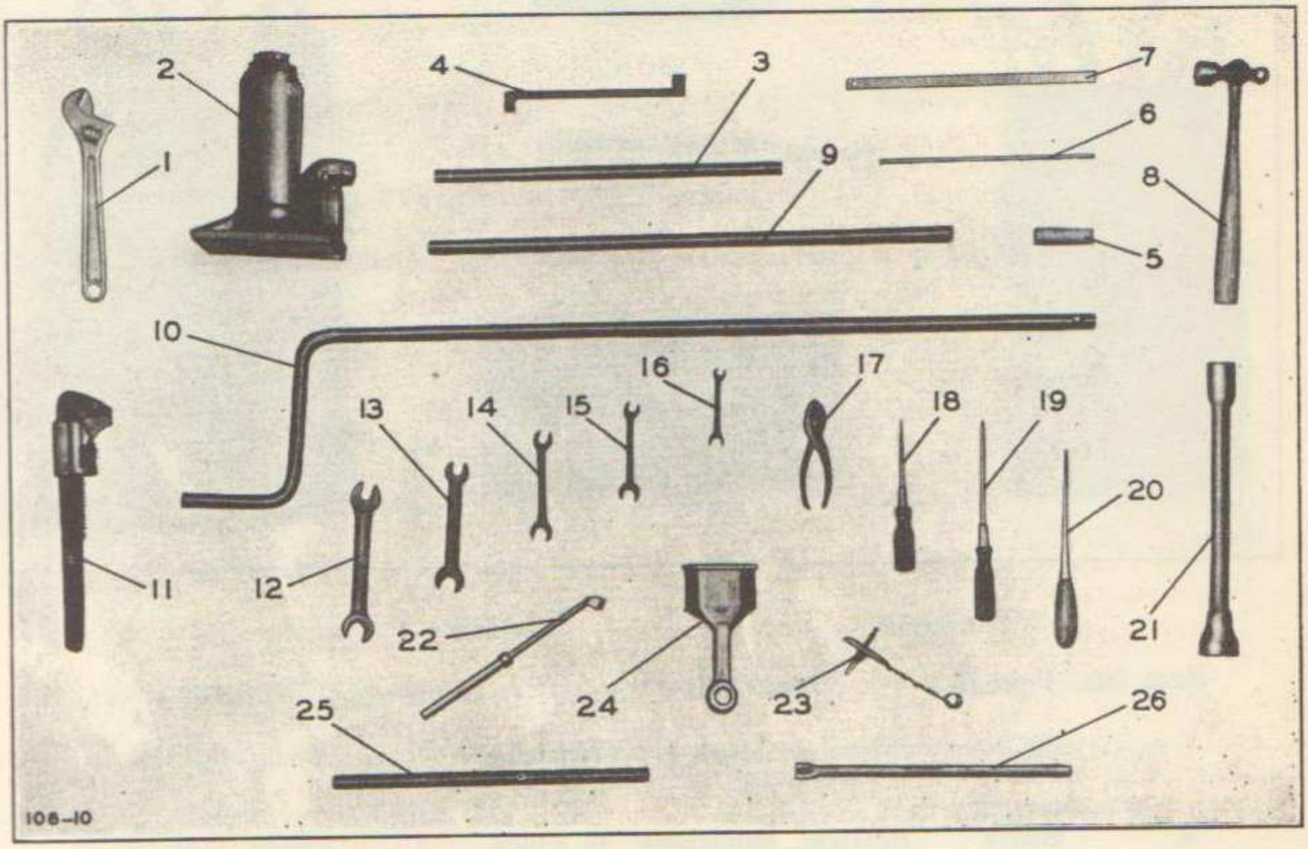
SECTION 9: TOOLS

As all dis-assembling, adjustments and re-assembling can be accomplished with the standard tool equipment furnished with the truck or with tools included in mechanics' kits, and as repairs are usually made by the RENEWAL of worn or broken parts, no special tools are required.

GROUP 23: TOOLS

The tools illustrated below and on the next page are provided with the vehicle.

Check to see that all items listed are in the vehicle at all times.



Item No.	Part No.	Description	Manufacturer
1.	———	Wrench, Adjustable, Crescent Type, 12"	Diamond Calk Horseshoe Co.
2.	E-811A	Jack, Hydraulic, 8-Ton	Hein Werner Motor Parts Co.
3.	———	Handle, Jack (Furnished with Item No. 2)	Hein Werner Motor Parts Co.
4.	33RC114	Wrench, Drain Plug, ¾" & ⅜" square	Mack Mfg. Corp.
5.	11RC18	Wrench, Spark Plug, 13/16", Double Hexagon	Bonney Forge & Tool Co.
6.	21RC11	Handle, Spark Plug Wrench, 5/16" diameter, 12" long	Mack Mfg. Corp.

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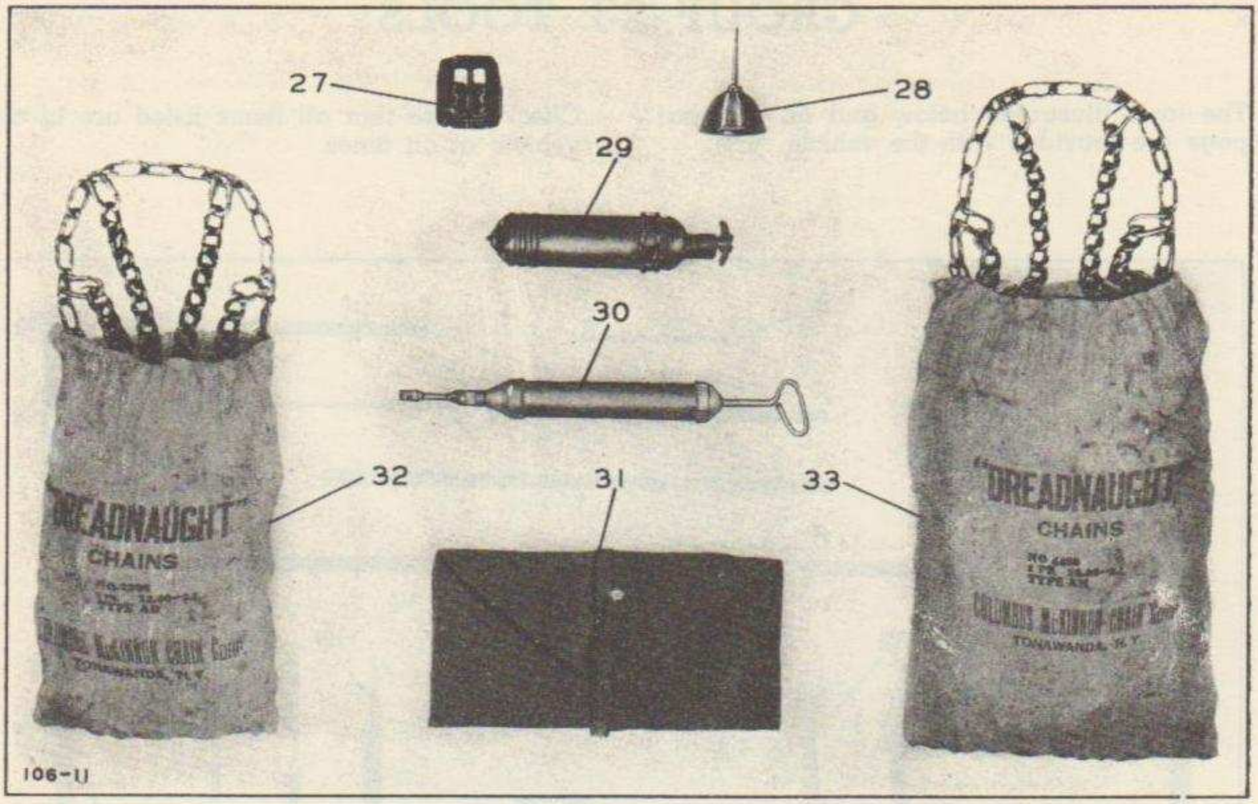

Item No.	Part No.	Description	Manufacturer
7.	22RC11	Extension, Spark Plug Wrench, ½" square, 14" long	Mack Mfg. Corp.
8.	HB516	Hammer, Machinists', 16 ounce	Vlchek Tool Co.
9.	31AX395	Handle, Wheel Stud Nut Wrench, ¾" diameter x 30" long	Mack Mfg. Corp.
10.	2RCA3010	Crank, Starting, ⅞" diameter, 44½" long	Mack Mfg. Corp.
11.	WF615	Wrench, Adjustable, Automobile Type, 15"	Vlchek Tool Co.
12.	723	Wrench, Engineers', 15°, ¾" & ⅞"	Vlchek Tool Co.
13.	25	Wrench, Engineers', 15°, ⅝" & 25/32"	Vlchek Tool Co.
14.	27-C	Wrench, Engineers', 15°, 9/16" & 11/16"	Vlchek Tool Co.
15.	28-S	Wrench, Engineers', 15°, ½" & 19/32"	Vlchek Tool Co.
16.	731-A	Wrench, Engineers', 15°, ⅜" & 7/16"	Vlchek Tool Co.

(Continued on next page)

Item No.	Part No.	Description	Manufacturer
17.	PRH506	Pliers, Combination, 6"	Vlchek Tool Co.
18.	SPA2	Screw-driver, Phillips Head #2	Vlchek Tool Co.
19.	SPA3	Screw-driver, Phillips Head #3	Vlchek Tool Co.
20.	———	Screw-driver, Heavy Duty, 6"	Tobrin Tool Co. or Irwin Auger Bit Co.
21.	7941	Wrench, Wheel Stud Nut 1-33/64" & 1-1/16"	Bonney Forge & Tool Co.
22.	7188-B7	Gage, Tire Pressure, 10 to 160 lbs.	A. Schrader & Son
23.	7570A	Air Chuck	A. Schrader & Son
24.	33RC22	Wrench, Trail Clamp, 3-7/32" across flats	Mack Mfg. Corp.
25.	21RC12	Handle, Trail Clamp Wrench, ¾" diameter, 18" long	Mack Mfg. Corp.
26.	16AB11540	Bar, Pilot, ⅝" diameter, 16" long	Mack Mfg. Corp.
27.	A363	Bracket, Oil Can	Bassick Co.
28.	4004	Can, Oil, ½" Pint	Eagle Mfg. Co.
29.	Vanguard	Extinguisher, Fire, 1 Quart	Pyrene Mfg. Co.
30.	5257	Gun, Grease, 14 to 16 ounce	Stewart Warner Corp.
31.	2695	Pocket, Tool Kit	Textile Industries Co.
32.	2288	Chains, Tire (front) Type AD, 12.00/24	Columbus McKinnon Chain Corp.
33.	4488	Chains, Tire (rear) Type AN, 12.00/24	Columbus McKinnon Chain Corp.

Special Service Tools

The above tools, which are furnished with the vehicle, enable the making of minor adjustments and temporary repairs.

However, in addition, many special service tools are required for the complete maintenance of the vehicle.

These special tools are specified thruout the manual under the title of the figures illustrating their use.

In some instances, the special tool is given in the paragraph describing the operation.

A summary of all the tools described in each group of the manual, is given as a complete listing in Section 9: Tools" to be found near the end of each group.

SUMMARY OF ADJUSTMENTS

Note: Summary of Fuel, Oil and Water Capacities is given on page 00-4.

Group 01: Engine

Firing Order 1-5-3-6-2-4

Compression @ 150 RPM 125

Cyl. Hd. Nut Tension 125-130

Oil Pressure, Maximum 45-60

Oil Pressure, Idling 10-20

Inlet Valve

Clearance, Hot Idle .... .006"-.008"

Valve Opens .... 8°BTDC

Valve Closes .... 43°ALDC

Exhaust Valve

Clearance, Hot Idle .... .022"-.024"

Valve Opens .... 40½°BLDC

Valve Closes .... 5½°ATDC

Group 02: Clutch

Free Pedal Travel, Maximum .... 1¾"

When reduced to ½" .... Adjust Clutch by removing Shims (11), see page 02-2. Do NOT readjust Pedal.

Group 03: Fuel

Governed Speed, Full-Load 2100

Governed Speed, No-Load 2250

Idling Speed 300

Fuel, Octane No. A.S.T.M., Minimum 68

Fuel Pump Pressure at Carburetor .... 3 to 4

Carburetor Float Setting .... 1⅞"

Carburetor Idle Adjustment .... Screw OUT to Lean Mixture.

Group 05: Cooling

Thermostat starts to open at .... 155°F.

Thermostat fully open at .... 175°F.

Fan Belt .... 15 lbs. deflects long side ½"

Group 06: Electrical

Generator output (cold) .... 25 Amps. at 8.10 Volts and 1150 Gen. RPM

Distributor, Point Opening .... .018" to .024"

Cam Angle .... 35°

Spark Plug Gap .... .030"

Ignition Timing, Initial .... 10°BTDC or 4½ Teeth on Flywheel Gear

Group 10: Front Axle

Toe-in .... ⅛" to 3/16"

Caster Angle, Positive, Empty .... 1° to 2°

Loaded .... 1½° to 2½°

Camber Angle, Positive .... ½° to ¾°

In Inches .... ⅛" to ¼"

L.H. Turning Angle .... Left Wheel 29°
Right Wheel 24°

R.H. Turning Angle .... Left Wheel 24°
Right Wheel 29°

Group 12: Brakes

Hand Brake Lining to Disk Clearance .... Front .020", Rear .020"

Foot Brake Slack Adjuster Rod Travel, Readjust Front at 1⅜" for ¾" to ⅞" and Rear at 1¾" for ⅞" to 1".

Governor .... Cut-in 85, Cut-out 105

Safety Valve Opens at 150

Low Pressure Indicator Operates at 60

Group 13: Wheels

Wheel Bearing End-Play, Front .... None
Rear .... .002" to .005"

Tire Pressure .... Front 80, Rear 65

Mack

TRUCKS • FIRE APPARATUS
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