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TM10-1287

# MAINTENANCE MANUAL

K3-24



# CHEVROLET

**3/4-TON (LC) 4 x 2 TRUCK**

*Built for*

**UNITED STATES ARMY**  
**Model 3605**

**CONTRACT NUMBER**  
**W-398-QM-1092**

**U.S.A. Registration Numbers**  
**W-243622 TO W-243665**

**Chevrolet Motor Division**  
**General Motors Sales Corporation**  
**Detroit, Michigan**

TM10-1287

**TM10-1287**  
**WAR DEPARTMENT**

*Washington, November 15, 1941*

TM10-1287, Maintenance Manual, Truck  $\frac{3}{4}$ -Ton (LC) 4 x 2, Chevrolet (Model 3605) published by the Chevrolet Motor Division, General Motors Sales Corporation, is furnished for the information and guidance of all concerned.

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By order of the Secretary of War:

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Chief of Staff

Official:

E. S. ADAMS,  
Major General  
The Adjutant General

**TM10-1287**

**MAINTENANCE  
MANUAL**

**CHEVROLET 3/4-TON  
4 x 2 TRUCK**

**FOREWORD**

This manual contains information covering the Operation, Maintenance and Repair of Chevrolet 3/4-Ton — 4 x 2 Trucks.

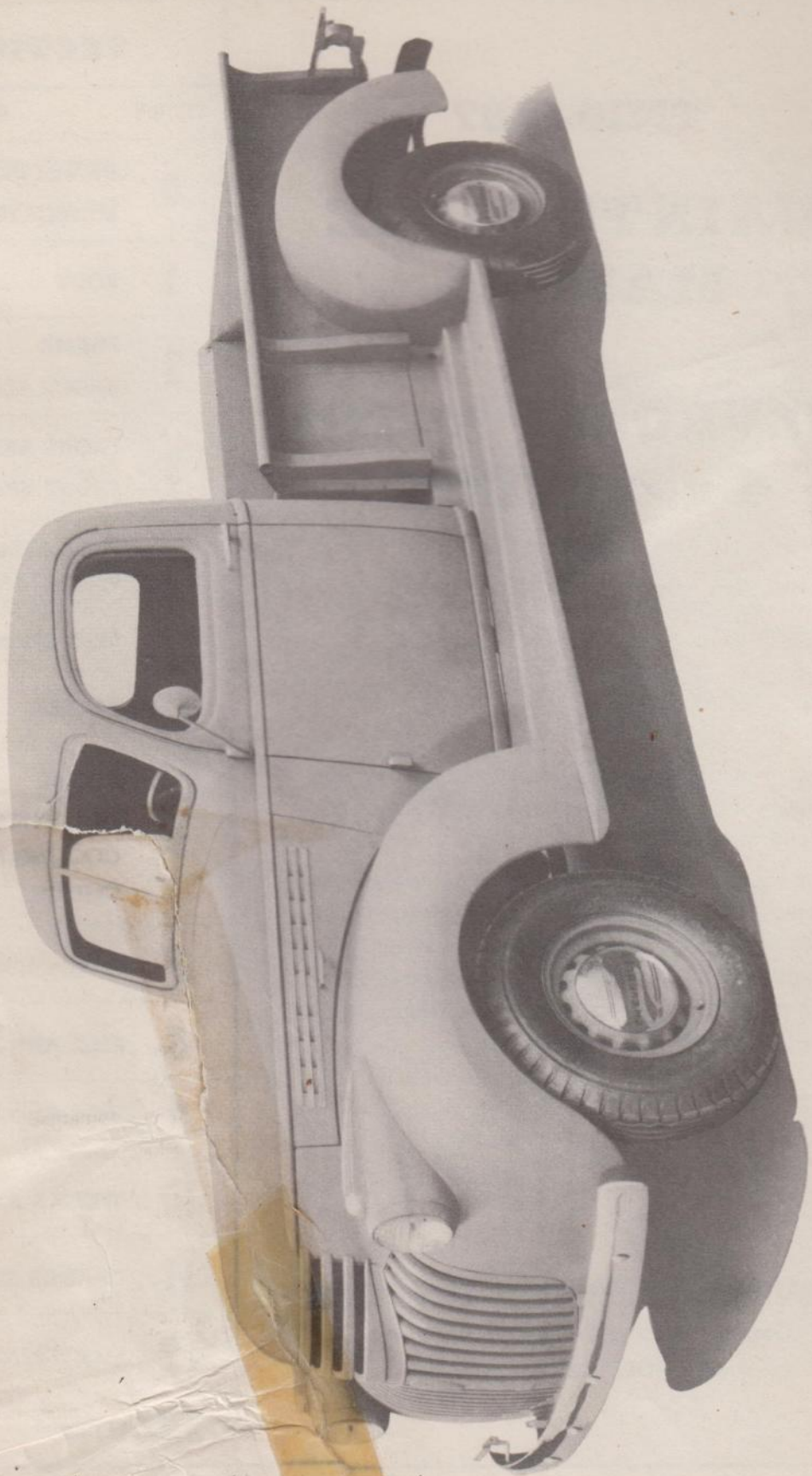
For the convenience of the user it is arranged in sections. All information pertaining to a given unit will be found in the section devoted to that unit. The manual is written for the guidance of the operator and repair men who are responsible for the vehicle. Keep it handy and refer to it often.

**CHEVROLET MOTOR DIVISION**

General Motors Sales Corporation  
DETROIT, MICHIGAN

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## Section 0

### DRIVER INSTRUCTIONS

It is of definite importance that the driver of one of these vehicles be thoroughly familiar with the various controls and instruments and their proper use. Even the experienced driver should study the controls before attempting to start the engine or move the vehicle.

Fig. 1 illustrates the controls and instruments; in the following paragraphs dealing with the purpose and use of the instruments and controls we will refer to the key number of the instrument or control being discussed, so the reader may easily follow the instructions. Starting with Fig. 1 we find the following:

**IGNITION SWITCH** No. 1 is operated by the ignition key; turning the switch to the right turns on the ignition and turning the switch to the left turns the ignition off.

**HAND THROTTLE** No. 2 is located on the instrument panel to the right of the ignition switch; pulling this button opens the throttle. This control may be used when starting or, if it is desired, to run the engine at a constant speed.

**CARBURETOR CHOKE** No. 3 is used when starting a cold engine. Pulling out this control button shuts off the air to the carburetor, providing a rich mixture for easy starting. The choke button should be pushed in when the engine starts. If the engine is warm, the use of the choke should be unnecessary.

**FUEL GAUGE** No. 4 registers the amount of fuel in the tank when the ignition switch is turned on. The dial has graduations for empty, half full and full.

**TEMPERATURE INDICATOR** No. 5 indicates the temperature of the liquid in the cooling system at all times. The driver should watch this instrument closely. A red band at the right of the dial is used to indicate excessive temperature. Whenever the indicator hand enters this band, the driver should immediately investigate the cause of the excessive temperature. Continuing to drive an overheated engine may cause permanent damage to its working parts.

**AMMETER** No. 6 is used to indicate whether the battery is being charged or discharged when the vehicle is in operation. If the ammeter shows discharge at all times, the cause should be investigated and corrected, otherwise the battery will be discharged.

**OIL GAUGE** No. 7 indicates the oil pressure. The dial has three divisions showing 0, 15 and 30. The driver should watch this instrument closely and, if the indicator hand drops below zero, the engine should be stopped immediately and the cause of the oil pressure failure investigated and corrected before continuing to run the engine.

**SPEEDOMETER** No. 8 indicates the speed at which the vehicle is being driven. The odometer registers the total number of miles the vehicle has been driven.

**LIGHTING SWITCH** No. 9 controls the lighting circuits. When the switch button is pulled out to the first position, it turns on the parking lights and tail light. Pulling the switch button all the way out turns on the headlights; the tail lamp is also turned on in this position.

**WINDSHIELD WIPER SWITCH** No. 10 is used to turn the windshield wiper on or off, by turning the button alongside the switch.

**WINDSHIELD QUADRANT ADJUSTING SCREWS** No. 11 are used to lock the windshield at various degrees of opening.

**GLOVE COMPARTMENT LOCK** No. 12. Pressing downward on the glove compartment lock cylinder opens the glove compartment door. A key is provided to lock this compartment.

**ASH RECEIVER** No. 13 is for the convenience of the driver; pulling the receiver outward uncovers the tray. The tray may be lifted out to empty the ashes.

**VENTILATOR CONTROL LEVER** No. 14 is used to open and close the cowl ventilator.

**CLUTCH PEDAL** No. 15 is used to disengage the engine from the transmission when shifting gears. The clutch pedal should never be engaged quickly when the vehicle is in gear. Driving with foot on pedal will cause wear of clutch facings and throw-out bearing. There should be one to one-and-a-quarter inches of free travel of the clutch pedal before the clutch starts to disengage.

**BRAKE PEDAL** No. 16. Pressing down on the brake pedal applies the hydraulic brakes at all four wheels. Avoid driving with foot on brake pedal, as brakes will be partially applied and cause rapid wear of lining.

**HEADLIGHT DIMMER SWITCH** No. 17 is a foot switch used to select the headlight beam (upper or lower) desired after the headlights are turned on, by pressing down on the switch button with the foot. When the upper beam is turned on, the headlight beam indicator is automatically turned on. This is a small red light located below the 50-mile graduation on the speedometer scale. When the lower beam is in use, the beam indicator is turned off. Always use the lower beam when passing approaching vehicles. This is an important highway safety rule in night driving.

**INSTRUMENT LIGHT SWITCH** No. 18 is used to turn on the instrument and ignition switch light. Moving the switch handle to the right turns on the ignition switch light, while moving it to the left turns on the instrument lights.

**ACCELERATOR** No. 19 is used in driving to control the speed of the engine.

**STARTER SWITCH PEDAL** No. 20. Pressing down on pedal with foot engages the starter and fly-wheel gears and also closes the starter switch, com-

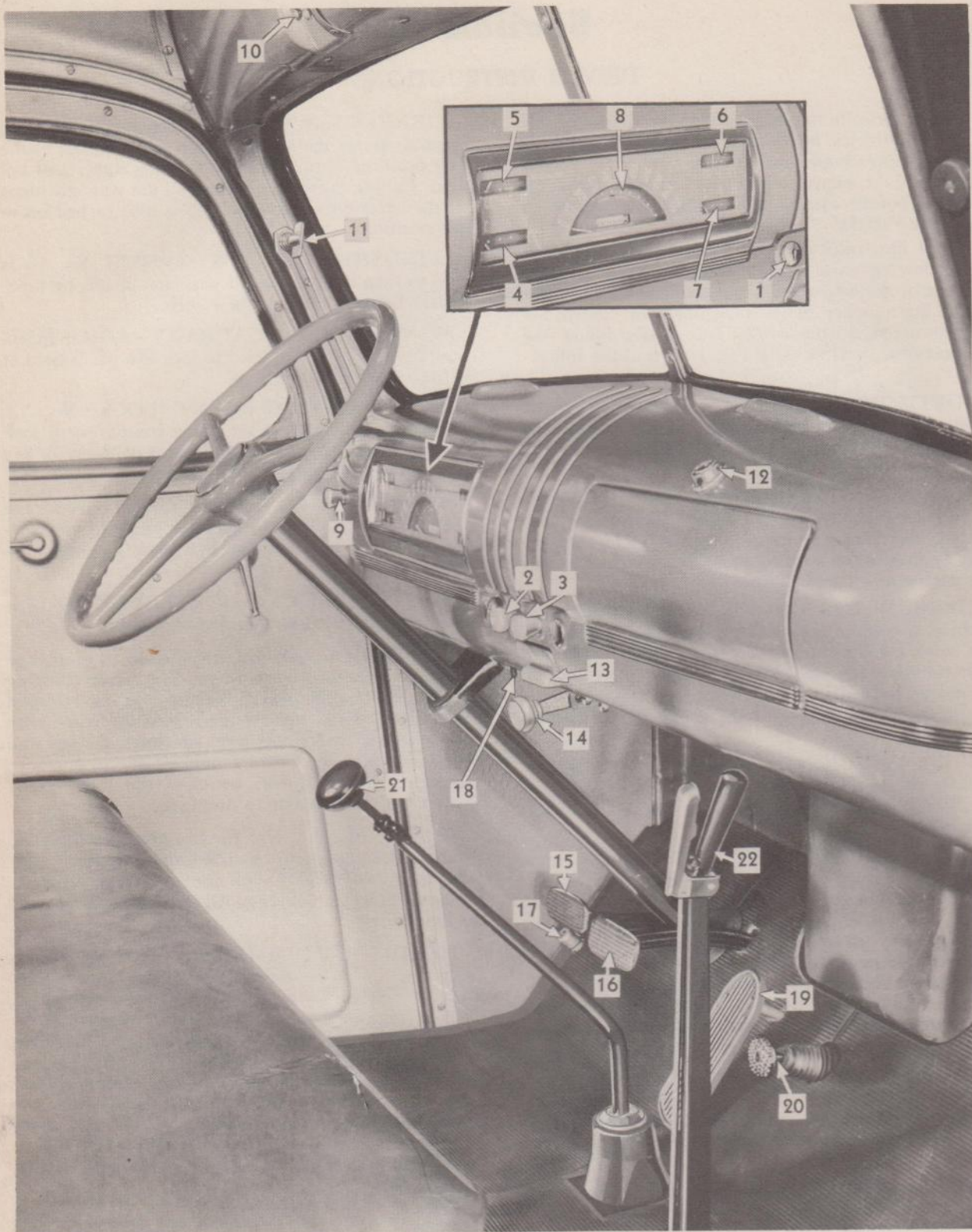


Fig. 1—Interior of Cab showing Location of Instruments and Controls

- |                         |                              |                             |                                 |
|-------------------------|------------------------------|-----------------------------|---------------------------------|
| 1—Ignition Switch       | 7—Oil Gauge                  | 13—Ash Receiver             | 18—Instrument Light Switch      |
| 2—Hand Throttle         | 8—Speedometer                | 14—Ventilator Control Lever | 19—Accelerator                  |
| 3—Carburetor Choke      | 9—Lighting Switch            | 15—Clutch Pedal             | 20—Starter Switch Pedal         |
| 4—Fuel Gauge            | 10—Windshield Wiper Switch   | 16—Brake Pedal              | 21—Transmission Gearshift Lever |
| 5—Temperature Indicator | 11—Windshield Control Handle | 17—Headlight Dimmer Switch  | 22—Hand Brake Lever             |
| 6—Ammeter               | 12—Glove Compartment Lock    |                             |                                 |

pleting the electrical circuit between battery and starter. Rotation of the starter armature through the gears cranks the engine. When the engine starts, foot should be removed from pedal immediately.

TRANSMISSION GEARSHIFT LEVER No. 21 is used to select various gear ratios provided in the transmission. There are four speeds forward and one reverse. Reverse gear can only be engaged when latch on gearshift lever is raised. Lever positions for various gears are shown on the shifting diagram, Fig. 2.

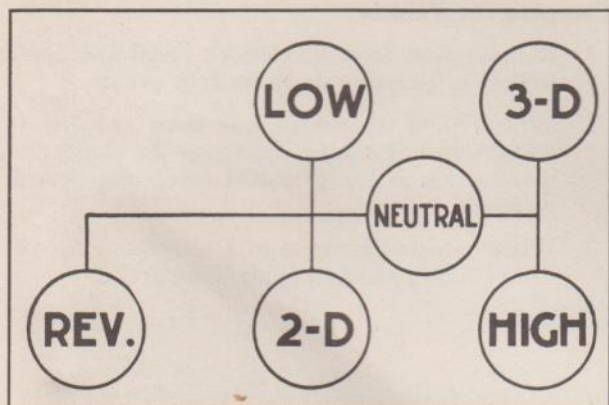


Fig. 2—Four-Speed Transmission Gearshifting Diagram

Half-ton Trucks are equipped with a three-speed transmission having three speeds forward and one reverse. Fig. 3, shifting diagram, shows the gearshift lever positions for the various speeds.

HAND BRAKE LEVER No. 22 operates the brakes on the rear wheels mechanically. Whenever the vehicle is parked, the lever should be pulled toward the rear as far as possible. Before moving the vehicle, lever should be in released position.

## OPERATING INSTRUCTIONS

Each day the following inspections should be made before starting the vehicle:

1. Check the oil level on the dip stick. If oil is down to the low mark, add oil.
2. Check the water in the radiator, and fill if necessary. Check hose connections for leaks. Check fan belt for looseness.
3. Note condition of tires and see that they are properly inflated.

### Starting the Engine

1. Transmission gearshift lever must be in neutral position. See shifting diagram.
2. Pull out hand throttle about  $\frac{3}{8}$  inch. This is not necessary if engine is warm.
3. Pull out choke button to obtain proper fuel and air mixture for starting. If the engine is warm, choking will be unnecessary.

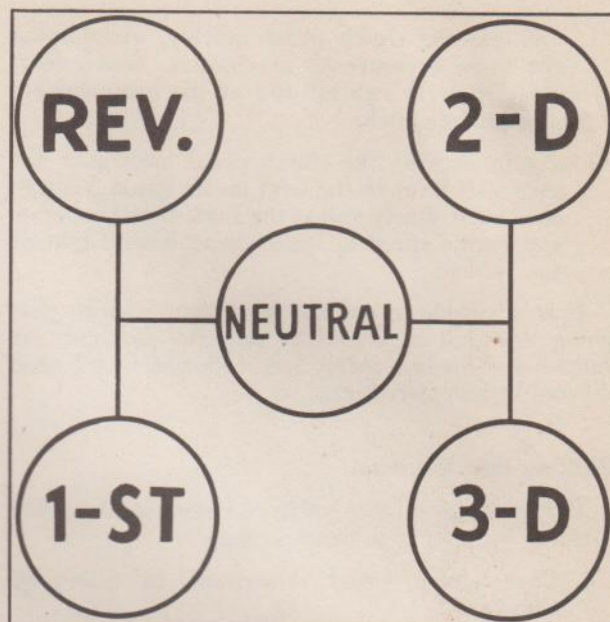


Fig. 3—Three-Speed Transmission Gearshifting Diagram

4. Insert key in ignition switch and turn switch to "On" position.
5. Step on starter pedal to crank the engine. Release pedal as soon as engine starts.
6. Push in on choke button and adjust hand throttle to obtain even idling. When engine is cold, it should be run several minutes before attempting to move the vehicle.

### Starting the Vehicle

1. Push clutch pedal downward to disengage the clutch.
2. On four-speed transmissions, move transmission gearshift lever to the left and forward into first gear position; on three-speed transmissions, move the gearshift lever to the left and backward into first gear position—see shifting diagram.
3. Release the hand brake lever.
4. Step down on accelerator pedal to speed up the engine. Release clutch pedal slowly and push accelerator pedal down as necessary to pick up the load and prevent stalling the engine as the vehicle starts to move.
5. As vehicle speed increases, release accelerator pedal, depress the clutch, move gearshift lever to neutral and then to next higher speed. Step down on accelerator and engage clutch as explained above. Repeat this operation until transmission is in high gear.

### Shifting to Lower Speed in Transmission

The transmission should always be shifted to the next lower speed before engine begins to labor or before vehicle speed is reduced appreciably. Shifting to lower speed is accomplished as follows:

1. Depress the clutch pedal quickly, maintaining the same pressure on accelerator. Move gearshift lever to neutral and at the same instant engage the clutch.
2. Again depress the clutch pedal and move the gearshift lever to the next lower speed. Engage the clutch slowly and at the same time accelerate the engine speed to synchronize it with that of the vehicle.

It is advisable to use the same transmission gear going downhill as would be required to climb the same hill. This is a safety rule followed by all good drivers in hilly territory.

#### **Shifting into Reverse**

Before attempting to shift into reverse, the truck must be brought to a complete stop.

1. Push clutch pedal downward to disengage clutch.

2. On four-speed transmissions, raise latch on gearshift lever and move lever to left as far as possible, then toward the rear; on three-speed transmissions, move the gearshift lever to left, then forward into reverse—see shifting diagram.
3. Engage clutch and accelerate the engine in the same manner as previously explained under the heading "Starting the Vehicle."

#### **Stopping the Vehicle**

1. Remove foot from accelerator pedal and apply brakes by pressing down on foot pedal.
2. When speed of vehicle has been reduced to idling speed of engine, disengage the clutch and move transmission gearshift lever into neutral position.
3. When vehicle has come to a complete stop, release clutch pedal and apply hand brake.



## GENERAL LUBRICATION

Lubrication of a truck is important to prevent damage to moving parts due to friction, heat or foreign material. As all moving parts are not subjected to the same type of operating conditions the lubricant to be used is that which most nearly meets the requirements of the part involved. In some places excessive heat or cold is the problem to overcome, in others it is extreme pressure, water, sand or grit. The type of operating surface must also be taken into consideration as certain parts rotate or oscillate on bronze bushings, roller bearings, ball bearings or cast iron bearings. Each of the above conditions or constructions make necessary the application of a specialized lubricant.

Lubricants are much cheaper than repair bills and should be applied regularly to secure a maximum of useful service from a truck. Consequently, it is of equal importance that not only the proper grade of lubricant be used but that it be applied in accordance with a definite schedule.

The chart at the end of this section should be referred to for instructions on the mileage of application and the grade and quantity of lubricant required for all parts of the truck. A more detailed account of certain phases of lubrication is given in the following paragraphs.

### ENGINE

#### Oil Gauge

When starting a cold engine, it will be noted that the oil gauge on the instrument panel will register a high oil pressure. As the engine warms up, the pressure will drop until it reaches a point where changes to higher speeds will raise the pressure very little, if at all.

If the oil pressure registers abnormally high after the engine is thoroughly warmed up, an inspection should be made to ascertain if the oil lines and passages are "plugged."

#### Lubrication

##### First 500 Miles

Proper selection of the oil to be used will add much to the performance, reliability, economy and long life of an engine.

It is important that the recommended light oils be used in the engine during the "breaking-in" period as they assure ease of starting the engine; prompt flow of a sufficient quantity of oil to the bearings; less friction between moving parts; less wear of moving parts, etc.

The crankcase of the engine, as delivered from the factory, is filled with 10-W oil. This should be left in during the first 500 miles and then the crankcase should be drained (while hot) and refilled to the proper level.

##### After 500 Miles

After the first 500 miles the crankcase oil should be selected to give the best performance for the

climatic and driving conditions under which the truck is being operated.

#### Climatic Conditions

During the colder months of the year, an oil which will permit easy starting at the lowest atmospheric temperature likely to be encountered should be used.

When the crankcase is drained and refilled, the crankcase oil should be selected not on the basis of the existing temperature at the time of the change, but on the lowest temperature anticipated for the period during which the oil is to be used.

If oil is selected for existing temperatures, starting trouble may be encountered due to slower cranking speeds caused by too heavy an oil.

The viscosity grade of crankcase oil will, therefore, depend upon the climatic conditions under which the truck is operated.

#### Fall — Winter — Spring

The viscosity grade best suited for use in the engine at the various temperatures is given under reference Note 5 at the end of this section. Use the grade indicated for the lowest temperature expected. Always use the lighter grade oil when in doubt.

10-W oil plus 10% kerosene is recommended only for those territories where the temperature falls below 10 degrees below zero for protracted periods.

#### Summer

The use of 20-W or SAE 20 oils during the summer months will permit better all around performance than will the heavier body oils, with no appreciable increase in oil consumption.

If SAE 20 or 20-W oil is not available, SAE 30 oil may be used if it is expected that the average prevailing daylight temperature will consistently be above 90° F.

#### Maintaining Oil Level

The Oil Gauge Rod (Fig. 1) is marked "Full" or "Add Oil." These notations have broad arrows pointing to the level lines.

The oil level should be maintained between the two lines; neither going above the "Full" line nor under the "Add Oil" line.

Check the oil level frequently and add oil when necessary. Always be sure the crankcase is full before starting on a long drive.



Fig. 1—Oil Gauge Rod

#### When to Change Crankcase Oil

Some oils have been greatly improved, driving conditions have changed, and improvements in en-

gines, such as the crankcase ventilating system, have greatly lengthened the life of good lubricating oils. However, to insure continuation of best performance, low maintenance cost and long engine life, it is necessary to change the crankcase oil whenever it becomes contaminated with harmful foreign materials. Under normal driving conditions draining the crankcase and replacing with fresh oil every 2000 or 3000 miles is recommended. Under the adverse driving conditions described in the following paragraphs, it may become necessary to drain the crankcase oil more frequently.

Driving over dusty roads or through dust storms introduces abrasive material into the engine. Carburetor Air Cleaners decrease the amount of dust that may enter the crankcase. The frequency of draining depends upon severity of dust conditions and no definite draining periods can be recommended.

Short runs in cold weather, such as city driving, do not permit thorough warming up of the engine and water may accumulate in the crankcase from condensation of moisture produced by the burning of the fuel. Water in the crankcase may freeze and interfere with proper oil circulation. It also promotes rusting and may cause clogging of oil screens and passages. Under normal driving conditions this water is removed by the crankcase ventilator. But if water accumulates it should be removed by draining the crankcase as frequently as may be required.

It is always advisable to let the engine reach normal operating temperature before draining the crankcase. The benefit of draining is, to a large extent, lost if the crankcase is drained when the engine is cold as some of the suspended foreign material will cling to the sides of the oil pan and will not drain out readily with the slower moving oil.

### **Crankcase Dilution**

Probably the most serious phase of engine oil deterioration is that of crankcase dilution, which is the thinning of the oil by fuel vapors leaking by the pistons and rings and mixing with the oil.

Leakage of fuel, or fuel vapors, into the oil pan occurs mostly during the "warming-up" period, when the fuel is not thoroughly vaporized and burned.

### **Automatic Control**

The Chevrolet engine is equipped with automatic devices which aid greatly in minimizing the danger of crankcase dilution.

Rapid warming up of the engine is aided by the thermostatic water temperature control, which automatically prevents circulation of the water in the cooling system until it reaches a predetermined temperature.

Thermostatic heat control on the exhaust manifold, during the "warming-up" period, automatically directs the hot exhaust gases against the center of the intake manifold, greatly aiding the proper vaporization of the fuel.

The down-draft carburetor is an aid to easy starting, thereby minimizing the use of the choke. Spring

use of the choke reduces danger of raw, or unvaporized, fuel entering the combustion chamber and leaking into the oil reservoir.

An efficient crankcase ventilating system drives off fuel vapors and aids in the evaporation of the raw fuel and water which may find its way into the oil reservoir.

### **Control by Truck Operator**

Ordinarily the above automatic control devices will minimize, or eliminate, the danger of crankcase dilution.

However, there are abnormal conditions of service when the truck operator must aid in the control of crankcase dilution.

Short runs in cold weather, such as city driving, do not permit the thorough warming up of the engine nor the efficient operation of automatic control devices. It is recommended that the oil be changed more often when the truck is subject to this type of operation.

Poor mechanical condition of the engine, such as scored cylinders, poor ring fit, "sloppy" or loose pistons, faulty valves, poor ignition, will increase crankcase dilution. Keep the truck in good mechanical condition.

Poor fuels which contain portions hard to ignite and slow to burn will increase crankcase dilution. Use good fuel.

### **Water in Crankcase**

Serious lubrication troubles may result in cold weather by an accumulation of water in the oil pan. This condition is, as a rule, little understood by the truck operator. To demonstrate the chief cause of water in the oil pan, hold a piece of cold metal near the end of the exhaust pipe of the engine and note the rapid condensation and collection of drops of water on it. The exhaust gases are charged with water vapor and the moment these gases strike a cold surface, they will condense, forming drops of water.

A slight amount of these gases pass the pistons and rings, even under the most favorable conditions, and cause the formation of water in the oil pan, in a greater or less degree, until the engine becomes warm. When the engine becomes thoroughly warm, the crankcase will no longer act as a condenser and all of these gases will pass out through the crankcase ventilator system.

Short runs in cold weather, such as city driving, will aggravate this condensing action.

### **Corrosion**

Practically all present-day engine fuel contains a small amount of sulphur which, in the state in which it is found, is harmless; but this sulphur on burning, forms certain gases, a small portion of which is likely to leak past the pistons and rings and reacting with water, when present in the crankcase, form very corrosive acids. The more sulphur in the fuel, the greater the danger from this type of corrosion. This

is a condition which we cannot wholly avoid, but it may be reduced to a minimum by proper care of the engine.

As long as the gases and the internal walls of the crankcase are hot enough to keep water vapor from condensing, no harm will result; but when an engine is run in low temperatures, moisture will collect and unite with the gases formed by combustion; thus, acid will be formed and is likely to cause serious etching or pitting. This etching, pitting or corrosion, when using fuel containing considerable sulphur, manifests itself in excessively rapid wear on piston pins, camshaft bearings and other moving parts of the engine, oftentimes causing the owner to blame the truck manufacturer or the lubricating oil when in reality the trouble may be traced back to the character of fuel used, or a condition of the engine, such as excessive blow-bys or improper carburetor adjustment.

### SAE Viscosity Numbers

The viscosity of a lubricant is simply a measure of its body or fluidity. The oils with the lower SAE numbers are lighter and flow more readily than do the oils with the higher numbers.

The SAE viscosity numbers constitute a classification of lubricants in terms of viscosity or fluidity, but with no reference to any other characteristics or properties.

The refiner or marketer supplying the oil is responsible for the quality of its product. His reputation is your best indication of quality.

The SAE viscosity numbers have been adopted by practically all oil companies, and no difficulty should be experienced in obtaining the proper grade of lubricant to meet seasonal requirements.

### REAR AXLE AND TRANSMISSION

The rear axle and transmission case are filled with SAE 90 Universal Gear lubricant at the factory—this being satisfactory for "year around" use.

Although SAE 90 grades of lubricants are recommended for "year around" service, whenever extremely low or high temperatures are encountered for protracted periods, or when the truck is excessively overloaded or subject to other severe service conditions, the recommendations given in reference notes 1 and 2 at the end of this section should be followed.

### "All Purpose" or "Universal" Gear Lubricants

Due to the increase in the number of truck manufacturers using Hypoid Rear Axles, "All Purpose" or "Universal" Gear Lubricants have been developed.

These lubricants can be satisfactorily used in truck rear axles, transmissions, steering gears, and universal joints requiring a fluid lubricant.

"All Purpose" or "Universal" Gear Lubricants must be manufactured under carefully-controlled conditions and the lubricant manufacturer must be responsible for the satisfactory performance of his

product. His reputation is your best indication of quality.

### Lubricant Additions

The lubricant level in these units should be checked periodically.

It is recommended that any additions required to bring up the lubricant level be made, using the same type of lubricant as in the housing.

### Lubricant Changes

While seasonal changes of the lubricant are not required, it is recommended that the housing be drained and refilled with the recommended lubricant at least twice a year, or every 6,000 to 10,000 miles.

It may be necessary and desirable to drain rear axles and transmissions in trucks subject to severe service more frequently than recommended above.

**CAUTION—Use a light flushing oil to flush out the housings when draining. DO NOT use water, steam, kerosene, gasoline, alcohol, etc.**

### OIL FILTER

The drain plug on the bottom of the oil filter should be removed periodically to drain off any water or sludge deposit trapped in the filter. The filter element should be replaced every 8,000 to 10,000 miles, or when the oil gauge rod shows the oil to be dark.

### OIL BATH AIR CLEANER

About once every 2,000 miles or oftener if the truck is being operated where an unusual amount of dust and dirt is in the air, remove the oil bath air cleaner and empty out the old oil and accumulated dirt. Wash out with clean gasoline and wipe dry. Wash the filter element by slushing up and down in clean gasoline. Dry thoroughly and fill the body with SAE 50 viscosity oil according to instructions given on the cleaner. Air cleaner oil capacities vary, and it is extremely important that the correct amount of oil be installed for satisfactory performance. SAE 50 viscosity oil is satisfactory for summer or winter use, however, in certain localities where exceptionally cold weather is encountered for protracted periods of time, an oil of lower viscosity should be used.

### SHOCK ABSORBERS

The shock absorbers should be kept filled with a low viscosity (light body) shock absorber fluid that has a pour test not higher than 30° below zero.

The same fluid is used both summer and winter and will have similar operating characteristics the year around.

The shock insulation fluid recommended should have a viscosity of from 70 to 80 seconds at 100° F. (Sayboldt Universal) and should not exceed 975 to 1,000 seconds at 20° F. This type of fluid is carried by all Chevrolet Dealers.

**NOTE**—Do not, under any circumstances, use a shock insulation fluid heavier in viscosity, or body, than that recommended above. Heavy body fluids are detrimental to the proper functioning at the unit.

### STEERING GEAR LUBRICATION

The steering gear is filled at the factory with an all-season gear lubricant. Seasonal change of this lubricant is unnecessary and the housing should not be drained. Whenever required, additions should be made using steering gear lubricants marketed by many oil companies, "All Purpose" or "Universal" gear lubricants or chassis lubricants.

A pipe plug is installed at this point to prevent over-lubrication, generally occasioned by the use of a pressure gun.

Over-lubrication of this unit might result in forcing lubricant up the steering gear tube to the horn button and steering wheel.

### PERMANENTLY LUBRICATED PARTS

#### Water Pump

The water pump bearing is of the permanently sealed and lubricated type and requires no lubrication throughout its life.

#### Clutch Throwout Bearing

The clutch throwout bearing is packed with lubricant at the time of assembly and requires no further attention. Upon removal for clutch overhaul, however, the recess in the throwout bearing collar should be cleaned and repacked with a high-melting-point lubricant.

#### Clutch Pilot Bearing

No lubrication of the clutch pilot bearing is neces-

sary unless the clutch is being overhauled, at which time it should be removed from the crankshaft, cleaned, inspected and repacked with a small amount of high-melting-point lubricant.

### CHASSIS LUBRICATION

For complete chassis lubrication consult the lubrication charts and Figs. 2 and 3 to which the "Key" numbers refer. These charts indicate the location of the units to be lubricated, capacity, type of lubricant, grade and mileage of lubrication or change.

The term "Chassis Lubricant" as used in this manual, describes a semi-fluid lubricant designed for application by commercial pressure gun equipment. For its composition refer to specification note "B" at the end of the lubrication chart.

#### Wheel Bearings

To lubricate the front wheel bearings, remove the drive flange and wheel hub according to instructions given in Section 3 of this Manual. Wash all old grease from the bearings and hub. Hand pack the bearings with Marfak lubricant or its equivalent, using No. 2 in Summer and No. 1 in Winter. In addition, distribute one pint of lubricant in the space between the bearings in the wheel hub. Reassemble wheel hub and adjust bearings according to instructions given in Section 3 of this Manual.

To lubricate the rear wheel bearings, remove the rear axle shaft and wheel hub according to instructions in Section 4 of this Manual. Wash out the old lubricant and hand pack the bearings with Marfak lubricant or its equivalent, using No. 2 in Summer and No. 1 in Winter. In addition, distribute one pint of lubricant in space between the bearings in the wheel hub.

Lubrication Charts showing the location of lubrication points and also the kind and quantity of lubricant to use will be found on the following pages.

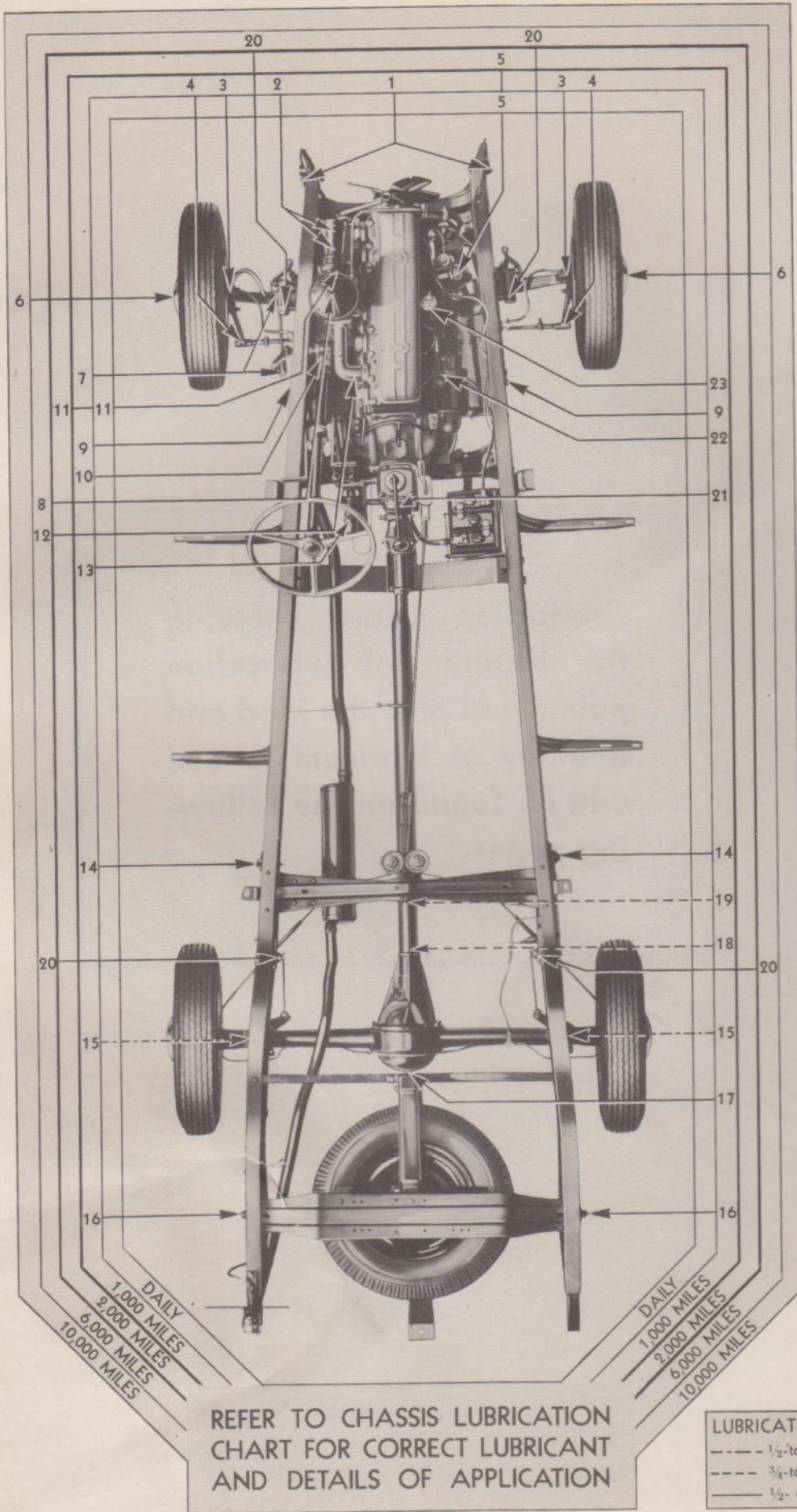


Fig. 2—1/2- and 3/4-Ton Truck Lubrication Chart

## CHASSIS LUBRICATION CHART — 1/2 AND 3/4 TON TRUCKS

Key	Location	How Applied	Capacity	Lubricant	Type Specification Notes	Grade Recommended		See Ref. Note	Miles
						Summer	Winter		
1	Front Spring Shackles	2 Fittings each side	—	Chassis	B	No. 2	No. 1	—	1,000
2	Generator	1 Oil Cup each end	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	1,000
3	King Pin	2 Fittings—top and bottom	—	Chassis	B	No. 2	No. 1	—	1,000
4	Tie Rod	1 Fitting each end	—	Chassis	B	No. 2	No. 1	—	1,000
5	Crankcase	Filler Neck—Right Side	5 qts. (when filter is drained 6 1/2 qts.)	Engine Oil	—	—	—	5	Change 2,000-3,000 Miles (Check Daily—Keep Up Level)
6	Front Wheel Bearings	Hand Pack	—	Marfak or equivalent	B	No. 2	No. 1	—	10,000
7	Steering Connecting Rod	1 Fitting each end	—	Chassis	B	No. 2	No. 1	—	1,000
8	Carburetor Pump Arm Shaft	Remove Dust Cover, Saturate Felt Ring	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	6,000
9	Front Spring Rear Eye Bolt	1 Fitting each side	—	Chassis	B	No. 2	No. 1	—	1,000
10	Steering Gear	Filler Hole—Top of Housing	—	Universal Gear	A	S.A.E. 90	S.A.E. 90	4	Check every 1,000 miles and add lubricant if required
11	Air Cleaner	Remove Cover	(See Instructions on Cleaner Body)	Engine Oil	—	S.A.E. 50	S.A.E. 50	6	2,000 (Check every day under extreme dust conditions)
12	Throttle Bell Crank	At Bell Crank Shaft	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	6,000
13	Brake Master Cylinder	Filler Hole—Top of Master Cylinder	1 pt.	Hydraulic Brake Fluid	—	—	—	—	1,000 mile inspection
14	Rear Spring Front Eye Bolt	1 Fitting each side	—	Chassis	B	No. 2	No. 1	—	1,000
15	Rear Spring Seat (1/2 Ton Trucks only)	1 Fitting each seat	—	Chassis	B	No. 2	No. 1	—	1,000
16	Rear Spring Shackles	2 Fittings each side	—	Chassis	B	No. 2	No. 1	—	1,000
17	Rear Axle Housing	Filler Hole in Differential Cover	4 1/2 pts.	Universal Gear	A	S.A.E. 90	S.A.E. 90	1	Change 6,000-10,000 miles (Check every 1,000 miles and add lubricant if required)
18	Rear Universal Joint and Propeller Shaft Slip Joint (3/4 Ton Trucks only)	1 Fitting each joint and slip joint	—	Transmission or Universal Gear	A	S.A.E. 90	S.A.E. 90	3	1,000

CHASSIS LUBRICATION CHART — (Cont.)

Key	Location	How Applied	Capacity	Lubricant	Type Specification Notes	Grade Recommended		See Ref. Note	Miles
						Summer	Winter		
19	Intermediate Universal Joint and Propeller Shaft Slip Joint (¾ Ton Trucks only)	1 Fitting each joint and slip joint	—	Transmission or Universal Gear	A	S.A.E. 90	S.A.E. 90	3	1,000
20	Shock Absorbers	Filler Hole— Top of Housing	—	Shock Absorber Fluid	—	—	—	—	6,000 miles or 6 months
21	Transmission 3-Speed 4-Speed	Filler Hole Filler Hole	1½ pts. 5½ pts.	Navy No. optional 3080-3100-1100 or Universal Gear	A	S.A.E. 90	S.A.E. 90	2	Change 6,000-10,000 (Check every 1,000 miles and add lubricant if required)
22	Starting Motor	1 Oil Cup	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	1,000
23	Ignition Distributor	1 Grease Cup— Fill and turn down	—	Marfak or Petrolatum	C A	No. 2	No. 1	—	1,000



## LUBRICATION SPECIFICATION AND REFERENCE NOTES

The following "Specification Notes" and "Reference Notes" apply to the 1/2 and 3/4-Ton Truck Lubrication Chart shown on pages 0-106 and 0-107; they also apply to the 1 1/2-Ton Truck Lubrication Chart shown on pages 0-111 and 0-112.

## SPECIFICATION NOTES

- A. See Federal Stock Catalogue or General Schedule of Supplies, 14-L-188, also circular letter No. 78.
- B. See Contract Bulletin No. 123, Subject—Q.M.C. Contract for Greases Lubricating, Mineral (for Automotive Use) Office Q.M. General. Sept. 14, 1940.
- C. See U. S. Army Specifications No. 2-67 or Federal Stock Catalogue No. 51-P-364.

## REFERENCE NOTES

1. For Rear Axle Housing—For extremely low temperatures Class 1 Universal Gear Lubricant may be used.
2. For Transmission—**Summer**—When temperatures are very high or for severe service conditions S.A.E. 140, Navy No. 1150—3120—1120—5150 may be used or Class 3 Universal Gear Lubricant.  
For Transmission—**Winter**—Extremely low temperatures—S.A.E. 80, Navy No. 3065—1080 or S.A.E. 90 to which has been added 10% to 20% transformer oil Navy No. 9045 may be used or Class 1 Universal Gear Lubricant.
3. Propeller Shaft Universal Joints—**Summer**—When temperatures are very high S.A.E. 140, Navy No. 1150—3120—1120—5150 may be used or Class 3 Universal Gear Lubricant.
4. Steering Gear—When temperatures are very high, Class 3 Universal Gear Lubricant may be used.
5. Engine Crankcase—Use Navy No. or S.A.E. No oil for temperatures indicated in the following chart.

Atmospheric Temperatures	Navy No.	S.A.E. No.
Above 90° F.....	3065	30
32° to 90° F.....	3050	20 or 20W
10° to 32° F.....	3050	20W
Plus 10° F. to Minus 10° F.....	2110	10W
	2110 plus	10W plus
Below Minus 10° F.....	10% No. 9045	10% kerosene

6. Oil Bath Air Cleaner—When exceptionally cold temperatures are encountered use S.A.E. 30 Navy No. 3065 or S.A.E. 20 Navy No. 3050.

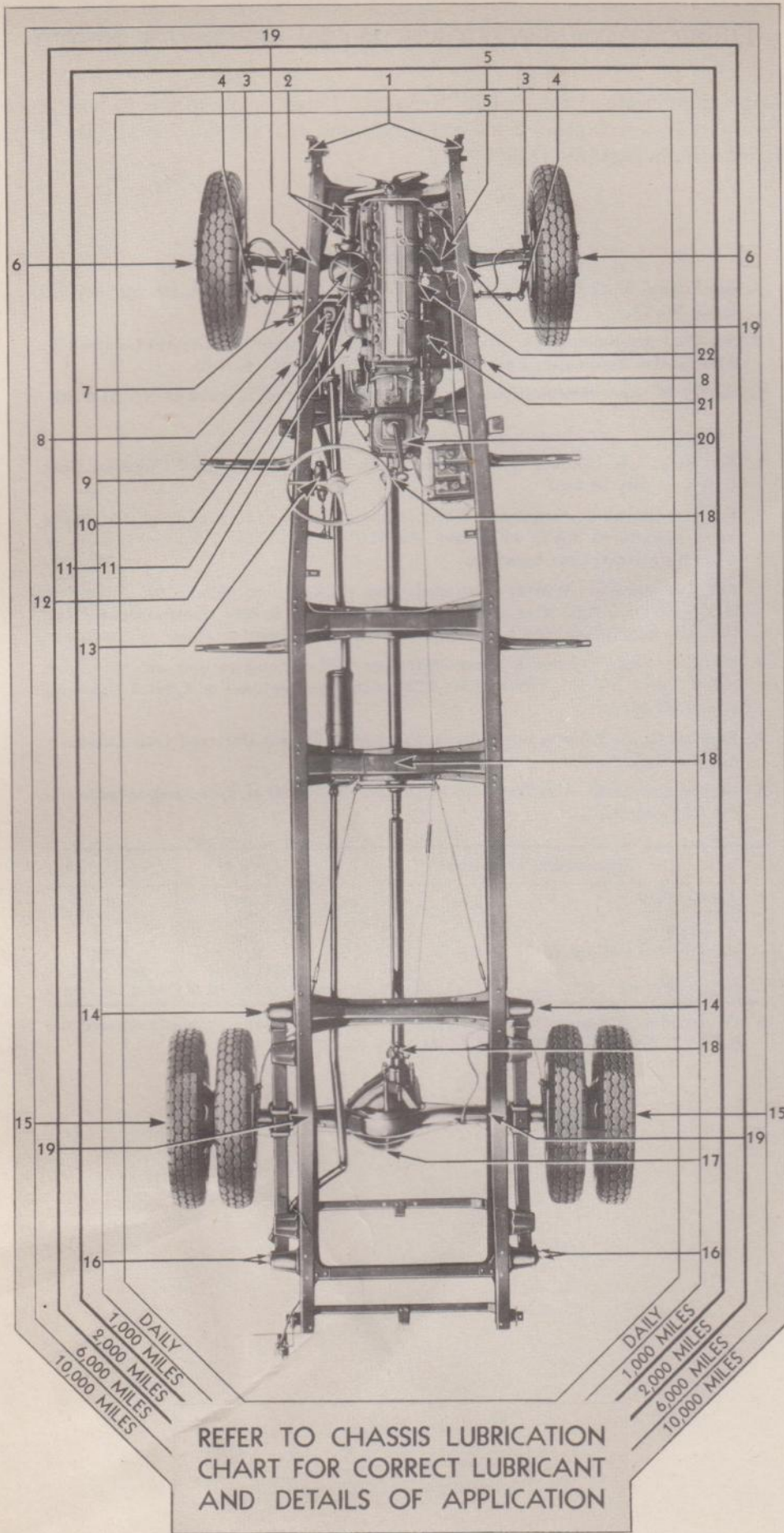


Fig. 3—1½-Ton Truck Lubrication Chart

CHASSIS LUBRICATION CHART — 1 1/2 TON TRUCKS

Key	Location	How Applied	Capacity	Lubricant	Type Specification (Notes)	Grade Recommended		See Ref. Note	Miles
						Summer	Winter		
1	Front Spring Shackles	2 Fittings each side	—	Chassis	B	No. 2	No. 1	—	1,000
2	Generator	1 Oil Cup each end	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	1,000
3	King Pin	2 Fittings— top and bottom	—	Chassis	B	No. 2	No. 1	—	1,000
4	Tie Rod	1 Fitting each end	—	Chassis	B	No. 2	No. 1	—	1,000
5	Crankcase	Filler Neck— Right Side	5 qts. (when filter is drained 6 1/2 qts.)	Engine Oil	—	—	—	5	Change 2,000-3,000 Miles (Check Daily—Keep Up Level)
6	Front Wheel Bearings	Hand Pack	—	Marfak or equivalent	B	No. 2	No. 1	—	10,000
7	Steering Connecting Rod	1 Fitting each end	—	Chassis	B	No. 2	No. 1	—	1,000
8	Carburetor Pump Arm Shaft	Remove Dust Cover, Saturate Felt Ring	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	6,000
9	Front Spring Rear Eye Bolt	1 Fitting each side	—	Chassis	B	No. 2	No. 1	—	1,000
10	Steering Gear	Filler Hole— Top of Housing	—	Universal Gear	A	S.A.E. 90	S.A.E. 90	4	Check every 1,000 miles and add lubricant if required
11	Air Cleaner	Remove Cover	1 pt.	Engine Oil	—	S.A.E. 50	S.A.E. 50	6	2,000 (Check daily under extreme dust conditions)
12	Throttle Bell Crank	At Bell Crank Shaft	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	6,000
13	Brake Master Cylinder	Filler Hole—Top of Master Cylinder	1 pt.	Hydraulic Brake Fluid	—	—	—	—	1,000 mile inspection
14	Rear Spring Front Eye Bolt	1 Fitting each side	—	Chassis	B	No. 2	No. 1	—	1,000
15	Rear Wheel Bearings	Hand Pack	—	Marfak or equivalent	B	No. 2	No. 1	—	10,000
16	Rear Spring Shackles	2 Fittings each side	—	Chassis	B	No. 2	No. 1	—	1,000
17	Rear Axle Housing	Filler Hole in Differential Cover	11 pts.	Universal Gear	A	S.A.E. 90	S.A.E. 90	1	Change 6,000-10,000 miles (Check every 1,000 miles and add lubricant if required)
18	Universal Joint and Propeller Shaft Slip	1 Fitting each joint and slip joint	—	Transmission or Universal Gear	A	S.A.E. 90	S.A.E. 90	3	1,000

CHASSIS LUBRICATION CHART—(Cont.)

Key	Location	How Applied	Capacity	Lubricant	Type Speci- fication (Notes)	Grade Recommended		See Ref. Note	Miles
						Summer	Winter		
19	Shock Absorbers	Filler Hole— Top of Housing	—	Shock Absorber Fluid	—	—	—	—	6,000 miles or 6 months
20	Transmission	Filler Hole— Right Rear Side	5½ pts.	Navy No. optional 3080-3100-1100 or Universal Gear	A	S.A.E. 90	S.A.E. 90	2	Change 6,000-10,000 miles (Check every 1,000 miles and add lubricant if required)
21	Starting Motor	1 Oil Cup	—	Engine Oil	—	S.A.E. 30	S.A.E. 10	5	1,000
22	Ignition Distributor	1 Grease Cup— Fill and turn down	—	Marfak or Petrolatum	C A	No. 2	No. 1	—	1,000

## Section 1

### BODY

#### TRUCK CAB ATTACHMENT TO FRAME

The Chevrolet truck cab is all-steel construction with mountings that provide a secure, yet flexible, attachment to the chassis frame.

The cab mounting of the 1½-ton truck is illustrated in Fig. 1. The mounting consists of four through-bolts on each side with fabric rubber insulation between the cab sill and the top of the frame side member to absorb shock. In order to prevent wrenching of the cab as the truck moves over uneven terrain or road, the two rear mounting bolts on each

The cushion spring method of mounting is designed to permit the truck frame to weave under certain conditions without placing undue strain on the cab structure. The cushion mounting bolt retaining nuts should only be tightened to a point where it is most possible to insert the cotter pin and no further. Greater tightening would compress the springs to such an extent that flexibility would be destroyed.

#### Door Glass

A metal frame is mounted on the door glass with the conventional rubber filler strip; this frame re-

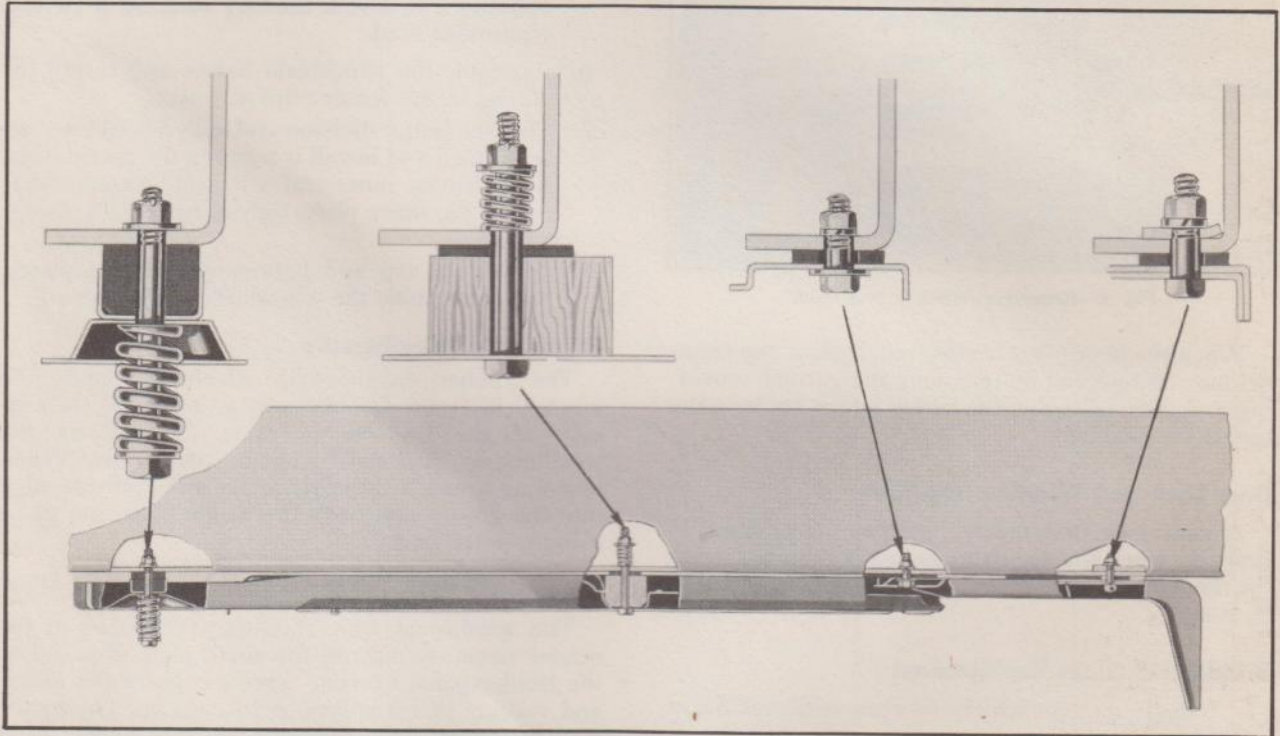


Fig. 1—Truck Cab Mounting

side of the cab are spring-loaded, as shown in Fig. 1. The cab is further insulated at each rear mounting bolt by a hard rubber bumper encased in a metal retainer. The mounting bolt passes through the center of the rubber bumper and retainer, and a heavy cushioning coil spring is placed between the bolt head and cab sill. The lower end of the bolt passes through the top channel of the frame side rail and terminates in a castellated nut, locked with a cotter pin.

The position of the rear center cab mounting bolt is reversed from that of the rear bolt in that the cushioning spring is placed below the top channel of the frame side rail and between it and the castellated retaining nut. The other two mounting bolts are not spring-cushioned but fabric rubber insulators are used between the cab sill and frame upper channel at each of these bolt positions.

inforces the glass and at the same time provides freedom from looseness and rattles. Procedure for installation of a door glass is as follows:

1. Remove door lock handle, window regulator and remote control handles.
2. Remove the door inner panel screws and remove the panel.
3. Remove the screws which mount the regulator board, and tip the regulator board away from the door. This disengages the regulator from the cam channel, as shown in Fig. 4.
4. Raise the glass and remove the glass run channel from its retainers on the lock pillar side, then remove the glass.
5. To install the metal channels, place a length of rubber filler strip over the edge of the glass, then

tap the channel over the glass and filler strip; trim the filler flush with the channel using a sharp knife or safety razor blade.

6. Install the glass in the door opening, lubricate the cam channel with graphite grease, connect the regulator to the cam channel, as shown in Fig. 2. Reassemble the regulator board, door inner panel, and control handles.

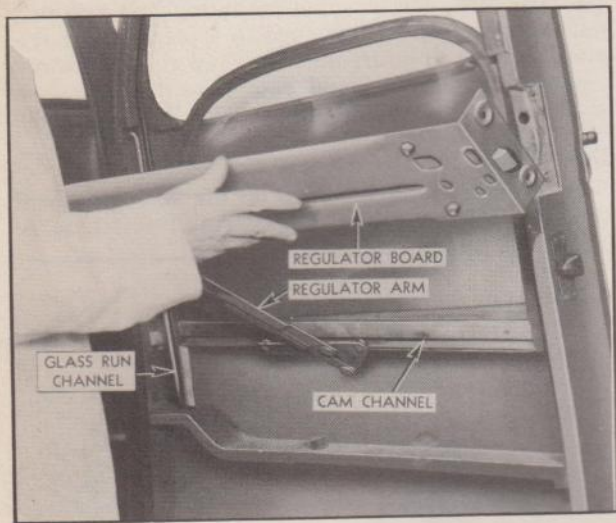


Fig. 2—Removing Window Regulator

When the door glass is removed, a glass run channel may be replaced by removing the garnish moulding and then removing the screw which anchors the top of the channel.

#### Door Lock and Window Regulator

A door lock or window regulator may be easily replaced when the regulator board is removed from the door, as they are mounted on the regulator board by screws.

#### Windshield Glass Replacement

1. Release the center lock and remove the quadrant adjusting screws.
2. Remove the two screws and sleeve nuts from each windshield hinge.

3. Remove the three screws from the top and bottom reinforcing plates, then remove the four screws from the center division channel and remove the inner and outer channels with their seals.

4. Remove the screws which attach the top and bottom channels to the frame reinforcement on one side of the center division channel. Then pull the two halves of the windshield apart at the center, as shown in Fig. 3.

5. When replacing a windshield glass, place a strip of Everseal filler channel over the edge of the glass, with the soap-stoned side out. Brush the inside of the windshield channel with light lubricant oil. Push the glass with the channel filler into the windshield channel by hand.

**NOTE—The oil acts on the channel filler, causing it to swell, thereby making a perfect watertight seal.**

6. Assemble the windshield halves and install the screws in the center reinforcement.

7. Coat the center division seal with FS-638 sealing compound and install it between the two glasses, then coat the inner seal with sealing compound; install the inner plate, tightening the screws securely.

8. Install the top and bottom reinforcing plates, and reassemble the windshield in its opening.

#### Windshield Weatherstrip

The rubber weatherstrip which surrounds the windshield frame fits into a groove around the outside of the windshield frame. To remove the weatherstrip, just pull it out of the groove. When installing a new weatherstrip, place the outside edge into the groove and push the inside edge into place using a putty knife.

#### Windshield Wiper

The windshield wiper motors are located in the header panel. Removing the small plate attached to the header panel by four screws exposes the motor and vacuum line connections for service. The motor may be removed by disconnecting the wiper blade and removing the mounting nut on the front of the header panel.

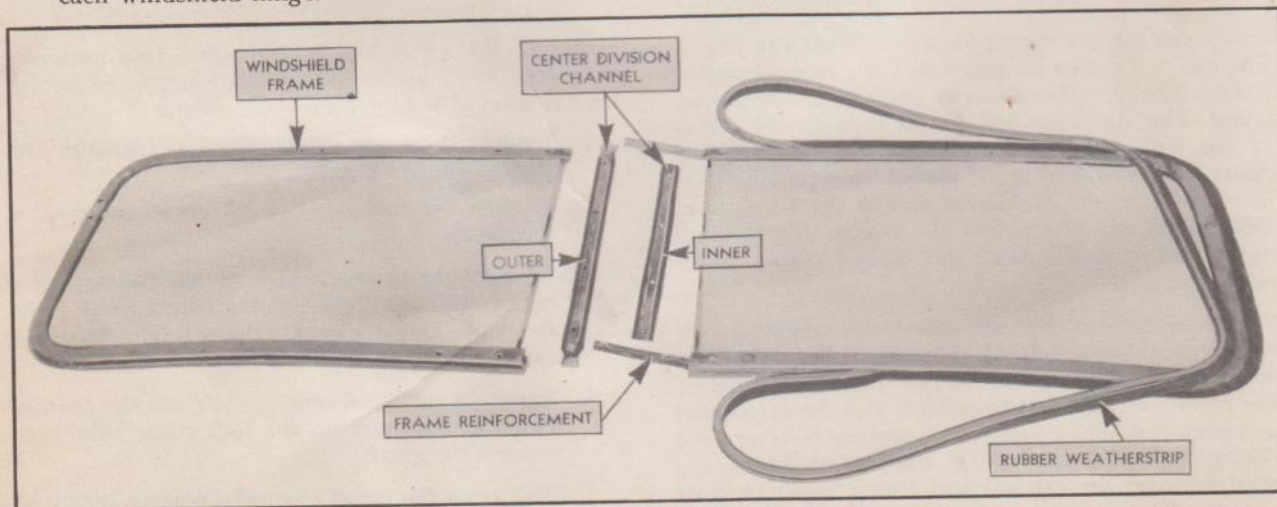


Fig. 3—Showing Windshield Split at Center Reinforcement

## Section 2

### FRAME

#### ½ Ton Truck

The ½ ton truck frame is a five cross member frame with a flat kick-up over the rear axle. At the rear of the kick-up, the side members continue at the same level as the portion ahead of the kick-up. This provides a very satisfactory surface upon which to mount bodies. The cross members are very rigid being of a flanged "U" and box section construction.

The engine rear support is a flanged inverted "U" member. This member is secured to the side members by means of a construction known as "alligator jaw" attachment.

The second cross member is of box member construction for its entire width. Bolt attachment to the side members provides easy removal for the servicing of the transmission.

The third cross member, also a flanged inverted "U" section, supports the hand brake cable pulleys and the pulley bracket forms a box section with the cross member.

A single rear cross member is used. This member is formed upward at the center for spare wheel mounting.

#### ¾ Ton Truck

The ¾ ton truck frame incorporates in its design many of the construction features of the ½ and 1½ ton truck frames.

The frame tapers from the front end to the second cross member, beyond which it forms a straight section. This arrangement supplies an excellent mounting for the bodies, as the straight section extends under the entire length of the load platform.

The side members are formed in a deep channel section from thick sheets of steel. The top flange is uniform in width over its entire length, but the lower flange is wider for a short distance at the front and rear to provide greater strength for the attachment of the cross members. Each side member is reinforced at the rear hanger of the front spring by a special channel. There is a small kick-up over the rear axle for clearance.

Cross members are of the flanged "U" and box-section construction—the type of design most suitable for truck service. Since the front end is similar to the ½ ton design, the rugged front cross member and engine rear support member of

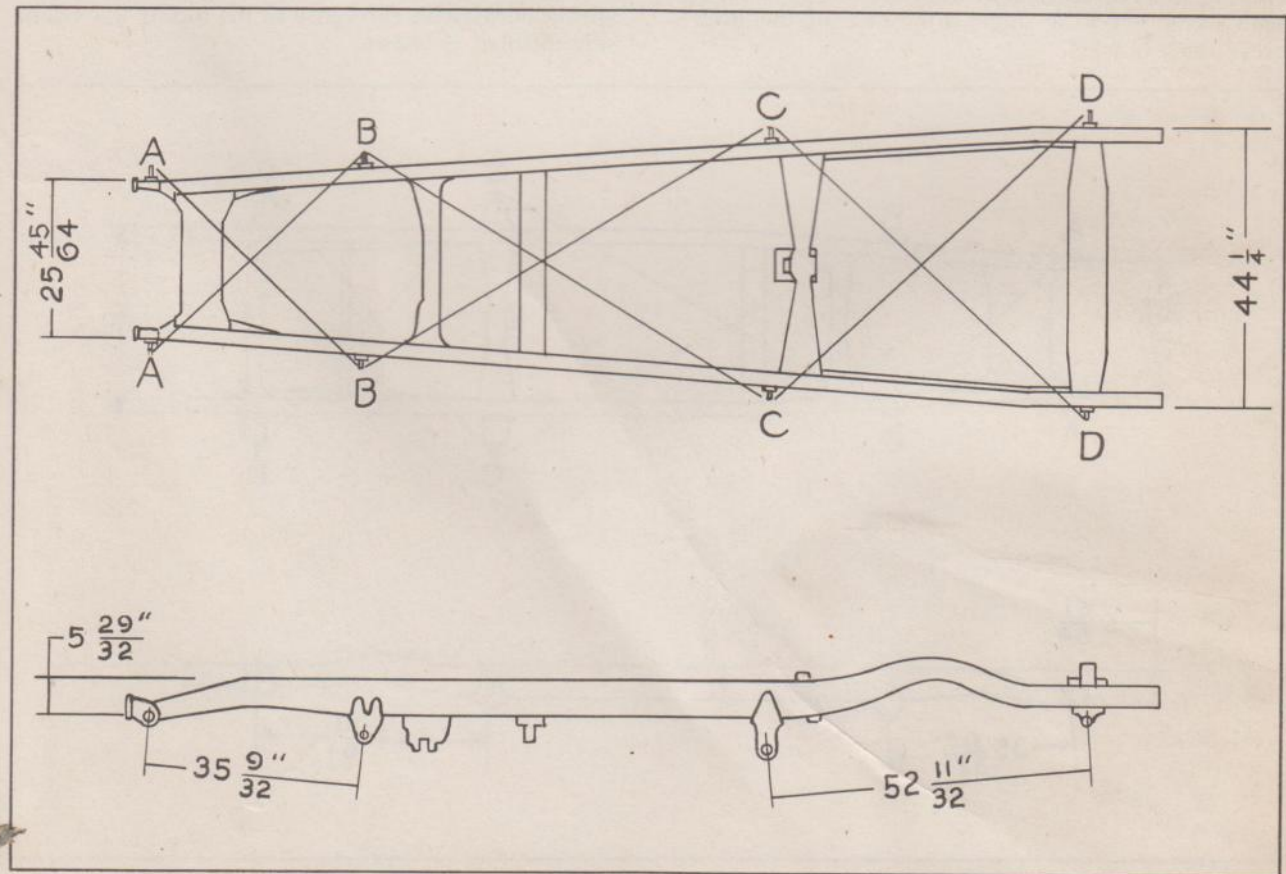


Fig. 1—½ Ton Truck Frame

that frame are utilized in this unit. In addition to supporting the rear of the power plant, the rear support also functions as a cross member.

The second cross member of box-section construction is identical to the 1/2 ton member, including the holes at the center section for attaching the universal joint support bracket. The plate of this support doubly ties together the flanges of the cross member in a reinforced box section, greatly increasing its strength over the entire center section. The side members and rear universal joint support are bolted to this cross member so that the transmission can be removed for servicing without disturbing the rear axle.

The third cross member is similar in design to the corresponding member in the 1/2 ton frame. It is of the inverted flange "U" type with alligator jaw attachment to the side members.

The rear cross member is identical to the one on the 1 1/2 ton frame. It is a strong panel rigidly riveted at each end to the flanges of the side members. This member continues to be located at the rear bracket of the rear spring, and in addition to being riveted to the lower flanges of the side members, it is reinforced at each end by a gusset that joins the upper flange of the member and side member in a sturdy connection. The gusset is the same part as used on the 1 1/2 ton truck.

**134 1/2" W.B. 1 1/2 Ton Trucks**

The 134 1/2" wheelbase 1 1/2 ton truck frame has five cross members. It is similar to the 3/4 ton truck frame with exception to a slight difference in the brake cross shaft bracket.

**1 1/2 Ton 160" W.B. Trucks**

Six cross members are used on the 160" wheelbase 1 1/2 ton truck. Its frame is similar in construction to the 3/4 ton truck frame with exception to a slight difference in the brake cross shaft bracket.

**STRAIGHTENING THE FRAME**

In the case of a collision or accident where the bending or twisting of the frame is not excessive, it is permissible to straighten the frame. This must be done cold, as heat applied to the frame will change the structure of the metal and weaken the frame at the point where heat is applied.

**Checking Frame Alignment**

When checking a frame for misalignment in case of damage, the most efficient method is "X" checking with a tram from given points on each side rail.

In the Figures 1, 2 and 3, reference points are indicated—"A," "B," "C" and "D" on each frame side member.

When making checks, the tram points should be set at the center of the lubrication fittings.

When "X" checking any section of the frame, the measurements should agree within 5/16". If the measurements do not agree within the above limit, it means that corrections will have to be made between those measurement points that are not equal.

The minimum dimensions between the spring hangers both front and rear are also shown on the illustrations. In addition the height of the front spring horns with reference to the top of the frame side member is shown.

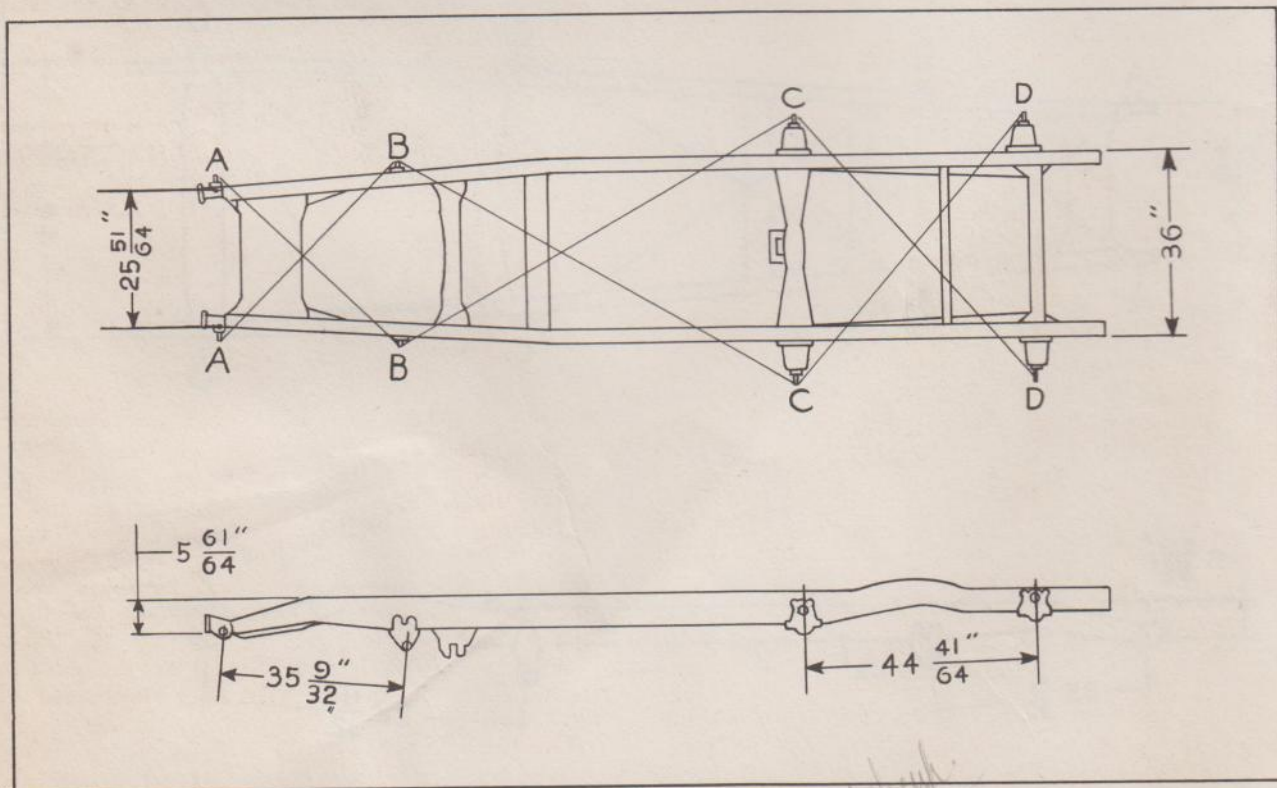


Fig. 2—3/4 Ton Truck Frame



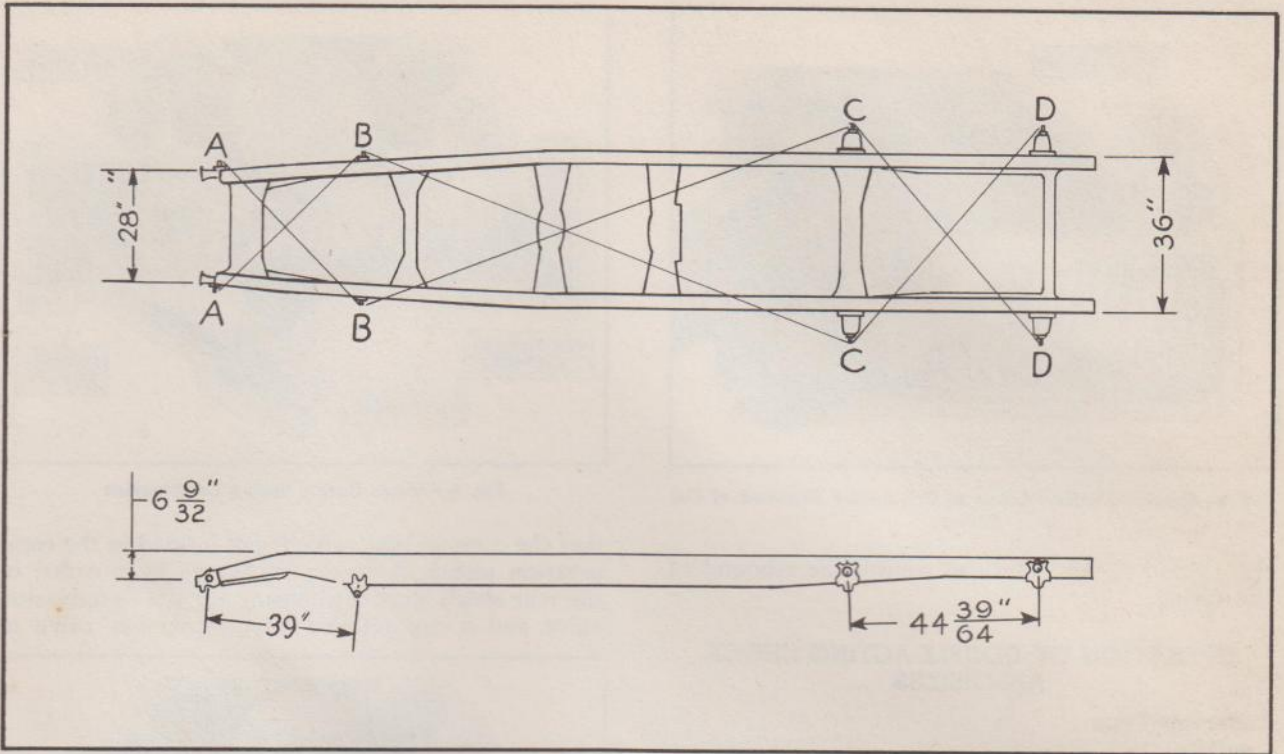


Fig. 3—1 1/2 Ton Truck Frame

**SHOCK ABSORBERS**

Shock absorbers provide a smoother ride for the occupants by dampening the spring vibrations as the truck passes over irregularities in the road. There are two types of shock absorbers: single-acting, and double-acting. The single-acting shock absorbers control the speed of REBOUND of the truck springs. Double-acting shock absorbers control the speed of both REBOUND and COMPRESSION of the truck springs.

shock absorber arm to move upward, relieving the cam pressure on the piston. Relieving this pressure allows the piston spring to force the piston outward, creating a vacuum behind the piston. The vacuum causes the intake valve under the head of the piston to open, permitting the fluid to flow under the piston head and fill the piston chamber, Fig. 5.

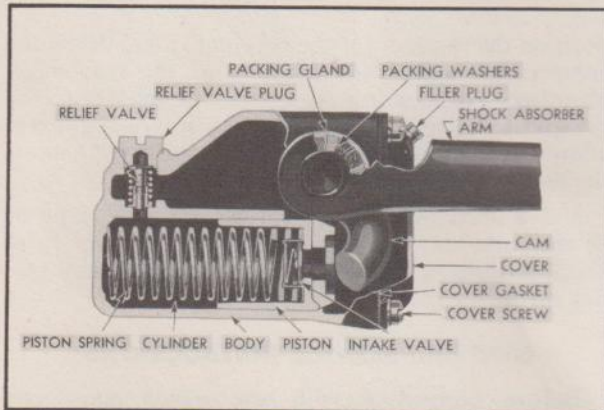


Fig. 4—Single-Acting Shock Absorber

**OPERATION OF SINGLE-ACTING SHOCK ABSORBERS**

The construction of the single-acting shock absorber is shown in the cross section view, Fig. 4.

When the wheels strike a bump, the car springs compress and the car frame moves downward, carrying the shock absorber with it. This causes the

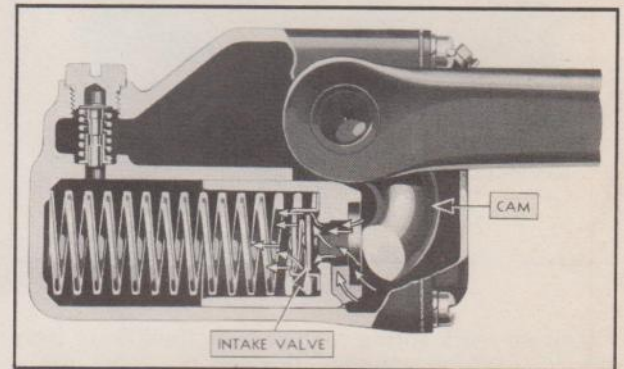


Fig. 5—Shock Absorber Action When Car Strikes a Bump

As the wheels pass over the bump, the car springs rebound and the car frame moves upward, carrying the shock absorber with it. This causes the shock absorber arm to move downward, applying cam pressure on the piston. The cam forces the piston into the cylinder, closing the intake valve. The oil, trapped in the cylinder, forces the relief valve off its seat and passes slowly into the reservoir. This action, Fig. 6, slows up the rebound of the truck springs.

The type of single-acting shock absorber shown in Fig. 4, with a separately mounted intake valve and relief valve, is used on the front and rear of

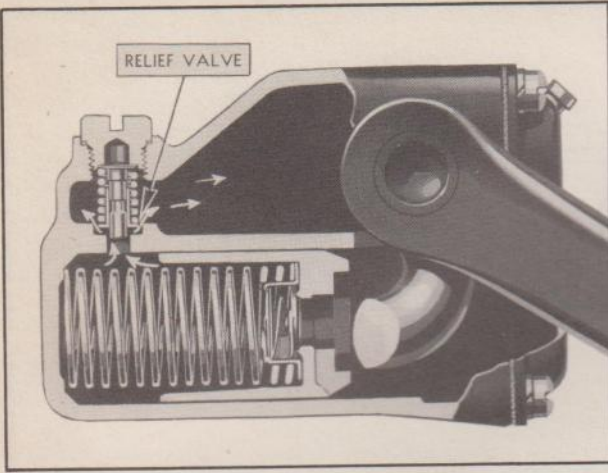


Fig. 6—Shock Absorber Action in Controlling Rebound of Car Spring

the 1/2 and 3/4 ton trucks to control the rebound of the springs.

**OPERATION OF DOUBLE-ACTING SHOCK ABSORBERS**

**Reservoir Type**

This type of shock absorber, available on all trucks, has both pistons contained in one housing. A cross section view of the double-acting shock absorber is shown in Fig. 7.

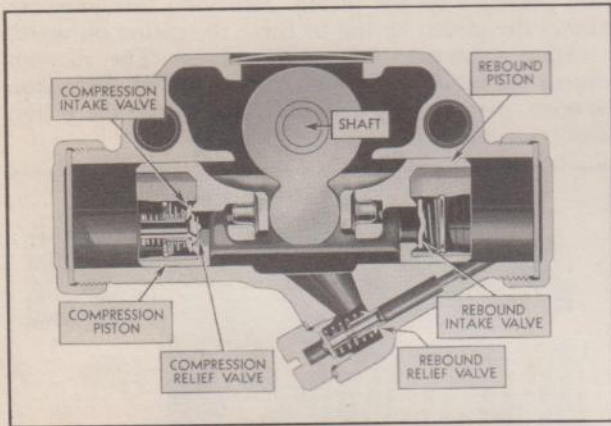


Fig. 7—Front Shock Absorber

During truck spring compression, fluid flows from the compression cylinder, through the relief valve, into the reservoir, and thus dampens the spring compression. At the same time, fluid enters the rebound cylinder through the intake valve. This action is shown in Fig. 8.

During truck spring rebound, fluid flows from the rebound cylinder, through the relief valve, into the reservoir, thereby dampening the spring rebound. At the same time, fluid flows into the compression cylinder through the intake valve. This sequence of events may be followed by referring to Fig. 9.

The cross-section views shown, Figs. 7, 8, 9, illustrate the type of shock absorber used at the front of the truck, but the operating principles of the rear shock absorbers are quite similar, the exception being

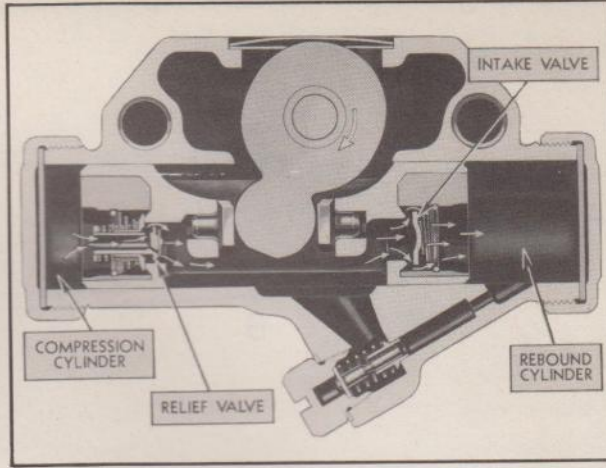


Fig. 8—Action During Spring Compression

that the compression valve is not located in the compression piston. A separate passage is provided in the rear shock absorber housing for the compression valve and a cap retains the compression valve in

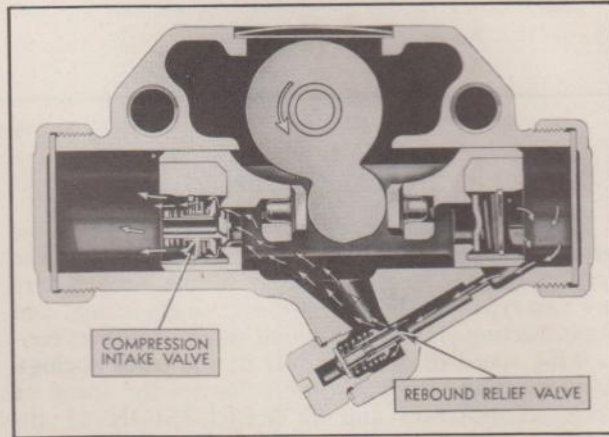


Fig. 9—Action During Spring Rebound

position the same as for the rebound valve. While the compression and rebound valves of the rear shock absorbers are identical with those of the front, the design of the rear shock absorbers differs slightly to allow for increased load distribution at the rear of the unit.

Valve markings are located on the valve caps or in the case of the compression valve on the front shock absorbers, on the end of the compression piston cover.

**GENERAL SERVICE INSTRUCTIONS**

Before proceeding with any repair operations on the shock absorbers, lubricate the truck springs and shackles and check the air pressure in the tires to see that it does not exceed the recommended pressure. In order to obtain a smooth ride, shackles must act freely and the tires must not be over-inflated.

After these preliminary operations have been completed, disconnect the link from the axle and pull the shock absorber arm down. If the arm comes down easily, part way, then comes to a stop

and moves down slowly the rest of the way, there is not enough fluid in the shock absorber.

Clean the shock absorber thoroughly, then remove the filler plug. With fluid injector, KMO-1026, fill the shock absorber with shock insulating fluid, to a level with the filler plug hole.

**NOTE—This method of filling applies to all shock absorbers.**

Replace the filler plug and move the arm up and down vigorously several times to work the oil into the piston cylinder.

After the arm has been moved up and down to fill the cylinder, insert additional fluid to fill the reservoir. Allow the fluid to escape down to the bottom edge of the filler plug hole before replacing the plug. This provides the necessary air space in the shock absorber.

Leaks at the cover or at the valve plug can be corrected by installing a new cover gasket or filler plug lead gasket washer.

On double-acting shock absorbers, leaks at the end caps, valve plug, or filler plug can be eliminated by installing new end cap fibre gaskets, or valve and filler plug lead gaskets.

Packing washers on shock absorbers which have been operating with oil below the proper level, are apt to become worn, causing oil leaks around the shaft. Such leaks can only be corrected by replacing the shock absorbers.

### SERVICE OPERATIONS—SINGLE-ACTING SHOCK ABSORBERS

#### Disassembly

Remove the shock absorber from the truck and place in an assembly fixture as shown in Fig. 10.

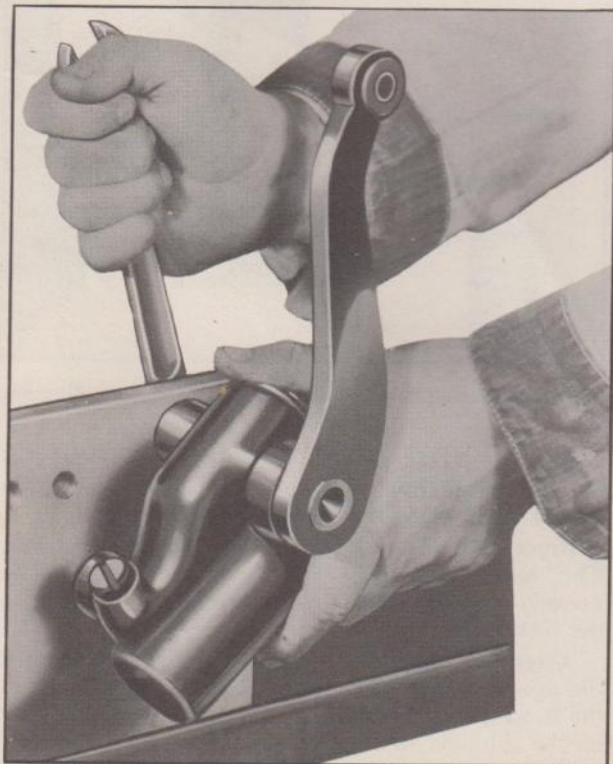


Fig. 10—Shock Absorber Holding Fixture

**CAUTION—Do not clamp the shock absorber in a vise as pressure on the cylinder will bind the piston.**

Remove the valve plug, relief valve, and cover from the shock absorber. Remove the piston, intake valve, and the piston spring. DO NOT attempt to remove the shock absorber arm, shaft, or cam, as these parts are assembled under 24,000 pounds pressure and are NOT to be removed.

If the bearings show excessive wear the shock absorber should be replaced.

Wash all parts in kerosene; inspect the piston, cylinder bore, valves, and springs before reassembling. Replace any worn or broken parts.

#### Reassembly

Assemble the intake valve onto the spring and place the piston over the spring and valve. Insert the assembly into the cylinder.

Push the piston into place and pull the shock absorber arm over until the cam holds the piston in the cylinder, then assemble the cover to the shock absorber, using a NEW gasket.

Fill the shock absorber with shock insulating fluid and install the relief valve and plug, using a NEW lead washer under the plug. Install the shock absorber on the truck.

### SERVICE OPERATIONS—DOUBLE-ACTING SHOCK ABSORBERS

#### Reservoir Type—Disassembly

Remove the shock absorber from the truck and place it in the assembly fixture. Remove the filler plug and valve and drain the fluid from the shock absorber, working the arm back and forth until completely drained. Remove both end caps, using special serrated wrench, J-766, Fig. 11.

Remove the valve retaining snap rings and valves from both pistons. Clean and inspect all parts.

#### Reassembly

Install valves and snap ring, using special tool, J-896-A, Fig. 12.

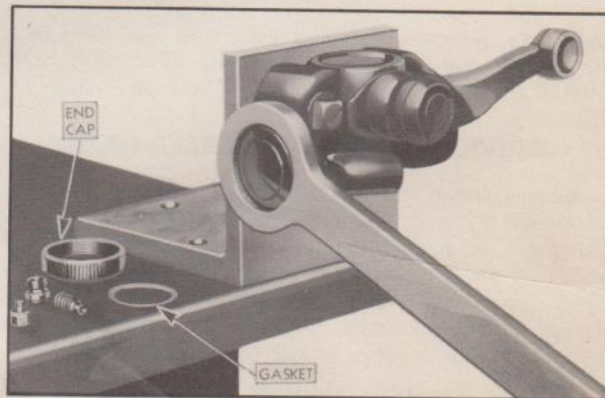


Fig. 11—Removing End Caps from Double-Acting Shock Absorbers

**CAUTION—Be sure to install the inlet valve in the piston, located at the same end as the separately mounted relief valve.**

The open side of the snap ring should be installed as shown in Fig. 13. If it is installed in any other position it is very difficult to remove.

After the valves have been installed, flip the valve with a screwdriver to make sure that the valve and spring are free.

Reassemble the end caps, using NEW lead gaskets under the plugs.

Fill the shock absorber with shock insulating fluid. Install the filler plug and move the arm up and down vigorously several times to insure filling the

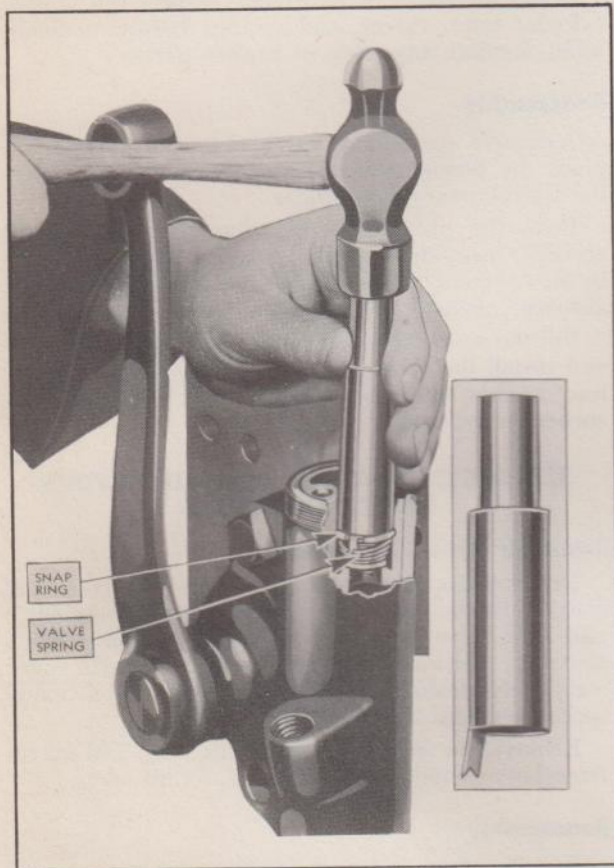


Fig. 12—Installing Valve and Snap Ring

cylinders. Remove the filler plug and add fluid to a level with the bottom edge of the filler plug hole. Install the filler plug, using a NEW lead gasket.

### SERVICING SHOCK ABSORBER LINKS

Unsatisfactory shock absorber action and shock absorber noise are usually due to worn links, link bushings, and grommets. To determine if one or more of these conditions exist, disconnect the link from the axle and check for lost motion at both ends. If wear has occurred, replace the grommets and bushings at both ends, in the following manner.

Remove the shock absorber from the truck and disconnect the link. Press the worn bushings and grommet from the shock absorber arm, using the bushing remover and support, J-903, in an arbor press, as shown in Fig. 14.

Coat a new rubber grommet with liquid soap, for easy installation, and press it into the shock

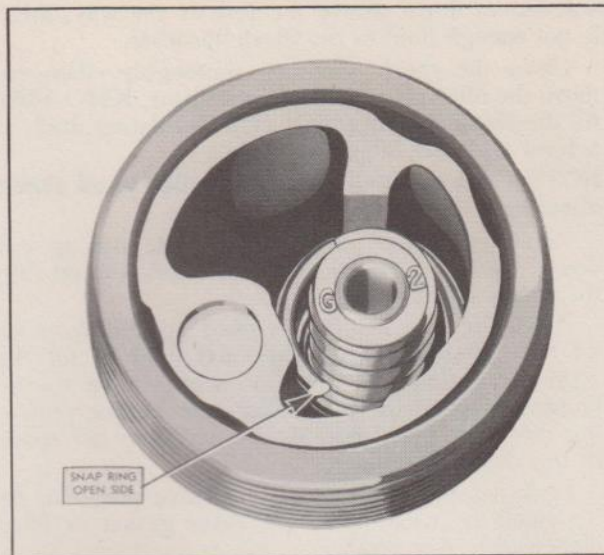


Fig. 13—Correct Position of Snap Ring

absorber arm, using tool, J-901, to insure proper seating of the grommet.

Place a new bronze bushing on the pilot of the bushing replacer and press the bushing into the grommet, Fig. 15. The replacing tool, J-899, expands the grommet and should be used for this operation to prevent damaging the grommet.

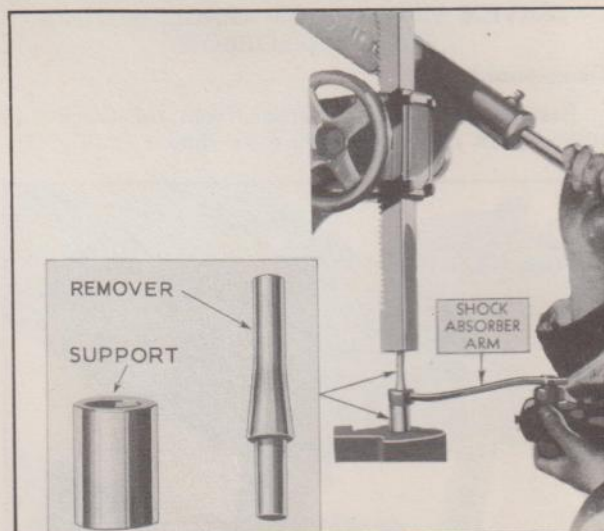


Fig. 14—Removing Bushing and Grommet from Shock Absorber Arms

The pin holes at the ends of the link are of different diameters and the knurled end of the pin should be inserted through the large hole.

Press the pin into the link, using tool, J-902. This tool limits the depth that the pin can be pressed through the link, preventing damage to the link holes.

After the pin is installed, strike the link against the press plate of the arbor press. A sharp blow on the head of the pin will properly seat the large hole on the shoulder of the pin.

Assemble cotter pins to the link pins and install the shock absorber on the truck.

## TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling shock absorbers:

Tool Number	Description
KMO-1026 .....	Fluid Gun
J-766 .....	Knurled End Cap Wrench
J-896-A .....	Valve Installing Tool
J-899 .....	Link Bushing Driver, Small
J-902 .....	Link Pin Setting Tool
J-901 .....	Rubber Bushing Depth Spacer
J-903 .....	Link Bushing Remover Support

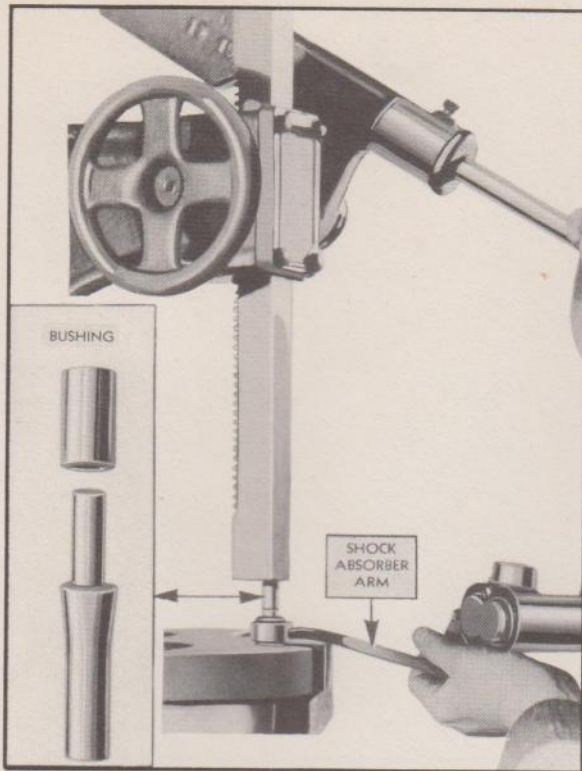


Fig. 15—Installing Bronze Bushing in the Grommet in the Shock Absorber Arm

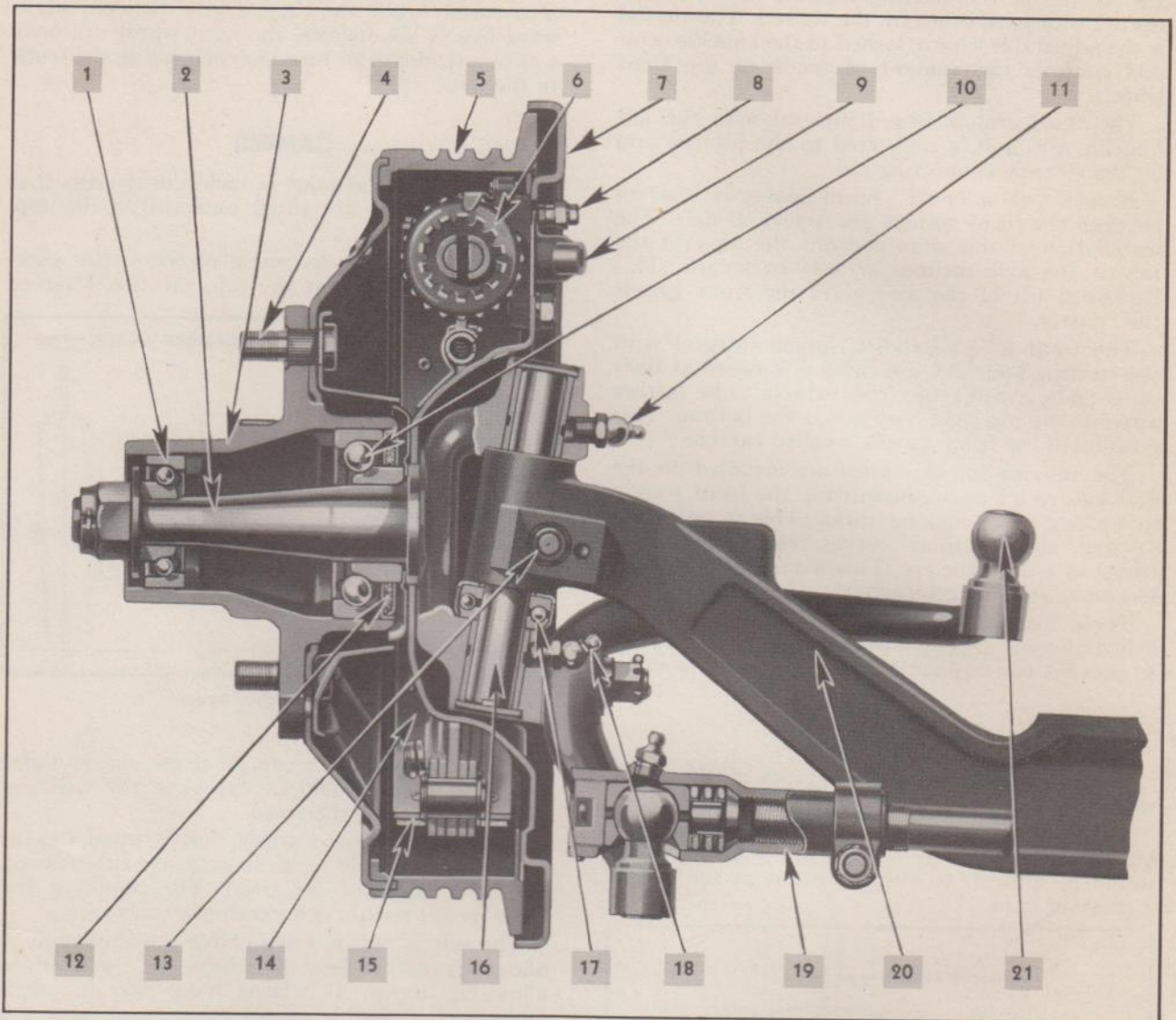
## SHOCK ABSORBER SPECIFICATIONS

	½ and ¾-Ton		½-Ton	¾-Ton
	Front		Rear	Rear
Model Number	1430CA-DA		1430LA-MA	1431X-Y
Type	Reservoir		Reservoir	Reservoir
Make	Delco-Hydraulic		Delco-Hydraulic	Delco-Hydraulic
Action	Single		Single	Single
Valve Markings: Rebound Compression	4CG —		3CG —	3CG —

	½, All ¾ and 1½-Ton	½-Ton	All ¾-Ton	1½-Ton
	Front	Rear	Rear	Rear
Model Number	1731-C-D	1731-T-U	1732-N-P	2000-V-W
Type	Reservoir	Reservoir	Reservoir	Reservoir
Make	Delco-Hydraulic	Delco-Hydraulic	Delco-Hydraulic	Delco-Hydraulic
Action	Double	Double	Double	Double
Valve Markings: Rebound Compression	2-J G-2	2-G G-2	1-J G-0	1-J G-0

## Section 3

Fig. 1—Front Axle Assembly— $\frac{1}{2}$ ,  $\frac{3}{4}$ ,  $1\frac{1}{2}$ -Ton Trucks

1—Outer Wheel Bearing  
 2—Wheel Spindle  
 3—Wheel Hub  
 4—Wheel Hub Bolt  
 5—Brake Drum  
 6—Brake Wheel Cylinder  
 7—Brake Flange Plate

8—Brake Bleeder Valve and Screw  
 9—Brake Wheel Cylinder Hose Connection  
 10—Inner Wheel Bearing  
 11—Lubrication Fitting  
 12—Inner Bearing Oil Seal  
 13—Kingpin Lock Pin  
 14—Brake Shoe

15—Brake Lining  
 16—Kingpin  
 17—Kingpin Thrust Bearing  
 18—Lubrication Fitting  
 19—Tie Rod End  
 20—Axle I-Beam  
 21—Steering and Third Arm

## FRONT AXLE

 $\frac{1}{2}$ ,  $\frac{3}{4}$  AND  $1\frac{1}{2}$ -TON TRUCKS

## CONSTRUCTION

The front axle used in the  $\frac{1}{2}$ ,  $\frac{3}{4}$  and  $1\frac{1}{2}$ -ton trucks is known as the reverse Elliot type. It is a steel dropforging with the spring seats forged integral with the "I" beam. The "I" beam is heat-treated for extreme toughness and is machined to very close limits.

The kingpin is recessed and held in position by a tapered pin drawn tightly into the recess by a

lock washer and nut. The holes at each end of the "I" beam are bored at a slight angle to permit the kingpin to tilt inward at the top. This inward tilt is called kingpin inclination.

The steering knuckle is mounted to the front axle by means of this kingpin, and rides on a ball bearing which makes steering easy.

The brake flange plate is securely bolted to the steering knuckle and carries the brake shoes and

wheel cylinders. The steering knuckle arms are also bolted to the steering knuckle and are connected with each other by the tie rod. The tie rod is the adjustable type attached to the knuckle arms and controls the amount of toe-in of the front wheels.

The third arm is forged integral with the left knuckle arm and is connected to the pitman arm by the steering connecting rod.

A caster shim or "I" beam spacer is inserted between the front springs and the front axle. The installation of this shim controls the amount the top of the axle inclines or tilts backward. This backward tilt of the axle gives the front wheels their caster.

The front wheel spindles, forged integral with the steering knuckles, are tilted downward at their outer ends, causing the front wheels to be farther apart at the top than they are at the bottom. This position of the front wheels is called camber.

The steering knuckle arms are installed on the knuckles at an angle, permitting the front wheels to toe-out when making turns. This is necessary so that when turning curves, each wheel may travel in a different arc. This toe-out on curves is known as steering geometry.

These five front end factors are built into the axle and must be in proper relation to each other to prevent steering faults and excessive tire wear.

### CASTER

Caster is the amount in degrees of the backward tilt of the axle and kingpin. See Fig. 2.

A truck without caster would lack steering stability, would tend to wander over the road and would be difficult to straighten out at the end of a curve or turn.

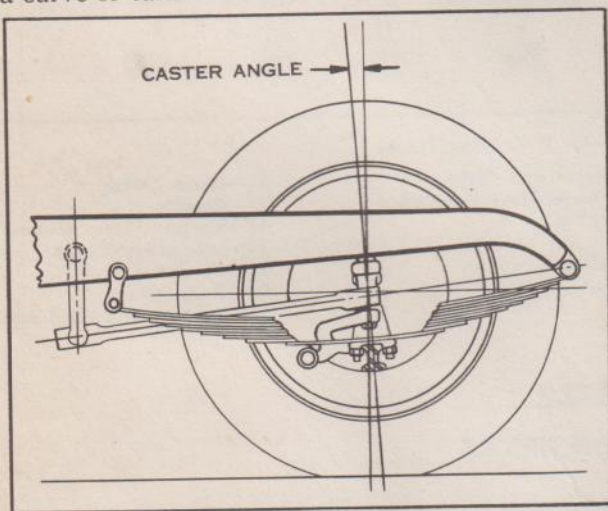


Fig. 2—Caster Angle

Unequal caster shows itself in the tendency of the truck to pull to the right or left. This condition comes about through the axle having been twisted so that there is a greater amount of caster in one kingpin than in the other. The direction in which the truck will tend to pull is towards the side with

less caster. Suppose that an accident has put a twist into the front axle so that the left side is zero caster, while the right side is castered backward five or six degrees, the right wheel will have a strong tendency to turn inward, pulling the truck to the left.

### CAMBER

Camber is the amount in inches or degrees that the front wheels are tilted outward at the top. See Fig. 3.

When a wheel has *too much camber*, or the wheel is tilted too far out at the top, the tire is forced

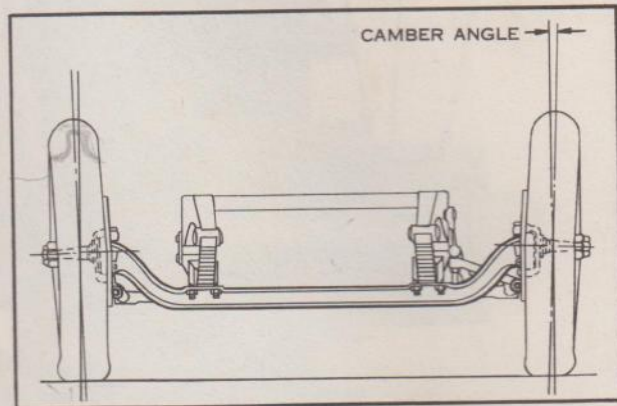


Fig. 3—Camber Angle

by road contact into a conical shape, on its under side. The result would be excessive tire wear on the outer edges of the tread.

*Reverse camber*, or a wheel that is tilted too far in at the top, would result in excessive tire wear on the inner edges of the tread. The center of the tread would remain comparatively unworn.

The rule is that if wheels have the maximum of allowable camber they must have the maximum of allowable toe-in. If wheels have the minimum amount of allowable camber they must have the minimum amount of allowable toe-in.

Kingpin inclination is the amount in degrees that the tops of the kingpins are inclined toward the center of the truck. See Fig. 4.

Kingpin inclination tends to keep the wheel spindles pointed outward, in line with the axle,

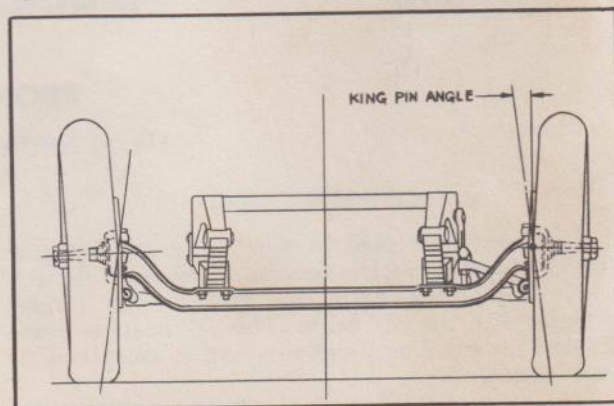


Fig. 4—Kingpin Inclination

just as caster tends to keep the wheels of an automobile pointed straight ahead. The effect is the same, since if the spindles are kept pointing out at right angles of the truck, the wheels will, as a result be kept pointing ahead. It makes the truck steer easier.

We have already referred to the close relationship between the factors that enter into the front axle assembly. It is a point that cannot be overstressed. One must keep this close interrelation constantly in mind to gain a full and true understanding of this cleverly designed mechanism. In order to correct any wrong adjustment, it is necessary to realize what effect a change in one element of the mechanism may have on the operation of the other parts.

### TOE-IN

Toe-in is the amount in inches that the wheels toe-in, that is, the distance between the wheels at the front "A," is less than it is at the rear "B." See Fig. 5.

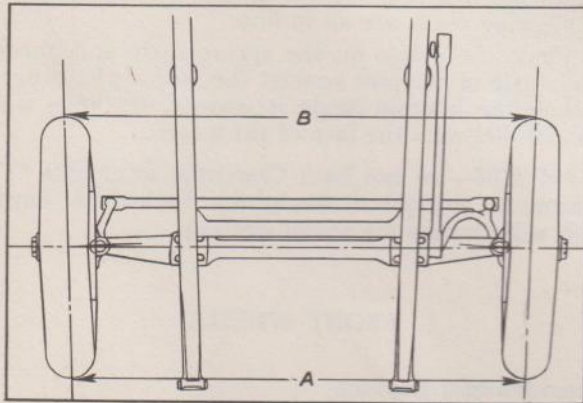


Fig. 5—Toe-In

Cambering the wheels out at the top makes it necessary to draw them in at the front.

Toe-in is a necessity growing out of camber and directly related to it. It might seem that since the wheels are headed inward toward the center of the road, while actually traveling a parallel course, there must be a constant grinding of their surfaces on the road surface. As a matter of fact, it is to avoid this tire-wearing surface grind that toe-in is employed.

Just as the purpose of camber is to give the wheel a setting so it will be in nearly a balanced free-running position as possible, so with toe-in, the purpose is to set the wheel in a position to reduce to a minimum the road friction on the tire.

### STEERING GEOMETRY

Steering geometry is the mechanics of keeping the front wheels in proper relative alignment as the wheels are turned left or right. Fig. 6.

The front wheels, when the truck is making a turn, are not on the same radius line, drawn from

the center around which the truck is turning, and because of this, it is necessary for the front wheels to assume a toed-out position when rounding curves. This position is governed by the angle of the steering arms.

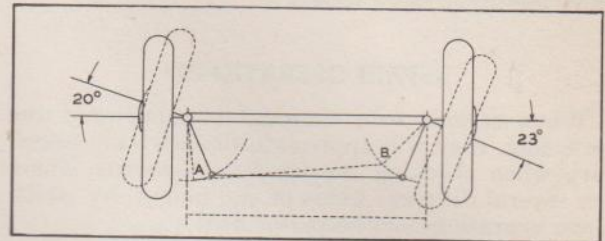


Fig. 6—Steering Geometry

The accuracy of the steering geometry is governed by the condition of the steering arms. For example, suppose a steering arm has been bent by bumping against a curb in such a way as to cause the right wheel to toe-in excessively when the car was turned around a corner. This tire would drag, causing rapid wear of that tire. The condition accounts for the cars and trucks we see once in a while that wear out one front tire twice as fast as the other, although, by usual tests, it is perfectly set for straight ahead driving.

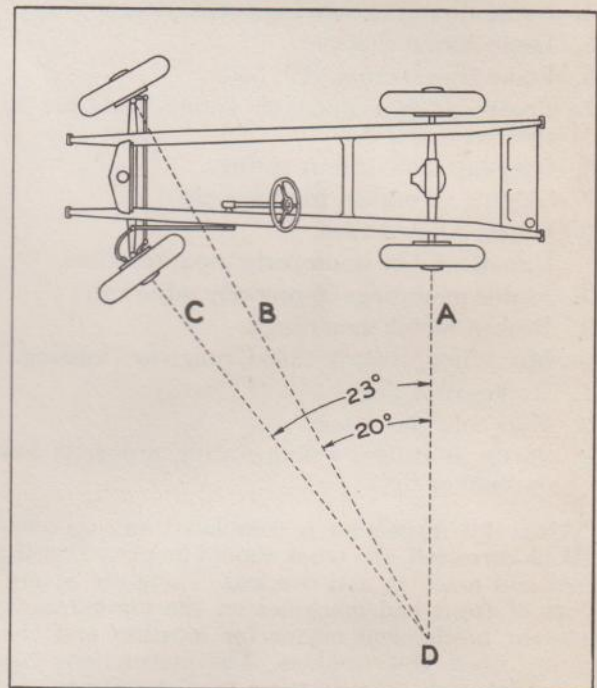


Fig. 7—Toe-Out on Curves

The wheel of any vehicle, if properly set on the curves, will be at a right angle to the radius line from the center or point around which the vehicle is turning.

Fig. 7 is a diagram of a truck making a left turn. The right wheel is set at an angle of twenty degrees—the angle being exaggerated to bring out the principles more clearly. A line "A" drawn through the rear axle and both rear wheels and a line "B"



drawn through the spindle of the right wheel meet at "D," which is the center around which the car is turning. Therefore, the left or inside wheel must be at right angles to the radius line "C" which passes through the spindle and strikes the lines from the other three wheels at "D."

### REPAIR OPERATIONS

When service men thoroughly understand the foregoing, they will appreciate the accuracy necessary when checking the front end system. There are several different kinds of equipment, by which these operations can be performed.

It must be remembered that no matter what kind of equipment is used, that all of these checks must be made with the truck level, with the weight of the truck on the wheels and with no pay load.

Bad steering performance may be due to some cause not connected with front wheel alignment. Therefore, check to see that none of the following conditions are present before placing the car on the front end machine:

1. Loose or improperly adjusted steering gear.
2. Steering housing loose at frame.
3. Play or excessive wear in kingpins or bushings.
4. Loose tie rod or steering connections.
5. Loose spring shackles.
6. Loose front spring "U" bolts.
7. Front spring slipped on spring seat due to sheared center bolt.
8. Over-lubricated front springs.
9. Sagging or broken front springs.
10. Under-inflated tires.
11. Unbalanced or improperly mounted tires.
12. Motor mountings improperly adjusted.
13. Broken motor mountings.
14. Motor not properly tuned, rough or "missing."
15. Brakes dragging.
16. Hub bolt nuts loose.
17. Shock absorbers not operating properly, low on fluid or dry.

After this inspection is completed and the conditions corrected, the truck should be placed on the front end machine and checked. There are several types of front end machines on the market using different mechanical means for locating and correcting front end troubles. The instructions furnished by each manufacturer for the operation of his particular machine should be followed.

### STRAIGHTENING FRONT AXLE "I" BEAM

When it is necessary to straighten the front axle "I" beam out of the truck, the gauge J-1185 illustrated in Fig. 8, should be used. The gauge consists of two pins that fit in the kingpin holes. These pins are tapered so that they properly fit and center in the axle.

The first operation in straightening "I" beams, is to properly level the spring seats either on an

arbor press or with a bending bar. Assemble the kingpin pins into the holes in the end of the beam. Place a cord on each pin and slide a square on the spring seat until it touches the cord. Check from the square to center of the spring tie bolt hole.

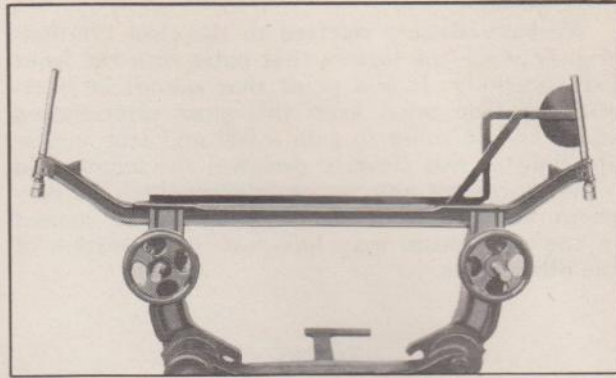


Fig. 8—Front Axle "I" Beam Gauge

When the axle is in proper alignment the kingpin holes and the hole for the spring tie bolt holes in the spring seats, are all in line.

Place the gauge on the spring seats and check the angle of the pins against the face of the gauge. When the kingpin angle is correct, the pins will be parallel with the face of the gauge.

**CAUTION—Do not heat Chevrolet front axle "I" beams to straighten. Straighten them cold—heating will change the metal strength.**

### FRONT WHEELS

#### Remove and Replace

Lift the wheel from the ground with a jack under the front axle "I" beam. Remove hub cap. Pull out cotter pin locking the spindle nut. Remove the spindle nut and spindle washer. Remove front wheel.

The outer cone and balls and the inner cone are loose and may be easily removed. The inner balls may be removed by prying out the inner bearing felt retainer. If this is done, a new felt retainer assembly should be used when reassembling. The ball cups are pressed into the hubs and can be driven out by inserting a bar through the hub so that one end rests against the cup. By tapping lightly at several points around the circumference of the cup, through notches in shoulder inside of hub, it can be removed without damage. It is well to remember that the cups are very hard, therefore, extreme care should be used in removing not to crack them.

In replacing the cups, be sure that they are pressed into the hubs evenly and as far as they will go, that is, that their backs are against the shoulder in the bottom of the hole.

Before installing the separator and ball assemblies in the hub they should be packed with Marfak lubricant or its equivalent, using No. 2 in summer and No. 1 in winter.

When replacing the front wheel be sure the inner oil deflector is in its proper place between the inner bearing cone and the shoulder on the knuckle spindle. As the wheel is pushed onto the spindle it should be made certain that the inner oil deflector has passed inside of the outer oil deflector.

Be sure that the nuts which hold the wheel to the wheel hub are put on with the taper side to the wheel hub.

### Adjustment

After the wheel has been replaced on the steering knuckle spindle, with the bearings and felt retainer in their proper location, install the spindle washer against the cone of the outer bearing then adjust the bearings as follows:—

1. Using an 8" wrench (never larger) and applying a steady force with one hand, pull up the adjusting nut until the wheel is somewhat hard to turn by hand. At the same time rotate the wheel to be sure that all parts are correctly seated.
2. Back off the adjusting nut one-half castellation or one-twelfth turn.
3. If the slot in the nut and the cotter pin hole line up, insert the cotter pin. If not, back the nut off until the slot and the hole are in line and then insert the cotter pin.

**NOTE—In order to provide for close bearing adjustment, the cotter pin hole is drilled in the spindle in both the vertical and horizontal plane.**

With the bearing inner cup an easy-push fit in the hub and the nut a free-running fit on the spindle threads, this will give an adjustment toward the tight side, which will allow for settling and working-in of the parts in service.

Front wheel bearings should never be set up on the loose side, as such an adjustment does not bring the balls and races into proper contact.

It is well to note that the slight friction of a new snugly fitting felt retainer assembly will temporarily produce a slight drag on the wheel, but this is easily recognized and should not be confused with adjustment of the bearing. Spin the wheel, making sure that all parts are in correct position, then clinch cotter pin securely.

### FRONT AXLE TIE ROD

The front axle tie rod is of the ball, seat and spring type, similar to the steering connecting rod construction.

Refer to Fig. 9, and note how parts are assembled. The parts on both ends are assembled in the same manner. First the spring seat, then the spring and ball seat, then the ball and ball seat, and then the plug. Ball seats should be assembled so that notches line up with ball neck.

To properly adjust the front axle tie rod:

1. Remove cotter pins.
2. Screw plugs in tight until springs are compressed solid and back off to first cotter pin hole.

3. Insert and clinch cotter pins.
4. Lubricate both ends of tie rod.

To remove the tie rod from the front axle, remove the cotter pin, end plug and ball seat. Screw end plug back into the end of the tie rod until the ball is in the center of the opening. A light tap with a soft hammer will remove the tie rod from the ball.

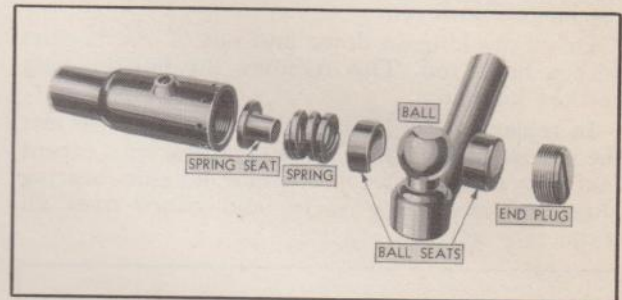


Fig. 9—Front Axle Tie Rod

### Toe-In Adjustment

Front wheel toe-in can be adjusted by loosening the clamp bolts at each end of the tie rod and turning the tie rod to increase or decrease its length until a toe-in of  $\frac{5}{64}$ " to  $\frac{1}{8}$ " is secured, then tighten the clamp bolts securely.

### $\frac{1}{2}$ -TON PANEL TRUCK STABILIZER

A ride stabilizer is used at the front of the  $\frac{1}{2}$ -Ton Panel Truck to prevent excessive side sway on turns.

To remove the stabilizer from the truck, first remove the spring "U" bolts attaching it to the top of the spring and then remove the large bolt at the upper end of the two-piece bracket which extends through the bracket, spacer, and frame side rail. The stabilizer assembly can then be removed. To remove the bracket from the bar it is necessary to remove the bolts holding the two-piece bracket together so as to relieve the pressure on the rubber bushings. The bracket and bushing can then be slipped off over the end of the bar.

Replacing the stabilizer on the truck is the reverse of the above, except that the bolts which clamp the two parts of the bracket together should not be tightened until after the stabilizer is in place on the truck, and the weight of the truck with no pay load on its wheels. This is important so that the rubber bushings will grip the bar in proper relation to the frame and axle, and prevent excessive up and down movement of one front wheel relative to the other.

**CAUTION—Do not attempt to adjust the stabilizer by tightening the bolts in the bracket when there is a load in the truck. This would destroy its effectiveness.**

All commercial frame front cross members are punched for the adaptation of this assembly if desired.

## KINGPIN

## Remove and Replace

To remove and replace the kingpin, jack up the front of the truck and remove the front wheel. Remove the nuts which attach the brake flange plate to the steering knuckle. Remove the brake flange plate. Remove the top kingpin bearing plug. This can be done with a sharp prick punch. Remove the kingpin lock pin.

Drive the kingpin down and out of the bottom with a brass rod. This removes the bottom plug and the kingpin.

In replacing the kingpin the operations are just the reverse of the above removal operations, except that you should always use new kingpin bearing plugs and new lockwashers, and clinch over all cotter pins securely.

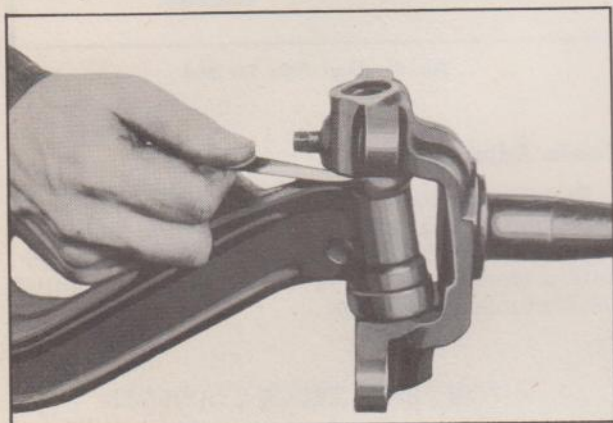


Fig. 10—Clearance Between Steering Knuckle and "I" Beam

The kingpin bearing plugs on all trucks have no "expansion" feature, and must be staked in place by peening or staking over the ends of the steering knuckle to hold the plugs securely in place.

Drive in the kingpin with a soft head hammer. After the kingpin is installed with the thrust bearing assembled at the bottom of the kingpin with the dust shield side at the top, check the clearance between the steering knuckle and axle "I" beam. See Fig. 10. If this clearance is more than .006" install a steel shim between the steering knuckle and the "I" beam at the top of the kingpin.

In installing this shim, start the kingpin in at the top of the knuckle and place the shim over the kingpin. Mount the knuckle over the end of the "I" beam and drive the kingpin part way through the "I" beam. Insert bearing between the "I" beam and the knuckle and drive the kingpin into position.

Trucks that have been operated for a period of time with loose kingpin bushings, in many cases, tend to "bell mouth" the kingpin holes in the ends of the "I" beam. As a means of making a satisfactory repair and prevent future kingpin breakage due to the kingpins being loose in the "I" beam, .010" and .020" oversize kingpins and bushings are available for 1½-Ton Trucks.

Special reamers are available on the market for reaming the holes in the "I" beam ends for oversize kingpins.

## KINGPIN FLOATING BUSHINGS

## ½ AND ¾-TON TRUCKS

On the ½ and ¾-ton trucks the kingpin bushings are bronze bushings of the "floating" type. When replacing these bushings it is not necessary to ream them to size, as service bushings are machined to finished dimensions. However, when replacing floating bushings care should be used to make sure that the oil groove in the bushing lines up with the lubrication fitting in the steering knuckle. These bushings should be free on the kingpin, but may be somewhat snug in the steering knuckle.

After the kingpin bushings have been installed, the front end alignment should be checked to make sure that all of the factors of front end alignment are within the specified limits.

## REMOVE AND INSTALL STEERING KNUCKLE BUSHINGS, 1½-TON TRUCKS

A bushing puller should be used in removing steering knuckle bushings. If a tool of this kind is not available, an ordinary coarse threaded tap of

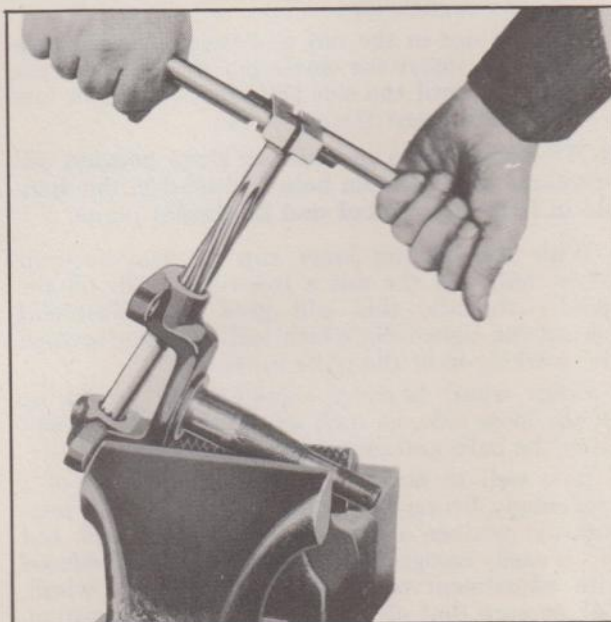


Fig. 11—Reaming Steering Knuckle Bushings

the proper size can be threaded into the bushing, and with a bar whose diameter is slightly less than the diameter of the hole and 1 inch longer than the distance through the steering knuckle, drive out the tap and bushing.

To install new bushing, round edges with a file; place in proper position with respect to knuckle to align oil holes, noting that the oil hole is nearer one end than the other. Press into place with a vise or arbor press, taking care to start bushing straight into the hole. Do not hammer on bushing or otherwise deform it.

After the bushings are in place, they should be carefully reamed to size, using a reamer long enough to reach through both bushings at once, or preferably a reamer having a long pilot bar which will just pass through the opposite bushing while one is

being reamed, the cutting flutes also being long enough to finish the bushings together. Fig. 11.

**NOTE**—When oversized kingpins are installed, it is necessary to ream the steering knuckle bushings first with the reamer used for fitting a standard size kingpin, and then with the special oversize reamer to fit the .010" or .020" oversize kingpin, to provide .002" clearance between the kingpin and bushing.

## FRONT SPRINGS

### ½-TON TRUCK

The front springs on the ½-ton truck are flat under load, contributing to improved steering geometry by reducing to a minimum the fore and aft movement of the front axle and attaching parts. The rear eye of the front spring is of the "Berlin" type, meaning that the horizontal center is approximately level with the main leaf center.

### ¾-TON TRUCK

The front springs of the ¾-ton truck are "two-stage" type, or in other words the spring rate with the truck light is considerably lower than when loaded. The advantage of this type spring is that the rebound or "throw" is much less when the truck is light and the resistance to "bumping through" is greater when the truck is loaded. The change in spring rate from the low to the higher rate takes place at or near the rated load capacity of the truck.

### 1½-TON TRUCK

The front spring on the 1½-ton truck is a low camber spring of high load carrying capacity. The rear eye is also of the "Berlin" type, with a second leaf which partially wraps the main eye for additional safety.

Front spring data will be found under the heading "Spring Specifications" at the end of this section.

### THREADED SHACKLE

A threaded type spring shackle is used at the front of the front spring on the ½, ¾ and 1½-ton truck models.

In this design threaded bushings are pressed into the spring hanger and into the eye of the spring. Threaded pins with tapered ends are screwed into the bushings with each end projecting the same distance. The shackles are plain, heavy gauge steel stampings with tapered holes which fit tightly on the tapered ends of the pins. A draw bolt, having a square shoulder under its rounded head, engages each outer shackle. A nut at the inner side of each inner shackle serves to draw both inner and outer shackle members up snugly on the pins. See Fig. 12.

The pins are drilled from their outer ends to the center where a cross hole connects it with the threaded portion. Lubrication fittings are assembled in the end of each central hole to provide for lubrication of the threads. Cork washers are assembled at each end between the shackle and the hanger and between the shackle and the spring, to retain the lubricant in the threaded portion.

In action, this shackle, being tight on the tapered pin end, oscillates the pin in the threaded portion.

This design uses all of the relatively large threaded surface for a bearing, reducing wear to a minimum and insuring long bearing life to these members.

If it becomes necessary to remove these bushings from either the spring eye or the spring hanger, Tool No. J-553 is required. Remove the draw bolt and the shackles. Screw tapered pins from the bushing and thread the end of the tool into the bushing. Turning the pull nut with a wrench will remove the bushing.

To install a new bushing, insert the threaded end of the tool through the spring eye or spring hanger and screw on a new bushing, until it is centered up with the hole in the spring eye or spring hanger. Turning on the pull nut will press this bushing into place.

Inspect the pin that was removed from the bushing and if it is worn, replace. Screw it into the

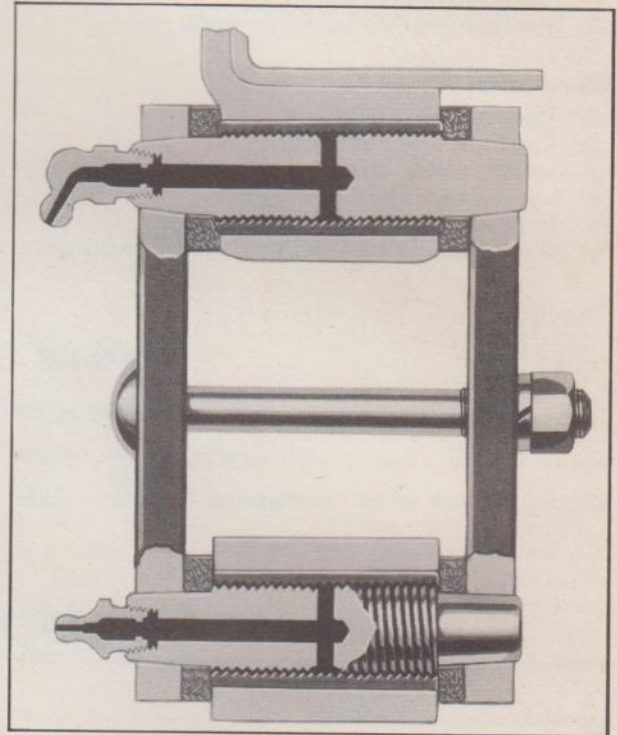


Fig. 12—Threaded Type Spring Shackle

bushing until each end projects  $2\frac{1}{32}$ " from the end of the bushing on either side. Place the four cork washers over the ends of the pins and assemble the shackle plates. Insert the draw bolt and draw the nut up snugly. Strike each end of each shackle a sharp blow with a hammer to insure seating of the tapers and retighten the shackle draw bolt.

Examine the lubrication fittings for damage, replacing when necessary and fill the pins completely full with chassis lubricant.

### PLAIN BUSHING

A plain bushing type spring eye bolt is used at the rear of the front springs on the ½, ¾, and 1½-ton truck models. The construction and method of removing and replacing this type of eye bolt is the same as for the eye bolt in the plain bushed shackle, as described under "Rear Springs" in Section 4 of this Manual.

## FRONT AXLE TROUBLES AND REMEDIES

Symptom	Probable Remedy
<b>Hard Steering</b>	
<ol style="list-style-type: none"> <li>1. Lack of lubrication.</li> <li>2. Tight steering gear.</li> <li>3. Improper toe-in.</li> <li>4. Tires improperly inflated.</li> </ol>	<ol style="list-style-type: none"> <li>1. Lubricate the following points—tie rod ends, steering gear and steering connecting rod.</li> <li>2. Adjust steering gear according to instructions in Section 9 of this manual.</li> <li>3. Adjust toe-in.</li> <li>4. Inflate tires according to specifications given in Section 10 of this manual.</li> </ol>
<b>Front Wheel Shimmy</b>	
<ol style="list-style-type: none"> <li>1. Improper tire inflation.</li> <li>2. Wheels loose on hubs.</li> <li>3. Improper toe-in.</li> <li>4. Loose front wheel bearings.</li> <li>5. Steering knuckle bushings worn.</li> </ol>	<ol style="list-style-type: none"> <li>1. Inflate tires to recommended pressure.</li> <li>2. Tighten wheel hub bolts.</li> <li>3. Adjust toe-in.</li> <li>4. Adjust front wheel bearings.</li> <li>5. Replace bushings.</li> </ol>
<b>Wandering</b>	
<ol style="list-style-type: none"> <li>1. Tight steering gear.</li> <li>2. Tires unevenly inflated.</li> <li>3. Spring center bolt sheared and axle shifted.</li> <li>4. Loose front wheel bearings.</li> <li>5. Improper toe-in.</li> <li>6. Worn kingpin or steering knuckle bushings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust steering gear.</li> <li>2. Inflate tires.</li> <li>3. Replace center bolt and relocate in spring seat.</li> <li>4. Adjust front wheel bearings.</li> <li>5. Adjust toe-in.</li> <li>6. Replace worn parts.</li> </ol>

### TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the Front Axle:

Tool Number	Description
J-1185.....	Axle Aligner Gauge
J-553.....	Shackle Bushing Tool
.923".....	Steering Knuckle Bushing Reamer—1½-Ton Models

### FRONT AXLE SPECIFICATIONS

	½ and ¾-Ton Trucks	1½-Ton Trucks
Caster—Degrees.....	$1\frac{3}{4} \pm \frac{1}{2}$	$2\frac{3}{4} \pm \frac{1}{2}$
Camber—Degrees.....	$1 \pm \frac{1}{2}$	$1 \pm \frac{1}{2}$
Kingpin Inclination—Degrees.....	$7^\circ 10' \pm 1^\circ$	$7^\circ 10' \pm 1^\circ$
Toe-In—Inches.....	$\frac{5}{64}$ to $\frac{1}{8}$	$\frac{5}{64}$ to $\frac{1}{8}$
Steering Geometry (Toe-Out on Turns);		
Outside Wheel—Degrees.....	20	20
Inside Wheel—Degrees.....	$23 \pm 2$	$23 \pm 2$

#### KINGPIN DIAMETER

½ and ¾-Ton Trucks.....	.866" to .8665"
1½-Ton Trucks.....	.921" to .9214"

#### THRUST BEARING (KINGPIN)

½ and ¾-Ton Trucks.....	Matthews Mfg. Co., No. 8261-TA4
1½-Ton Trucks.....	Matthews Mfg. Co., No. 7801-TA2

#### WHEEL BEARINGS

½ and ¾-Ton Inner	
Inner Race.....	ND-909502
Separator and Balls.....	ND-909702
Outer Race.....	ND-909602

#### ½ and ¾-Ton Outer

Inner Race.....	ND-909501
Separator and Balls.....	ND-909701
Outer Race.....	ND-909601

#### 1½-Ton Inner

Inner Race.....	ND-909526
Separator and Balls.....	ND-909726
Outer Race.....	ND-909626

#### 1½-Ton Outer

Inner Race.....	ND-909525
Separator and Balls.....	ND-909725
Outer Race.....	ND-909625

## SPRING SPECIFICATIONS

	½-Ton	¾-Ton	1½-Ton 134½ & 160'
Length.....	36"	36"	40"
Leaf Width.....	1¾"	1¾"	2"
Stage.....	Single	Two	Single
Rate—Lbs. per Inch.....	260	(275) (365)	475
No. of Leaves.....	7	8	7
Leaf Thickness			
Nos. 1, 2.....	.237	.237	.297
No. 3.....	.237	.214	.297
Nos. 4, 5.....	.194	.214	.297
Nos. 6, 7.....	.194	.262	.297
No. 8.....	—	.262	—
No. 9.....	—	—	—
Total Thickness.....	1.487	1.902	2.037
Spring Clip Type			
No. 1.....	Clinch	Clinch	Bolt
No. 2.....	—	—	—
No. 3.....	Clinch	Bolt	Bolt
No. 4.....	Clinch	Clinch	Bolt

## Section 4

### REAR AXLE ASSEMBLY 1/2 AND 3/4-TON TRUCKS

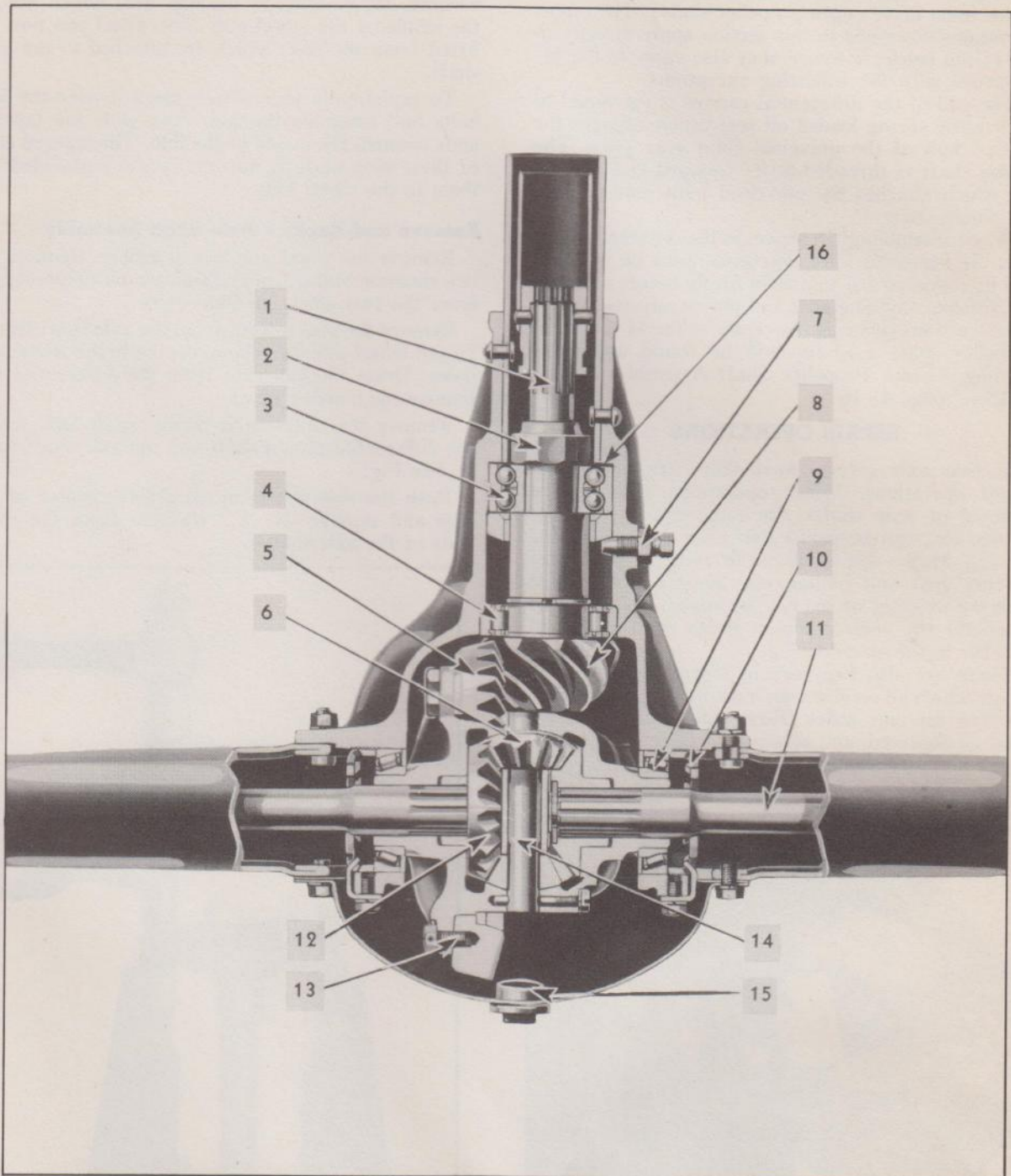


Fig. 1—Rear Axle Assembly 1/2-Ton Truck

- 1—Pinion Shaft
- 2—Pinion Bearing Retaining Nut
- 3—Front Pinion Bearing
- 4—Rear Pinion Bearing
- 5—Ring Gear
- 6—Differential Pinion Gear

- 7—Front Pinion Bearing Retaining Screw
- 8—Drive Pinion
- 9—Differential Side Bearing
- 10—Differential Side Bearing Adjusting Nut

- 11—Axle Shaft
- 12—Differential Side Gear
- 13—Ring Gear Cap Screw
- 14—Differential Pinion Gear Shaft
- 15—Filler Plug
- 16—Shims

The 1/2-ton truck rear axle is of the semi-floating type with Hypoid gears mounted in a one-piece banjo-type housing, Fig. 1.

The 1/2 and 3/4-ton truck rear axles are similar in construction although the 1/2-ton is a torque tube drive (enclosed propeller shaft), while the 3/4-ton is a Hotchkiss drive (open propeller shaft). The repair operations described in this section apply directly to the 1/2-ton truck; however, they also apply to the 3/4-ton truck with the following exceptions.

The end of the differential carrier is machined to receive the spring loaded oil seal which engages the ground hub of the universal joint rear yoke. The pinion shaft is threaded at its forward end for the nut which attaches the universal joint rear yoke to the pinion shaft.

When assembling the pinion to the differential carrier, the universal joint rear yoke must be installed and its retaining nut tightened firmly before attempting to make any ring gear and pinion adjustment.

Instructions covering the repair of the 3/4-ton front propeller shaft assembly will be found under the heading, "Front Propeller Shaft Assembly, 3/4-Ton Trucks," page 4 - 16.

### REPAIR OPERATIONS

In rear axle service work there are minor and major operations. Minor operations such as the removal of axle shafts, the replacement of brake drums, etc., can be performed with the axle under the car. Major operations, such as the replacement of ring gear and pinion, etc., must be performed with the axle out of the car, because it is impossible to obtain the correct pinion depth with the third member in the axle housing.

There are also two very important and essential points which all service men must keep in mind when working on rear axles. First—absolute cleanliness must be observed, and second—factory limits, clearances, and specifications must be maintained.

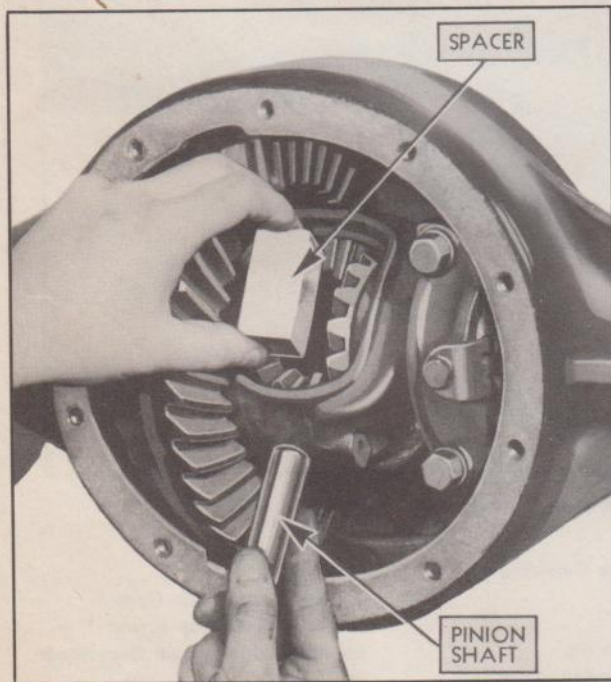


Fig. 2—Removing Axle Shaft Spacer

### MINOR SERVICE OPERATIONS

#### To Remove and Replace Rear Wheel

Remove the hub cap by inserting a screwdriver between the inside edge of the hub cap and the wheel hub flange and turning the screwdriver until the cap becomes loose. Remove the hub nuts which are on the inside of the wheel hub. The wheel can now be lifted from the bolts which are attached to the axle shaft.

To replace the rear wheel, place it over the hub bolts and assemble the hub nuts with the tapered ends towards the inside of the hub. The tapered ends of these nuts must fit into the recesses provided for them in the wheel hub.

#### Remove and Replace Axle Shaft Assembly

Remove the wheel and tire assembly. Remove the two stamped brake drum retaining nuts (Zipon-type) from the two wheel, or hub, bolts.

Remove the brake drum from the axle shaft flange. Install wheel cylinder clamp on the brake wheel cylinder. Drain the lubricant from the differential and remove the housing cover.

Remove the differential pinion shaft lock screw, the differential pinion shaft and the axle shaft spacer. See Fig. 2.

Push the axle shafts in toward the center of the axle and remove the "C" washers from the inner ends of the axle shafts.

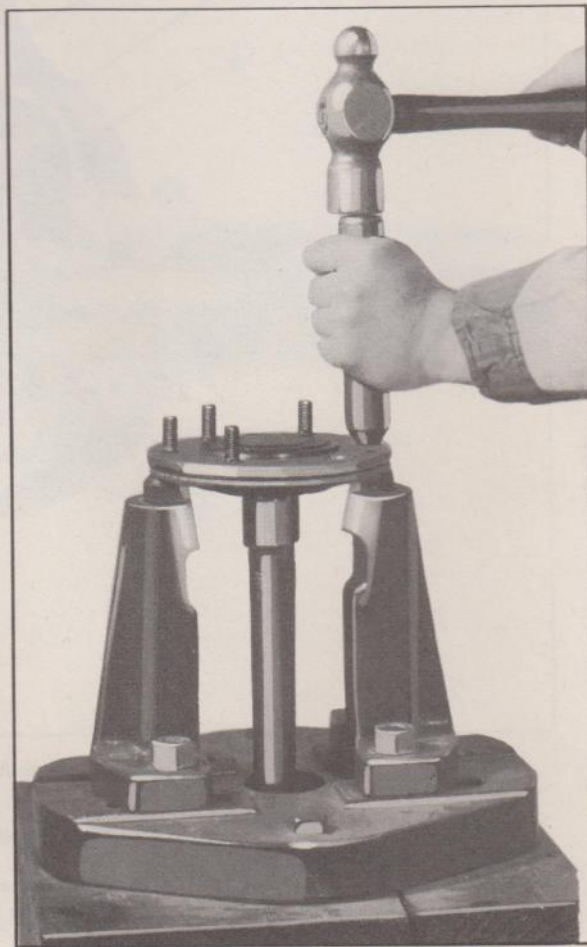


Fig. 3—Use of Peening Tool and Anvil



After this has been done, the axle shafts can be removed from the axle housing.

The wheel hub bolts are special serrated bolts pressed into the holes in the axle shaft flange, thus holding the bolts rigidly in place. These bolts are also used to hold the oil deflector and the gasket to the axle shaft flange.

When installing a new axle shaft, it is necessary to install new bolts, a new oil deflector, and a new gasket. Upon installing new hub bolts, the gasket between the deflector and the flange must be covered with a heavy shellac or paint on both sides to prevent oil leaks. The axle shafts have a hole through the flange which permits excess oil from the axle to drain out of the oil deflector, and keeps it out of the brake drum and brakes. The brake drums and gaskets have an extra hole, the center one of the three that are closest together should be lined up with the notch in the hub flange of the axle shaft. There is an oil pocket in the oil deflector which should also be in line with the notch in the hub.

When the axle shaft flange, the gasket, and the oil deflector are in line as mentioned above, insert the six special bolts and force the heads down to the deflector. The end of the shoulder on the bolts should then be peened into the countersink around the bolt holes in the flange, using the peening tool and anvil, J-554, shown in Fig. 3, thus riveting these parts securely together. It is good practice to turn the peening tool after each blow of the hammer to prevent damage to the tool.

**CAUTION—This peening operation is very important from a safety standpoint.**

It will be noticed that the axle shafts are of different lengths, the longer one being used on the right-hand side.

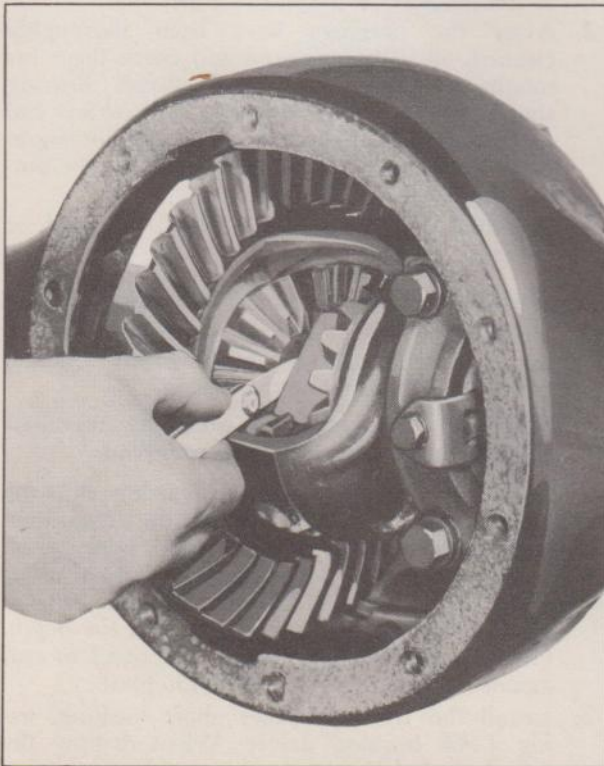


Fig. 4—Checking Clearance Between Axle Shaft and Spacer

Before replacing the axle shafts, examine the leather oil seal on the inside of the axle housing to be sure that it is not worn, damaged or out of place. Slide the axle shaft into place, being careful that the splines on the end of the shaft do not cut the leather oil seal, and that they engage with the splines of the differential gears. Replace the "C" washers on the inner end of the shaft and pry the shaft ends apart carefully (do not scratch or damage inner ends) so that the "C" washers are seated in the counterbore in the differential side gears.

Select the proper axle shaft spacer so that there is from a free fit to .014" clearance between the ends of the axle shafts and the spacer. See Fig. 4.

#### Axle Shaft Spacers

There are three sizes of axle shaft spacers serviced for the 1/2 and all 3/4-ton truck rear axles. The dimensions of these spacers are:

**Narrow—1.1485" Wide Across Ground Surfaces.**  
**Wide** { **1.1575" Wide Across Ground Surfaces.**  
           { **1.1675" Wide Across Ground Surfaces.**

These three dimensions are obtained with the use of only two axle shaft spacers, the 1.1485" spacer being ground on only two sides, while the larger spacer is ground on all four sides to obtain both the 1.1575" and the 1.1675" dimensions.

After the proper clearance is obtained between the axle shafts and the spacer and it is properly installed in its place, assemble the pinion differential shaft and lock it in place with the special screw, using a lockwasher under its head.

Replace the axle housing cover, using a new cork gasket and fill the differential with the proper hypoid gear lubricant.

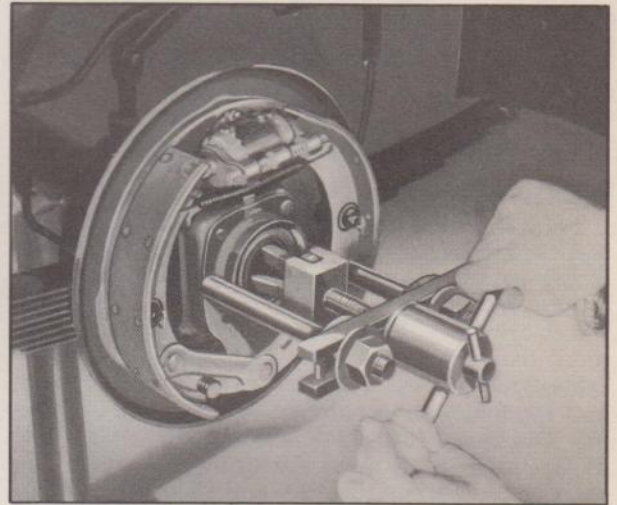


Fig. 5—Axle Shaft Bearing Puller

#### AXLE SHAFT BEARING

##### Disassembly

The wheel end of the axle shaft is mounted in a Hyatt roller bearing which is pressed into the axle housing. To remove this bearing, it is necessary to remove the wheels and axle shafts as previously described and insert the special bearing puller, K-344, shown in Fig. 5. This puller should be assembled into the bearing and the axle housing with the jaws

of the puller in a vertical position so as to keep them away from the welding flash on the inside of the axle housing. This tool not only removes the bearing but the bearing retainer on the inside and the leather oil seal on the outside.

**Reassembly**

To replace a new bearing and leather oil seal in the axle housing, the special driver, K-466-A, shown in Fig. 6, can be used to locate the bearing in its correct position.

With the bearing and inside bearing retainer and the outside leather oil seal assembled to the end of the driver, start the bearing into the axle housing. A few light blows with a hammer on the end of the tool will seat the bearing in its correct position, as well as the retainer and the oil seal. After the tool has been removed, the oil seal should be staked in place with a prick punch.

Assemble the axle shafts and wheels as previously described.

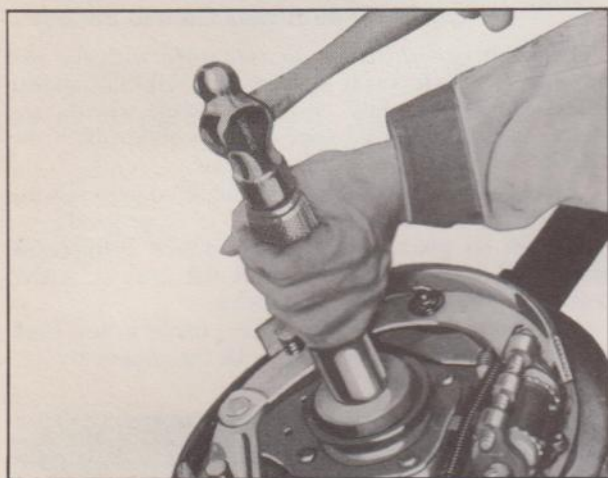


Fig. 6—Axle Shaft Bearing and Retainer Replacer

**MAJOR SERVICE OPERATIONS**

**Removing Rear Axle Assembly**

Raise the truck from the floor by the use of jacks and car horses, or by the use of a chain hoist and a lifting device. Remove both rear wheels and brake drums. Install wheel cylinder clamps on the brake wheel cylinders. Disconnect the hand brake cables from the brake pull rods, and remove the brake cables from the cable clamps on the frame. Disconnect the hydraulic connection at the rear axle housing. Disconnect the shock absorber "I" bolts from the spring seats. Remove the spring "U" bolts; disconnect the spring shackles and drop the springs. Slide the axle back to disconnect the torque tube at the front end. The axle is now free and can be moved to the axle stand.

During the disassembly operations, all adjustments should be closely checked. This inspection will be of material assistance in making the necessary repairs to insure a satisfactory job.

1. Check the clearance between the spacer and the end of the axle shafts.
2. Check ring gear and pinion back lash.
3. Check pinion depth in ring gear.

4. Check for ring gear being loose on the differential case.
5. Check and make sure the propeller shaft and pinion assembly rolls free in its bearings.
6. Check for looseness at the front propeller shaft bushing.

The axle shafts are removed as previously described and the third member is removed by the removal of the nuts which hold it to the axle housing. The differential assembly may be removed by taking out the two adjusting nut locks, the four differential carrier cap screws and removing the bearing caps and adjusting nuts.

The pinion and propeller shaft assembly can then be removed from the third member by removing the three tapered bearing retaining screws on the side of the carrier and letting it drop so that the spline end of the propeller shaft will strike on a wooden block or wooden floor and the pinion shaft will slide out. Remove the shims from the inside of the propeller shaft housing.

After the axle has been disassembled, all of the parts removed should be washed in cleaning solvent to insure absolute cleanliness.

**Propeller Shaft Housing—1/2-Ton Truck**

It is good practice when the propeller shaft is being removed from the propeller shaft housing, to check to see that there is not too much clearance between the propeller shaft and its bushing. If this clearance exceeds .010", the bushing should be replaced.

**Propeller Shaft and Pinion Assembly**

1. Inspect the splines for excessive wear or looseness in the universal joint; also inspect the shaft at the propeller shaft bushing location.
2. After the bearings have been thoroughly cleaned, oil with engine oil and check them for roughness. The double row thrust bearing should be checked for end play, because any end play in this bearing will allow the pinion to work back and forth, thereby changing the pinion depth in the ring gear.
3. Examine the pinion for cracked, chipped or scored teeth.

**Propeller Shaft Bushing and Oil Seal Replacement**

1. Drill out the dowel pins which retain the bushings and drive out both bushings and oil seal from the pinion end of the housing.

**NOTE—A new oil seal must be installed whenever the bushings are removed.**

2. Start a new oil seal into the housing with the free side of the leather towards the front, then install a new rear bushing, driving both the oil seal and bushing firmly against their seat, using J-968 bushing driver. Drill the dowel hole in the bushing, being careful to control the depth. Coat the dowel with sealing compound to seal against leakage. Peen the dowel in place.
3. Install the front propeller shaft bushing, using J-968 bushing driver. When drilling the dowel pin hole in this bushing, great care must be exercised not to break through the wall of

the bushing. Due to the thin wall of this bushing, an arbor of the right size or a universal joint rear yoke should be used to prevent distortion while peening the dowel pin.

4. Any burrs that may have been set up during the peening operation should be dressed down with a fine cut mill file.

**Propeller Shaft and Pinion Disassembly**

The following covers the operations necessary when replacing the propeller shaft, pinion or the pinion bearings:

1. To disassemble the pinion from the propeller shaft, first drill the end of the rivet to clear the countersink into which it is upset, being careful to properly center the rivet with a center punch. Then drive out the rivet.
2. Loosen the pinion bearing lock nut and then disassemble the pinion from the propeller shaft.
3. Remove the front pinion bearing lock nut and press the bearing from the pinion, using J-996 pinion bearing remover.
4. Remove the rear pinion bearing lock ring and remove the bearing.

**Reassembly**

1. Install the rear Hyatt roller pinion bearing on the pinion shaft and install the lock ring in its groove in the shaft. Then thread the pinion front bearing oil retainer over the shaft with the bevel of the large diameter of the retainer toward the pinion.
2. Install the lock sleeve with its beveled side towards the pinion. Press the front (double row) bearing on the pinion shaft and install the bearing lock nut.

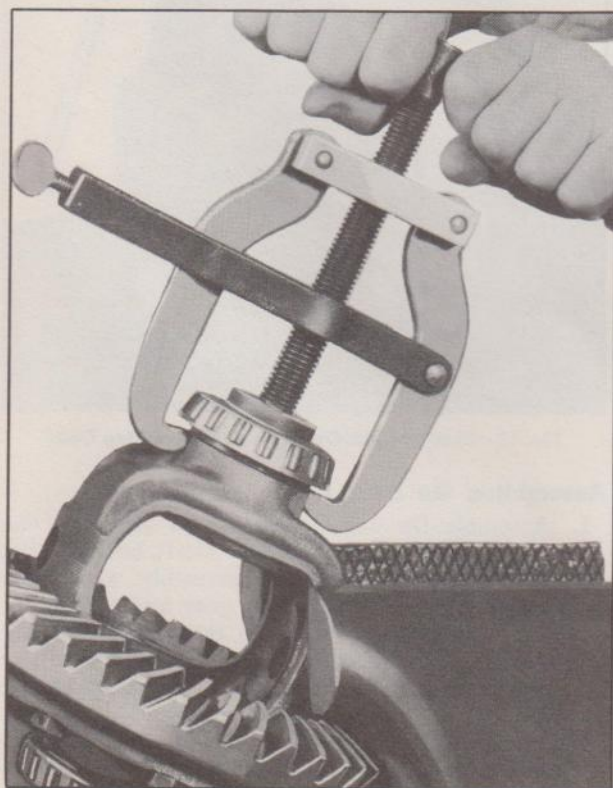


Fig. 7—Removing Differential Bearings

3. The pinion assembly may now be assembled to the propeller shaft by pressing the splined end into the coupling on the end of the propeller shaft so that the rivet hole in the pinion shaft lines up with the hole in the propeller shaft. Insert a new rivet in this hole and rivet over both ends.
4. Tighten the bearing lock nut and lock it in the milled slot in the pinion shaft.

**Front Propeller Shaft—3/4-Ton Truck**

Instructions covering the repair of the 3/4-ton front propeller shaft will be found on page 4 - 17 in this section.

**Differential Assembly**

1. Examine both differential side gear bearing surfaces in the differential case; also the thrust surfaces for the differential pinion gears.
2. Check both differential side bearings for roughness after they have been thoroughly cleaned and oiled.
3. Check each ring gear bolt to make sure they are all tight.
4. Inspect the differential side gears for scored hubs or thrust surfaces. Examine the internal splines and check their fit on an axle shaft.
5. Inspect the thrust surfaces on the differential pinion gears and check their fit on the pinion shaft.  
Any worn or damaged parts should be replaced.

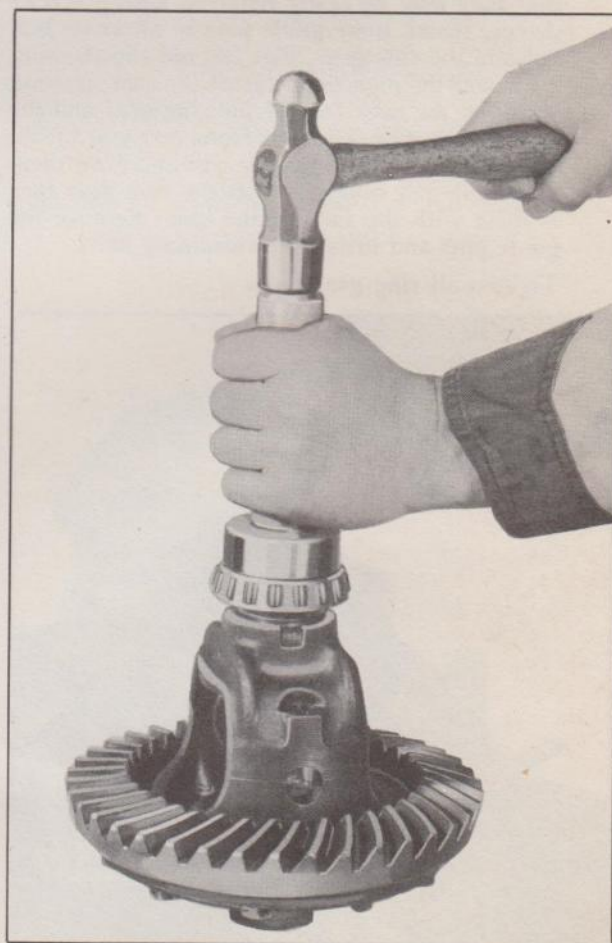


Fig. 8—Replacing Differential Bearings

**Differential Bearing Replacement**

The differential side bearings are a press fit on the hubs on each side of the differential case. These bearings must be removed and replaced as follows:

1. The legs of differential bearing puller, TR-278-R, should be fitted into the two notches in the case and the clamp screw tightened. Turning the puller screw will remove the bearing without damage to either the bearings or the case, Fig. 7.
2. After the bearings have been removed, they should be thoroughly cleaned, oiled and then checked for roughness.
3. To replace the differential side bearings, place them on the hubs with the thick side of the inner race towards the case and drive them in place with J-994 differential side bearing replacer, Fig. 8.

**Ring Gear Replacement**

1. Remove the bolts. The ring gear may then be tapped off the case with a soft-faced hammer.
2. Place the differential case in the "V" blocks of the checking fixture U-4 and indicate the run-out of both the ring gear pilot and the case flange, Fig. 9. Neither of these run-outs should exceed .001".
3. When replacing the ring gear, it is good practice to use five guide pins made by cutting the heads from  $\frac{3}{8}$ "—24 cap screws about  $1\frac{1}{2}$ " long. Slots should be cut in the heads of these guide pins so that they may be easily removed with a screwdriver. Install these guide pins in alternate bolt holes in the ring gear, Fig. 10, and slip the ring gear over the pilot diameter of the case, making sure that the back face of the ring gear and the face of the case are free from dirt and burrs. Install every other ring gear bolt and draw them up evenly and snugly so that the ring gear face is flush with the face of the case. Remove the guide pins and install the remaining bolts.

Tighten all ring gear bolts.



Fig. 9—Checking Run-Out of Differential Case

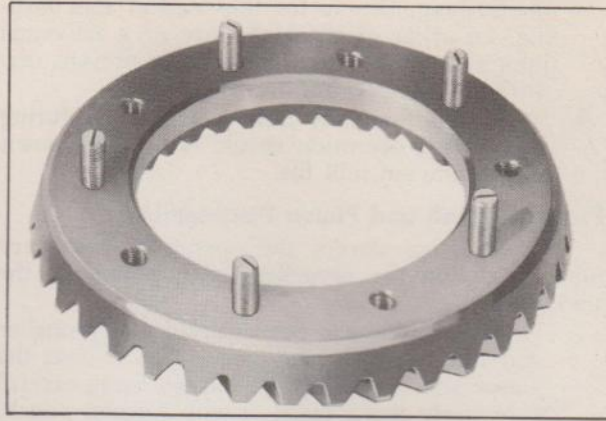


Fig. 10—Use of Guide Pins in Ring Gear

**NOTE**—New lockwashers should be used under the head of each bolt.

With the assembly mounted in "V" blocks, check the run-out of the back face of the ring gear with a dial indicator, Fig. 11. This run-out must not exceed .004".

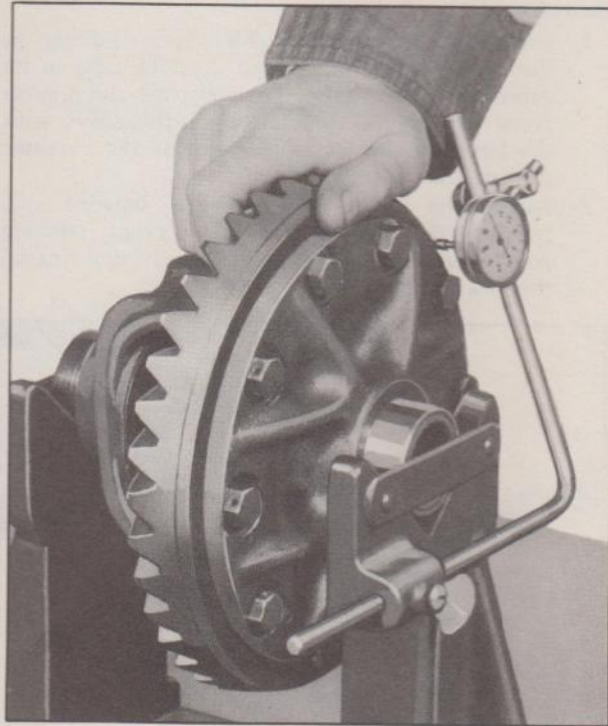


Fig. 11—Checking Run-Out of Back Face of Ring Gear

**Assembling the Rear Axle**

1. Assemble the same thickness of shims in the counterbore of the propeller shaft housing that were removed when the assembly was taken down (if the original ring gear and pinion are to be used), making sure that the shims are flat in the counterbore and are not cocked. The total thickness of the shims will be found to be from .030" to .036" and usually .033". Shims are serviced in thicknesses of .012", .015", .018", and .021" so that a combination of shims may be selected to replace the original ones if they are damaged.

**NOTE**—Whenever a new ring gear and pinion is installed, one .015" shim and one .018" shim should be used as this is the standard setup.

2. Assemble the propeller shaft assembly, driving it down until the bearings are seated in the housing. Drive by using a drift in the  $\frac{7}{8}$ " hole in the pinion, and NOT on the pinion teeth.
3. Check through the bearing lock screw holes to make sure that the lock sleeve is in the correct position up against the back of the front pinion bearing. Install the three tapered lock screws and draw them down evenly and tightly. Tighten the lock screw lock nuts.

**Ring Gear and Pinion Adjustment**

1. Install the differential case assembly in the carrier and then install the adjusting nuts, taking care to slide these nuts alongside the bearings so that the threads on the nuts fit into the threads of the differential carrier. Install the bearing caps, making sure that the marks on the caps line up with the marks on the carrier. Tighten the cap screws until the lockwashers just flatten out.

**NOTE**—This adjustment should be made only with the third member assembly out of the rear axle housing.

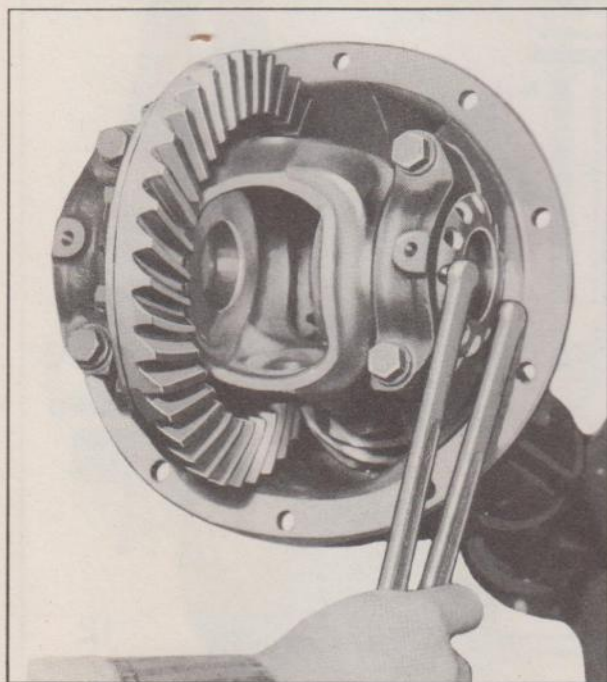


Fig. 12—Adjusting Ring Gear and Pinion Back Lash

2. Loosen the right-hand adjusting nut and tighten the left-hand adjusting nut, using differential adjusting wrench J-972, while at the same time turning the ring gear. Continue tightening the left-hand nut until all lash is removed, then back off the left-hand nut one notch.
3. Tighten the right-hand adjusting nut snugly (this position may easily be determined as the nut comes to a definite stop). Then tighten the

right-hand nut from a minimum of one to a maximum of two notches more, to a locking position, Fig. 12.

4. Mount a dial gauge on the carrier and check the back lash between the ring gear and pinion, Fig. 13; this should be from .005" to .007". If the back lash is more than the above, loosen the right-hand adjusting nut one notch and tighten the left-hand adjusting nut one notch. If the back lash is less than above, loosen the left-hand adjusting nut one notch and tighten the right-hand nut one notch.
5. Tighten the bearing cap bolts securely, then recheck the back lash. Install both adjusting nut locks.
6. Assemble the third member assembly to the axle housing, using a new gasket. Lubricate the hubs of the differential side gears with hypoid gear lubricant and install them in the differential case.
7. Install the axle shafts, making sure that the longer shaft is used on the right-hand side, and install the "C" shaped axle shaft locks. Spread the ends of the axle shafts to make sure that

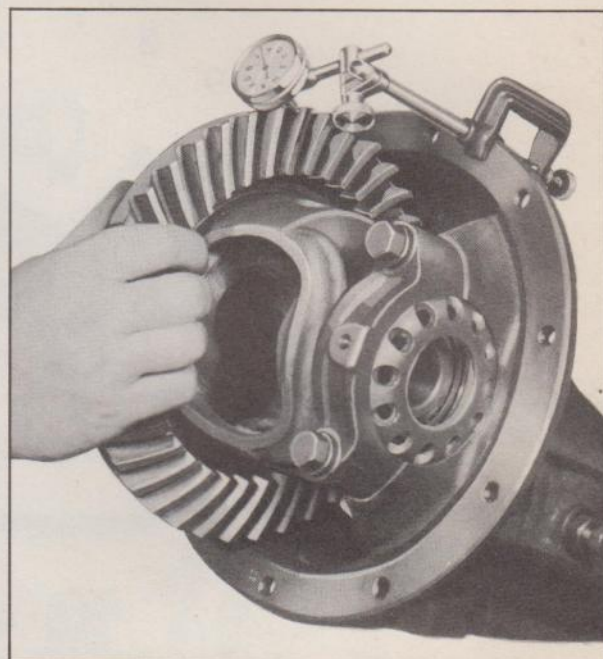


Fig. 13—Checking Ring Gear and Pinion Back Lash

the shafts, locks and differential side gears are in positive contact. Roll the two differential pinions into place and install the axle shaft spacer, pinion gear shaft and lock screw. Check the clearance between the end of the axle shaft and spacer—this should be from a free fit to .014". See Fig. 4.

8. Install the inspection cover, using a new cork gasket and fill the differential with 3½ pints of the proper hypoid lubricant.

**To Replace the Rear Axle Assembly**

Reverse the operation shown under the removal of the rear axle. Care should be taken to see that

all cotter pins are assembled and securely bent over. The "U" bolts holding the springs to the spring seats must be drawn up securely.

When connecting the brake cables, make sure that all of the play is out of the cables before installing the clevis pin.

After replacement of the rear axle, it will be

necessary to bleed the brake lines at ALL FOUR WHEELS, as described in the "Brake Section" of this Manual.

Lubricate the universal joint through the battery ground cable bolt hole at the rear of transmission case. This provides initial lubrication for the universal joint and propeller shaft bushings.

**REAR AXLE ASSEMBLY**  
**1½-TON TRUCKS**

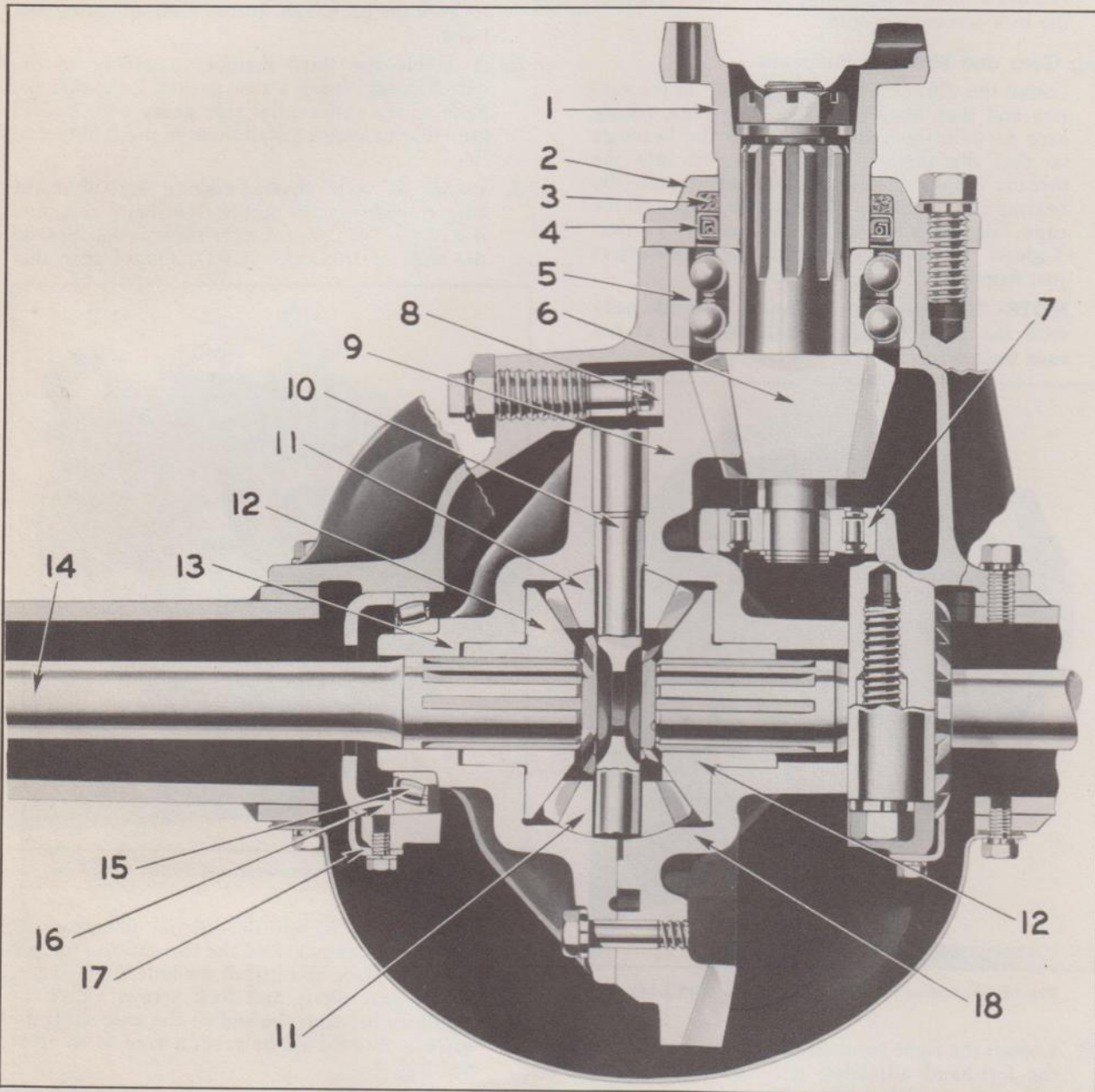


Fig. 14—1½-Ton Truck Rear Axle

- |  |                        |                                      |                                       |
|--|------------------------|--------------------------------------|---------------------------------------|
| 1—Universal Joint Yoke                 | 6—Drive Pinion         | 11—Differential Pinion (Spider) Gear | 16—Differential Bearing Adjusting Nut |
| 2—Pinion Bearing Retainer and Oil Seal | 7—Rear Pinion Bearing  | 12—Differential Side Gear            | 17—Adjusting Nut Lock                 |
| 3—Oil Seal Packing                     | 8—Ring Gear Thrust Pad | 13—Differential Case—Left Half       | 18—Differential Case—Right Half       |
| 4—Oil Seal                             | 9—Ring Gear            | 14—Axle Shaft                        |                                       |
| 5—Front Pinion Bearing                 | 10—Differential Spider | 15—Differential Bearing              |                                       |

**Construction**

The full-floating type rear axle used on 1½-ton trucks is so constructed that the axle shafts can be removed without removing the truck load or jacking up the rear axle. This axle is equipped with a hypoid ring gear and pinion, Fig. 14.

The differential bearing caps are piloted to the carrier by sleeve dowels, preventing any possibility of the bearing caps shifting.

The differential case is a two-piece case with the ring gear piloted to the right side. The case halves and the ring gear are bolted together with ½" bolts. This permits ring gear replacement without changing the differential case. The differential bearings are of Hyatt barrel roller type.

The front pinion bearing is a large double row ball bearing, and the rear pinion bearing is a large Hyatt roller bearing. A spring-loaded rawhide oil seal is used at the rear of the universal joint yoke.

The axle shaft to wheel hub gasket is made of soft sheet aluminum to reduce the load on the bolts. A lock plate is used to lock these bolts.

**Identification of Rear Axles**

The 6.16 to 1 rear axle ratio may be identified by the serial number stamped on the top right-hand side of the housing being prefixed by the letters "BR" or "BS."

The 5.43 to 1 ratio rear axle may be identified by the letters "BT" prefixed to the serial number.

**MINOR SERVICE OPERATIONS**

**Axle Shaft Removal**

1. With a cold chisel and hammer, bend the lugs of the lock plate away from the bolt heads.
2. Remove the eight ½" cap screws and lock plate.
3. Install two 7/16"—14 cap screws in the threaded holes provided in the axle shaft flange. Turning these cap screws alternately, the axle shaft may easily be removed. Remove the axle shaft and aluminum gasket, Fig. 15.

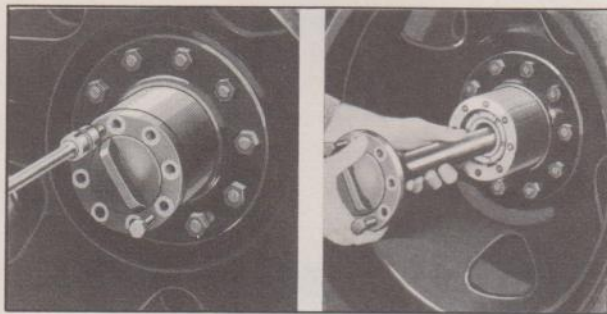


Fig. 15—Loosening and Removing Axle Shaft

**Axle Shaft Replacement**

Place a new aluminum axle shaft flange gasket on the axle shaft and push the shaft into the housing. Use a new lock plate at the axle shaft cap screws and insert the eight cap screws in the axle shaft flange, tightening them alternately and make sure they are all pulled up tight. Then bend the tangs of the lock plate against the heads of the cap screws.

**Removal of Rear Wheel Bearings**

1. Jack up the rear axle and remove the wheel and axle shaft.

**NOTE—Removal of the wheel is important; it prevents damage to the oil seal and permits more accurate adjustment of the bearings.**

2. Raise the lip of the special lock from the notch in the lock nut. Remove lock nut with special wrench J-870, and remove the lock, inner adjusting nut, and thrust washer.



Fig. 16—Removing Inner Bearing and Oil Seal

3. Remove the hub and drum assembly.
4. Install brake wheel cylinder clamp to prevent the brake fluid from leaking should the brake pedal be accidentally depressed.
5. To remove the inner bearing and oil seal, use puller J-918-A.

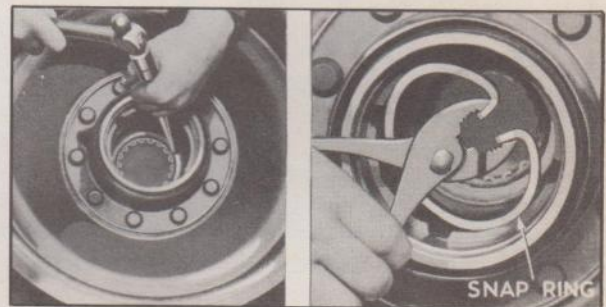


Fig. 17—Removing Outer Bearing Snap Ring

The puller is installed by tilting the plate with the chain attached, so that it may be slipped through the bearing and engage the outer race of the bearing. The plate is then held in this position by the chain while threading the puller shaft into the tapped hole. The puller body is then located against the housing and the bearing assembly and oil seal are removed by turning the puller handle, Fig. 16.

6. To remove the outer bearing, first tap the outer race to relieve the tension at the snap ring; then remove the snap ring on the inside of the hub, Fig. 17. Remove the bearing by driving on the

outer race of the bearing by using a long  $\frac{1}{8}$ " punch through the cap screw holes in the end of the hub. This will also bring out the inner race and roller assembly.

**NOTE**—Care must be taken to engage the edge of the race with the punch and not damage the bearing seat in the housing; the race must also be driven out evenly.

### Replacement of Rear Wheel Bearings

1. Check the fit of the inner races on housing; these races should be free to turn, but not loose.
2. Wash the bearings in cleaning solvent and pack the roller assemblies with Marfak lubricant or its equivalent, using No. 2 in Summer and No. 1 in Winter.
3. To replace the outer bearing, place the inner-race-and-roller assembly and the outer race in the wheel hub with the thin edge of the outer race downward. Use outer wheel bearing replacer, J-872-1, to press the bearing in the hub.



Fig. 18—Driving Outer Race into Contact with Snap Ring

**CAUTION**—Press the race only far enough to install the snap ring; this operation should be done in an arbor press.

Install the snap ring in the groove on the inside of the hub. Use special driver J-872-3 through the cap screw holes in the end of the hub to force the outer race back in positive contact with the snap ring, Fig. 18.

4. To replace the inner bearing, place outer race of the bearing in the wheel hub with the wide side of the race down. Use special driver J-872-4 to press the race against its seat. Install the inner race and roller assembly. Install the oil seal, using the wheel bearing oil seal replacer J-872-2, with an arbor press. Lock the seal in

place by prick punching at three equally spaced places.

5. Install the wheel hub and drum assembly, turning the hub to properly line up the bearings.
6. Install the thrust washer and adjusting nut, Fig. 19.

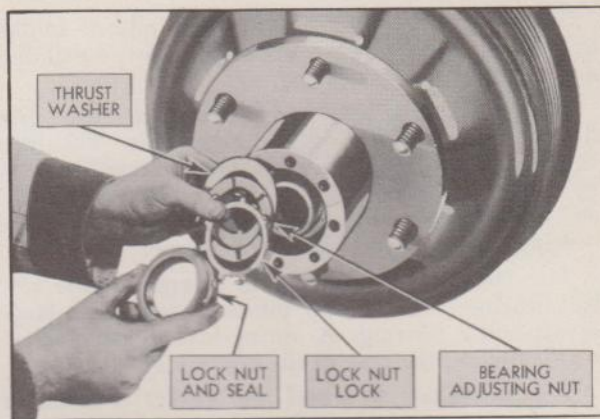


Fig. 19—Installing Thrust Washer, Adjusting Nut, Lock Nut and Lock Nut Lock

### Adjustment of Rear Wheel Bearings

1. Using special wrench J-870, tighten the adjusting nut tight, then back it off 45 degrees. Turn the wheel hub by hand to make sure the hub turns freely.
2. Install the adjusting nut lock and check the alignment of the tangs with the slots in the nut.
3. Rotate the hub by hand, grasping the hub at the wheel bolts, to see that the bearings are properly seated and that the hub turns freely.
4. Bend the tang on the lock down into the notch of the adjusting nut. Install the outer lock nut and pull up tight to prevent any loosening of the adjusting nut. Bend the tang of the lock into the notch of the lock nut.
5. Install the axle shaft, and a new aluminum gasket.
6. Install the lock plate.
7. Install the axle shaft bolts and tighten securely.

### Replacement of Oil Slinger

The location of the oil slinger requires that it be driven on the rear axle housing. If for any reason



Fig. 20—Oil Slinger Replacer



the oil slinger is removed, it must be replaced with a new one.

A special tool is necessary for this purpose because the slinger must be located with relation to the bearings. The oil slinger replacer J-973 is designed so it will pilot on the housing and drive the slinger into proper position so it will mate with the oil slinger in the wheel hub, Fig. 20.

**MAJOR SERVICE OPERATIONS**

**Differential Carrier Removal**

To remove the differential carrier or third member from the truck, proceed as follows:



Fig. 21—Removing Rear Universal Joint "U" Bolts

1. Drain lubricant from differential, remove differential cover and axle shafts.
2. Split the rear universal joint by removing the two trunnion bearing "U" bolts from the rear yoke as shown in Fig. 21. The bearings can be left on the trunnion and held in place with tape. This will prevent dirt getting into the bearings as well as saving considerable time in reassembly. Sufficient clearance can be obtained for dropping the propeller shaft by sliding the entire assembly forward on the splines of the propeller shaft.
3. Remove the bolts and lockwashers which retain the differential carrier assembly to the axle housing and remove the differential carrier.

**Disassembly**

1. Mount the assembly in a bench vise and remove the ring gear thrust pad. Remove differential adjusting nut locks. Remove the bearing cap bolts and lockwashers. The bearing caps may now be removed. Then remove the differential case and ring gear assembly from the carrier.
2. Remove the bolts from the pinion bearing retainer and oil seal, remove the pinion and shaft assembly from the carrier.

**Pinion Disassembly**

1. Clamp the rear yoke of the universal joint in a bench vise and remove the cotter pin, nut and

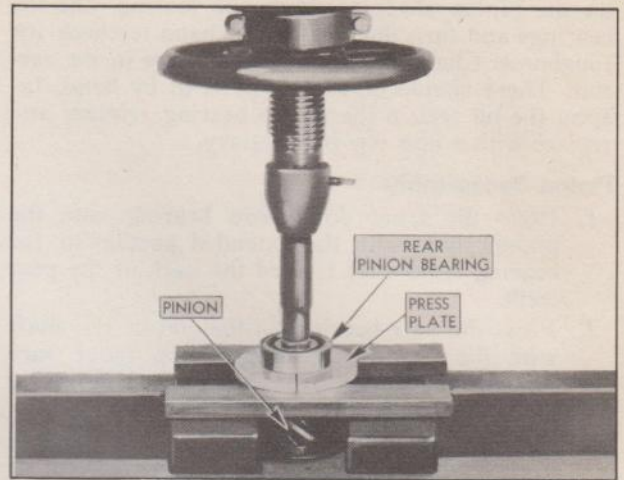


Fig. 22—Removing Rear Pinion Bearing

washer from the end of the pinion shaft.

The universal joint as well as the bearing retainer and oil seal may then be removed from the pinion shaft.

2. To remove the rear pinion bearing, take off the lock ring and then, using a special press plate, J-1453, press the pinion and shaft out of the bearing, Fig. 22.

**NOTE**—The raised portion of the press plate must be against the inner race otherwise the bearing will be damaged.

3. Install the front pinion bearing remover J-1439 for 6-tooth pinions, J-1440 for 7-tooth pinions, over the pinion teeth and against the inner race of the double row bearing. Then press the bearing off the pinion shaft, Fig. 23.

**Inspection**

Wash all parts in cleaning solvent. Inspect the pinion for worn or chipped teeth. Inspect the splines

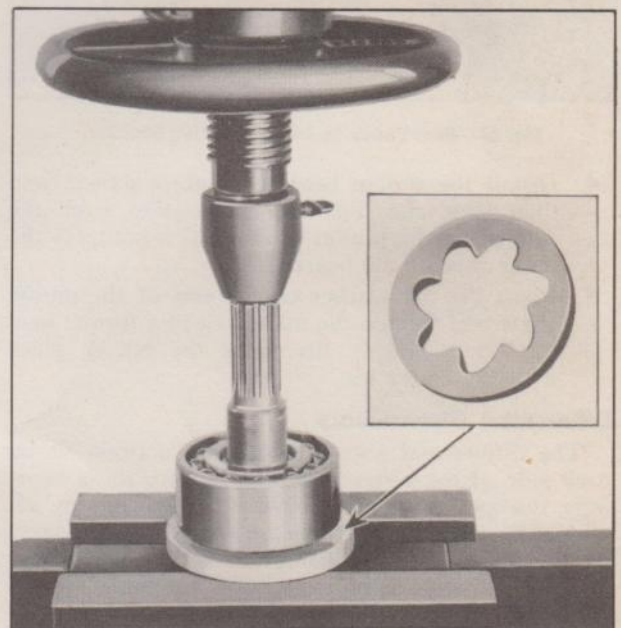


Fig. 23—Removing Front Pinion Bearing

on the pinion shaft for wear or scoring. Oil the bearings and turn them slowly by hand to check for roughness. Check the fit of the bearings in the carrier. These should be a close push fit by hand. Inspect the oil seal in the pinion bearing retainer and replace with a new one if necessary.

**Pinion Reassembly**

1. Press the front double-row bearing onto the pinion shaft with the extended portion of the bearing inner race toward the back of the gear teeth.
2. Press the rear bearing on the end of the shaft with the chamfered side of the inner race towards the pinion. Install the lock ring, using the lock ring installer J-1364, Fig. 24.
3. Slide the pinion bearing retainer and oil seal over the universal joint yoke. If replacement of the oil seal is necessary, install the felt packing toward the bottom of the recess and then the oil seal with the open end of the leather toward the pinion bearing. The oil seal should be pressed down against the felt packing, see Fig. 14.

**NOTE**—Soak a new leather oil seal in light engine oil for at least one hour before installing.

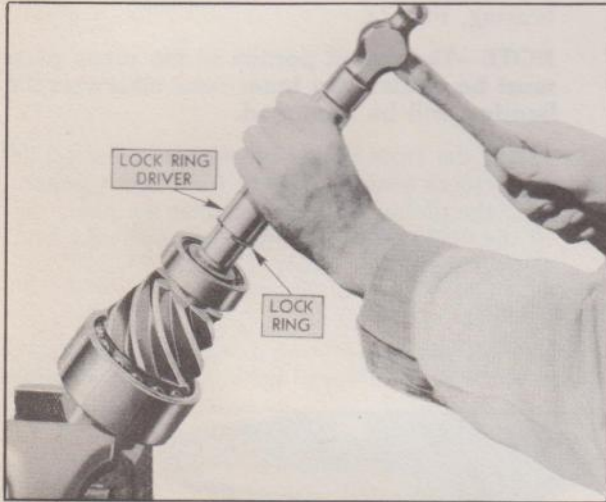


Fig. 24—Rear Pinion Bearing Lock Ring Installer

4. Install the pinion bearing retainer gasket and then slide the universal joint yoke over the splines on the pinion shaft until it contacts the inner race of the bearing.
5. Place the flat washer on the end of the pinion shaft and tighten the nut down to a torque load of 160 to 280 ft. lbs. Lock the nut in place with the cotter pin.

**Differential Disassembly**

The differential side bearings are a press fit on each side of the differential. To remove these bearings, the special puller TR-278-R, shown in Fig. 25, should be assembled to the case with the two fingers of the puller in the two notches of the case. This allows the fingers to pull in against the inner race of the bearing which will prevent damage to the bearing. These bearings should never be removed in an

arbor press because removing them in this way will damage the bearings so that they will be unusable.

After the bearings have been removed, they should be washed in cleaning solvent and blown out with clean air. They should then be oiled and rotated by hand, to check for roughness.

To disassemble the differential, check and make sure the case halves are marked (Fig. 26) so it may be assembled in the same position. Remove the twelve 1/2" bolts from the case. Lift off the case cover and remove the differential gears and pinions.

The ring gear may be removed from the right-hand side of the case by tapping it with a soft-faced hammer.



Fig. 25—Differential Bearing Puller

**Inspection**

Wash all parts thoroughly in cleaning solvent. Check all gears for chipped, cracked or scored teeth. Inspect the differential side gear and pinion thrust surfaces in the housing halves for wear or score marks. Check the fit of the side gear hubs in the differential case halves. The fit of the pinions should be checked on the spider. The differential side bearings should be carefully inspected for worn, checked, scored or broken rollers. They should then be oiled and rotated by hand to check for roughness.

Any damaged or worn parts should be replaced.

**NOTE**—If any one of the differential gears are damaged or scored all should be replaced.

**Reassembly**

When reassembling the differential, the flanges of the case, ring gear pilot and the back of the ring gear must be clean and free from burrs.

When replacing the ring gear, it is good practice to use two guide pins made from differential and ring gear screw, part No. 3652253. Their ends should be slightly tapered and screwdriver slots cut so they may be easily removed, Fig. 27.

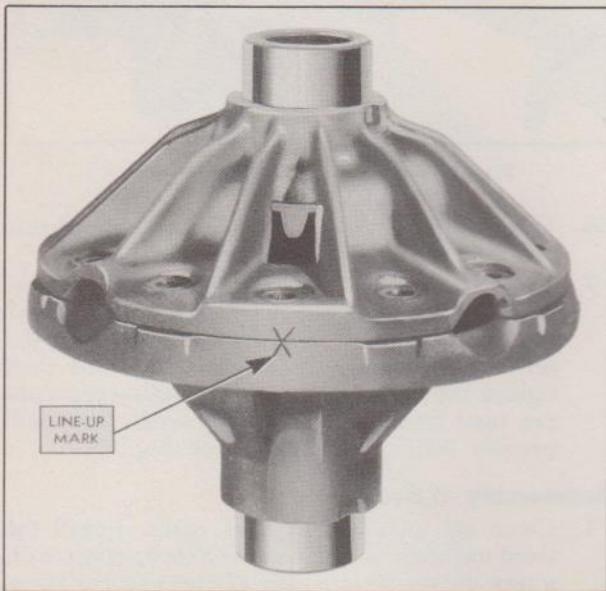


Fig. 26—Differential Case Marks

1. Lubricate the differential side gears and pinions and install them in the left half of the differential case.
2. Assemble the right side of the case to the left side, being sure to line up the marks on the case halves, Fig. 26.

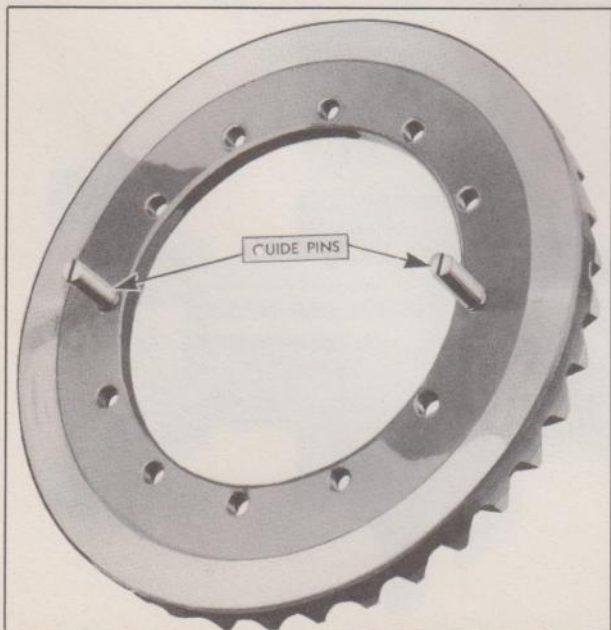


Fig. 27—Guide Pins in Ring Gear

3. Install the guide pins. Slip the ring gear over the pilot diameter of the right-hand half of the differential case.
4. Install ten differential to ring gear cap screws and lockwashers, tightening them evenly one turn at a time until the ring gear face is flush with the case flange. Remove the guide pins and install the two remaining bolts and lockwashers. Then pull up all twelve bolts *tight*.
5. Assemble the differential side bearings to the case, using the special driver, J-1488.

**NOTE**—The wide side of the inner race must be towards the case.

**Differential Carrier Reassembly**

1. Place the differential carrier in a vise and install the bearing cap dowels in the carrier or in the bearing caps.
2. Assemble pinion assembly to the carrier using new gaskets and tighten the pinion bearing retainer bolts securely.
3. Install the differential assembly in the carrier. Install the bearing caps, making sure the marks on the caps line up with marks in the carrier. Install the cap screws and tighten them until the lockwashers just flatten out. Screw the adjusting nuts into the carrier, making sure they turn freely. Tighten them snugly to straighten up bearing outer races.



Fig. 28—Adjusting Ring Gear and Pinion Back Lash

4. Back off the right-hand adjusting nut and tighten left-hand adjusting nut, using wrench J-972, just to a point where all lash between the ring gear and pinion is removed. Then back off the left-hand nut approximately two notches and to locking position. Tighten right-hand nut to solid

position. Back off right-hand nut free of bearing, then tighten up right-hand nut until all play in bearing is removed and then one to two notches more to a locking position, Fig. 28.

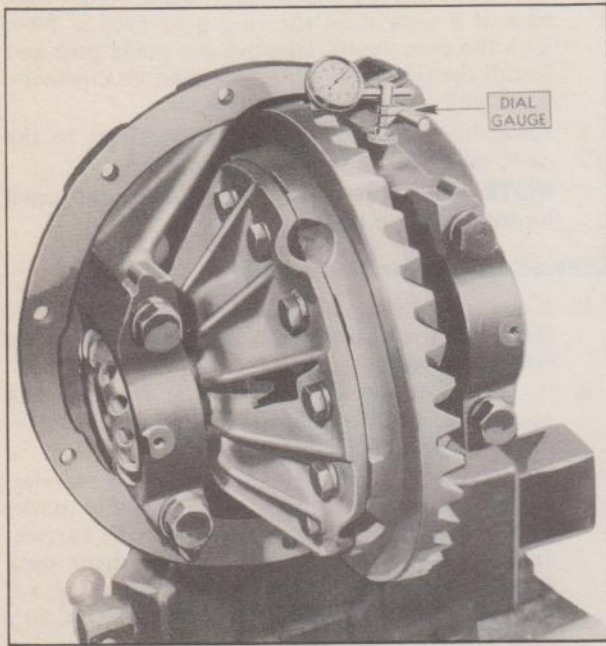


Fig. 29—Checking Ring Gear and Pinion Back Lash

5. Check ring gear and pinion back lash. This should be from .005"-.008". If it is more than .008", loosen the right-hand adjusting nut one notch and tighten left-hand nut one notch. If less than .005", loosen the left-hand nut one notch and tighten the right-hand nut one notch. Tighten down the cap screws and recheck the ring gear and pinion back lash with a dial gauge as shown in Fig. 29. Assemble and tighten the adjusting nut locks.

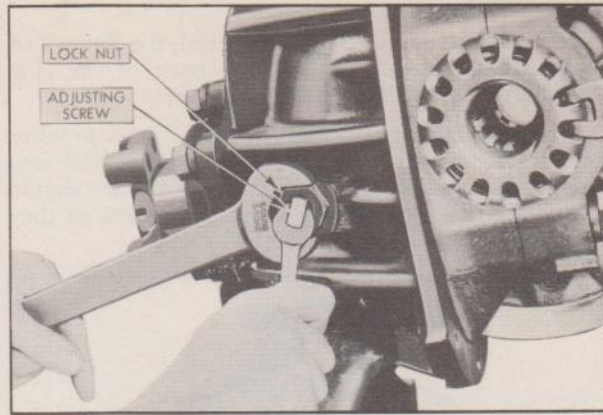


Fig. 30—Ring Gear Thrust Pad Adjustment

6. Examine the bronze tip of the ring gear thrust pad and, if worn, install a new one.
7. Install the thrust pad and tighten the screw until the bronze tip lightly engages the back of the ring gear while rotating gear. Back off the screw one-twelfth ( $1/12$ ) of a turn and then tighten the lock nut, making sure the screw does not turn during the locking process. This will provide .005" to .007" clearance, Fig. 30.

**Reassembly of Rear Axle**

1. Clean out axle housing and cover. Install the third member assembly in the axle housing, with a new gasket between the carrier and the housing. Install the cap screws and tighten them securely.
2. Assemble the axle shafts, using a new aluminum gasket between the axle shaft flange and wheel hub. Install the bolts through a new locking plate and pull them down tight. Lock the bolts by bending the tangs on the locking plate firmly against each bolt head.
3. Assemble the rear universal joint.

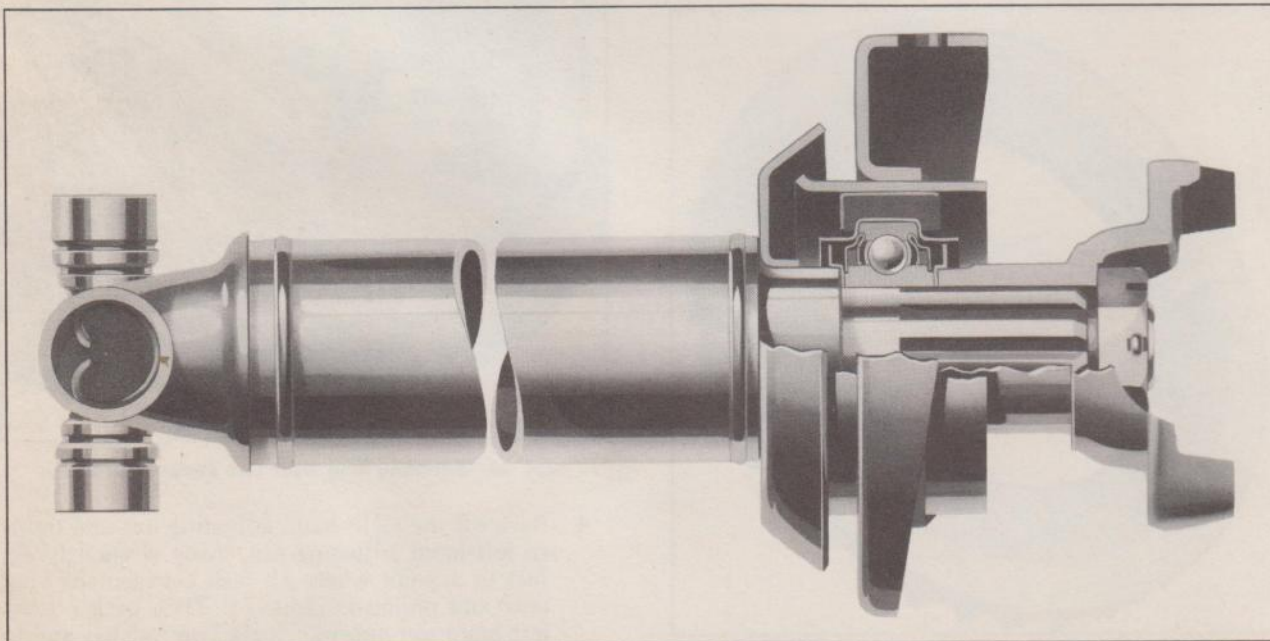


Fig. 31—1 1/2 Ton Front Propeller Shaft

4. Replace the axle housing cover and gasket.
5. Fill the rear axle with eleven (11) pints of lubricant of the type recommended in the Lubrication Section.

**PROPELLER SHAFTS**

**1½ Ton Trucks**

The drive line from the transmission to the rear axle comprises two tubular propeller shafts and three needle bearing universal joints. On the front propeller shaft the rear yoke of the front universal joint is an integral part of the propeller shaft. The rear end of this shaft is machined to receive the support bearing, and it is also splined and threaded to mount the front yoke of the intermediate universal joint, Fig. 31.

The support bearing is mounted in the support bracket by means of a rubber cushion which fits over the outer race of the bearing and inside a sleeve in the support bracket. This bearing is of the permanently lubricated and sealed type.

On the rear propeller shaft the front yoke of the rear universal joint is an integral part of the propeller shaft. The front end of this shaft is splined to fit the splines in the rear yoke of the intermediate universal joint.

**UNIVERSAL JOINTS**

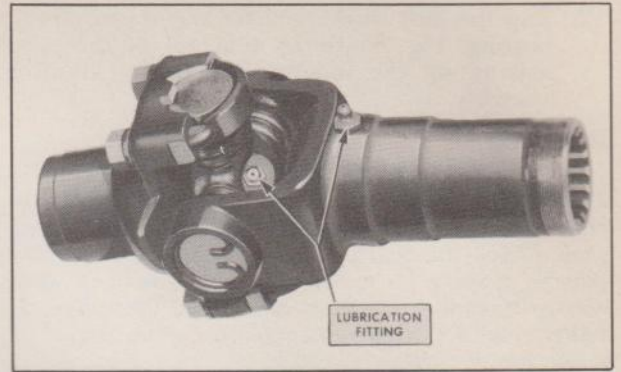
All three universal joints are of the needle bearing type. The front and rear yoke of each universal is machined to receive the trunnion bearings. The bearings are anchored to the front yokes of the front and intermediate universals and the rear yoke of the rear universal by "U" clamps. The bearings in the rear yokes of the front and intermediate universals and the front yoke of the rear universal are pressed into the yokes and locked by snap rings. The front yoke of the front universal is splined to the transmission main shaft, and the rear yoke of the rear universal is splined to the rear axle drive pinion.

Each trunnion is drilled and fed by a central lubrication fitting for lubricating the bearings, Fig. 32. On the side opposite the lubrication fitting, a relief valve is mounted. This valve is adjusted to "pop" at from 40 to 80 pounds pressure, thereby preventing overlubrication or damage to the trunnion bearing seals.

A lubrication fitting is mounted on the rear yoke of the intermediate universal to lubricate the splines, Fig. 32. A plug is staked into the forward end of the splined opening to retain the lubricant. A small hole is drilled in the center of this plug to relieve trapped air. The rear end of the splined opening is sealed by a cork packing contained in a retainer cap which screws on the end of the yoke.

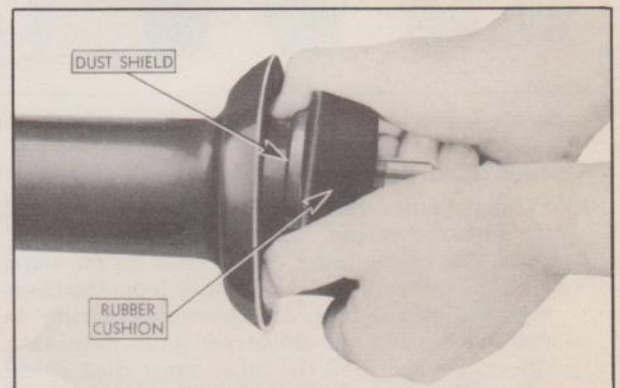
**Propeller Shaft Disassembly**

1. Remove the nuts from the trunnion bearing "U" clamps and remove the clamps. (This may be done at either or both the transmission end and/or the rear axle end depending upon the amount of disassembly desired.)
2. Unscrew the oil seal retainer from the rear yoke of the intermediate, or center, universal joint.



**Fig. 32—Truck Intermediate Universal Joint**

3. Remove the rear propeller shaft from the front propeller shaft by slipping it out of the universal joint splines.
4. Split the front universal joint at the transmission end of the front propeller shaft.
5. Remove the two bolts which mount the intermediate universal joint support bracket to the frame cross member.
6. Disconnect the intermediate universal joint by removing the two trunnion-bearing "U" clamps. **NOTE—To hold the trunnion bearings in place as well as to prevent dirt entering and save time in reassembling, leave the bearings in the trunnion and tape them in place.**
7. Clamp one side of the front yoke of the intermediate universal in a bench vise and remove the retaining nut with a 1½" socket wrench.
8. Using a soft hammer for the purpose, tap the yoke from the propeller shaft.
9. Wet the rubber cushion located in the support bracket with water to soften the soap used on the rubber when assembled. Mount the support bracket in a bench vise and move the propeller shaft from side to side to work the rubber cushion out of the support.
10. After the support bracket has been removed, the rubber cushion can be removed from the bearing with the hands as shown in Fig. 33.



**Fig. 33—Removing or Replacing Bearing Rubber Cushion**

11. Mount the special puller, J-1619, in a bench vise and fit the jaws of the puller in behind the bearing outer race. Turning the screw of the puller will remove the bearing from the shaft, Fig. 34.

- Tap the dust shields off the outer race of the bearing. Fig. 35 shows a layout of the parts making up the intermediate support bearing assembly.

**Inspection**

Thoroughly wash all parts, EXCEPT THE SUPPORT BEARING, in cleaning solvent. Inspect the shaft for worn splines and replace shafts if necessary. Check the bearing for roughness or excessive play by holding the inner race with one hand while slowly turning the outer race with the other. If either condition is present, replace the bearing.

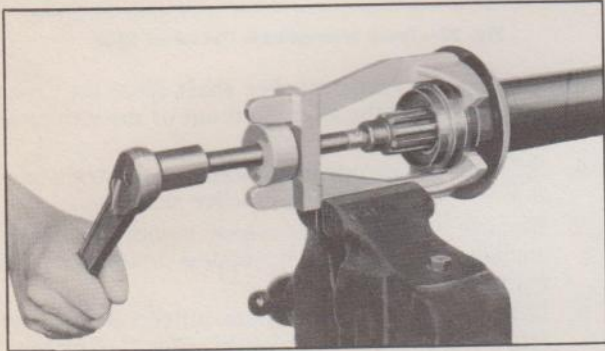


Fig. 34—Removing Propeller Shaft Intermediate Bearing

**NOTE**—The intermediate support bearing is of the permanently lubricated and sealed type, therefore, no attempt should be made to wash it out with cleaning solvent or to re-lubricate it.

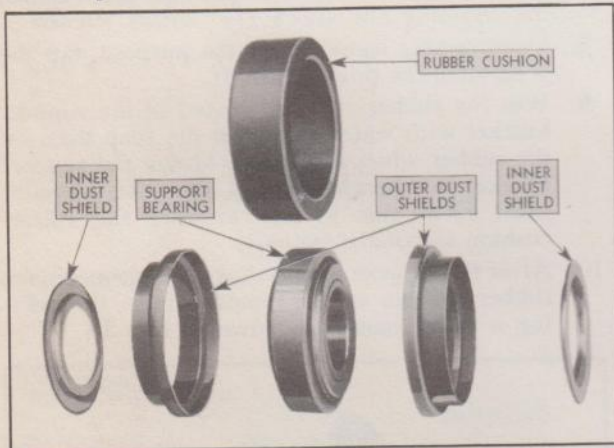


Fig. 35—Layout of Intermediate Support Bearing Parts

**Propeller Shaft Reassembly**

- Press the outer dust shields on the outer race of the support bearing.
- Place one of the inner dust shields on the shaft with the offset in the shield away from the bearing as shown in Fig. 35. Drive the bearing on the shaft using the universal joint yoke as a driver. Then install the other inner dust shield on the shaft with the offset away from the bearing.
- Install the rubber cushion over the bearing as shown in Fig. 33.
- Coat the outside surface of the rubber cushion lightly with soft soap and slide the support bracket over the rubber cushion as in Fig. 36.

- Install the front yoke of the intermediate universal joint, making sure that the yoke is turned 90 degrees, in relation to the rear yoke of the front universal joint which is a part of the propeller shaft. Then by installing the rear yoke of the intermediate universal onto the rear propeller shaft so that it is in the same plane (line) with the front yoke of the rear propeller shaft rear universal joint, it will correctly align all three universal joints.
- Reassemble the front universal joint and then bolt the intermediate support bracket to the frame cross member.
- Assemble the rear propeller shaft and adjust the packing retainer on the rear sleeve yoke of the intermediate universal joint.

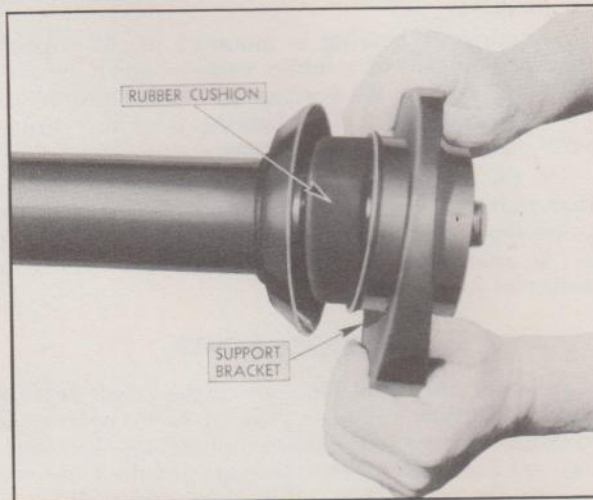


Fig. 36—Installing Bearing Support Bracket

**NOTE**—When necessary to replace a cork oil seal in this retainer, press the old one out of the retainer, and, because it is split, Fig. 37, it can then be removed from the propeller shaft.

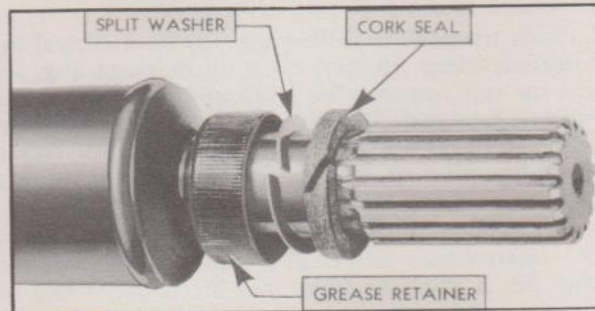


Fig. 37—Packing at Intermediate Joint Rear Yoke

- Lubricate the universal joints with S.A.E. 90 gear lubricant—(transmission lubricant).

**FRONT PROPELLER SHAFT ASSEMBLY**

**3/4 Ton Trucks**

The front propeller shaft assembly used on the 3/4 ton truck differs from that used on the 1 1/2 ton models in that it is of the enclosed type, Fig. 38.

The housing incorporates the universal ball as part of the assembly. A thin wall bushing is pressed into the front end of the housing tube.

The hub of the rear yoke of the front universal joint takes its bearing in this bushing. The rear end of the shaft is supported by a single row ball bearing of the permanently lubricated and sealed type. A spring loaded oil seal is pressed into the housing ahead of the bearing and a dust shield is assembled on the shaft at the rear of the bearing.

A rubber cushion slips over the machined rear end of the housing. This cushion in turn fits inside the sleeve which is a part of the support bracket.

**Removal from Truck**

1. Split the intermediate universal joint by removing the two trunnion bearing "U" clamps from the front yoke of the universal. Tape the bearings as already described and drop the front end of the rear propeller shaft.
2. Remove the four bolts which attach the universal ball retainer to the rear end of the transmission and slip the retainer back on the tube.
3. Remove the nuts from the bolts which attach the support bracket to the cross member. Then pull the assembly towards the rear to clear the splines in the front universal joint.

**Disassembly**

1. Clamp one side of the universal joint yoke in a bench vise. Remove the cotter pin and nut from the shaft. The yoke may now be tapped off the shaft splines with a soft hammer. Remove the bearing dust shield.
2. Wet the inside of the sleeve in the support bracket with water to soften the soap used when assembling. Place the bracket in a bench vise, then by moving the housing from side to side and at the same time pulling on the housing, it may be removed from the support bracket.
3. Remove the rubber cushion from the housing by slipping it off the machined part of the housing. The universal ball retainer may then be removed over the rear end of the housing.
4. With a pair of pliers compress the tangs on the end of the bearing retainer snap ring and remove the snap ring.
5. Using a brass drift and hammer drive the propeller shaft and bearing from the housing.
6. The bearing may now be removed by pressing it off the shaft in an arbor press.

Wash all parts except the bearing thoroughly in cleaning solvent.

Examine the leather oil seal for wear or damage.

**NOTE—The seal should not be removed unless for the purpose of replacement. To remove the seal drive it out from the front of the housing using a piece of shafting. When installing a new seal, be sure that the free end of the leather is toward the front end of the housing.**

**NOTE—The seal should be thoroughly soaked in light engine oil before assembling.**

Inspect the bushing in the front of the housing for wear. Check the ball bearing for roughness by turning it by hand.

**Propeller Shaft Bushing Replacement**

Drill out the dowel pin which retains the bushing and drive out bushing from pinion end of housing. A new oil seal must be installed whenever the bushing is removed.

**Reassembly**

1. Press the bearing on the shaft in an arbor press.
2. Assemble the shaft and bearing in the housing. Seat the bearing by tapping around its outer race using a soft drift punch and hammer. Then install the snap ring.
3. Install a new cork packing in the universal ball retainer. It is recommended that the packing be shellacked to the retainer. Install the retainer over the housing.
4. Install the rubber cushion over the machined end at the rear of the housing.
5. Coat the rubber cushion lightly with soft soap and assemble the support bracket over the cushion.
6. Install the bearing dust shield and universal joint front yoke. Tighten the nut and cotter pin securely.

**Replacement in Truck**

1. Place the transmission in gear and then slide the splines of the front propeller shaft into the rear yoke of the front universal joint.
2. Bolt the support bracket to the cross member.
3. Lubricate the universal ball and then bolt the universal ball retainer to the rear end of the transmission housing.

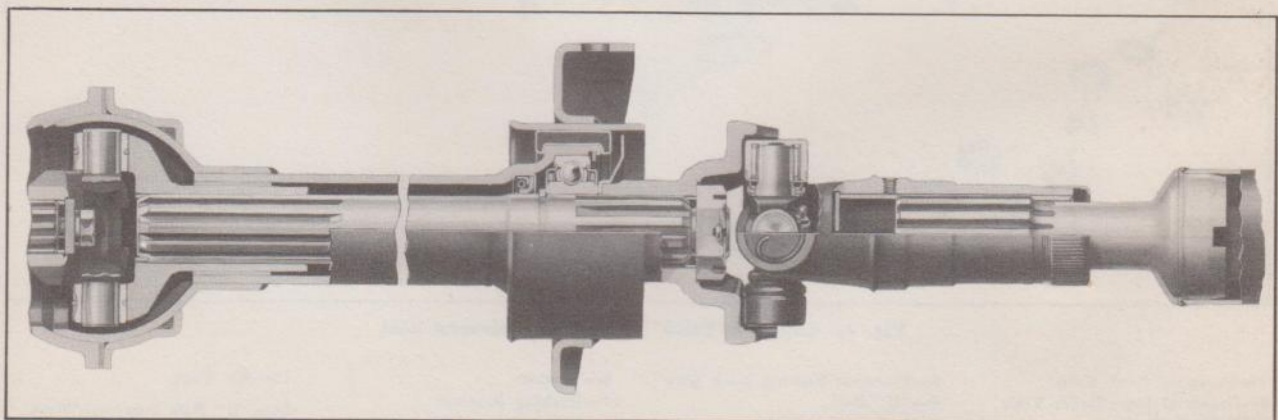


Fig. 38—¾ Ton Truck Front Propeller Shaft Assembly

4. Raise the rear propeller shaft; remove the tape from the trunnion bearings. Seat the bearings in the front yoke of the universal; install the "U" clamps and tighten the nuts securely.
5. Lubricate the intermediate universal joint with S.A.E. 90 transmission lubricant and lubricate the front universal by filling the housing with 1 pint of S.A.E. 90 transmission lubricant.

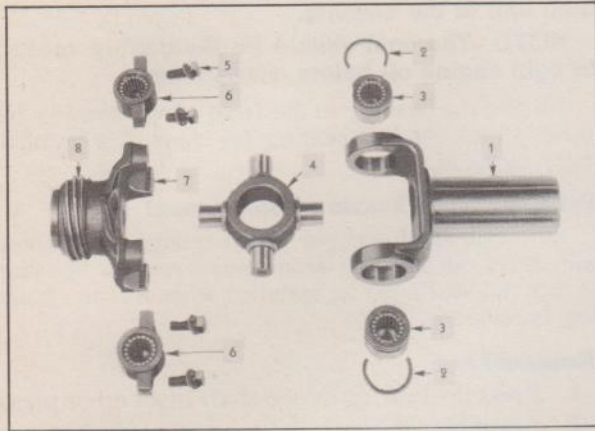


Fig. 39—1/2 Ton Truck Universal Joint

- |                                      |                                     |
|--------------------------------------|-------------------------------------|
| 1—Front Universal Yoke               | 4—Universal Joint Trunnion          |
| 2—Trunnion Bearing Lock Ring         | 5—Cap Screw                         |
| 3—Front Trunnion Bearing and Rollers | 6—Rear Trunnion Bearing and Rollers |
|                                      | 7—Rear Universal Yoke               |
|                                      | 8—Speedometer Drive Gear            |

UNIVERSAL JOINT

1/2 Ton Truck

The universal joint is a fully enclosed needle bearing unit. This type unit provides great smoothness and durability, and at the same time reduces friction. Figure 39 shows a layout of the universal joint parts.

Service operations of the universal joint are as follows:

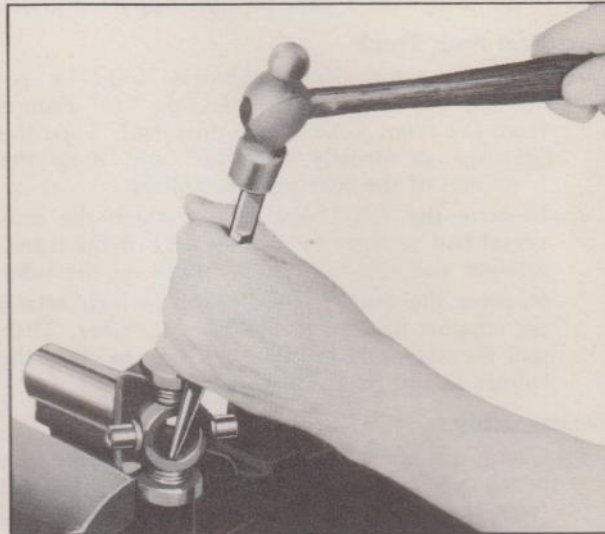


Fig. 40—Disassembly of Universal Joint

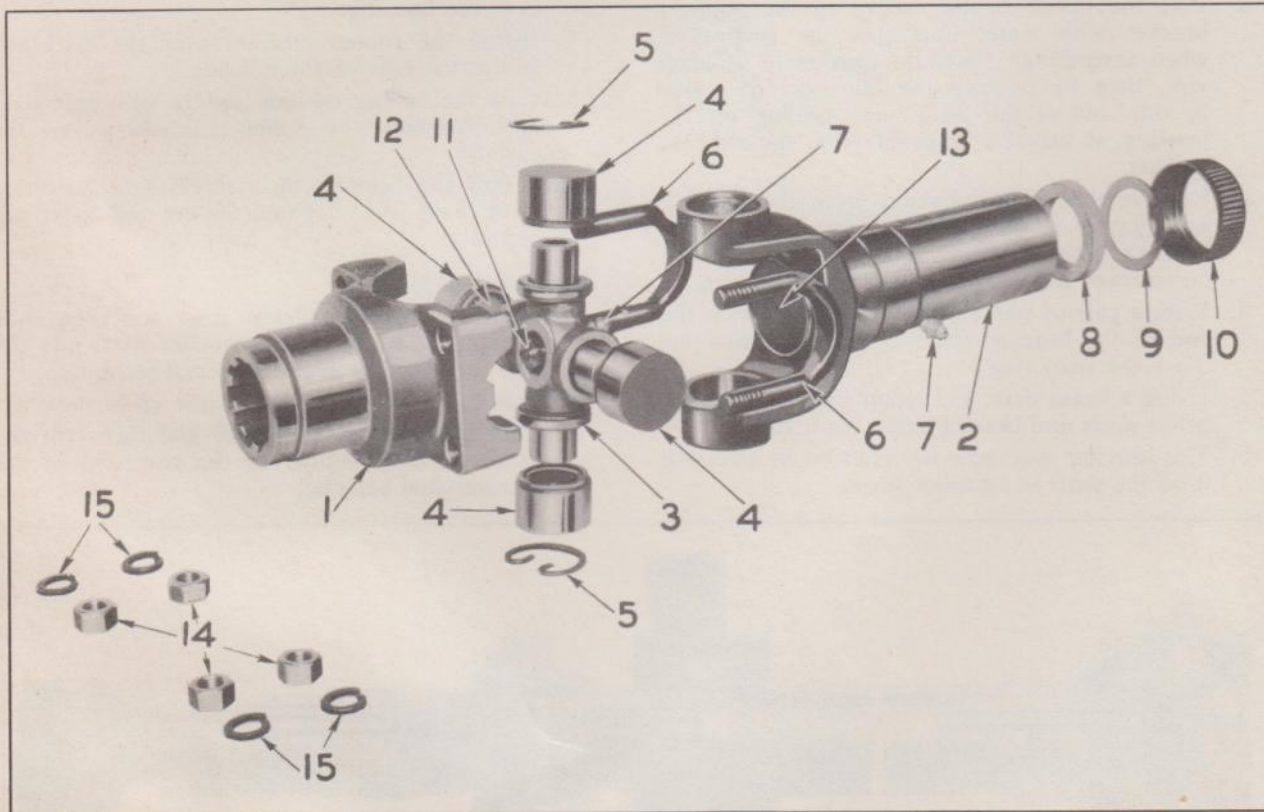


Fig. 41—Layout of Truck Intermediate Universal Joint

- |                               |                              |                             |                            |
|-------------------------------|------------------------------|-----------------------------|----------------------------|
| 1—Universal Joint Yoke        | 5—Trunnion Bearing Lock Ring | 9—Washer                    | 13—Air Vent                |
| 2—Universal Joint Sleeve Yoke | 6—"U" Bolt                   | 10—Packing Retainer         | 14—"U" Bolt Retaining Nuts |
| 3—Yoke Trunnion               | 7—Lubrication Fitting        | 11—Relief Valve             | 15—Lockwashers             |
| 4—Trunnion Bearing            | 8—Oil Seal                   | 12—Trunnion Bearing Rollers |                            |



**Disassembly**

1. Remove the four cap screws which fasten the retaining collar to the ball retainer and slide the ball back on the propeller shaft housing.
2. Remove the four cap screws which fasten the front trunnion bearings to the front yoke. Remove the two front yoke trunnion bearings and split the joint.
3. The rear yoke and trunnion can then be removed from the propeller shaft splines. The front yoke can be removed from the transmission mainshaft by removing the bolt and lockwasher.
4. Wash all parts in cleaning solvent, and inspect the yokes, trunnion, and bearings for wear. Worn or damaged parts must be replaced.
5. Remove the lock rings from the trunnion bearings and drive the caps from the yoke, using a drift punch in the center of the trunnion as shown in Fig. 40. After the trunnion has been driven down to the yoke, raise the trunnion and slip a flat washer 15/16" in diameter over the bearing. Again drive on the center of the trunnion until the bearing is free of the yoke. This method prevents cocking the bearing, which would result in damage to both the yoke and the bearing.

**Reassembly**

1. Install the front yoke on the transmission mainshaft. Install the lockwasher and bolt.
2. Install the trunnion by threading it into the rear yoke.
3. Coat the inside of the trunnion bearings with light cup grease and install the 19 roller bearings. Then start the trunnion bearings into the rear yoke, at the same time fitting the ends of the trunnion into the bearings. Press each bearing into the yoke just far enough to install the snap ring. Install the rear yoke and trunnion on the propeller shaft splines.
4. Install the rollers in the front yoke trunnion bearings and place them on the ends of the trunnion. Line up the trunnion bearings with the front yoke, making sure the pilots on the trunnions fit into the opening of the yoke. Install the lockwashers and cap screws and tighten them securely.
5. Slide the universal ball forward and install the four cap screws which attach the retainer collar to the rear of the transmission. Fill the universal joint housing with transmission lubricant through the opening for the speedometer driven gear.

**UNIVERSAL JOINTS****¾ Ton and 1½ Ton Trucks**

Whenever it becomes necessary to remove the trunnion and trunnion bearings from the rear yokes of the front or intermediate universals and the front yoke of the rear universal, the snap rings and lubrication fittings should be removed. Support the yoke on a bench vise, then, using a soft drift and hammer,

drive on the end of one trunnion bearing. The shock loads of the hammer blows are transmitted through the trunnion to the other trunnion bearing driving it out of the yoke, Fig. 42.



Fig. 42—Removing Trunnion Bearings from Joint Yoke

Care should be exercised when driving through the trunnion not to drive it into the side of the yoke. After one bearing has been removed, support the other side of the yoke on the vise and drive the other bearing out by using a brass drift on the end of the trunnion pin.

When reassembling the bearings they should be pressed into the yokes just far enough to install the snap rings. Then, while holding the trunnion in one hand, strike the yoke a few light blows with a hammer to firmly seat the bearings against the lockrings.

**REAR SPRINGS**

The rear springs on all truck models are of the semi-elliptic type and are designed for each individual unit to provide adequate load-carrying capacity and a spring rate which is proportional to that of the front springs to give the smoothest ride possible. The rear spring data is given in the specifications at the end of this section.

**Rear Spring Shackle**

The threaded type spring shackle is used at the rear of the rear spring on the 1/2 ton truck, Fig. 43.

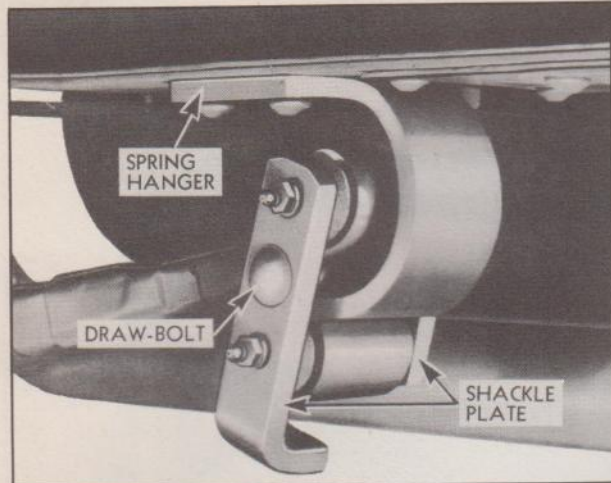


Fig. 43—1/2 Ton Truck Rear Shackle

To replace the threaded bushing raise the truck with a chain hoist just enough to relieve the spring tension. Remove the draw bolt and the shackle plates. Unscrew the shackle pins from the bushings. The threaded end of the bushing removing and replacing tool J-553 should be screwed into the threaded bushing. Turning the pull nut on the tool with a wrench will remove the bushing.

To install a new bushing insert the threaded end of the tool through the spring eye or spring hanger and screw a new bushing on the shaft of the tool. Turning the pull nut on the tool will draw the bushing into place. Screw a new shackle pin into the bushing until each end projects 21/32" from the end of the bushing. Place the four cork gaskets over the ends of the pins and assemble the shackle plates. Insert the draw bolt and draw the nut up snugly. Strike each end of the shackle a sharp blow with a hammer to insure seating of the tapers and retighten the shackle bolt.

Examine the lubrication fittings for damage. Replace them when necessary and fill the pins completely full with chassis lubricant.

**PLAIN BUSHED SHACKLE**

This type of shackle is used at the rear of the rear springs on all 3/4 and 1 1/2 ton trucks, Fig. 44. It consists of a heavy malleable shackle bushed at the upper end to serve as a bearing for the upper shackle pin which passes through the shackle and the spring hanger, and a lower shackle pin which passes through the shackle and the spring eye bushing. A "pinch" bolt at the spring hanger keeps the upper pin from turning while the lower pin is anchored in the same way by the "pinch" bolt at the shackle.

The upper shackle pin may be removed by first removing the "pinch" bolt and then driving the pin out from the inside, using a drift through the hole in the frame side rail for that purpose. The shackle pin at the front of the rear spring may be removed

by driving the pin from the spring eye bushing, through the hole in the frame side rail, and into the "alligator jaw" of the frame cross member.

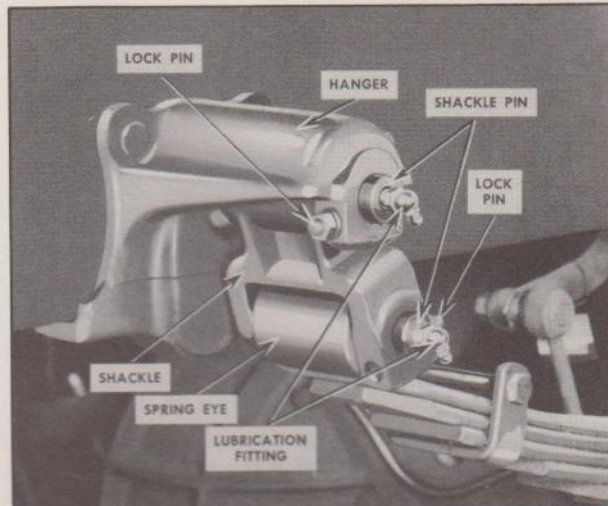


Fig. 44—3/4 and 1 1/2 Ton Truck Rear Shackle

If the spring eye bushings or shackle bushings require replacement, press out the spring eye bushings, using driver J-1668 and the shackle bushings, using driver J-1667.

After pressing in the new bushing on an arbor press, use a .877" reamer to provide .002" to .004" clearance between the housing and the shackle pin.

**NOTE**—On all 3/4 ton trucks the rear springs are 2" wide, while on the 1 1/2 ton truck they are 2 1/2" wide. In order to use the same shackle bracket on both trucks it is necessary to use 1/2" spacers on all 3/4 ton models to fill this space. These spacers are located on the inner side of the spring.

**FITTING 1/2 TON TRUCK REAR SPRING SEATS**

If it becomes necessary to adjust the rear spring seats on the truck models the correct clearance between the spring seat and the rear axle housing may be obtained as follows:

1. Jack up the rear end of the truck and block it in this position by using car horses under the frame side rails.
2. Disconnect the spring shackle and drop the rear end of the spring.
3. Remove the spring U-bolts.
4. Remove the two screws from the lower spring seat cap and remove both halves of the spring seat.
5. Clamp the two halves of the spring seat in a bench vise and file evenly from face of each half. Assemble the spring seat to the axle housing and check the fit of the seat on the housing. Continue to file evenly from both halves until such a fit is obtained that a slight drag is felt when turning the spring seat on the axle housing.

## REAR AXLE TROUBLES AND REMEDIES

<b>Symptom</b>	<b>Probable Remedy</b>
<b>Axle Noisy on Drive</b>	
1. Ring gear and pinion adjustment too tight.	1. Readjust ring gear and pinion (see Instructions).
2. Rear side of double row pinion bearing rough.	2. Replace bearing and readjust ring gear and pinion.
<b>Axle Noisy on Coast</b>	
1. Excessive lash between ring gear and pinion.	1. Readjust ring gear and pinion (see Instructions).
2. Front side of double row bearing rough.	2. Replace bearing and readjust ring gear and pinion.
3. End play in double row bearing.	3. Replace bearing and readjust ring gear and pinion.
<b>Axle Noisy on Both Drive and Coast</b>	
1. Pinion too deep in ring gear.	1. Double row bearing installed backward (see Instructions — Pinion Reassembly).
2. Ring and pinion adjustment too tight.	2. Readjust ring gear and pinion (see Instructions).
3. Worn or damaged pinion or differential bearings.	3. Replace damaged bearing or bearings.
4. Loose or worn wheel bearings.	4. Adjust or replace bearings as necessary.
<b>Backlash</b>	
1. Axle shaft flange loose.	1. Replace aluminum gasket, retighten and lock axle shaft flange bolts.
2. Worn differential and side gear spacers.	2. Replace any worn spacers.
3. Worn universal joints.	3. Replace worn universal joint parts.

### TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the rear axle:

#### ½ Ton and ¾ Ton Rear Axle

<i>Tool Number</i>	<i>Description</i>
J-973.....	Oil Slinger Replacer
J-554.....	Axle Shaft Peening Tool and Anvil
K-344.....	Axle Shaft Bearing Puller
K-466-A....	Axle Shaft Bearing and Retainer Replacer
J-968.....	Propeller Shaft Bushing Driver
J-996.....	Pinion Bearing Remover
TR-278-R...	Differential Bearing Puller
J-994.....	Differential Side Bearing Replacer
U-4.....	Differential Checking Fixture
J-972.....	Differential Side Bearing Adjusting Wrench
J-553.....	Spring Bushing Removing and Replacing Tool (½ Ton)

#### 1½ Ton Rear Axle

J-870.....	Rear Wheel Bearing Lock Nut Wrench
J-918-A....	Inner Bearing and Oil Seal Puller
J-872-1.....	Outer Wheel Bearing Replacer
J-872-3.....	Special Bearing Race Driver
J-872-4.....	Special Bearing Race Driver
J-872-2.....	Bearing Oil Seal Replacer
J-973.....	Oil Slinger Replacer
J-1453.....	Rear Pinion Bearing Press Plate
J-1439.....	Front Pinion Bearing Remover (6-Tooth Pinion)
J-1440.....	Front Pinion Bearing Remover (7-Tooth Pinion)
J-1364.....	Rear Pinion Bearing Lock Ring Installer
TR-278-R...	Differential Side Bearing Puller
J-1488.....	Differential Side Bearing Driver
J-972.....	Differential Side Bearing Adjusting Wrench

REAR AXLE SPECIFICATIONS

	½-Ton Truck	All ¾-Ton Trucks	Heavy Duty 1½-Ton Trucks
	Semi-Floating	Semi-Floating	Full-Floating
Type.....	Hypoid	Hypoid	Hypoid
Type of Gearing.....	4.111 to 1	4.55 to 1	6.17 to 1
Regular Gear Ratio.....	37	41	37
Number of Gear Teeth.....	9	9	6
Number of Pinion Teeth.....	None	None	5.43 to 1
Optional Gear Ratio.....	—	—	38
Number of Ring Gear Teeth.....	—	—	7
Number of Pinion Teeth.....	.005" to .008"	.005" to .008"	.005" to .008"
Back Lash Between Ring Gear and Pinion..	Free Fit	Free Fit	—
Clearance Between Axle Shaft..... and Spacer.....	to .014"	to .014"	—
Allowance Run-Out of Propeller Shaft Assembly at:			
Front Bearing.....	.002"	.002"	.003"
Front of Rear Splines.....	.010"	.010"	.010"
Center of Propeller Shaft.....	.015"	.015"	.015"
Extreme Forward End.....	.005"	.005"	.005"
Allowable Run-Out of Differential Case at:			
Ring Gear Pilot.....	.004"	.004"	.004"
Face to Which Ring Gear is Bolted.....	.004"	.004"	.004"
Back of Ring Gear After Bolted to Case....	.007"	.007"	.007"
Clearance Between Thrust Pad and Back of Ring Gear.....	—	—	.005" to .007"

	½-Ton Truck	¾-Ton Trucks	1½-Ton Trucks
Front Pinion Bearing.....	New Departure ND-5306	New Departure ND-5306	New Departure ND-H-5310A
Rear Pinion Bearing.....	Hyatt U-1506	Hyatt U-1506	Hyatt U-1305
Differential Side Bearing.....	Hyatt KA-11445Z	Hyatt KA-11445Z	Hyatt KA-11820Z
Wheel Bearing (Inner).....	—	—	Hyatt KD-12051
Wheel Bearing (Outer).....	Hyatt C-1500	Hyatt 1512	Hyatt KB-11786
Propeller Shaft Support Bearing.....	—	New Departure NDX-88107	New Departure NDX-88107

REAR SPRINGS	½-Ton	¾-Ton	1½-Ton Except Panel	1½-Ton Panel
	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic
Type.....	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic	Semi-Elliptic
Length.....	54½"	46"	46"	46"
Width.....	1¾"	2"	2½"	2½"
Number of Leaves.....	8	7	10	8
Leaf Thickness				
Nos. 1, 2, 3, 4.....	.291"	.291"	.323"	.291"
No. 5.....	.291"	.323"	.323"	.291"
Nos. 6, 7.....	.291"	.323"	.323"	.323"
No. 8.....	.291"	—	.323"	.323"
Nos. 9, 10.....	—	—	.323"	—
Total Thickness.....	2.328"	2.133"	3.230"	2.424"
Spring Clip and Type.....	4-Clinch	3-Bolt	2-Bolt	4-Bolt
Mounting;				
Front.....	Plain Bushing	Plain Bushing	Plain Bushing	Plain Bushing
Rear.....	Threaded "H" Shackle	Plain Shackle	Plain Shackle	Plain Shackle
Axle Housing.....	2 U-Bolts	2 U-Bolts	2 U-Bolts	2 U-Bolts

AUXILIARY SPRINGS—1½ Ton Trucks

Number Leaves.....	6
Leaf Thickness.....	.323"
Total Thickness.....	1.938"
Length.....	31" Between Bracket Centers
Width.....	2½"

## Section 5

### BRAKES

The braking system of all trucks combines hydraulically operated service brakes with a mechanically operated parking brake. Fundamentally, the braking system of all the trucks is the same. However, due to variance in the brake lining sizes, wheel brake drum sizes, and frame design there are several differences in the braking systems. Fig. 1 shows the brake construction.

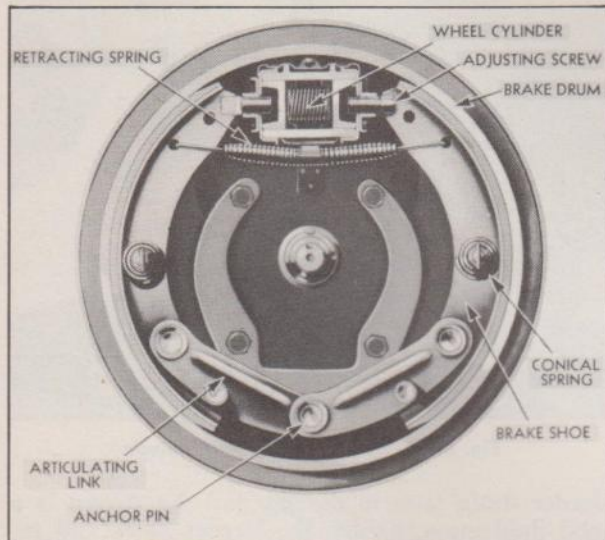


Fig. 1—Front Brake Mechanism

In order to thoroughly understand the operation of the hydraulic brake system, it is necessary to have a good knowledge of the various parts and their functions and to know what takes place throughout the system during the application and release of the brakes.

#### MAIN CYLINDER

The piston in the main cylinder, Fig. 2, receives mechanical pressure from the push rod and exerts pressure on the fluid in the lines, building up the hydraulic pressure which moves the wheel cylinder pistons. The primary cup is held against the piston by the piston return spring which also retains the return valve against its seat. The spring maintains a slight pressure in the lines and in the wheel cylinders to prevent the possible entrance of air into the system. The secondary cup, which is secured to the opposite end of the piston, prevents the leakage of fluid into the rubber boot. Holes in the piston head allow the fluid to flow from the annular space around the piston into the space between the primary cup and the check valve thereby keeping sufficient fluid in the lines at all times. Holes in the valve cage allow the fluid to flow through the cage and around the lip of the rubber valve cup and out into the lines during brake application. When the brake is released the valve is forced off its seat, permitting the fluid to return to the main cylinder. The push rod assembly is held in the opposite end of the housing by means

of a snap ring. The rubber boot that fits around the push rod and over the end of the housing prevents dirt or any other foreign matter from entering the main cylinder, Fig. 2.

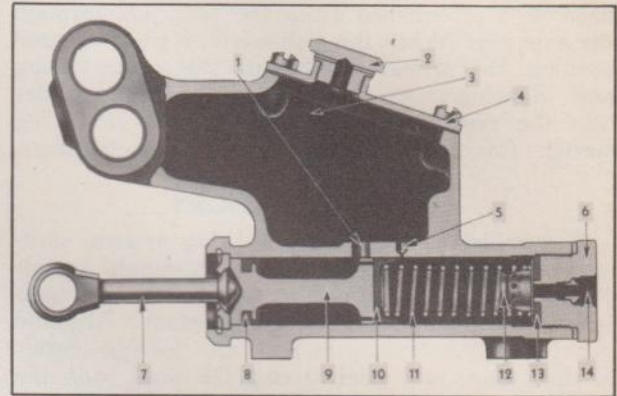


Fig. 2—Main Cylinder Cross Section

- |                     |                        |
|---------------------|------------------------|
| 1—Inlet             | 8—Piston Cup—Secondary |
| 2—Filler Plug       | 9—Piston               |
| 3—Reservoir         | 10—Piston Cup—Primary  |
| 4—Housing Cover     | 11—Spring              |
| 5—Compensating Port | 12—Valve               |
| 6—End Plug          | 13—Valve Seat          |
| 7—Pedal Link        | 14—Outlet              |

#### WHEEL CYLINDER

The wheel cylinder (see Fig. 1) contains two pistons, the purpose of the two pistons being to distribute the pressure evenly to each of the two brake shoes. The rubber piston cups maintain pressure on the pistons and prevent the leakage of fluid past the pistons. The adjusting covers serve two purposes: first, to cover the ends of the cylinder and prevent the entrance of dirt and foreign matter into the cylinder, and second, serve as a means of adjusting the brake shoes to the proper drum clearance, being threaded to receive the slotted adjusting screws which fit the webs of the brake shoes.

#### SEQUENCE OF OPERATION

As pressure is applied to the brake pedal and is transmitted from the push rod to the piston in the main cylinder, the primary cup closes the compensating port and fluid is forced through the holes in the valve cage, around the lip of the rubber valve cup, into the pipe lines and into the wheel cylinders. This pressure forces the pistons in the wheel cylinders outward, expanding the brake shoes against the drums. As the pedal is farther depressed, higher pressure is built up within the hydraulic system, causing the brake shoes to exert greater force against the brake drums. Fig. 1.

As the pedal is released, the hydraulic pressure is relieved and the brake shoe retracting springs draw the shoes together, pressing the wheel cylinder pistons inward and forcing the fluid out of the wheel cylinders back into the lines toward the main cylinder. The piston return spring in the

main cylinder returns the piston to the pedal stop faster than the brake fluid is forced back into the lines, creating a slight vacuum in that part of the cylinder ahead of the piston. This vacuum causes a small amount of fluid to flow through the holes in the piston head, past the lip of the primary cup and into the forward part of the cylinder. This action keeps the cylinder filled with fluid at all times, ready for the next brake application. As fluid is drawn from the space behind the piston head it is replenished from the reservoir through the inlet port. When the piston is in a fully released position, the primary cup clears the compensating port, allowing excess fluid to flow from the cylinder into the reservoir as the brake shoe retracting springs force the fluid out of the wheel cylinders.

**SERVICE OPERATIONS**

To properly maintain the braking system, servicemen must appreciate that a thorough knowledge of the system, absolute cleanliness, and careful workmanship are very important. Absolute cleanliness is necessary in that, any foreign matter in the system will tend to clog the lines, ruin the rubber cups of the wheel and main cylinders, and cause inefficient operation or even failure of the braking system; dirt or grease on a brake lining will cause that lining to take effect first on brake application and fade out on heavy brake application. Careful workmanship will result in a well done job.

**BLEEDING THE HYDRAULIC BRAKE SYSTEM**

The hydraulic brake system must be bled whenever a pipe line has been disconnected, or when a leak has allowed air to enter the system. A leak in the system may sometimes be evident through the presence of a "spongy" brake pedal. Air trapped in the system is compressible, and does not permit all pressure applied to the brake pedal to be transmitted through to the brake shoes. The system must be *absolutely* free from air at all times.

The longest pipe line of the brake system should be bled first. The proper sequence for bleeding is: left rear, left front, right rear, and lastly, right front. During bleeding operations the main cylinder must be kept at least half full of hydraulic brake fluid. The main cylinder filler, (J-713C) Fig. 3 automatically maintains the correct fluid level in the main cylinder during bleeding.

**TO BLEED THE HYDRAULIC BRAKE SYSTEM**

Carefully clean all dirt from around the main cylinder filler plug.

Remove filler plug, install adapter and automatic filler. Open automatic valve in the filler.

Remove bleeder valve screw. Attach bleeder drain, (J-747) Fig. 4, keeping the end of the drain hose below the surface of the fluid in the jar.

Unscrew bleeder valve in wheel cylinder  $\frac{1}{2}$  to  $\frac{3}{4}$  turn.

Depress the foot pedal by hand, allowing it to return slowly. Continuing this pumping action forces the fluid through the lines and out at the bleeder drain, carrying with it any air in the system.

When bubbles cease to appear at the end of the

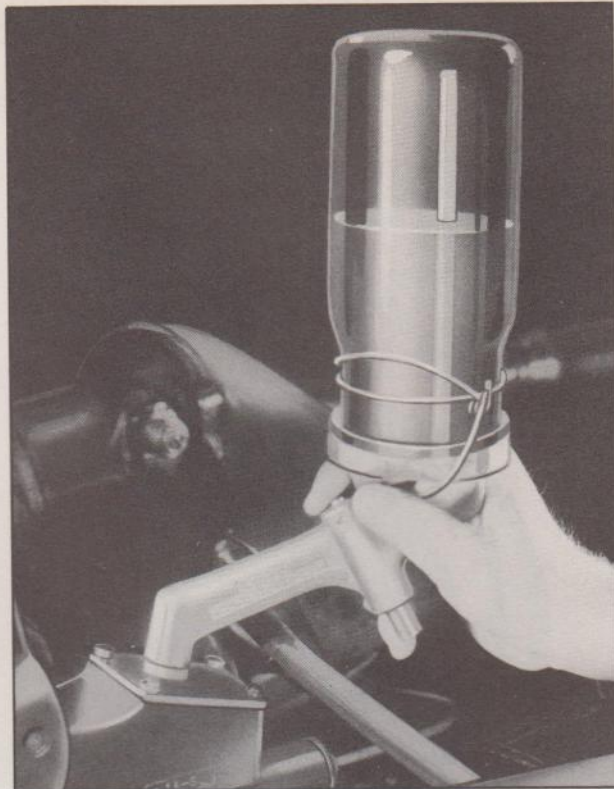


Fig. 3—Filling Main Cylinder Reservoir

bleeder drain hose in the jar and the stream is a solid fluid mass, tighten the bleeder valve and remove the drain hose.

Replace and tighten the screw at the end of the bleeder valve.

After bleeding operation has been completed at all wheels, fill the main cylinder reservoir approximately full, and replace the filler plug.

**NOTE—Fluid withdrawn in the bleeding operation should not be used again.**

**HYDRAULIC BRAKE FLUID**

As there are several general classifications of Hydraulic Brake Fluids on the market, care should be taken to make certain that the fluid being used will not injure the brake parts. Some brake fluids may have a rather severe action on the rubber parts, causing them to become sticky, preventing proper piston action or, due to expansion of the rubber parts, cause them to lose their sealing qualities. Other types of fluid may cause vapor lock or, due to extreme thinness, leak past the rubber cups in the wheel cylinders and saturate the brake linings.

G. M. Hydraulic Brake Fluid-Super No. 9 can be used with certainty that it will not have a damaging effect upon the rubber cups in the brake system.

In the event that improper fluid has entered the system, it will be necessary to:

1. Drain the entire system.
2. Thoroughly flush out the system with clean alcohol, 188 proof, or a hydraulic brake system cleaning fluid, known to the industry as Declene.
3. Replace all rubber parts of the system.
4. Refill with proper Hydraulic Brake Fluid.

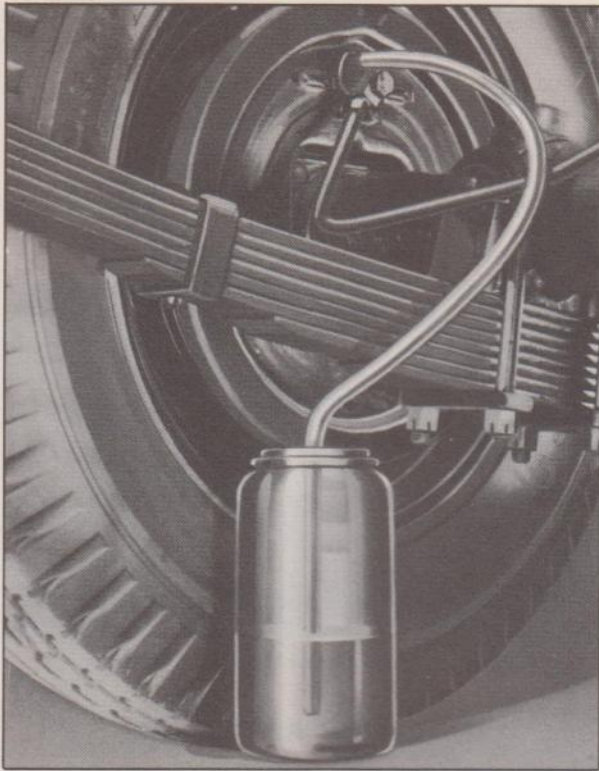


Fig. 4—Bleeding Brake System at Wheel Cylinder

### HYDRAULIC BRAKE TUBING

The hydraulic brake tubing is a double layer flexible steel, copper-coated, tin-plated tubing which resists corrosion and also stands up under the high pressures which are developed when applying the brakes.

The important thing in connection with making up hydraulic brake pipes is the proper flaring of the ends of the tubing for the compression couplings. Unless the tubing is properly flared the couplings will leak and the brake will become ineffective.

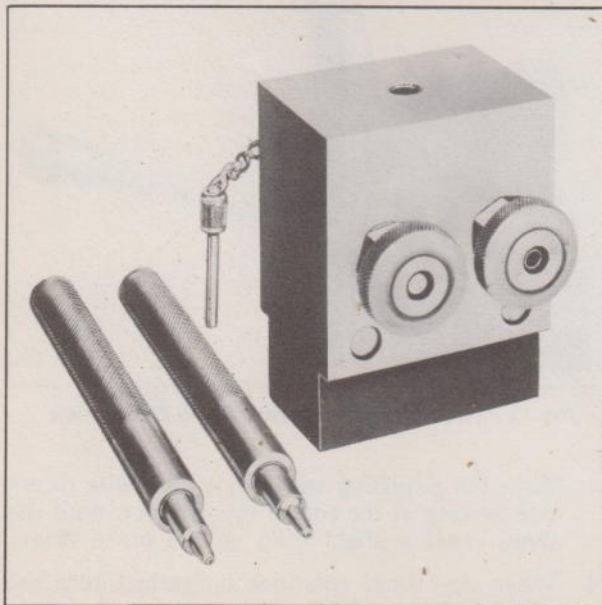


Fig. 5—Hydraulic Brake Tubing Flaring Tool

This safety steel tubing must be double-lap flared at the ends in order to produce a strong, leak-proof joint.

The brake tube flaring tool shown in Fig. 5 is used to form the double-lap flare.

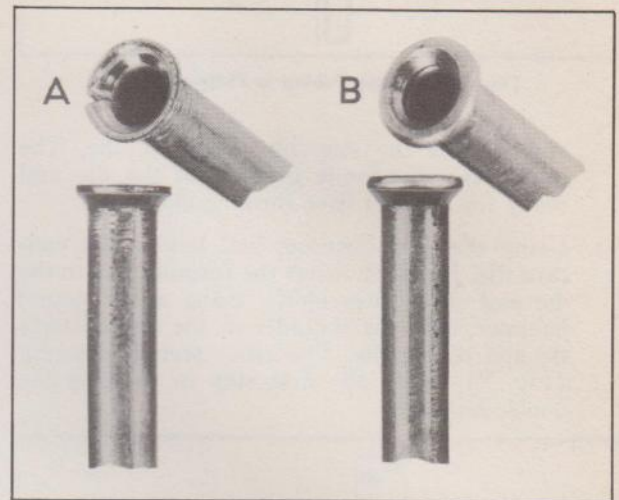


Fig. 6—Single and Double-Lap Flare on Tubing End

Fig. 6 shows two pieces of tubing—one with a single-lap flare ("A") and the other with the double-lap flare ("B"). It will be noted that the single-lap flare split the tubing while the one shown in "B" has a heavy, well-formed joint.

### DIRECTIONS

1. Cut the tubing to the desired length, using tube cutter KMO3 to prevent flattening the tubing. Square off the end with a fine-cut mill file, then ream the sharp edges with the reamer blade provided on the tube cutter. (Fig. 7.)

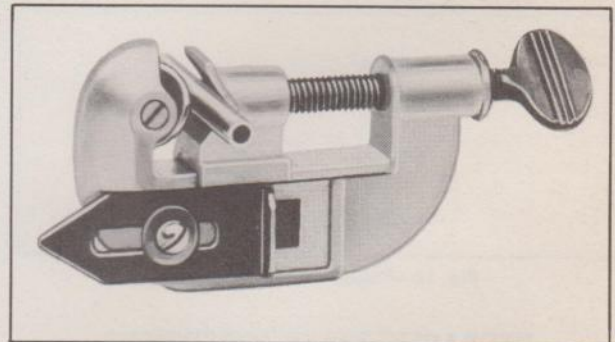


Fig. 7—Cutting Hydraulic Brake Tubing

2. Place new compression coupling nuts on the tubing. Dip end of tubing to be flared in hydraulic brake fluid. This lubrication results in a better formation of the flare. Loosen the clamping nuts on the flaring tool, KMO J-1280-1, and insert finished end of the tubing in the channel of the die until it bears against the stop pin, Fig. 8.

Tighten the clamping nuts by hand and place the fixture in a bench vise. Then tighten down the clamping nuts firmly with a wrench

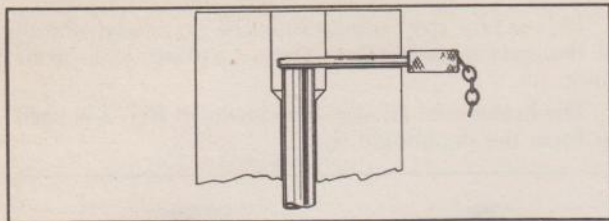


Fig. 8—Installing Tubing to Proper Depth

and remove the stop pin from the die. The tubing is now firmly gripped in the die and ready for the first flare forming operation.

- Using the flare forming tool having the concave die, J-1280-2, insert the forming tool in the die and strike firm blows, using a one pound hammer, until the shoulder of the tool contacts the top of the die. The cross section drawing (Fig. 9) shows the first step in forming the double-lap flare.

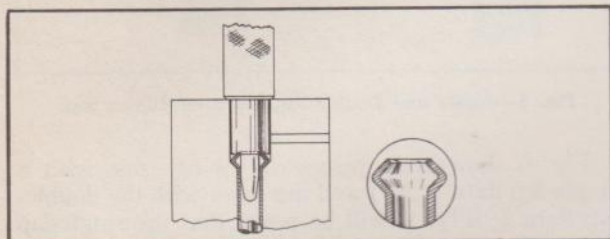


Fig. 9—First Flaring Operation

- Next, use the flare forming tool, J-1280-3, having the 45 degree die at its lower end. Insert the tool in the die and strike firm blows, using a one pound hammer, until the shoulder of the tool contacts the top of the die. The cross section drawing, Fig. 10, shows the second and final forming operation in making a double-lap flare.

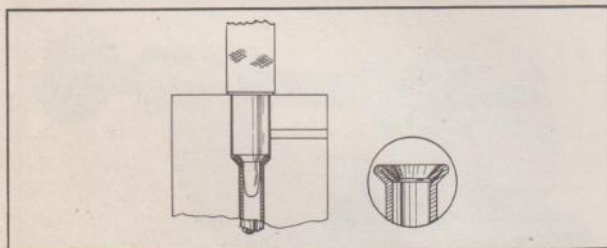


Fig. 10—Finish Flaring Operation

### HYDRAULIC BRAKE ADJUSTMENT

Chevrolet hydraulic brakes can be adjusted without the removal of the wheels as all brake flange plates have openings with spring snap covers to simplify brake adjustment.

### TOE-BOARD CLEARANCE

Toe-board clearance very seldom needs to be adjusted. The pedal stop, located in the brake main cylinder, is permanent. Before attempting to adjust this stop, be certain that the pedal returns to the fully released position freely, with no binding, and that the pedal retracting spring has not lost its tension.

- Loosen the check nut on the rear of the clevis on the main cylinder push rod.
- Remove clevis pin and turn the clevis attached to the main cylinder push rod, Fig. 11, in the proper direction to secure  $\frac{1}{4}$ " toe-board clearance—measurement being taken between pedal arm and underside of toe-pan.
- Tighten the check nut against the clevis.

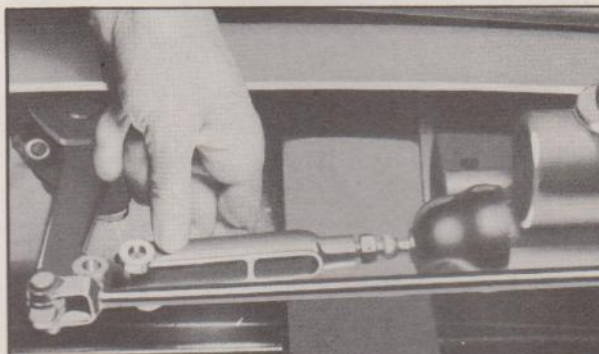


Fig. 11—Adjusting Pedal Toe-Board Clearance

### BRAKE SHOE ADJUSTMENT

#### $\frac{1}{2}$ and $\frac{3}{4}$ Ton Trucks

- Raise the truck and place stand jack front and rear so that all four wheels rotate freely.
- Disconnect the parking brakes. This precaution should be taken to eliminate the possibility of the brake shoes dragging the drum due to misadjustment of the parking brakes.
- Remove the adjusting hole covers and insert a screwdriver through the adjusting hole and engage the teeth on the adjusting cover of the wheel cylinder. Fig. 12.

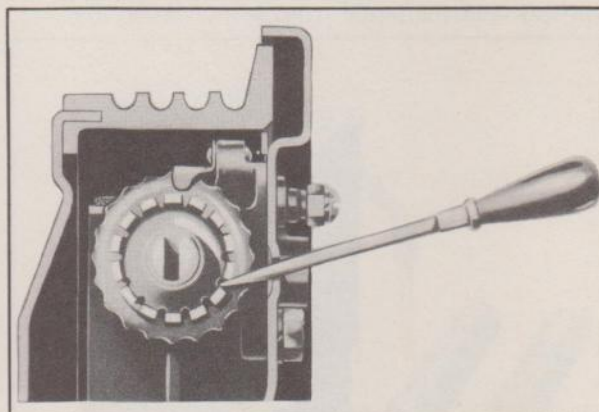


Fig. 12—Adjusting Brakes Through Slot in Flange Plate

Turn the adjusting cover in a clockwise direction looking at the end of the cylinder, until the shoes cause a slight drag on the brake drum.

- When the "drag" condition is reached, turn the adjusting cover back, the opposite direction, four (4) notches.



## BRAKE SHOE ADJUSTMENT

### 1½ Ton Trucks

The adjustment of the front brakes on the 1½ ton trucks is the same as for the ½ and ¾ ton trucks with the exception that the wheel cylinder adjusting covers are backed off five (5) notches instead of four (4).

To adjust the rear brakes on these trucks use a 5/8" open end wrench to turn the adjusting pinion.

1. Turn the adjusting pinion in a clockwise direction until the shoe causes a slight drag on the brake drum, as shown in Fig. 13.
2. Turn the adjusting pinion back in the opposite direction ¾ of a turn to provide running clearance.

The backing-off of the adjusting cover, the specified number of notches will be indicated by a faint click of the cover lock spring as the cover is turned. This backing-off of the adjusting cover moves the brake shoe away from the drum to insure proper running clearance of the shoes in the drum.

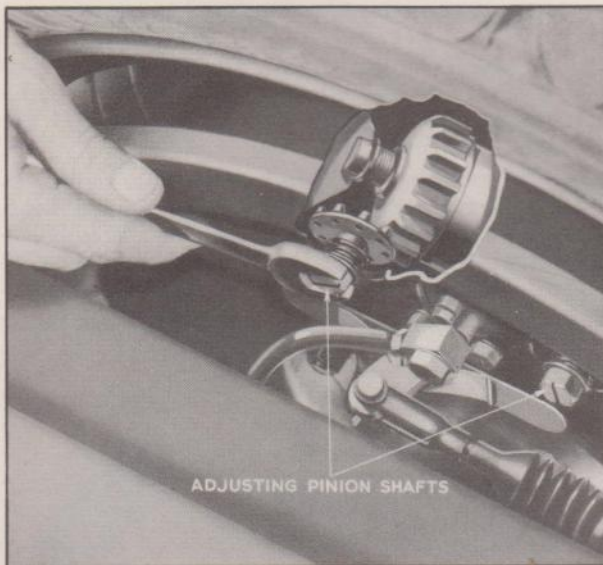


Fig. 13—Adjusting 1½-Ton Truck Rear Brakes

## PARKING BRAKE ADJUSTMENT

### ½ and ¾ Ton Trucks

The parking brake adjustment should be checked each time the hydraulic service brakes are adjusted.

When making a parking brake adjustment the service brakes must be properly adjusted first as a base for adjusting the parking brakes:

1. Set the parking brake lever in the fully released position.
2. Loosen the check nuts at the cable ends.
3. Pull the cables out of the conduit by hand until a positive stop is felt. While holding the cable in this position, adjust the check nuts against the clevis plates. Then tighten the check nuts securely.

### 1½ Ton Trucks

The parking brake adjustment should be checked each time the Hydraulic Service Brakes are adjusted.

When making a parking brake adjustment, the service brakes must be properly adjusted first as a base for adjusting the parking brakes.

1. Set the parking brake lever in the fully released position.
2. Remove the cotter pin and clevis pin from the pull rods. Loosen the check nut.
3. Pull the cables out of the conduit by hand until a positive stop is felt. While holding the cable in this position, turn the clevis until the hole in the clevis registers with the hole in the rod eye on the cable. Replace the clevis pin and cotter pin. Tighten the check nut securely.
4. Check the brakes for freedom from drag or unequal braking. If further adjustment is necessary to eliminate either shoe drag or unequal braking, proceed as outlined in 2 and 3 above. Never attempt to eliminate shoe drag by making adjustments at the wheel cylinder, as this would result in improper running clearance between shoe and drum.

## BRAKE LININGS

### Inspection

After removal of the brake drums and before disassembly of the shoes from the flange plate, all linings should be inspected for wear, improper alignment causing uneven wear and oil or grease on linings. If any of these conditions exist, it will be necessary to replace or reline the shoes. If in checking the lining it is noticed that they have the appearance of being glazed, this is a normal condition with the hard type lining used. Do not use a wire brush or any abrasive on the lining to destroy this glazed surface as it is essential for proper operation.

Satisfactory performance can be obtained by replacing only the forward shoes when the reverse shoe linings do not show excessive wear. Tests have shown that in most cases the reverse lining will outlast two sets of forward linings. This is true of both front and rear wheel brakes.

Shoes should be changed in sets; that is, both forward shoes on the front wheels, or both forward and reverse shoes on front wheels. The same is true on the rear wheels.

## BRAKE SHOE REMOVAL

### ½ and ¾ Ton Trucks

1. Jack up the truck and remove wheel and brake drum.
2. Install wheel cylinder clamp, Fig. 14 (J-718C) to keep the wheel cylinder pistons in place and prevent leakage of brake fluid while replacing shoes.
3. Remove brake shoe retracting spring with special pliers, KMO 142, Fig. 15.
4. Remove conical guide springs.

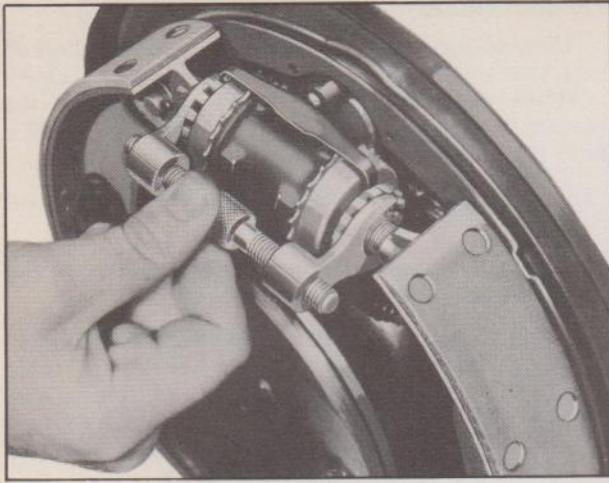


Fig. 14—Installing Brake Wheel Cylinder Clamp

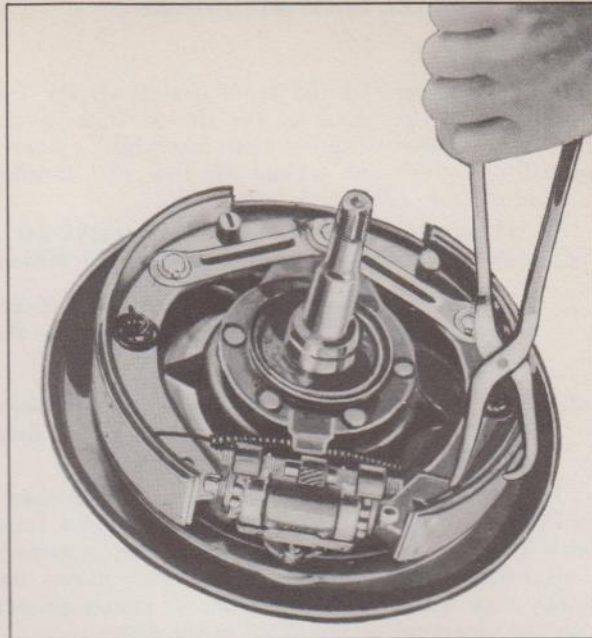


Fig. 15—Removing Brake Shoe Retracting Spring

5. Remove brake shoe anchor pin lock and pin. On rear brakes—remove toggle lever, eccentric bolt and nut from the rear brake shoe.
6. Remove articulating link friction spring pin lock, pin and spring. Disassemble articulating links from shoes by removing pin lock and pin.

The illustration, Fig. 16, shows a layout of the  $\frac{1}{2}$  and  $\frac{3}{4}$  ton truck rear brake parts.

**$\frac{1}{2}$  Ton Trucks**

The removal and replacement of the brake shoes of the  $\frac{1}{2}$  ton trucks is identical with that of the  $\frac{3}{4}$  ton trucks except for slight variations in the design of the hook-up.

1. It is necessary to remove the wheels and brake drums with the wheel hubs to replace brake linings, necessitating the readjustment of the wheel bearings.
2. The operating mechanism of the parking brakes at the rear wheels on the trucks is a lever and link assembly. This lever and link assembly is attached to the rear brake cable on the outside of the brake flange plate. The lever on the in-

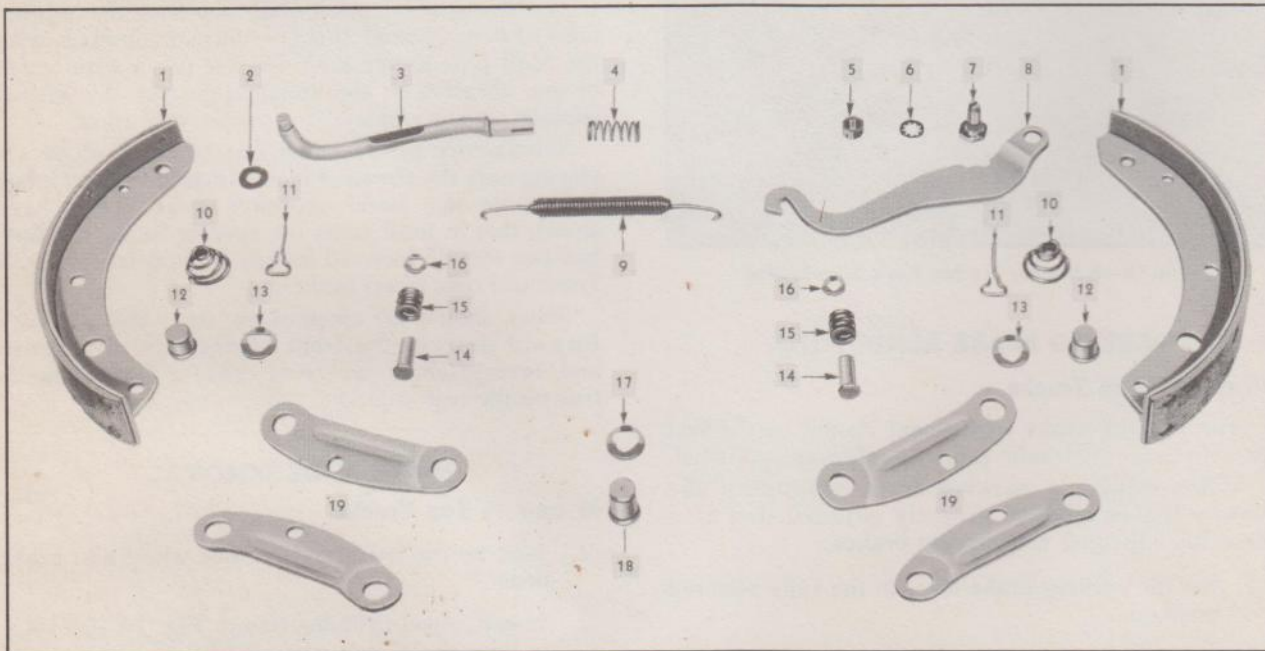


Fig. 16—Layout of Rear Wheel Brake Parts— $\frac{1}{2}$  and  $\frac{3}{4}$ -Ton Trucks

- |  |  |  |   |
|--|--|--|---|
| 1—Brake Shoe and Lining                | 5—Parking Brake Lever Anchor Bolt Nut        | 9—Brake Shoe Retracting Spring           | 15—Articulating Link Friction Spring          |
| 2—Parking Brake Lever Extension Washer | 6—Parking Brake Lever Anchor Bolt Lockwasher | 10—Brake Shoe Guide Spring               | 16—Articulating Link Friction Spring Pin Lock |
| 3—Parking Brake Lever Extension        | 7—Parking Brake Lever Anchor Bolt            | 11—Brake Shoe Guide Spring Pin           | 17—Anchor Pin                                 |
| 4—Parking Brake Lever Extension Spring | 8—Parking Brake Lever                        | 12—Articulating Link Pin                 | 18—Anchor Pin Lock                            |
|  |  | 13—Articulating Link Pin Lock            | 19—Articulating Link                          |
|  |  | 14—Articulating Link Friction Spring Pin |   |

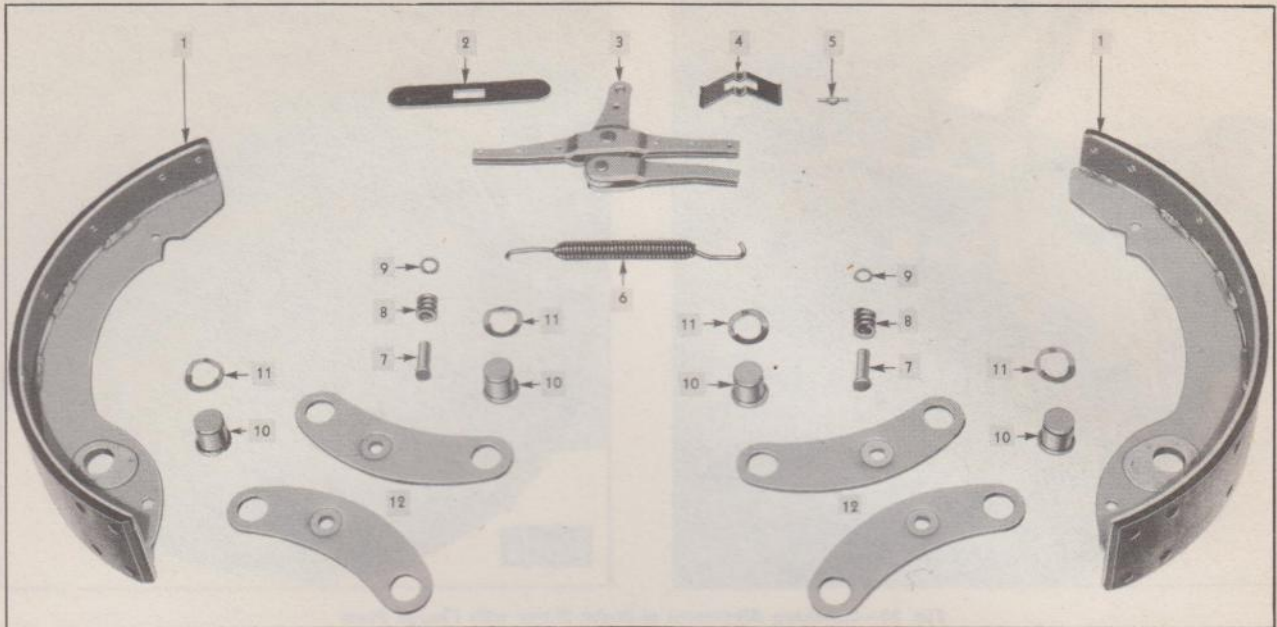


Fig. 17—Layout of Rear Wheel Brake Parts—1½-Ton Trucks

1—Brake Shoe and Lining  
2—Camshaft Hole Cover  
3—Parking Brake Link Assembly  
4—Brake Camshaft Hole Cover Spring

5—Parking Brake Lever Hole Cover Spring Pin  
6—Brake Shoe Retracting Spring  
7—Brake Shoe Articulating Link Friction Spring Pin

8—Brake Shoe Articulating Link Friction Spring  
9—Brake Shoe Articulating Link Friction Spring Pin

10—Brake Shoe Articulating Link Pin  
11—Brake Shoe Articulating Link Pin Lock  
12—Brake Shoe Articulating Link

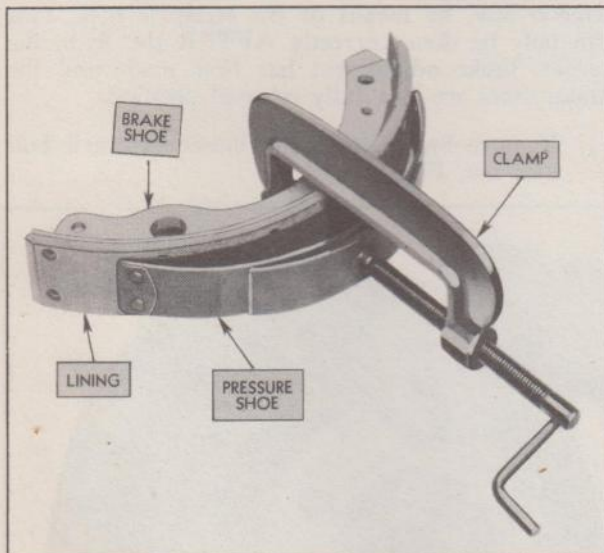


Fig. 18—Installing Brake Lining Clamp

side, as it is actuated by the parking brake lever to set the brakes, moves the links outward expanding the brake shoes. Each link has a support at its outer end.

- Each brake shoe of the rear brakes has an individual anchor pin.

The illustration, Fig. 17, shows a layout of the 1½ ton truck rear brake parts.

#### BRAKE SHOE RELINING

- Remove the rivets, using the deliner punches in a brake shoe relining machine.
- Wash the shoes in cleaning solvent, then buff them on a wire buffer.

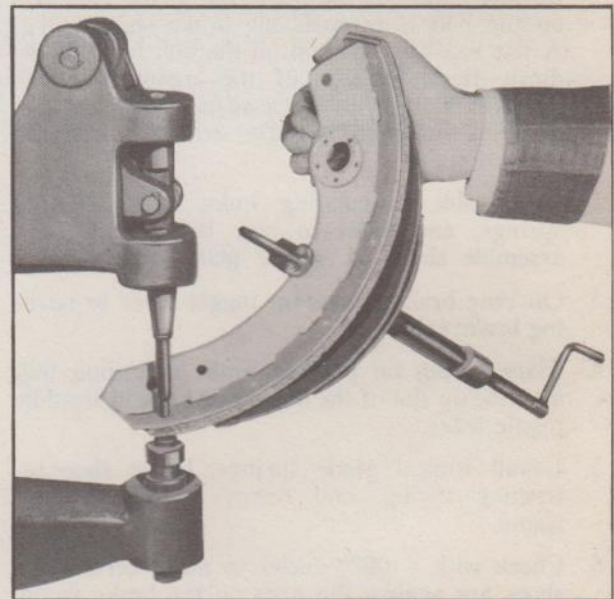


Fig. 19—Riveting Brake Lining to Shoe

- Install new lining in place on shoe and rivet two holes at center.
- In order to eliminate air pockets between lining and shoe which might cause uneven contact or squeaky brakes, a brake shoe lining clamp should be used to force the lining against the shoe, Fig. 18.
- After the end holes in the lining and shoe are in alignment, the rivets may be installed in both ends, Fig. 19.
- Remove the clamp and install the remaining rivets.

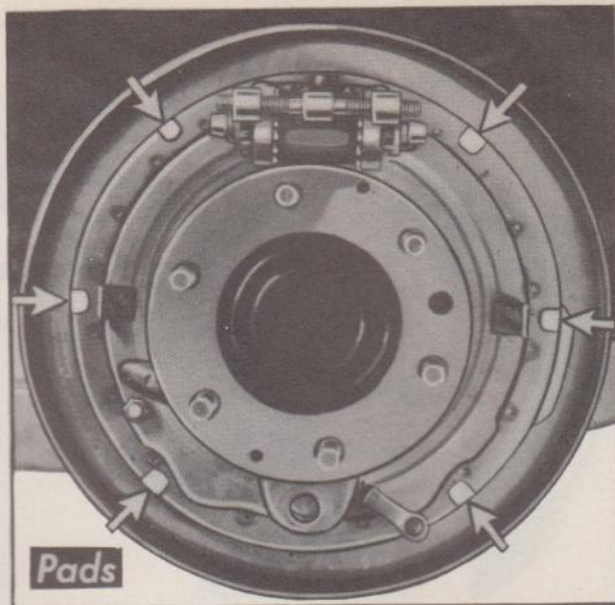
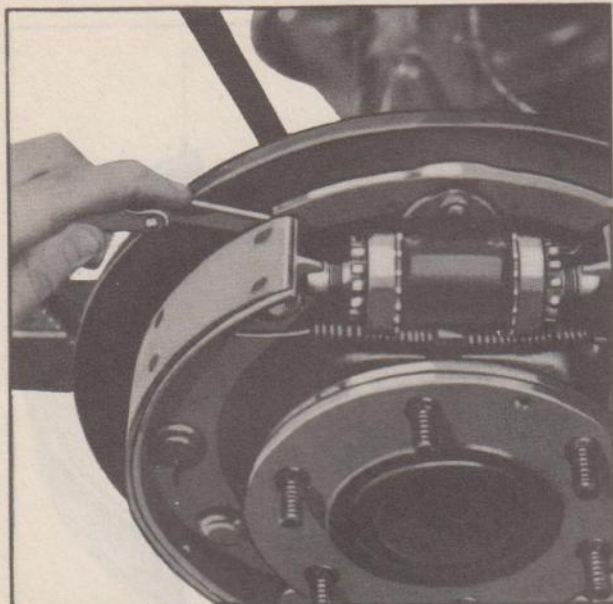


Fig. 20—Checking Alignment of Brake Shoes with Flange Plate

### BRAKE SHOE REPLACEMENT

#### ½ and ¾-Ton Truck Rear Brakes

1. Reassemble toggle lever to new shoe assembly, making sure that the high side of the eccentric on the bolt is towards the brake shoe facing. A flat has been ground on the bolt head to indicate the high side of the eccentric. (This eccentric bolt is used to adjust the clearance between the parking brake extension and the toggle link.)
2. Reassemble articulating links, pins, friction springs, and locks to new brake shoes and assemble shoes to anchor plate.
3. On rear brakes, hook-up toggle lever to parking brake cable.
4. Place spring on parking brake extension link and line up slot of the link so that it will straddle toggle lever.
5. Install conical guide springs, brake shoe retracting spring, and remove wheel cylinder clamp.
6. Check with a .002" feeler to make certain the shoes are against the pads on the brake flange plate, Fig. 20. If the shoes do not touch all pads it may be necessary to bend the anchor plate to correct this condition.
7. When replacing rear brake drums, make sure the tongue in the web section of the drum extends into the drain hole in the axle shaft flange. This serves as a positive locating point to line up the hole in the drum with the drain hole in the axle shaft flange.

Whenever a brake drum has been removed for replacement of brake shoes or for shoe adjustment, it will be necessary to depress the foot pedal firmly to align the brake shoe articulating links before making brake adjustment.

### PARKING BRAKE TOGGLE LEVER ADJUSTMENT

Whenever new rear brake shoes are installed on the ½ ton and all ¾ ton trucks, it is necessary to adjust the toggle lever with the emergency brake extension link, by means of the eccentric bolt. This can only be done correctly AFTER the hydraulic service brake adjustment has been made and the brake shoes are in a fully released position.

1. Remove brake drum and loosen eccentric bolt lock nut, Fig. 21.

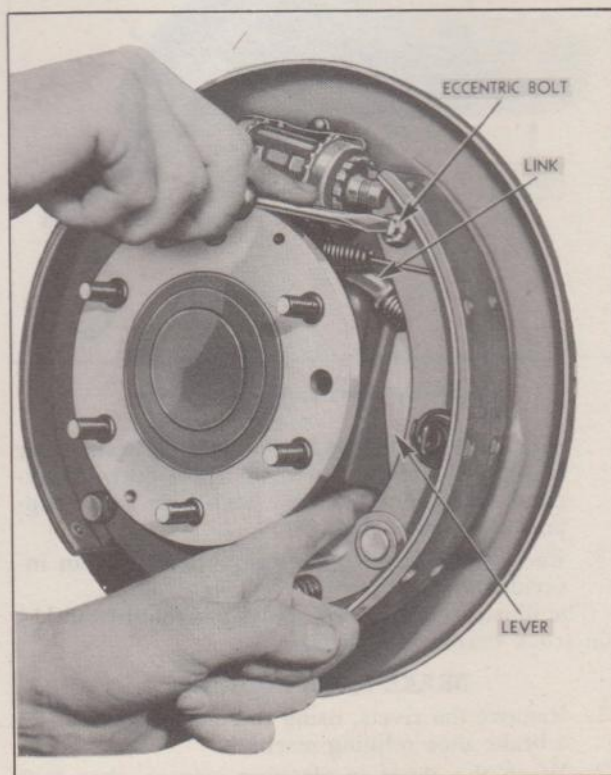


Fig. 21—Adjusting Rear Brake Toggle

2. Hold the toggle lever against the shoe and turn the eccentric bolt until there is only a slight clearance between the lever and the bottom of the slot in the parking brake extension link.
3. Tighten eccentric bolt lock nut and again check for clearance.
4. Replace brake drum, adjust parking brakes and road-test car for performance.

**1/2 and 3/4-Ton Truck Front Brakes**

The front brake shoes on 1/2 and 3/4 ton trucks are installed in the same manner as on the rear with the exception that the front brakes do not have a parking brake toggle link.

**1 1/2-Ton Truck Brakes**

1. Reassemble articulating links, pins, friction springs, and locks to new brake shoes and assemble shoes to anchor plate.
2. Check fit of shoe in the brake shoe guide riveted to the anchor plate. The shoe should be free without excessive side movement.
3. Install brake shoe retracting spring and remove wheel cylinder clamp.
4. Replace wheels and hubs and adjust the wheel bearings as outlined in the Front and Rear Axle Sections.
5. Adjust brakes as previously outlined under Wheel Cylinder and Emergency Brake Adjustments.

**Brake Drums**

The brake drums are attached to the wheel hubs by serrated bolts. These bolts are also used for mounting the wheels to the hubs.

To remove a brake drum, drive out the serrated bolts and remove the drum.

When replacing a drum, the gasket between the inside of the brake drum and oil deflector should be coated with heavy shellac or paint on both sides to prevent oil from leaking on to the braking surface of the drum. The small hole in the gasket and the



Fig. 22—Peening Hub and Drum Bolts

channel in the oil deflector must be lined up with the oil relief hole in the drum. Insert six new bolts through the oil deflector, brake drum and hub flange, then place the assembly on the riveting fixture with the threaded end of the bolt passing into the hole in one of the supports. Drive the bolts into place, solidly. Place the assembly on the fixture as shown in Fig. 22 and peen the shoulder of the bolt into the chamfer in the hub flange. It is good practice to turn the peening tool after each hammer blow to prevent damage to the tool.

**NOTE—The above operation is very important from a safety standpoint.**

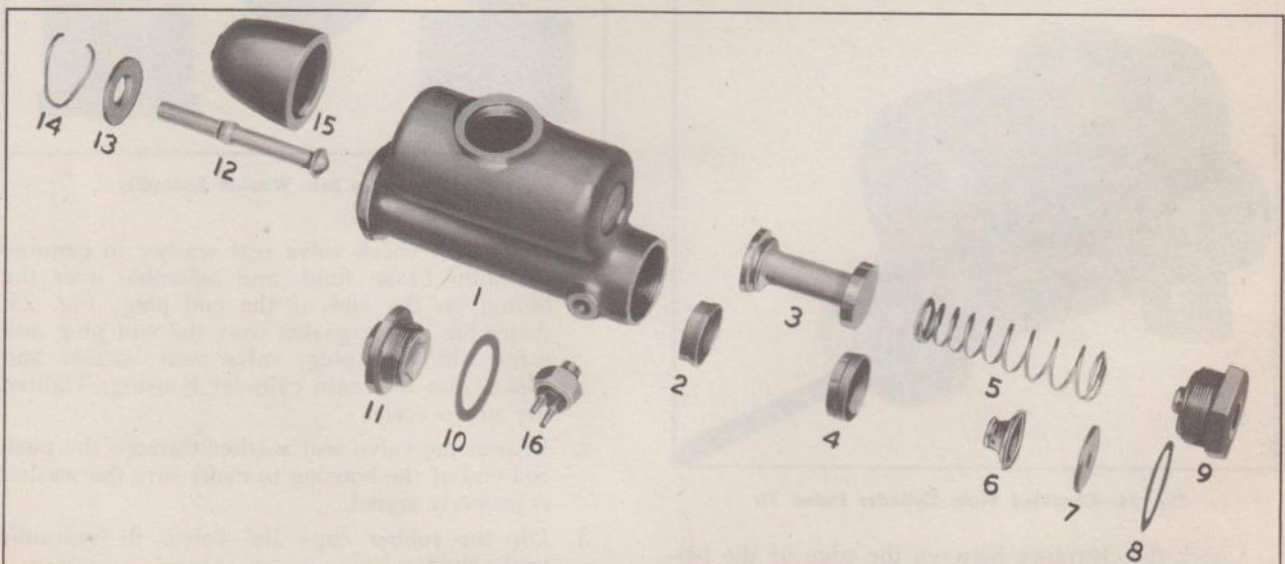


Fig. 23—Layout of Main Cylinder Parts

- |                        |                   |                       |                      |
|------------------------|-------------------|-----------------------|----------------------|
| 1—Main Cylinder Body   | 5—Return Spring   | 9—End Plug            | 13—Link Retainer     |
| 2—Secondary Piston Cup | 6—Outlet Valve    | 10—Filler Plug Gasket | 14—Snap Ring         |
| 3—Piston               | 7—Valve Seat      | 11—Filler Plug        | 15—Dust Boot         |
| 4—Primary Piston Cup   | 8—End Plug Gasket | 12—Pedal Link         | 16—Stop Light Switch |

## MAIN CYLINDER OVERHAUL

### Disassembly

1. Remove the end plug and valve seat washer.
2. Remove the valve seat washer from the button on the end plug, Fig. 25.
3. Remove the valve assembly and spring.
4. Remove the main cylinder boot.
5. Remove the pedal stop snap ring with a screwdriver and remove the pedal stop assembly.
6. Remove the piston with the secondary cup.
7. Remove the primary cup.

After all parts have been removed from the main cylinder, they should be washed in CLEAN ALCOHOL. Special care should be taken to make sure that the compensating port in the main cylinder housing, and the bleeder holes of the piston are clean. **BEFORE WASHING PARTS, HANDS MUST BE CLEAN. DO NOT WASH HANDS IN GASOLINE OR OIL BEFORE CLEANING HYDRAULIC BRAKE CYLINDER PARTS. USE SOAP AND WATER TO CLEAN HANDS.**

The illustration, Fig. 23, shows a layout of the main cylinder parts.

### Inspection

Inspect the cylinder bore to make sure it is smooth.

Inspect primary and secondary cups, valve and valve seat for damage or swelling. Replace when necessary. Swelling of the rubber parts is due to the use of improper brake fluid, or the washing of the parts in gasoline, or kerosene.

**NOTE—The primary cup of the main cylinder has a brass support ring vulcanized in its base to prevent the primary cup from imbedding in the bleeder holes during braking action.**

Check piston fit in the cylinder bore, see Fig. 24. The clearance between the piston and wall of the cylinder should be from 1 to 5 thousandths of an inch.

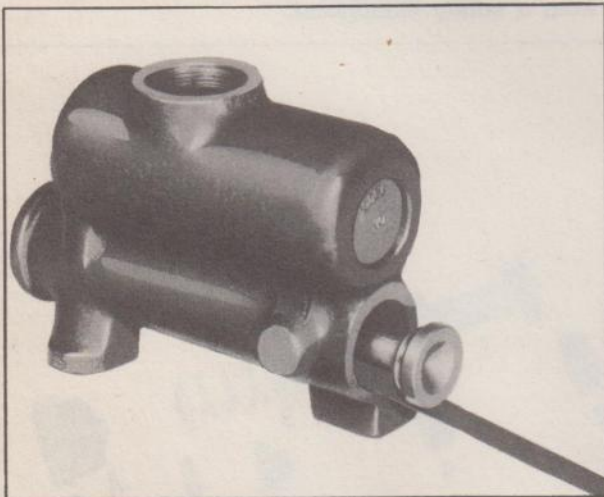


Fig. 24—Checking Main Cylinder Piston Fit

Check the clearance between the edge of the primary cup and the center of the compensating port, Fig. 25. In order to check this clearance accurately the main cylinder must be partially assembled as follows:

1. Install pedal stop assembly and lock in place with snap ring.
2. Assemble secondary cup on piston and install assembly in housing. Place the primary cup in the housing, with the flat side of the cup against the piston.
3. Push the piston and cup against the pedal stop and check the clearance between the edge of the primary cup and the center of the compensating port. This clearance should be a minimum of 35 thousandths of an inch. This check is made easiest by using a wire inserted through the reservoir of the housing and extending into the piston chamber, Fig. 25. If the clearance is less than 35 thousandths of an inch, the primary cup must be replaced with a new one.
4. After this clearance has been checked, the main cylinder must be again completely disassembled and reassembled according to the following directions.

### Reassembly

Whenever a hydraulic brake master cylinder is being overhauled for any purpose, care must be taken to reassemble the valves and seats correctly. Improper assembly of the check valve seat rubber washer will result in its distortion. When the check valve seat is distorted, there will be no check valve seal and there will be a loss of brake pedal travel and the pedal must be depressed or pumped one or more times before actual car braking occurs.

In order to minimize the chances of distorting the check valve seat the following method of assembly is recommended:

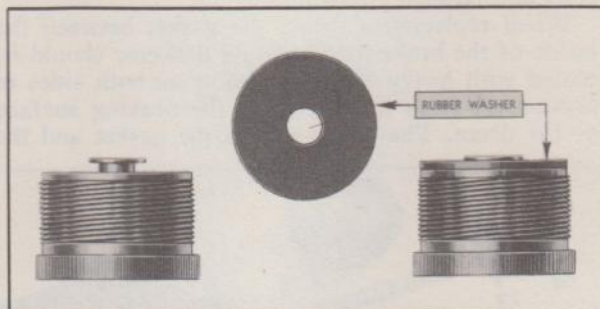


Fig. 25—Valve Seat Washer Assembly

1. Dip a new check valve seat washer in genuine hydraulic brake fluid, and assemble over the button on the end of the end plug, Fig. 25. Assemble a new gasket over the end plug and screw the end plug, valve seat washer and gasket into the main cylinder housing. Tighten the nut securely.
2. Inspect the valve seat washer through the push rod end of the housing to make sure the washer is properly seated.
3. Dip the rubber cups and valves in hydraulic brake fluid.
4. Install the valve assembly from the push rod end of the main cylinder.
5. Install piston spring.

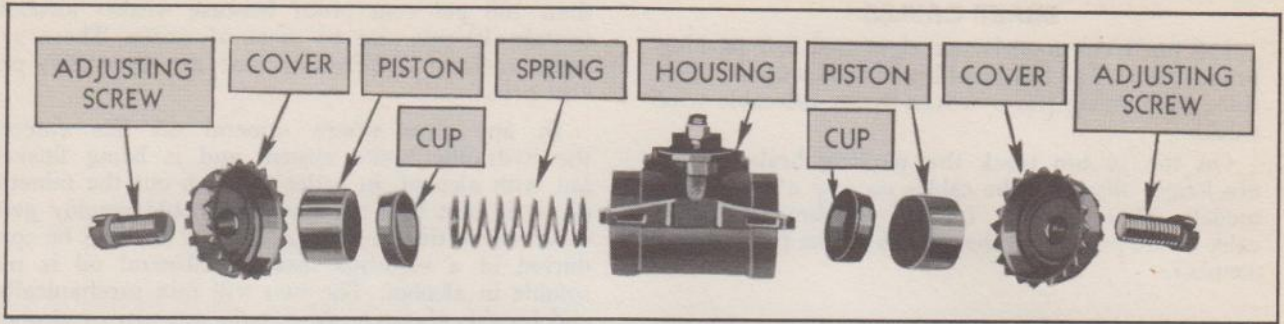


Fig. 26—Wheel Cylinder Parts Layout

6. Place the primary cup in the housing, with the cupped side against the spring.
7. Assemble secondary cup to the piston and install assembly to the housing so that the bleeder hole end of the piston will be against the flat side of the primary cup.
8. Install the pedal stop assembly and lock in place with the snap ring.
9. Install the rubber pedal stop boot, making sure this seal is tight on the housing and the vent hole in the boot is at the bottom. This seal must be tight to keep water and other foreign matter from entering the main cylinder through the pedal stop.
10. After the main cylinder has been assembled to the chassis, it should be filled with genuine G. M. Super No. 9 hydraulic brake fluid, and all pipe lines at each wheel cylinder bled.

**WHEEL CYLINDER OVERHAUL**

**Removal**

In order to remove a hydraulic brake wheel cylinder the truck must be jacked up, the wheel and brake drum removed, the brake system wheel cylinder pipe or hose disconnected at the wheel, and the brake shoe retracting spring disconnected from the brake shoes. Two cap screws which hold the cylinder to the brake flange plate must be removed before the cylinder can be taken from the flange plate.



Fig. 27—Checking Wheel Cylinder Piston Fit

**Disassembly**

1. Remove the cylinder adjusting covers.
2. Remove the pistons, rubber cups and spring.
3. Wash all parts in CLEAN ALCOHOL. WASH YOUR HANDS BEFORE WASHING THE PARTS IN ALCOHOL. HANDS MUST BE CLEAN.

The illustration, Fig. 26, shows a layout of the wheel cylinder parts.

**Inspection**

1. Inspect the cylinder bore, making sure that it is smooth. A scored or damaged cylinder must be replaced.
2. Check rubber cups for damage or swelling due to improper brake fluid. Replace the cups when necessary. Improper brake fluid will cause the cups to swell as much as 40 per cent.
3. Check the fit of the piston in the cylinder bore, using a feeler gauge, Fig. 27. This clearance should be from 2 to 4 thousandths of an inch.

**Reassembly and Replacement**

1. Dip pistons and rubber cups in brake fluid.
2. Place the spring in the center of the housing, the rubber cups at each end of the spring, with their open face to the spring and the flat face of the cup flush with the piston.
3. Replace the adjusting covers with the adjusting screws in place.
4. Reassemble the wheel cylinder to the flange plate, connect the wheel cylinder pipe or hose and replace the brake shoe retracting spring, brake drum, and the wheel.

**After a wheel cylinder has been overhauled and replaced, all hydraulic brake lines must be bled.**  
**WHEEL CYLINDER SIZES AND IDENTIFICATION**

Each brake has a specified wheel cylinder, depending on the area of the brake shoe. It is important that *only the specified wheel cylinder be used* at that wheel.

	Front	Rear
1/2 and 3/4 Ton Truck.....	1 1/4"	1-3/16"
1 1/2 Ton Truck .....	1 1/4"	1 1/2"

The above sizes are stamped under the adjusting cup lock spring on each cylinder housing. The numbers stamped on the housing indicate the size of the piston.

**BRAKE CABLES**

1½ ton truck models use right and left parking brake cables. The left hand brake cable may be identified by a string tracer woven under the cable wire shield.

On the ½ ton truck the parking brake cables are longer than are the cables on any of the other models. This provides for the attachment of the cable to the pull rod at the pulleys on the frame cross member.

**ALCOHOL FOR CLEANING HYDRAULIC BRAKE PARTS**

We cannot recommend using any alcohol for cleaning the hydraulic brake system which is less

than 188 per cent proof because weaker alcohols contain 10 per cent or more of water. There are some radiator antifreezes that are even 200 per cent proof.

In any case where mineral oil has entered the hydraulic brake system and is being flushed out with alcohol, in order to clean out the mineral oil, it is best that the flushing should employ generous quantities of alcohol and the flushing be conducted in a vigorous manner. Mineral oil is not soluble in alcohol. The two will mix mechanically, and for this reason a rather large quantity of alcohol, with considerable pressure behind it, must be used. Alcohol that has been used for cleaning out a system containing any mineral oil should never be used again.

**BRAKE TROUBLES AND REMEDIES**

Symptom	Probable Remedy
<b>Brake Pedal</b>	
1. Brake pedal "spongy."	1. Air in lines, bleed brakes.
<b>All Brakes Drag</b>	
1. Mineral oil in system.	1. Thoroughly wash out all lines and cylinders, and replace all rubber parts.
2. Improper toe-board clearance.	2. Adjust toe-board clearance. See Instructions.
3. Dirt in main cylinder compensating port.	3. Remove main cylinder and clean thoroughly. See Instructions.
<b>One Brake Drags</b>	
1. Loose wheel bearing.	1. Adjust wheel bearing.
2. Weak retractor spring.	2. Replace spring.
3. Brake shoes adjusted too close to drum.	3. Readjust brakes according to instructions.
<b>Loose Brakes</b>	
1. Normal lining wear.	1. Readjust brakes according to instructions.
2. Brake lining worn out.	2. Replace linings and readjust.
3. Fluid low in main cylinder.	3. Fill main cylinder and bleed all brake lines.
<b>Brakes Uneven</b>	
1. Oil on lining.	1. Thoroughly clean brake mechanism and install new lining.
2. Shoes tight on brake anchor.	2. Remove brake drum and free up shoes on anchor.
3. Tires improperly inflated.	3. Inflate tires according to specifications.
4. Spring center bolt sheared and spring shifted on axle.	4. Replace spring center bolt, relocate spring on axle.
<b>Excessive Pedal Pressure, Poor Brakes</b>	
1. Oil on lining.	1. Thoroughly clean brake mechanism and install new lining.
2. Full area of lining not contacting drum.	2. Sand shoes so linings contact drum properly.
3. Scored brake drum.	3. Turn drum, or replace it. If lining is badly scored, it should also be replaced.

**TOOLS REQUIRED**

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling brakes:

<i>Tool Number</i>	<i>Description</i>
J-713C.....	Brake Main Cylinder Filler
J-747.....	Brake Bleeder Tube

<i>Tool Number</i>	<i>Description</i>
J-718C.....	Brake Cylinder Clamps (Set of four)
KMO-142.....	Brake Spring Pliers
J-554.....	Hub Bolt Peening Tool
J-1280.....	Brake Tube Flaring Tool
KMO-3.....	Tube Cutter



## BRAKE SPECIFICATIONS

SERVICE BRAKE TYPE...4-Wheel Hydraulic

HAND BRAKE TYPE.....Mechanical Linkage to Rear Brake Shoes

### MAIN CYLINDER

Mounting.....L.H. Frame Side Rail

Size

1/2 Ton .....1"  
3/4 and 1 1/2 Ton.....1 1/4"

### FRONT WHEEL CYLINDER

Size

All .....1 1/4"

### REAR WHEEL CYLINDER

Size

1/2 and 3/4 Ton ..... 1-3/16"  
1 1/2 Ton ..... 1 1/2"

### BRAKE DRUM DIAMETER

Front

1/2 and 3/4 Ton.....11"  
1 1/2 Ton .....14"

Rear

1/2 and 3/4 Ton.....11"  
1 1/2 Ton .....16"

Regrinding Limits......125" on Diameter

### BRAKE LINING—FRONT

Width

1/2 and 3/4 Ton.....1 3/4"  
1 1/2 Ton .....2"

Length

1/2 and 3/4 Ton.....11-5/16"  
1 1/2 Ton .....14 1/8"

Thickness

1/2 and 3/4 Ton......187"—.194"  
1 1/2 Ton Conventional......243"—.250"

### BRAKE LINING—REAR

Width

1/2 and 3/4 Ton.....1 3/4"  
1 1/2 Ton .....3"

Length

1/2 and 3/4 Ton.....11-5/16"  
1 1/2 Ton .....17-37/64"

Thickness

1/2 and 3/4 Ton......187"—.194"  
1 1/2 Ton Conventional......243"—.250"

### AREA—BOTH AXLES

Service Brakes

1/2 and 3/4 Ton.....158 1/4 Sq. In.  
1 1/2 Ton .....330 1/4 Sq. In.

Hand Brakes

1/2 and 3/4 Ton.....79 1/8 Sq. In.  
1 1/2 Ton .....214 3/4 Sq. In.

### MASTER CYLINDER

Fluid Level .....Check Periodically

Brake Fluid.....DuPont or Delco Super No. 9

Piston Clearance ......001"—.005"

### WHEEL CYLINDER

Piston Clearance ......002"—.004"

### FRONT SHOE ADJUSTMENT

From slight drag on drum back off 4 notches, adjusting screw at each end of wheel cylinder.

### REAR SHOE ADJUSTMENT

From slight drag on drum back off 2/3 turn or 4 sides of hexagon head of adjusting bolt, adjusting bolt outside of shoe backing plate at each end of wheel cylinder.

### HAND BRAKE ADJUSTMENT

With brake lever fully released, adjust clevis on end of pull rod to engage hole in idler lever when cables are pulled out of conduits by hand until a positive stop is felt.

### PEDAL ADJUSTMENT

Pedal to Toe-Board Clearance.....1/4"

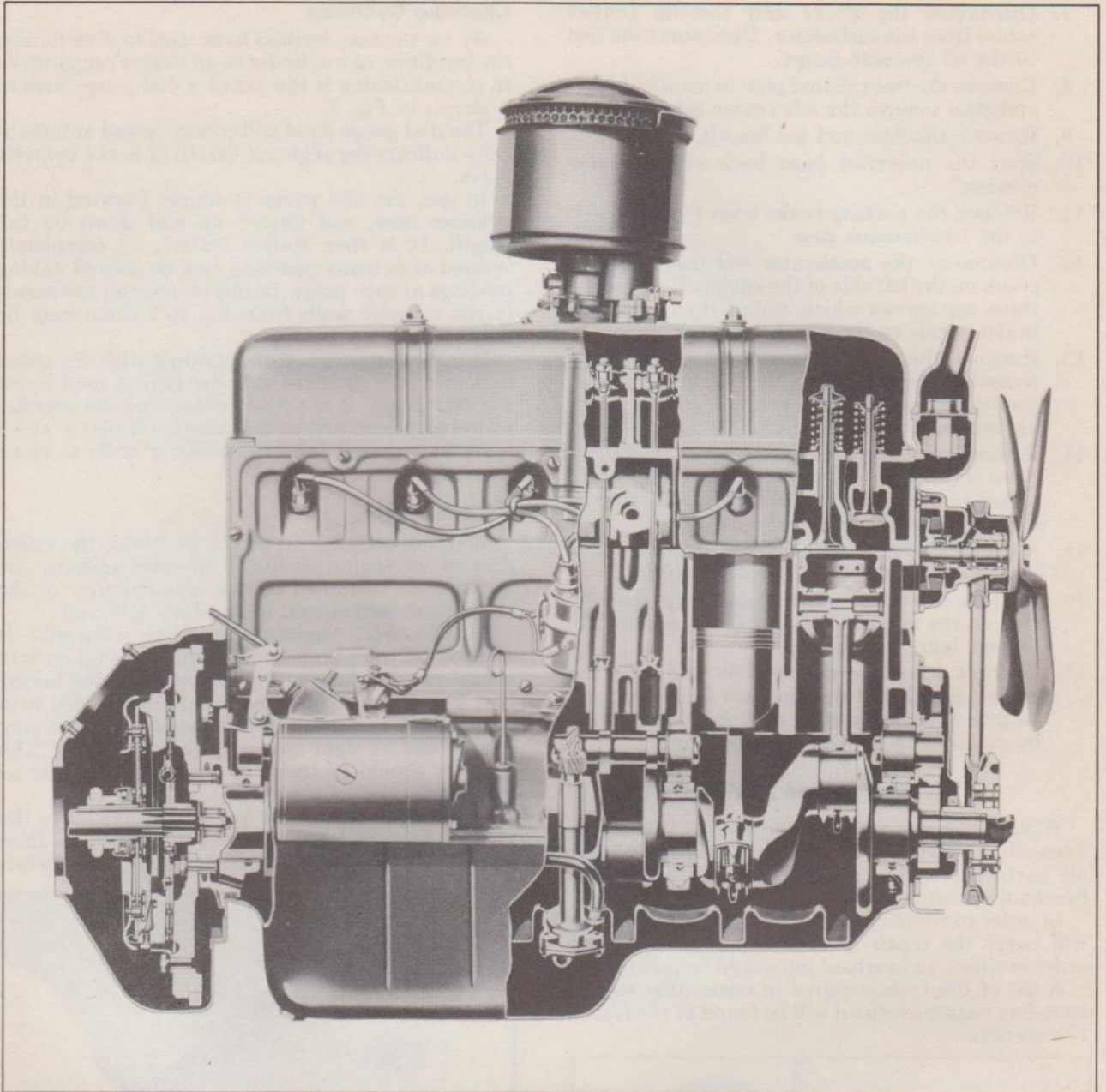


Fig. 1—Engine—Cross-Section

## ENGINE

The engine is a six cylinder valve-in-head type, equipped with a counterbalanced crankshaft.

The displacement of this engine is 216.5 cubic inches, it develops 90 horsepower at 3300 revolutions per minute.

Maximum torque is 174 foot-pounds. The illustration Fig. 1 shows a view of the engine assembly in cross-section.

### Engine Removal from Chassis

1. Drain radiator and cylinder block. Remove the hood and hood side panels.
2. Remove the radiator, front end sheet metal, and fenders as a unit as described in Section 11 of this manual.
3. Remove the battery cable and ammeter wire from the starter switch terminal. Tape the end of the battery wire to prevent the possibility of shorts. Remove the coil wire from the center terminal of the reversing switch. Remove the two screws which mount the coil and lay the coil with the electrolock cable attached on top of dash.
4. Disconnect the gasoline line from the fuel pump.
5. Remove the right engine side pan.
6. Remove the generator and field wires from the generator. Remove the wires from the horn.

7. Disconnect the choke and throttle control cables from the carburetor. Disconnect the line to the oil pressure gauge.
8. Remove the two exhaust pipe to manifold bolts and then remove the left engine side pan.
9. Remove the floor and toe boards.
10. Split the universal joint back of the transmission.
11. Remove the parking brake lever from the side of the transmission case.
12. Disconnect the accelerator rod from the bell crank on the left side of the engine. Remove the three cap screws which mount the clutch and brake pedals to the clutch housing.
13. Remove the starting motor cross shaft by removing the bolts from the brackets and disconnecting the link and spring from the starting motor gear shifter lever.
14. Remove the transmission cover and place a piece of cardboard on top of the transmission to prevent the possibility of dirt falling into it during the following repair operations.
15. Remove the bolts from the rear engine mountings. Remove the front engine mounting.
16. Remove the third cylinder head bolt from the rear on the left side and install the engine lifting eye bolt.
17. Connect a hoist to the eye bolt and raise the engine, clutch and transmission from the chassis as a unit. The engine assembly should then be mounted in an engine repair stand.

### REPAIR OPERATIONS

When it becomes necessary to overhaul an engine assembly it should be completely disassembled and all parts thoroughly cleaned before starting the overhaul operations.

In order to simplify the following instructions we will cover the repair of the various parts in the order in which an overhaul job would be performed.

A list of the tools required in connection with a complete engine overhaul will be found at the end of this section.

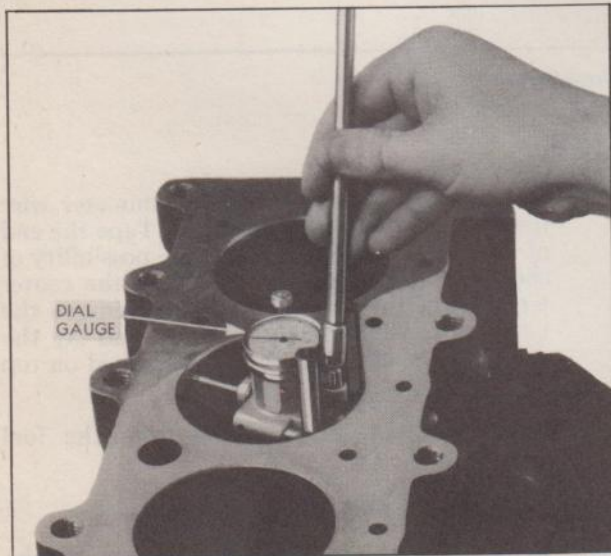


Fig. 2—Checking Cylinder Walls with Dial Gauge

### Checking Cylinders

By far the best method to be used in determining the condition of a cylinder in an engine preparatory to reconditioning is the use of a dial gauge such as is shown in Fig. 2.

The dial gauge hand will instantly and automatically indicate the slightest variation in the cylinder bores.

In use, the dial gauge is simply inserted in the cylinder bore, and moved up and down its full length. It is then turned spirally or completely rotated at as many points as may be desired, taking readings at each point. In this manner all variations in the cylinder walls from top to bottom may be determined.

If a master gauge, corresponding with the exact diameter of a standard cylinder bore is used to set the dial gauge, it is easy to determine the oversize piston to use as well as the amount of metal which must be removed from the cylinder walls to make them true.

### Cylinder Boring

When it becomes necessary to rebore the cylinders of an engine to install oversize pistons, the instructions furnished by the manufacturer of the equipment used should be carefully followed.

In Chevrolet engines the piston clearance is allowed on the piston and this must be taken into consideration when setting the cutter in the boring bar. The piston to be fitted should be checked with a micrometer, measuring just below the lower ring groove and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston.

If a micrometer is not available to measure the piston, the cylinder should be bored .002" less than the oversize piston to be fitted. For example, when

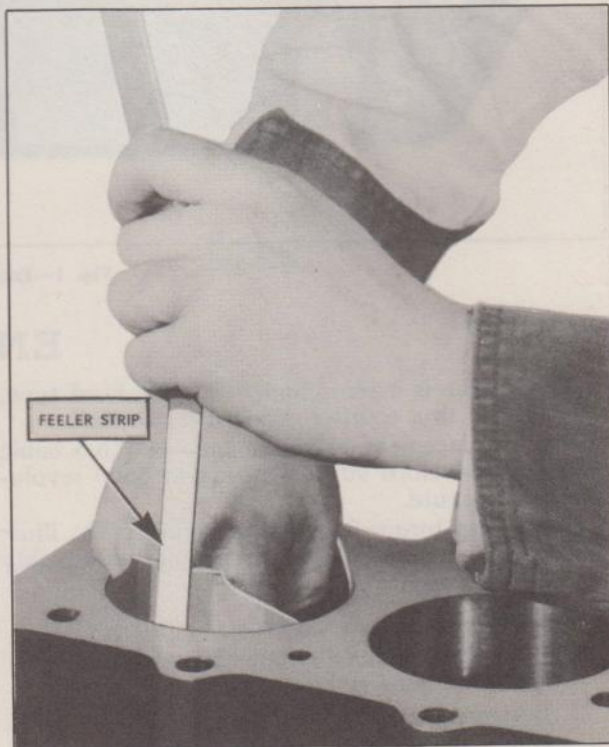


Fig. 3—Fitting Pistons

fitting a .020" oversize piston, the cylinder should be bored .018" oversize.

### Cylinder Hone

After a cylinder has been rebored within .002" of the size desired, they should be finished or polished with a cylinder hone.

In operation, the hone is placed into the cylinder bore and expanded until it can just be turned by hand. The hone is then operated, up and down, in the bore until it begins to run free. During this operation kerosene should be used as a cutting fluid to keep the stones of the hone clean. This procedure should be followed until the piston you are fitting can be pushed through the cylinder on a .0015" feeler gauge. **THE FEELER GAUGE MUST BE INSERTED VERTICALLY, 90° AROUND PISTON FROM THE PISTON PIN.** See Fig. 3.

### Pistons

Chevrolet pistons are cast iron electroplated, with a slipper skirt with three ring grooves located above the piston pin. They are of unusual design, being cam ground (out of round). This method of grinding the piston compensates for heat expansion along the line of the piston pin bosses.

Chevrolet pistons are furnished in standard sizes as well as .003", .010", .020", .030" and .040" oversizes.

**NOTE—Any time a piston is removed from the cylinder it should be examined for carbon on the inside and any carbon deposit removed. This helps keep the engine oil clean.**

### Fitting Piston Pins

Chevrolet pistons are serviced with the piston pin bushings and piston pins fitted in them. Should it become necessary to install oversize piston pins the following procedure should be carefully followed:



Fig. 4—Reaming Piston Pin Bushings

1. Place the piston pin bushing reaming fixture J-965 in a bench vise. The purpose of the reaming fixture is to make sure the piston pin bushings will be reamed at right angles to the skirt of the piston, assuring proper alignment of the piston in the cylinder.
2. Adjust the expansion reamer for a light cut.

3. Insert the reamer in the piston bushing and start the reamer pilot into the guide in the fixture.
4. Hold the piston in the V-block of the fixture with one hand and turn the reamer handle with the other hand until the reamer has passed through both bushings as shown in Fig. 4.
5. Expand the reamer by easy stages and repeat the reaming operation until the piston pin is fitted.

The proper fit of the piston pin is a "thumb push" fit as shown in Fig. 5.



Fig. 5—Checking Piston Pin Fit

Chevrolet piston pins are serviced in standard sizes as well as .003", .005", and .010" oversizes.

### Piston Rings

The compression ring used in the Chevrolet engine is designed to control oil consumption during the break-in period. The face of the ring is tapered one-thousandth of an inch. With this design the lower edge of the ring tends to scrape the excess oil from the cylinder wall and acts as an oil control ring until the regular oil control ring is seated (broken-in) in the cylinder. All compression rings are marked with the word "TOP" cast in the upper side of the ring. When installing compression rings make sure the side marked "TOP" is toward the top of the piston.

Piston rings are furnished in standard sizes as well as .005", .010", .015", .020", .030" and .040" oversizes.

To properly fit new piston rings, proceed as follows:

Slip the ring into the cylinder, pressing it down about two inches into the bore with a piston. This will square the ring in the cylinder.

Check the gap between the ends of the ring with a feeler gauge. This should be from .005" to .015".

If the space between the ends of the ring is less than .005", remove the ring and with a fine file dress the ends until proper clearance is obtained. Fit each ring separately.

Carefully remove all particles of carbon from the faces of the ring grooves in the piston, and inspect

the grooves for burrs or nicks that might cause the rings to hang up.

Slip the outside of the ring into the groove, and roll it entirely around the groove, to make sure that the ring is free and does not bind in the groove at any point, Fig. 6.



Fig. 6—Checking Ring Fit in Groove

Proper clearance of the piston ring in its groove is very important and when fitting new rings the following clearances should be adhered to:

At the top ring a .002" feeler should be very free, but a .003" feeler should cause a rather heavy drag.

At the center ring, the .002" feeler should be just free and the use of a .003" feeler should cause the ring to lock in the groove.

At the bottom, or oil control groove, the .002" feeler should produce a light drag.



Fig. 7—Checking Piston Ring Clearance

Fig. 7 shows the method of checking ring groove clearance with a feeler gauge.

### Main Bearings

Chevrolet main bearings are steel back babbitt-lined. The babbitt is centrifugally cast or "spun-in" into the steel lining. This method assures a positive bond between the steel and the babbitt and also

prevents the formation of air pockets in the babbitt metal.

When it is necessary to replace main bearings, the clutch housing should not be removed from the cylinder block. This is very important, as the transmission pilot hole in the clutch housing is used in the alignment of the boring bar. Should it be necessary to replace the clutch housing, the new part must be assembled to the cylinder block and checked for alignment before main bearings are installed. The main bearing boring machine J-1000 illustrated in Fig. 8 is used for boring new main bearings in proper alignment.

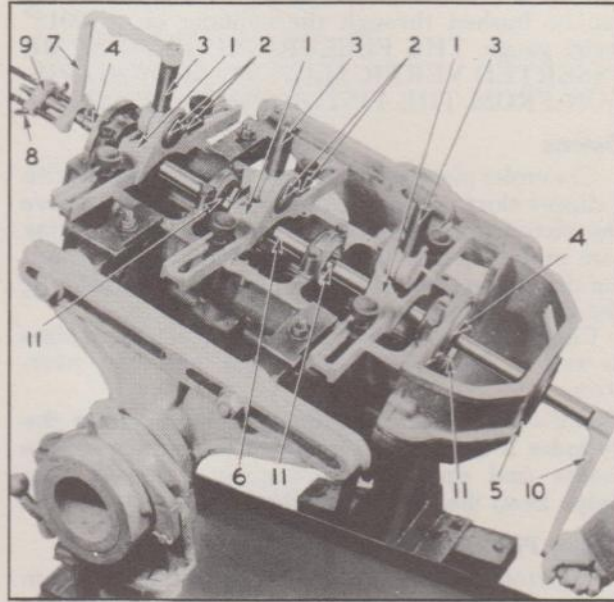


Fig. 8—Main Bearing Boring Machine

- |   |                                   |
|---|-----------------------------------|
| 1—Support Bracket and Clamps            | 6—Boring Bar                      |
| 2—Universal Clamp Bolts                 | 7—Boring Bar Feed Support Bracket |
| 3—Boring Bar Supports and Ball Bearings | 8—Feed Nut Yoke                   |
| 4—Boring Bar Centering Bushings         | 9—Feed Screw                      |
| 5—Clutch Housing Centering Bushing      | 10—Turning Handle                 |
|   | 11—Boring Bar Cutters             |

### Replacing Main Bearings

The operations for replacing main bearings are as follows:

1. Support the crankcase in motor stand with bearing side of case up.
2. Remove old bearings and see that case is well cleaned.
3. Install centering bushings (4), Fig. 8, in the front and rear bearing bores and install the bearing caps without shims.
4. Thread the boring bar (6) through the bushings from the rear to the front. Then mount the dial gauge on the boring bar and check the alignment of the transmission pilot hole in the clutch housing as shown in Fig. 9. The runout must not exceed .015". If it does, it will be necessary to replace the clutch housing before proceeding with the job of installing new main bearings.
5. Remove the boring bar and the centering bushing in the rear bearing. Then install the clutch housing centering bushing (5) in the transmission pilot hole of the clutch housing.

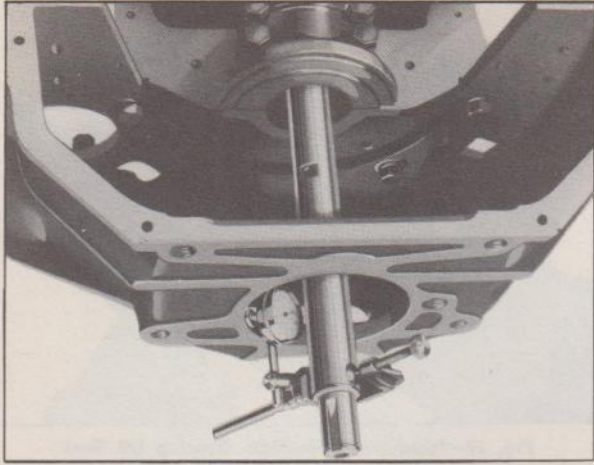


Fig. 9—Clutch Housing Alignment

6. Install the boring bar through the rear centering bushing and thread the boring bar support bearings (3) over the bar, locating one support in the space between each two bearings. Be sure to push the boring bar through the front centering bushing beyond the reduced diameter portion.
  7. Install the boring bar support brackets (1) and line them up so there will be clearance between the bearing cap and support bracket for the installation and removal of cutters. Clamp the support brackets firmly to the pan rail of the cylinder block.
  8. Tighten the universal clamp bolts (2) on each support bracket evenly. As the bolts are being tightened, the boring bar should be turned by hand to make sure that it is free to turn without any indication of a bind. Remove the boring bar and the front centering bushing.
  9. Install the bearing shells in the cylinder block and caps.
- NOTE—The front and front intermediate bearing shells are very similar in appearance and it is possible to get them mixed. The front intermediate shells are identified by the letter "I" in the bottom of the oil groove. Should the intermediate bearing shell be installed in the front bearing bore, the sides of the bearing would be too high and would not permit the cap to seat firmly on the shims.**
10. Place four .002" shims on each side of each bearing and install the caps. The intermediate bearing caps are marked "front" and "rear" for identification purposes. The front intermediate bearing cap is installed with the "FRONT" mark to the front of the engine and the rear intermediate bearing cap is installed with the "REAR" mark to the rear of the engine.

The rear intermediate bearing shell is flanged because it takes the end thrust of the crankshaft.

Tighten the bearing cap bolts evenly and make sure they are drawn down tight.

11. Examine the boring bar to make sure the cutter seats are clean; then install the bar through the rear centering bushings and bearing sup-

ports. Examine the cutters to make sure they are clean and install them in the slots in the cutter bar. Cutters are lettered F—FC—RC—R to designate front, front center, rear center, and rear.

12. Mount the feed screw support bracket (7) on the front boring bar support. Mount the feed screw (9) in its U-shaped yoke and install the screw in the end of the boring bar. Adjust the bar so that the cutters are just about to enter the bearings; then tighten the two feed screw support thumb screws.
13. Install the turning handle on the end of the boring bar and proceed with the boring operation. During this operation, use a liberal supply of kerosene to keep the cuttings washed out of the bearings.
14. After the cutters have passed through the bearings, remove turning handle and feed screw. Blow all cuttings out of the bearings with compressed air, being careful not to blow the cuttings into the boring bar support bearings.
15. Slide the boring bar back until the cutters have passed through the bearings; then again install the feed screw and bore through the bearing a second time. This is very important in order to obtain a perfectly smooth, true bearing.
16. Remove turning handle, feed screw, cutters and boring bar. Do not disturb the boring bar supports because they will be used when facing rear intermediate bearing for crankshaft end clearance.

#### Facing the Rear Intermediate Bearing

1. Install the boring bar through the centering bushing and the rear bearing support. Slip the facing cutters on the boring bar, one on each side of the rear intermediate bearing.
2. Place the feed screw sleeve in the front intermediate bearing and push the boring bar through the sleeve. Install the feed screw drive key through the hole in the sleeve and into No. 2 cutter hole in the boring bar, locking the key in place with its screw.
3. Adjust the feed screws for equal feed range on each side of the front intermediate bearing. Adjust the facing cutters to provide about .015" clearance between the cutter face and the flange of the bearing. Lock the cutters to the boring bar with the clamp screws.



Fig. 10—Facing Rear Intermediate Bearing

4. Caliper the width of the rear intermediate bearing journal on the crankshaft with the special inside and outside calipers, KMO-964.
5. Install the turning handle on the end of the boring bar. Back off the front feed screw collar several turns and tighten the rear feed screw collar until the front facing cutter contacts the bearing flange. Then proceed with the facing operation; tightening the feed screw is necessary to keep the cutter in contact with the bearing flange.

The front flange of the bearing should be machined just enough to thoroughly clean up the face. The proper installation of this tool is shown in Fig. 10.

6. Back off the rear feed screw collar and tighten the front collar until the rear cutter engages the bearing rear flange. Then continue with the facing operation, checking the progress of the job every few turns with the special caliper that was set for the width of the crankshaft journal. Continue facing the bearing until the special caliper will pass over the bearing and a .004" feeler laid alongside the bearing flange.

Remove the bearing cap and place it on the rear intermediate journal of the crankshaft. Check the end clearance with a feeler gauge; the correct clearance is .004" to .007".

7. Disassemble the facing cutters and boring bar from the cylinder block. All parts of this tool should be thoroughly cleaned and oiled to prevent rusting, and put away in the special boxes provided for this purpose.

#### Crankshaft Rear Bearing Seal

The rear main bearing is sealed by a wick-type seal installed in a groove machined in the block and cap as shown in Fig. 11.

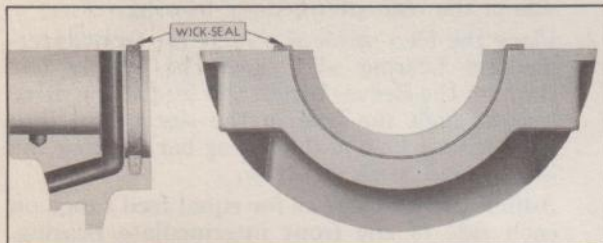


Fig. 11—Rear Main Bearing Oil Seal

To install a new wick seal at the rear main bearing cap, insert the packing in the groove with the fingers. Then using a rounded tool, roll the packing into the groove. When rolling the packing, start at one end and roll the packing to the center of the groove, Fig. 12. Then starting from the other end, again roll toward the center.

By following the above procedure you are assured that the wick is firmly pressed into the bottom of the groove.

The small portion of the wick which protrudes from the groove at each end should be cut flush with the surface of the bearing cap. To prevent the possibility of pulling the wick out of the groove while cutting off the ends, it is recommended that a round block of wood the same diameter as the crankshaft flange be used to hold the packing firmly in position while the ends are being cut off.



Fig. 12—Installing Rear Main Bearing Oil Seal

If it should become necessary to replace the upper half of the wick seal, it will be necessary to remove the engine from the chassis and remove the crankshaft.

The procedure for installing the wick in the cylinder block is exactly the same as for installing it in the bearing cap.

#### CRANKSHAFT

One of the main reasons for the smooth engine performance of Chevrolet's six-cylinder engine is its rugged crankshaft. It weighs 68 pounds, has heavy counterweights and extra large bearing diameters.

The crankshaft main bearing journal and connecting rod journal sizes are as follows:—Front, 2.6835"-2.6845"; Front Intermediate, 2.7145"-2.7155"; Rear Intermediate, 2.7455"-2.7465"; Rear, 2.7765"-2.7775"; Connecting Rod Journal, 2.311"-2.312".

Whenever a crankshaft has been removed from an engine, it is important that these dimensions be checked with a micrometer for out of round, taper and undersize. If the journals exceed .001" out of round or taper, the crankshaft should be replaced. Slightly undersize journals can be used providing that they are within the above limits for out of round or taper.

Any time the crankshaft is removed from the engine it should also be checked for runout. To perform this operation, support the crankshaft at the front and rear main bearing journals in "V" blocks and indicate the runout of both the rear intermediate and front intermediate journals, using a dial indicator. The runout limit of each of these journals is .002".

#### Installing Crankshaft

Blow out all cuttings from the bearings.

Clean out all oil passages by blowing them out with compressed air. It is a good practice to blow out each oil passage separately—this can be done by placing the fingers on the oil hole in three of the bearings while the nozzle of the air gun is placed in the oil inlet of the cylinder block. After blowing out the oil passages of all four bearings, then blow through each of the oil passages from the main bearings to the camshaft bearings.

Proper cleaning of all oil passages is very important and must be done thoroughly.

Lubricate all four bearings and carefully place the crankshaft in the bearings.

Check the end play by forcing the crankshaft to its extreme rear position. Check at the rear side of the rear intermediate bearing with a feeler gauge. See Fig. 13. This clearance should be from .004" to .007".



Fig. 13—Checking Crankshaft End Play

Install the bearing caps with four .002" shims on each side and pull the bolts down snugly. Check to see that the crankshaft rolls freely.

#### Adjusting Main Bearings

Starting with the rear bearing, remove shims evenly until there is a slight drag on the crankshaft (turning it by hand) with the bolts pulled down tight. Then replace one .002" shim for clearance, again tighten the bolts and check for drag. The crankshaft should now roll freely without any indication of a drag.

Loosen the bolts on the bearing that has just been adjusted and proceed to adjust the next one in the same manner and so on until all bearings have been adjusted.

When adjusting the bearings, shims should be removed evenly. If an uneven number of shims have to be used, it is good practice to have the greater number of shims on the same side of all bearings.

By following the procedure of removing shims to check and then replacing one .002" shim, there will be no possibility that the bearing will be too loose. Then if the crankshaft may be turned freely by hand, it is certain that the bearing is not too tight.

If the shaft turns freely by hand, after all bolts have been tightened, you know the bearings are properly adjusted.

## CAMSHAFT BEARINGS

All four of the camshaft bearings are steel backed, babbitt lined bearings. They are pressed into the crankcase and staked into place to prevent rotation and endwise movement. They are accurately line reamed at the time of assembly, assuring proper alignment of the camshaft. These bearings are lubricated through holes which line up with the oil passages from the main bearings.

To remove, replace, and line ream the camshaft bearings in service, a special set of tools, J-946, is necessary. This set consists of a removing and replacing bar, four removing and replacing sleeves, a bracket which is attached to the rear of the cylinder block and a special camshaft bearing reamer, shown in Fig. 14.

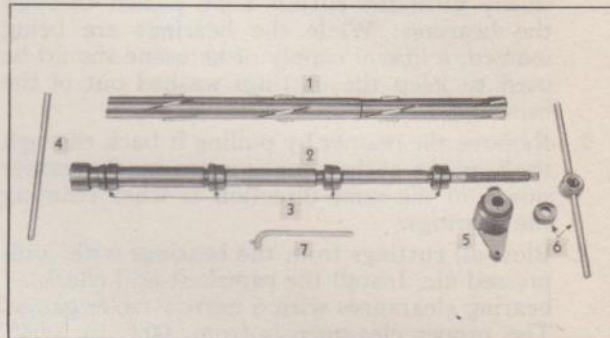


Fig. 14—Camshaft Bearing Tools

- |                                  |                             |
|----------------------------------|-----------------------------|
| 1—Reamer                         | 4—Extension Handle          |
| 2—Removing and Replacing Bar     | 5—Bracket                   |
| 3—Removing and Replacing Sleeves | 6—Handle and Thrust Bearing |
|                                  | 7—Staking Tool              |

#### Removal

1. Drive out the expansion plug at the rear of the rear camshaft bearing.
2. Assemble the camshaft bearing remover bracket loosely to the rear of the cylinder block.
3. Start the bearing puller bar through the front bearing and install the puller sleeve for each bearing over the bar before the bar has passed through that particular bearing. Then pass the bar through the hole in the bracket. Tighten the bolts that hold the bracket to the crankcase. Then install the thrust bearing and puller handle on the end of the bar.
4. Turning the puller handle will now remove all four bearings at one time. An extension handle is provided to aid in starting bearings that may have corroded in the case.

#### Replacement

1. To make sure that the oil holes in the camshaft bearing bores will line up with the oil holes in the camshaft bearings after the bearings have been installed, mark the position of the oil hole in the bore on the front face of the bearing bore.
2. Place a new front camshaft bearing over the puller bar and start the bar through the front bearing bore. Place the puller sleeve with a new bearing over the bar before passing the bar through the bearing bore in the cylinder block. Pass the end of the bar through the puller bracket and install the thrust bearing and turning handle.



- Line up the oil holes in each bearing with the oil hole location marks previously made. All four bearings can now be pulled into place at the same time.
- Remove the puller bar and bracket and then stake each bearing into the hole provided in the bore for that purpose.

### Reaming Camshaft Bearings

The special camshaft bearing line reamer has all four cutters mounted on one bar so that all of the camshaft bearings will be in perfect alignment after the reaming operation.

- Pass the reamer through the first, second, and third bearings. Then start the reamer cutters into all four bearings and turn the reamer slowly until the cutters have passed through the bearings. While the bearings are being reamed, a liberal supply of kerosene should be used to keep the cuttings washed out of the bearings.
- Remove the reamer by pulling it back through the bearings, at the same time turning the reamer slowly in the same direction as when reaming the bearings.
- Blow all cuttings from the bearings with compressed air. Install the camshaft and check all bearing clearances with a narrow feeler gauge. The proper clearance is from .002" to .004". Install the expansion plug in the cylinder block at the back of the rear camshaft bearing.

### Camshaft

The camshaft is designed to assure quiet operation, combined with accurate valve timing. The contour of the cams is carefully worked out to take up the valve clearance gradually. The valve lifters are located slightly off the center line of the cams. This design results in spinning the lifter so the cams do not engage the same point on the lifters each time the valves open, resulting in long valve lifter life and quiet operation.

The following is a list of the sizes of the camshaft bearing journals: front, 2.0282"-2.0292"; front intermediate, 1.9657"-1.9667"; rear intermediate, 1.9032"-1.9042"; rear, 1.8407"-1.8417".

Whenever a camshaft is removed from an engine, it is important that these dimensions be checked with a micrometer for out of round. If the journals exceed .001" out of round, the camshaft should be replaced.

Another very important inspection operation, when the camshaft is removed from the engine, is to check it for alignment. The best method is by use of "V" blocks and a dial indicator as shown in Fig. 15. The dial indicator will indicate the exact

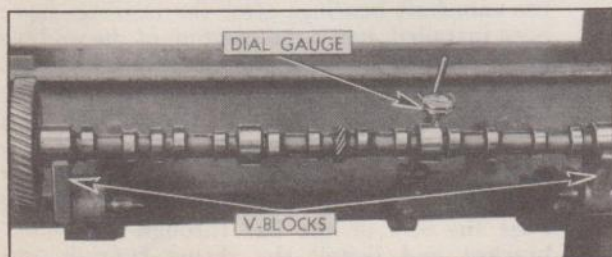


Fig. 15—Checking Camshaft Alignment

amount that the camshaft is out of true. If it is out more than .002" dial indicator reading, the camshaft should be straightened. When checking, the high reading of the dial indicator indicates the high point of the shaft. This point should be chalk marked so you can tell exactly where to apply pressure when straightening.

**NOTE**—During the straightening operation, care should be taken to protect the bearing journal to prevent damage to its surface.

After the camshaft has been straightened, it should be re-checked to be sure that it is within .002" dial indicator reading for alignment.

### CRANKCASE FRONT END PLATE

The crankcase front end plate is assembled to the cylinder block with from one to three gaskets. The removal or replacement of one or more gaskets provides an adjustment for aligning the timing gears.



Fig. 16—Checking Alignment of Timing Gears

In assembling the crankcase front end plate to the cylinder block, first use two gaskets and hold in place with three screws. Then place a new camshaft thrust plate over the camshaft hole in the end plate. Using a scale laid against the thrust plate and over to the shoulder on the crankshaft for the timing gear, check to see whether or not these two surfaces are flush, Fig. 16. If the scale strikes the shoulder on the crankshaft, add another gasket. If there is space between the scale and the shoulder on the crankshaft, remove one gasket.

After the proper number of gaskets have been installed between the plate and the crankcase, assemble the screws and bolts, setting the screws with a center punch.

### Crankshaft and Camshaft Gears (Timing Gears)

The gear on the end of the crankshaft, or the crankshaft timing gear, is cut from a solid piece of steel. It is a drive fit on the end of the crankshaft as well as being held in place with a key.

To remove this gear, without damage to it, a gear puller T-126-R, such as is shown in Fig. 17, is necessary. To replace this gear, a driver is essential so that the gear can be driven straight back on its seat accurately.

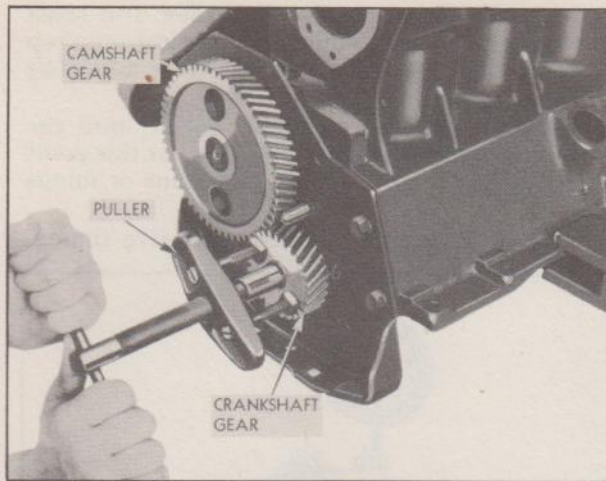


Fig. 17—Crankshaft Gear Puller

The camshaft gear, or camshaft timing gear, is a composition gear which has been pressed into gear blanks under enormous pressure. After this blank has been made, the teeth and the inside hole of the gear is machined, the timing mark punched on it and the keyway cut. This gear together with the steel crankshaft gear gives long, quiet, trouble free life.

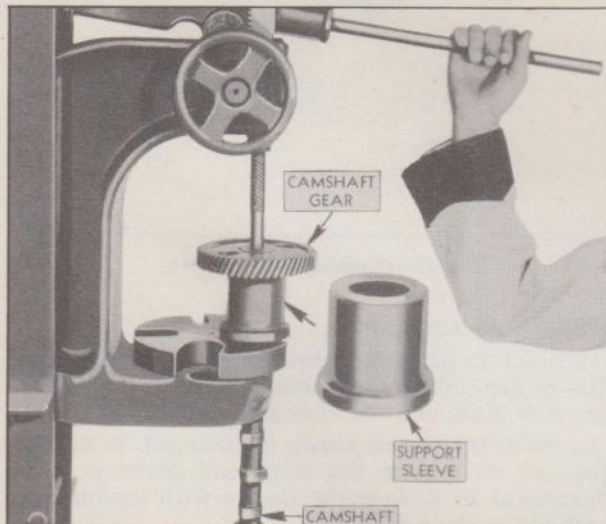


Fig. 18—Camshaft Gear Removing Sleeve

If it becomes necessary to replace the camshaft gear, a sleeve J-971 to properly support the gear on its hub is necessary. This sleeve, shown in Fig. 18, removes the gear, but it so damages the thrust plate that it is very important that every time a gear is removed from the camshaft, a new thrust plate must be used.

In replacing the gear on the camshaft, the back of the front journal of the camshaft must be firmly supported in an arbor press and the camshaft thrust plate assembled to the camshaft, after which the gear is pressed on the shaft far enough so that the camshaft thrust plate has practically no clearance, yet is free to revolve. The correct clearance is—a free fit to a maximum of .003". It is very important that the gear be pressed on the camshaft using the hub of the gear as a pressing medium and not the

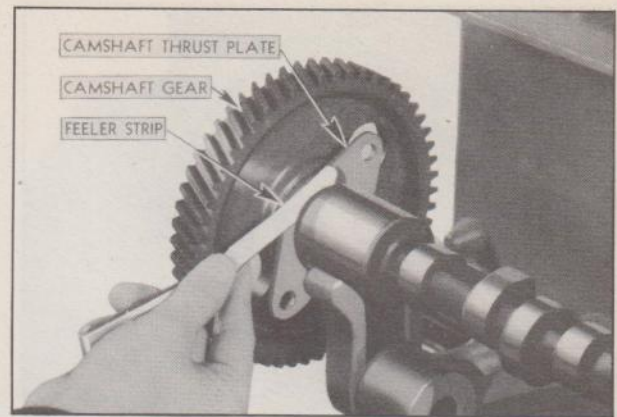


Fig. 19—Checking Camshaft End Play

outside of the gear. Serious damage will be done to the gear if it is pressed on the shaft using the outside of the gear.

The thrust bearing, on the inside of the camshaft gear, when it is assembled to the camshaft, determines the amount of camshaft end play.

If there is an excessive amount of end play in the camshaft, it is necessary to remove the gear and shaft assembly and press the gear further on the shaft so that the thrust plate is tight, yet free to revolve, to a maximum of .003" clearance. See Fig. 19.

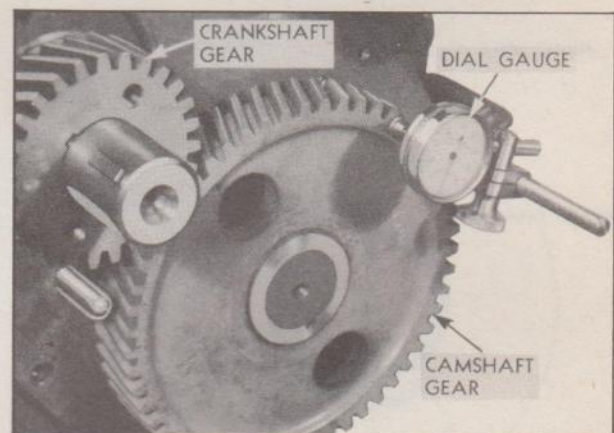


Fig. 20—Checking Run-Out of Camshaft Gear

When the camshaft and gear are assembled to the engine, it is important that the punch marks on both the camshaft and the crankshaft gear be opposite each other.

The camshaft will then be in its proper position so that the valves will open and close in the proper relation to the movement of the piston.

After the camshaft and crankshaft gears are in their proper places, check the crankshaft timing gear for run-out with a dial indicator. This should not exceed .003". Then check the run-out of the camshaft gear. This should not exceed .004". Fig. 20.

If these run-outs are excessive, remove gears to be sure that burrs on the shaft or gears are not causing run-out. If necessary replace with new gears. The back lash should be checked. This check

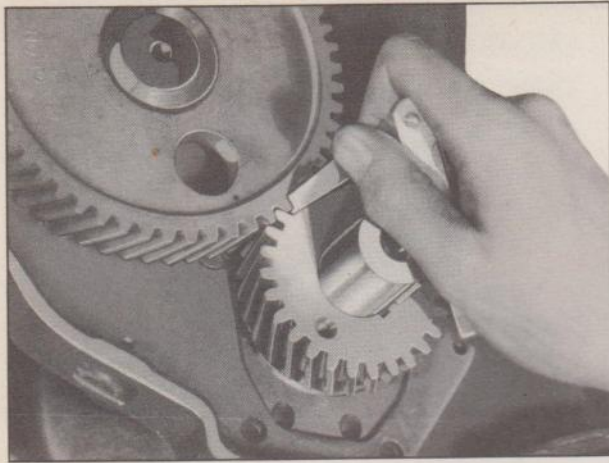


Fig. 21—Checking Timing Gear Backlash

is made with a feeler gauge placed between the teeth of the gears. This should be from .002" to .005". Fig. 21.

**Valve Timing**

The valve timing is illustrated in Fig. 22. The reader will note that the inlet valve starts to open 3 degrees before upper dead center and continues open for 218 degrees, closing 35 degrees past lower dead center.

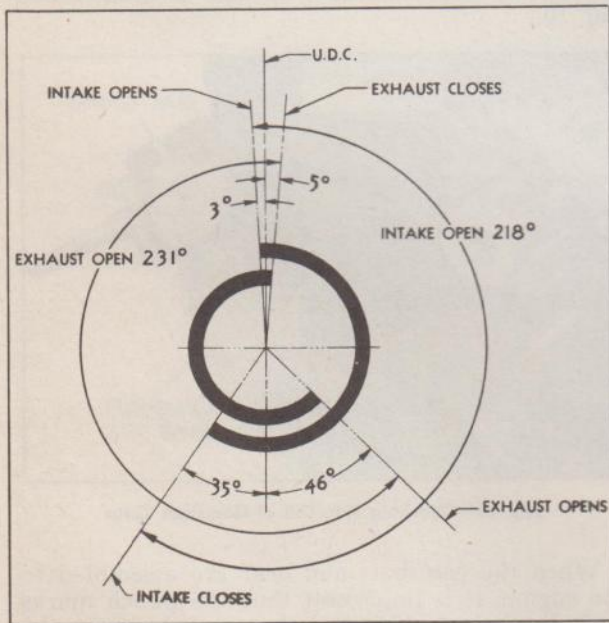


Fig. 22—Valve Timing

The exhaust valve starts to open 46 degrees before lower dead center and continues open for 231 degrees, closing 5 degrees past upper dead center.

To check the valve timing use Number 1 cylinder exhaust valve.

1. Tighten the adjusting screw to just remove all tappet clearance.
2. Hand crank the engine until the Number 1 cylinder exhaust valve starts to close. Continue cranking the engine until the triangular mark on the flywheel lines up with the pointer in the flywheel housing.

3. Mount a dial gauge on the rocker arm shaft support with the spindle of the indicator on top of Number 1 cylinder exhaust valve adjusting screw. Set the indicator at .036".
4. Continue to hand crank the engine until the indicator hand just stops moving. At this point the indicator should read zero, plus or minus .003".

Fig. 23 illustrates checking the valve timing.

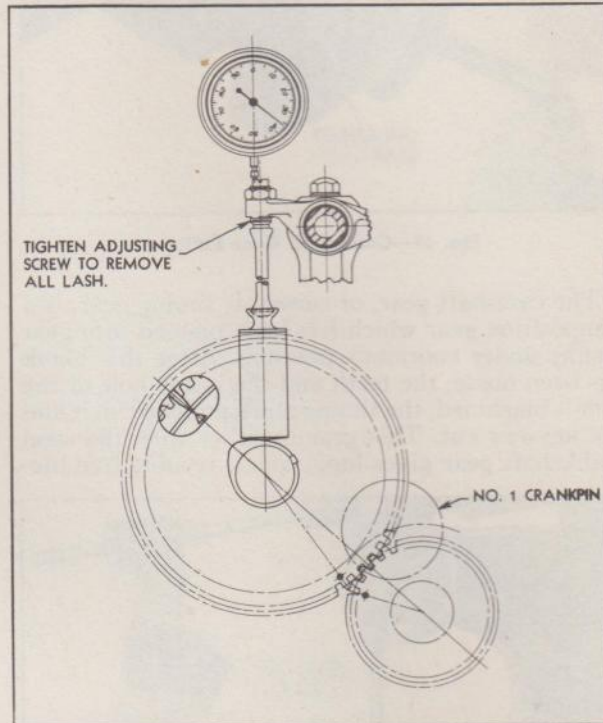


Fig. 23—Checking Valve Timing

**Timing Gear Lubrication**

In order to properly lubricate the timing gears, a timing gear oil nozzle is pressed into the crankcase front end plate and the end spun over.

In the event the oil nozzle is damaged, it will be necessary to replace the front end plate as it is impractical to replace the nozzle with equipment available in the field.

**TIMING GEAR COVER**

The timing gear cover is a pressed steel stamping, heavily ribbed for strength. A spring loaded leather seal is assembled into the crankshaft opening to prevent oil leakage around the hub of the fan pulley. The seal is pressed into a pocket in the cover by the use of Oil Seal Replacer J-995.

When it becomes necessary to replace the leather seal, the special tool, J-995, illustrated in Fig. 24, should be used. Place a new oil seal on the driver with the free end of the leather toward the end of the tool. The seal can then be driven into place in the cover with a few light blows of a hammer.

When installing a timing gear cover, it is essential that it be centered. The guide J-966, illustrated in Fig. 25, fits over the crankshaft and, when in position, guides and holds the timing gear cover in

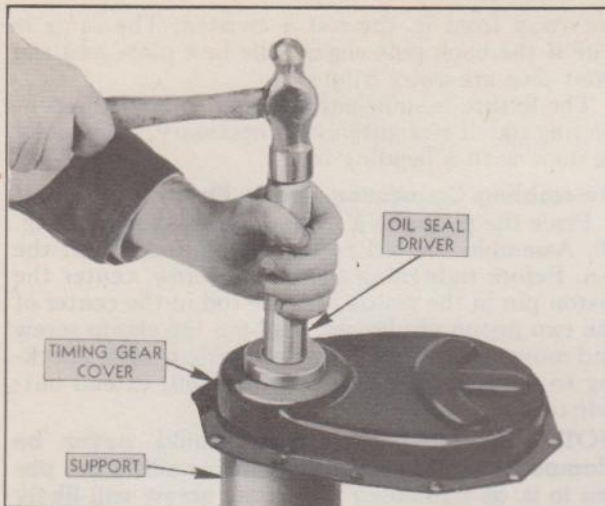


Fig. 24—Installing Timing Gear Cover Oil Seal

its correct position, so when the Harmonic Balancer is installed it will not damage the oil seal. A coating of grease, around the inside surface of the leather, will aid in preventing damage to the seal during this operation.

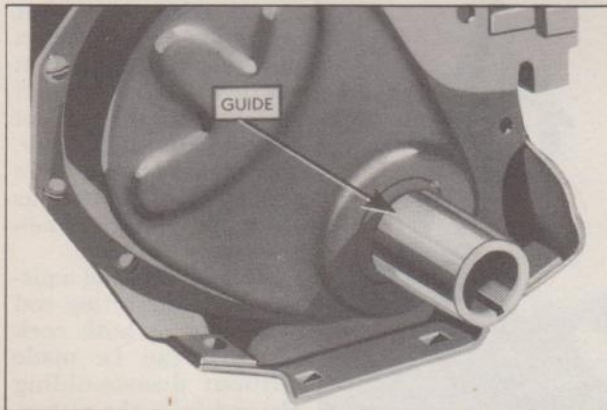


Fig. 25—Timing Gear Cover Centering Gauge

### HARMONIC BALANCER

The Harmonic Balancer consists of a small flyweight attached to and driven by the crankshaft through two rubber annular rings mounted over six studs which are riveted to the hub.

When the engine is running, any change in the speed of the crankshaft, which would cause vibration, will be resisted by the action of the balancer. This resistance is produced by a floating action between the rubber annular rings and the six driving studs. The flyweight moves back and forth on the rubber mounted studs in the opposite direction to that of the crankshaft, and thereby dampens out or absorbs crankshaft vibrations.

Due to the construction of the balancer the parts are not serviced separately. The Harmonic Balancer is not interchangeable with previous models due to a difference in length.

The puller J-1287 (Fig. 26) is made in three parts, a drop forged puller body, a puller screw and a driver head. The driver head is made of tool steel with a drill rod pin which is replaceable.

In operation the puller body is attached to the balancer by means of the two cap screws in the

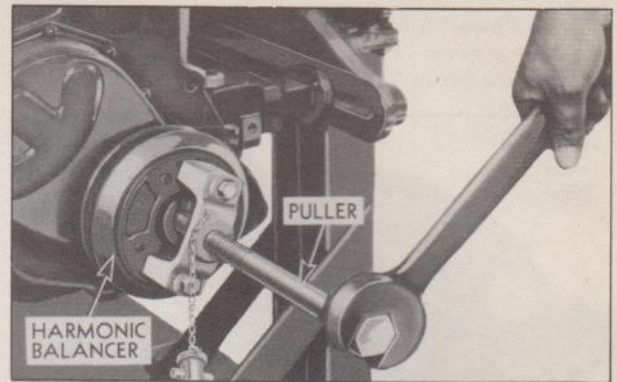


Fig. 26—Harmonic Balancer Puller and Driver

puller, which screw into the tapped holes in the balancer. This insures the puller body being held firmly against the balancer and helps to hold the balancer together while it is being removed. Next turn the puller screw into the body until the balancer is removed. This puller provides a steady pull on the balancer allowing its removal without damage.

In installing this part the puller body is removed and the driver placed in the starting crank jaws and the puller body reassembled to the balancer. Next line up the key in the crankshaft and the keyway in the balancer and drive the balancer in position using the puller screw as a driver. If the puller is assembled in any other than this way serious damage will be done to the balancer.

### Flywheel

The flywheel is made from a grey iron casting which is accurately machined and balanced to assure smooth engine performance. A steel ring gear is shrunk on its outer diameter, that meshes with the starter gear when starting.

The flywheel is located on the crankshaft flange

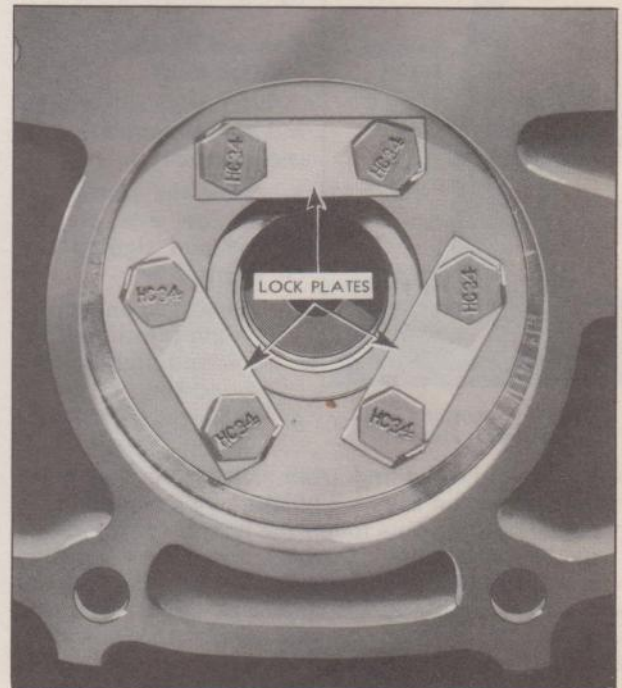


Fig. 27—Flywheel Bolt Locks

by three dowels and is retained by six special large head cap screws. These bolts are locked by lock plates as shown in Fig. 27.

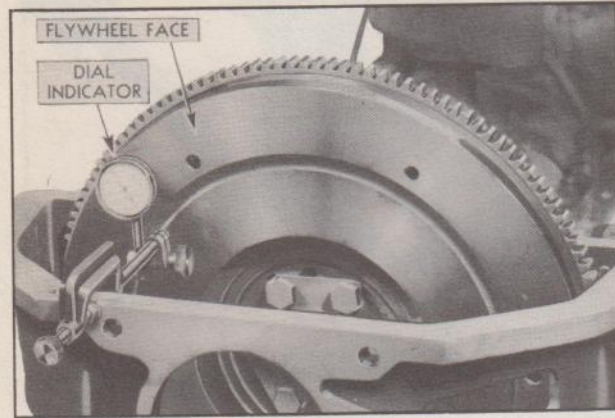


Fig. 28—Checking Flywheel Run-Out

After the flywheel has been assembled to the crankshaft, it is necessary that the face and the rim of the flywheel be checked for run-out.

This can be done with the dial indicator as shown in Fig. 28. The face and rim of the flywheel should not exceed .008" run-out.

**Connecting Rods**

The connecting rods are made of special steel, drop-forged and of unusual strength. The babbitt bearings are centrifugally cast or "spun-in" into the forging. This method assures a positive bond between the steel and babbitt which aids in dissipating heat from the bearings.

Every time a connecting rod is removed from an engine or a new connecting rod is being installed it should be checked for alignment on a connecting rod alignment fixture as shown in Fig. 29.

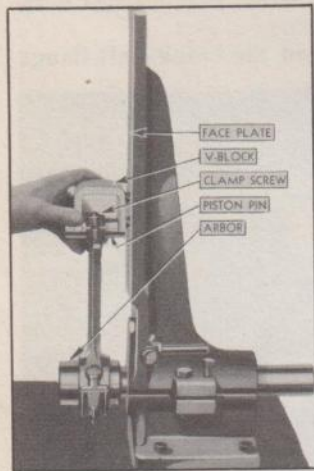


Fig. 29—Connecting Rod Alignment Fixture

**Connecting Rod Alignment**

To check a connecting rod for alignment, proceed as follows:

1. Place the piston pin in the eye of the rod and tighten the clamp screw.
2. Place the connecting rod on the aligner arbor and tighten the connecting rod bolts.
3. Place the "V" block on the piston pin,

then move the rod and arbor toward the face plate until the pins on the "V" block just engage the face plate. If all four pins touch the face plate the rod is in perfect alignment. However, should the top pins rest against the face plate and the bottom pins are away from it, the rod is cocked or bent. The same is true if the bottom pins rest against the face plate and the top pins are away from it.

If the two pins on the front side of the "V" block rest against the face plate and the two back pins

are away from it, the rod is twisted. The same is true if the back pins engage the face plate and the front pins are away from it.

The fixture is sufficiently strong to hold the connecting rod, if straightening is necessary, which may be done with a bending bar.

**Assembling Connecting Rod to Piston**

Place the piston in a piston vise as shown in Fig. 30. Assemble the rod to the piston and install the pin. Before tightening the clamp screw, center the piston pin in the piston and the rod in the center of the two piston pin bosses. Tighten the clamp screw and move piston on the pin from side to side, checking to see that the piston pin does not extend outside of the piston.

**NOTE**—The connecting rod should never be clamped in a bench vise when installing the piston to it, as tightening the clamp screw will likely twist the rod.



Fig. 30—Assembling Connecting Rod to Piston

does not normally require the removal of the rod from the piston. To make this check, the connecting rod and piston assembly is mounted on the alignment fixture and the piston is set in line with the connecting rod.



Fig. 31—Checking Piston and Connecting Rod Assembly

Assemble the piston and connecting rod assembly to the alignment fixture, shown in Fig. 31, and check with the "V" block resting against the piston skirt to see that the rod and piston are in alignment. Both pins on the "V" block should rest against the face of the plate on the fixture. The piston should be in the same alignment as the connecting rod when this check is made.

A quick check of a piston and connecting rod assembly for both cock or twist can be made without disassembling the rod from the piston. This method saves considerable time on any repair operation that does not normally require the removal of the rod from the piston. To make this check, the connecting rod and piston assembly is mounted on the alignment fixture and the piston is set in line with the connecting rod. Then place the "V" block on the piston skirt, and if both pins on the block contact the face plate, the rod is not cocked. See Fig. 31. Then, with the "V" block on the piston skirt and the pins against the face plate, tip the piston first in one direction and then in the other, Fig. 32. If the pins on the block follow the face plate, there is no twist in the connecting rod. But if one pin leaves the face

plate while the piston is being tipped in one direction and the other pin leaves the face plate while the piston is in the other direction, the connecting rod is twisted and should be straightened until both pins follow the face plate.

#### Assembling Piston and Connecting Rod to Engine

In production, both the rod and the cap are stamped with the number of the cylinder in which they are to be assembled. The numbers are stamped on the camshaft side. When the rods are being reassembled they should be placed back in the same cylinder from which they were removed and the stamped numbers should be placed on the camshaft side.

The gaps in the three rings should not be in a vertical line, neither should there be any ring gap over the piston pin, as the gases could leak by

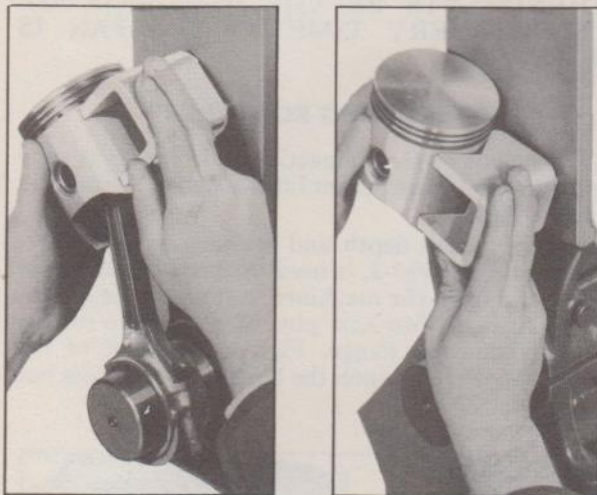


Fig. 32—Checking for Twisted Connecting Rod

more easily at this point. Therefore, it is desirable to stagger the gaps so that they will be equally spaced around the circumference of the piston.

Lubricate either the piston or the cylinder bore and start the piston and connecting rod assembly into the cylinder. Compress the rings with a ring compressor, then push the piston into the cylinder.

Lubricate the bearing, pull the connecting rod down on the crank pin making sure the marks on the rod are toward the camshaft. Install three .002" shims on each connecting rod bolt and then install the cap with the marks toward the camshaft. Install the connecting rod dipper with the mouth of the dipper towards the camshaft. Assemble and tighten the nuts.

#### Adjusting Connecting Rod Bearings

Remove shims, an equal number from each side of the bearing, until the rod cannot be snapped back and forth on the crank pin by hand, but can be tapped back and forth with a light blow of an 8 ounce hammer. Then replace one .002" shim, being careful to keep the number of shims on each side equal, if possible. When the bearing is properly fitted, it should be possible to snap the rod back and forth on the crank pin with one hand, Fig. 33.

If it is not possible to keep the number of shims on each side equal for all bearings, it is preferable

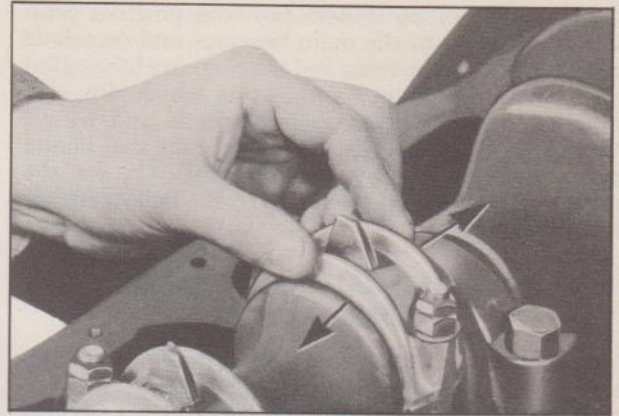


Fig. 33—Checking Connecting Rod Bearing Fit

to have the greater number of shims on the camshaft side.

Check connecting rod end clearance between the upper half of the connecting rod (not the connecting rod cap) and the side of the crank pin with a feeler gauge. This clearance should be from .004" to .011". See Fig. 34.



Fig. 34—Checking Connecting Rod Bearing Side Clearance

Lock the connecting rod bolt nuts by installing new "pal" nuts. The "pal" nuts must be installed with the open side of the nut toward the end of the bolt. Turn the "pal" nut up finger tight and then  $\frac{1}{2}$  turn more.

As a final and last check to be sure that the assembly will travel true with the bore, check the clearance between the piston pin end of the connecting rod and the piston pin bosses on the piston with a feeler gauge. This should not be less than .025".

#### ENGINE OILING SYSTEM

Lubrication for the engine is supplied by a positively driven gear pump that is equipped with a spring loaded by-pass valve which controls the maximum pressure at high speeds and when the engine oil is apt to be heavy and sluggish during cold weather starting.

The engine oiling system provides positive pressure lubrication to the main bearings and camshaft bearings. The connecting rod bearings are lubricated by means of dippers on the rods which dip into troughs in the oil pan at low speeds and by oil nozzles at higher speeds. Cylinder walls and piston pins are lubricated by the oil spray. Oil for the valve mechanism is pumped up to the hollow rocker arm shafts.

### MAIN AND CAMSHAFT BEARING LUBRICATION

The oil flow is from the pan, through the pump screen and oil pump to the block fitting pipe, and then to the oil manifold, thence through drilled passages in the bearing support webs in the cylinder block, to the four main bearings. The oil then passes through grooves in the bearings to the drilled passages in the cylinder block webs and to the camshaft bearings. In this manner full pressure feed lubrication is supplied to all main and camshaft bearings.

### TIMING GEAR LUBRICATION

Lubrication for the timing gears is supplied by conducting the oil from the front camshaft bearing, through a milled slot in the back of the engine front end plate, to a nozzle which is so aimed that the oil stream effectively lubricates the timing gears.

### CONNECTING ROD BEARING LUBRICATION

Oil for the connecting rods passes from the cylinder block fitting to the oil manifold, through a drilled passage in the cylinder block and to the oil distributor. As the oil pressure builds up, the oil distributor valve opens and releases the oil into a drilled passage in the block, this passage connecting with the short pipe that fits into the main supply pipe in the oil pan. From the main supply pipe the oil passes to the oil manifold in the oil pan, where it is distributed to the six oil nozzle pipes.

The six oil troughs in the oil pan are adjusted to the proper height so that the connecting rod dippers will dip into the oil and supply lubrication for the lower speeds.

As the engine speed is increased and the oil pressure is built up, the oil streams from the nozzles rise, and are intercepted by the dippers, forcing the

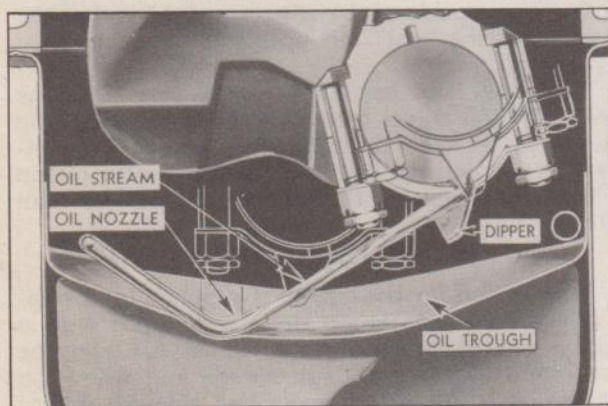


Fig. 35—Connecting Rod Bearing Lubrication

oil into the connecting rod bearings under high pressure, Fig. 35. The cylinder walls, pistons, and piston pins are lubricated by the oil spray thrown off by the connecting rods.

### VALVE MECHANISM LUBRICATION

Oil for lubrication of the valve mechanism is tapped off at the oil manifold and is carried by a pipe which passes through the water jacket to a fitting between the two hollow rocker arm shafts where it is distributed to all rocker arm bearings. A bleeder hole in each rocker arm supplies oil for lubrication of the valve stems and push rod sockets.

Proper functioning of the oiling system is dependent upon the proper adjustment of connecting rod dippers, oil troughs, and oil nozzles.

**IT IS VERY IMPORTANT THAT THESE ADJUSTMENTS BE CHECKED AND ADJUSTED EVERY TIME AN OIL PAN IS REMOVED.**

### CONNECTING ROD DIPPERS

The height of the connecting rod dippers is very important to insure proper lubrication of connecting rod bearings.

The oil trough depth and connecting rod dipper height gauge, J-969-2, is used to check the height of the dipper from the machined surface of the crankcase. With the two side pins of the gauge resting on the crankcase flange, Fig. 36, the end of the dipper should just touch the bottom of the cross bar on the gauge.



Fig. 36—Checking Connecting Rod Dipper Height

If the dipper is lower than the gauge, a new dipper must be installed.

If the dipper is higher than the gauge, it may be bent down to the correct position.

**NOTE—The oil pan gasket must be removed during this operation.**

### Oil Pan Removal

To remove the oil pan when the engine is mounted in the chassis, raise the front end with a jack until the wheels are free, then turn the wheels to the extreme left. This is necessary to gain clearance at the tie rod.

### CHECKING THE OIL PAN

To check the oil pan, proceed as follows:

1. Check the oil trough height with the oil trough depth gauge, J-969-2, by placing the bar of the gauge on the pan rail. The stem of the gauge should just touch the edge of each of the six oil troughs, Fig. 37.



Fig. 37—Checking Oil Trough Depth

2. To check the aiming of the oil nozzles, install the oil pan target gauge, J-969-1, on the oil pan by locating the dowels of the gauge in the screw holes in the oil pan. Insert the water nozzle, J-793-3, in the main oil pipe. Tip the oil pan

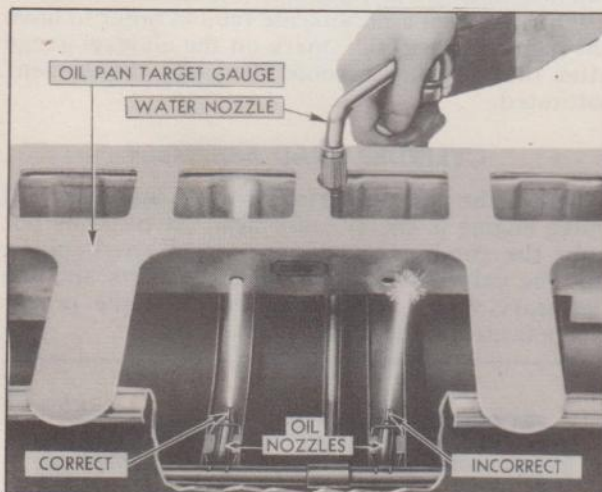


Fig. 38—Checking Aim of Oil Nozzle

about 45 degrees to prevent the water from covering the ends of the nozzles. Open the water nozzle just enough to straighten the water streams. If the oil nozzles are properly adjusted, the water streams will pass through the centers of the target holes. Both the correct and incorrect aiming of the water nozzles is shown in Fig. 38.

The oil nozzles may be adjusted by using the oil nozzle wrench, J-793-2, as shown in Fig. 39. Continue adjusting and checking the oil nozzles until each water stream passes through the center of its target hole.

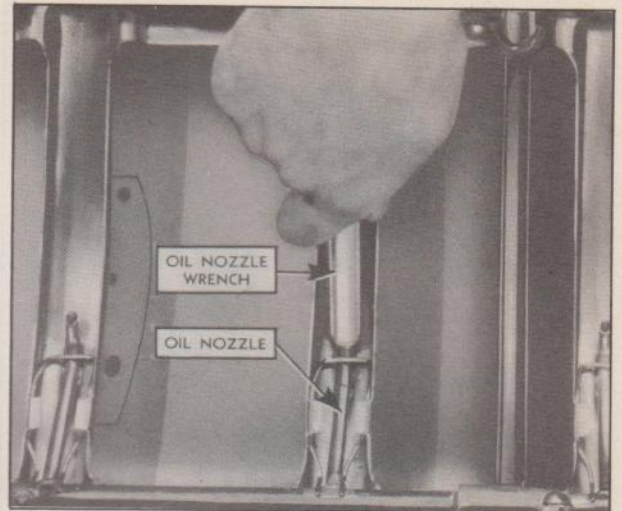


Fig. 39—Adjusting Oil Nozzle Aim

### OIL DISTRIBUTOR

The Oil Distributor Valve Assembly is mounted in the side of the cylinder block. When assembling the oil distributor valve assembly, a cork gasket must be installed between the valve assembly and the block, and then another cork gasket between the valve assembly and the oil distributor cover. Fig. 40 shows the oil distributor assembly.

**NOTE**—Care must be used not to get these gaskets mixed. The gasket indicated by the number "1" in Fig. 40 must be assembled between the valve and the block, and gasket numbered "2" between the valve and cover.

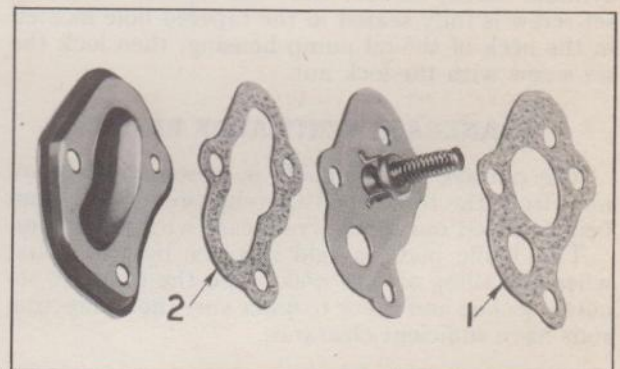


Fig. 40—Oil Distributor Parts

### OIL PUMP ASSEMBLY

The oil pump is a positive gear type. It consists of two spur gears enclosed in a one-piece housing, and is provided with a relief valve to control maximum oil pressure. In operation, oil is drawn from the crankcase through a fine mesh screen which is mounted on the rear intermediate bearing. The oil then passes through a pipe to the oil pump, from which it passes to the oil distribution system as previously described.

To disassemble the oil pump, remove the cover screws and cover. Then remove the drive gear and shaft and the idler gear. Fig. 41 shows a layout of the oil pump parts.



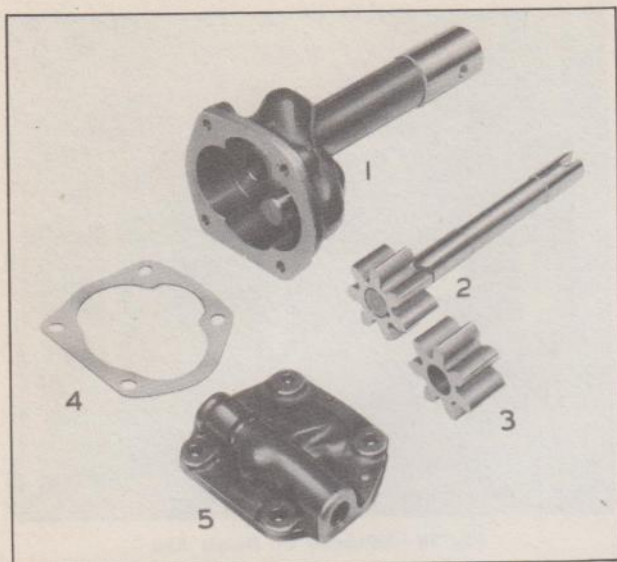


Fig. 41—Oil Pump Parts

- |                        |                |
|------------------------|----------------|
| 1—Oil Pump Body        | 4—Cover Gasket |
| 2—Drive Gear and Shaft | 5—Cover        |
| 3—Idler Gear           |                |

The fit of the shaft should be checked in the pump housing. Also check the spur gears for wear. If the pump parts are badly worn it is good policy to replace the entire oil pump assembly.

When reassembling an oil pump, make sure that the ground side of the idler gear is toward the cover. It is also important that only a Genuine Chevrolet Gasket be used as this gasket controls the clearance in the pump.

When securing the oil pump assembly to the cylinder block, be sure that the tapered oil pump set screw is fully seated in the tapered hole located in the neck of the oil pump housing, then lock the set screw with the lock nut.

### CRANKCASE VENTILATOR Baffle

The purpose of this baffle is to separate the oil mist from the fumes and thereby prevent oil from being carried out of the crankcase with the fumes.

This baffle plate is held in place by two bolts; when installing always make sure the nuts are securely locked and check to make sure the connecting rods have sufficient clearance.

### OIL DISTRIBUTOR TO ROCKER ARM PIPE

The pipe leading from the oil distributor to the rocker arm shaft passes directly through the water jacket of the cylinder block. This construction serves to stabilize the oil temperature.

If the oil distributor to valve rocker oil pipe is removed for any reason, it must be discarded and a new nipple and pipe assembly installed according to the following instructions:

Coat the threads of the nipple with white lead, thread the pipe through the block and screw the nipple securely into the block. Install nipple and sleeve nut at the lower end of pipe on left side of block, coating threads of nipple with white lead and tighten securely. Make bend in lower end of pipe and connect to fitting at oil distributor location. Bend pipe on right side of block so as to clear

the push rod cover. Then bend the upper portion of pipe to pass through the hole in the cylinder head. Connect the pipe to the valve rocker shaft coupling. Fill the cooling system with water, start the engine and check all connections for both oil and water leaks.

### Oil Filter

The oiling system of this truck is equipped with an oil filter as a further means of keeping the oil being pumped to the bearing surfaces of the engine from becoming contaminated.

The inlet pipe to the top of the filter is connected to the oil pressure gauge fitting. This fitting taps the oil manifold which extends the full length of the cylinder block. The return line from the bottom of the filter is connected with the drilled passage from the oil distributor valve. This passage connects with the oil manifold in the oil pan which feeds the oil nozzles for the connecting rods.

The drain plug on the bottom of the filter should be removed periodically to drain off any water or dirt trapped in the filter.

The filter element should be replaced every 8,000 to 10,000 miles, or when oil gauge rod shows oil is dark.

To replace the element, remove the top cover and remove the element. Remove the drain plug and drain the filter case. Wipe out inside of filter with a clean cloth. Install a new filter element and replace the cover and drain plug.

When the engine oil is changed at the same time the filter element is replaced, it is necessary to use  $6\frac{1}{2}$  quarts of oil for crankcase refill in order to have the oil up to the "full" mark on the oil level gauge after the filter has become filled and the element saturated.

### CYLINDER HEAD ASSEMBLY

One of the most important units of any overhead valve engine is the cylinder head. It contains not only the combustion chambers and spark plugs, but the valves, inlet ports, exhaust ports and the necessary water passages to maintain the proper temperature of these important parts.

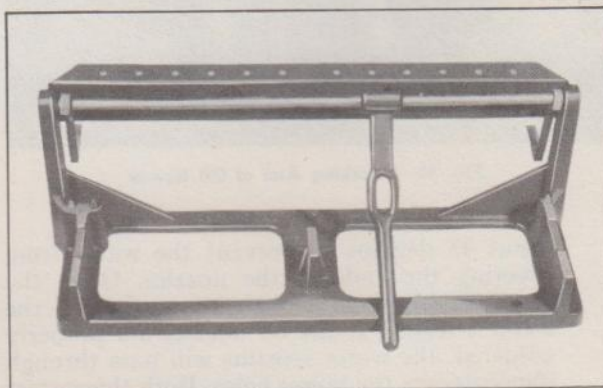


Fig. 42—Cylinder Head Holding Fixture

### Grinding Valves

There is no operation, in the maintenance of an automobile, that is more important than the valve grinding operation from the standpoint of engine economy and performance.

Extreme care should, therefore, be used whenever valves are ground to maintain factory limits and clearances, as only by maintaining these limits and clearances can one expect to get good engine economy and performance.

#### Cylinder Head Holding Fixture

The valve heads are located in pockets in the cylinder head, and this construction necessitates the use of a cylinder head holding fixture J-982-A combined with a valve spring compressor, see Fig. 42, for the removal of valve springs and the grinding of valves.

After the cylinder head has been removed from the engine, and all of the parts disassembled from it, all carbon should be thoroughly cleaned from the combustion chambers, valve ports and guides, and the head thoroughly washed.

#### Valve Guides

The clearance between the valve guides and the valve stems is very important. Lack of power and noisy valves, in many instances, can be traced to worn valve guides.

The intake valve guides should be checked with a new intake valve and the exhaust valve guides should be checked with a new exhaust valve, because the diameters of the stems are different.

The exhaust valve guide is designed to bring the inner end of the guide flush with the inside of the valve port. With this design the heat dissipating properties are increased and aids in eliminating valve sticking.

The clearances that must be maintained between the intake valve stem and their guides is .001" to .003" and the clearance between the exhaust valve stems and their guides is .002" to .004".

Quite naturally, if the valve guides are worn, they should be replaced. To remove them from the cylinder head, the driver J-267 shown in Fig. 43 must be used. The cylinder head is placed in an arbor press and the guide pressed from it, using this tool.

The valve guides do not have a shoulder to determine the distance they should be pressed into the cylinder head. The intake guides should extend above the cylinder head  $1\frac{1}{16}$ " while the exhaust guide extends above the head  $\frac{61}{64}$ ". These dimensions are very important. See Fig. 44.

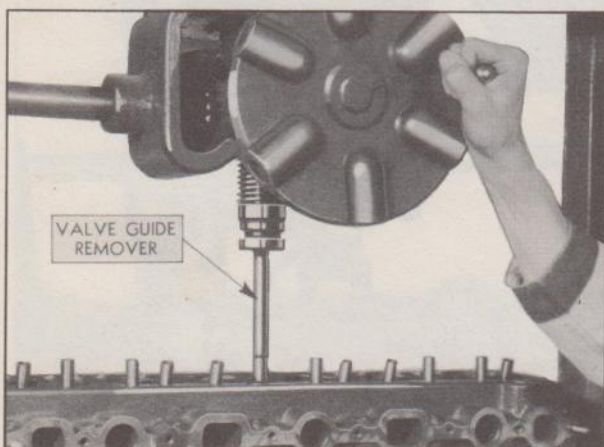


Fig. 43—Valve Guide Remover

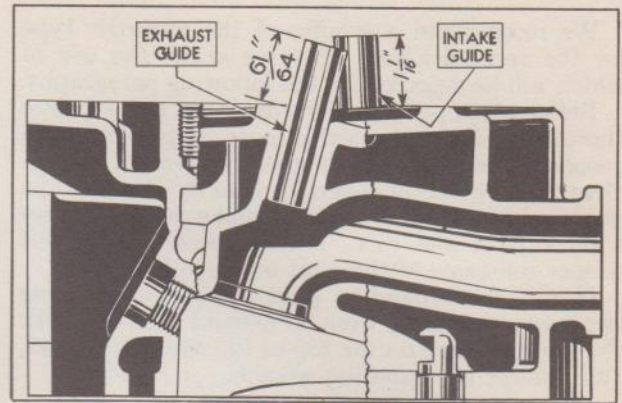


Fig. 44—Valve Guide Height

To simplify this operation and make sure the valve guides are pressed in the proper distance, two valve guide drivers are available. These drivers have stop collars on the driver body to automatically stop the guides at the proper height.

After the guides have been pressed into the cylinder head, they should be rough reamed with a .341" reamer and then finish reamed with a .343" reamer.

#### Reseating Valve Seats in Cylinder Head

Reconditioning of the valve seats on modern high compression engines is becoming more and more important, because the seating of the valves must be perfect in order for the engine to deliver the power and performance that has been built into it.

Another important factor is the cooling of the valve heads. Good contact between the valve and its seat is imperative if the heat in the valve head is to be properly dissipated.

There are a number of valve seat grinders and various valve reseating equipment on the market. When using them, the instructions of the manufacturer should be followed.

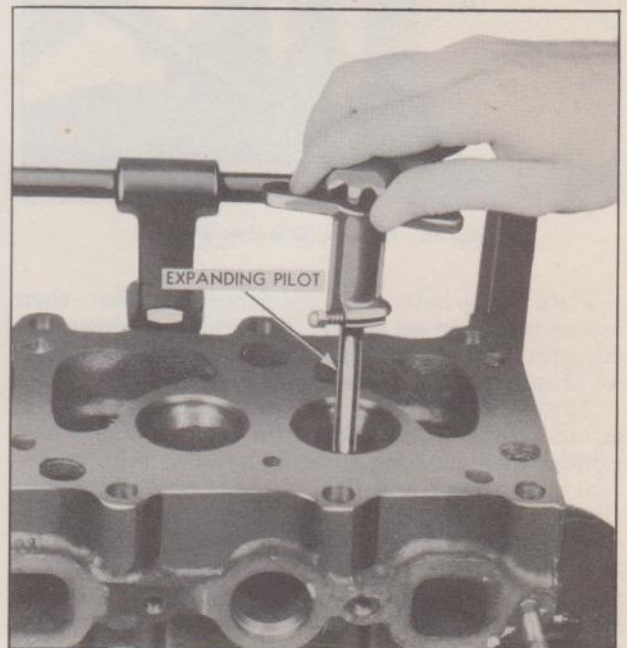


Fig. 45—Installing Expanding Pilot

We recommend a grinder of the eccentric type for the reconditioning of valve seats, the use of which will be described in the following paragraphs.

Before attempting to grind any seat, clean carbon thoroughly from the valve port, wipe seat with gasoline, cleaning it of any grease or foreign matter. Great care should be taken to clean the inside of the guide with a wire brush and make sure it is free from carbon and dirt. These precautions permit proper centering of the pilot in the guide.

Install the expanding pilot in the guide, using the special handling wrench; expand the pilot with the knurled knob on the top of the wrench, Fig. 45, and remove the handling wrench.

#### Dressing the Grinding Wheel

The grinding wheel should be dressed before commencing any valve regrind job. Set the grinder over the two top pilots of the dresser stand. When the grinder is seated on these pilots, the wheel will pass over the stud projecting through "A" and the grinder will be in position ready to dress the wheel, Fig. 46. Set the diamond dressing tool at the 30 degree angle. Turn on the switch and dress the grinding wheel.

**NOTE**—Never let the grinding wheel become glazed or loaded, as it will not grind freely and do accurate work.

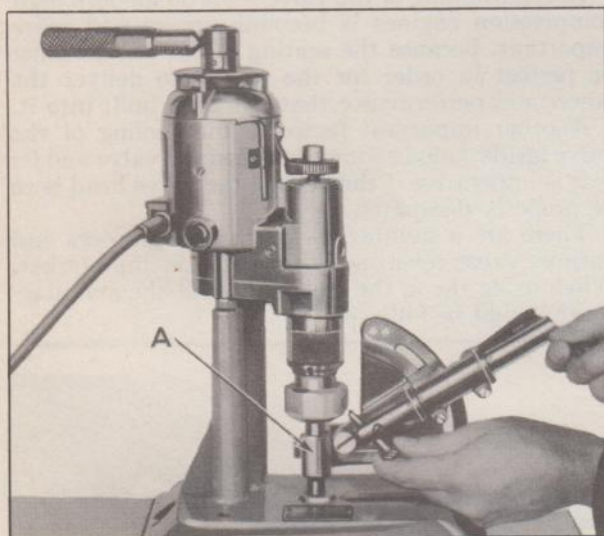


Fig. 46—Dressing Grinding Wheel

Place the grinder over the expanding pilot, then loosen the Allen set screw "B," and push down the adjusting rod "C" against the top of the pilot, Fig. 47. Then lock the set screw "B" tightly.

Turn the feed screw "E" to the right until the grinding wheel just clears the seat. Balance the grinder with the compensating handle "F," Fig. 48. Start the motor and feed the grinding wheel into the seat by turning the feed screw "E" to the left one notch at a time until the wheel is grinding all around the face of the valve seat. Before shutting off the grinder, stop feeding the wheel into the seat and give it time to grind itself free. Turn off the switch and allow the grinder to come to a stop before lifting it from the pilot.

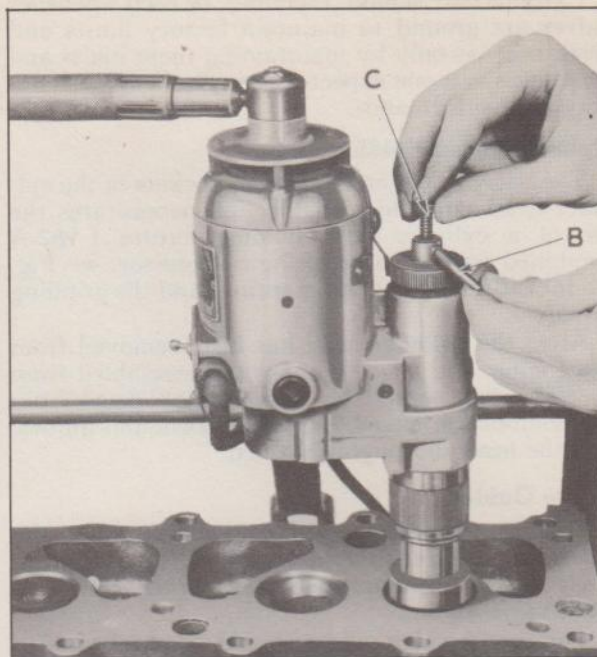


Fig. 47—Setting Adjusting Rod

Mount the valve seat dial indicator on the stationary pilot, set the indicator at zero and turn the sleeve of the indicator with thumb and finger. When the seat is properly ground, the indicator reading will be within .001", Fig. 49.

The valve seat may now be narrowed down to the proper width by machining both the port and the top of the valve seat. A 70 degree grinding wheel may be used in the port, but a form cutter, KMO-105-7, must be used to thin down the valve seat from the top, Fig. 50, and at the same time

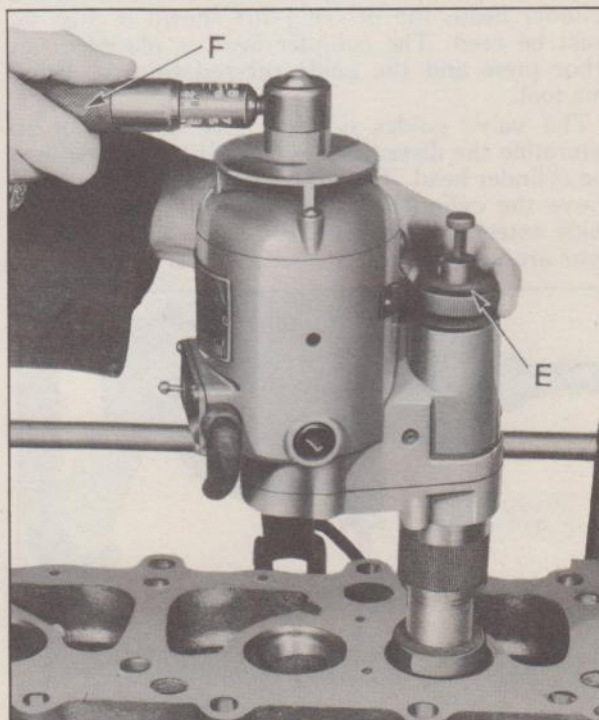


Fig. 48—Grinding Valve Seat

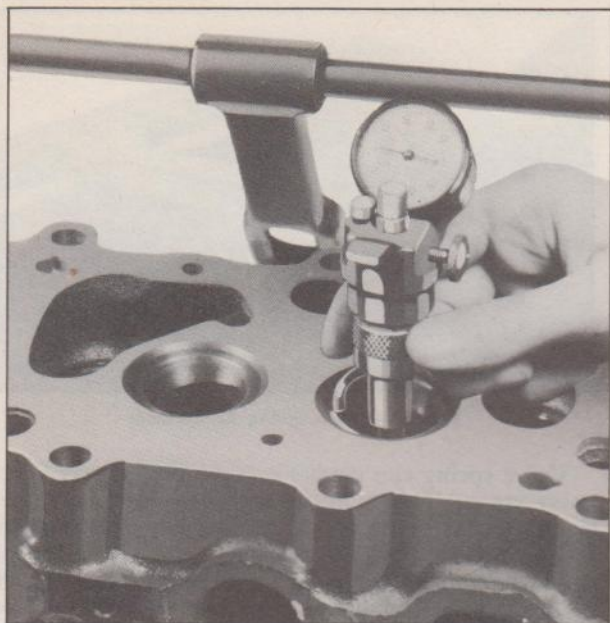


Fig. 49—Checking Valve Seat with Indicator Gauge

machine the edge of the valve recess, thereby preventing restriction of free flow of the incoming gases.

Good judgment must be used when narrowing a valve seat to make sure the seat contacts the center of the valve. The width of the intake valve seat should be from  $\frac{3}{64}$ " to  $\frac{1}{16}$ " and the exhaust valve seat from  $\frac{1}{16}$ " to  $\frac{3}{32}$ ". This is very important because the life of a valve grind job depends to a great extent upon the width of the valve and seat contact.

If the valve seat is too narrow, heat cannot be dissipated from the valve head fast enough. If the

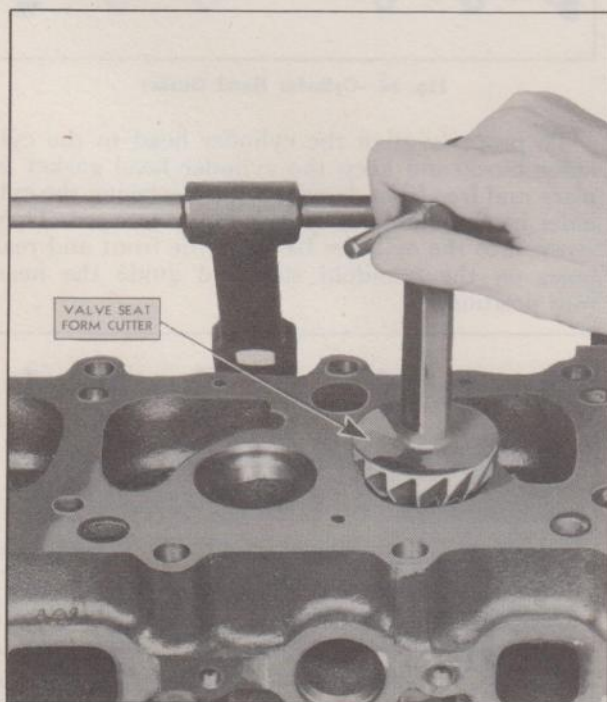


Fig. 50—Narrowing Valve Seat

valve seat is too wide, carbon particles can be readily caught between the valve and seat causing blow-by, that will soon burn both the valve and the seat.

### Valves

Chevrolet valves have a high resistance to heat, corrosion and pitting. They are made from silichrome stainless steel by what is known as an extruding process.

From the rough forging to the finished product all operations are carefully performed and inspections are frequent.

When valves are removed, the valve stems and heads should be cleaned on a buffing wheel to remove all carbon and other foreign matter.

The condition of the valves and valve stems can now be checked.

### Refacing Valves

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem, on a valve refacing machine. The grinding wheel on the valve refacing machine should be properly dressed to make sure it is true and smooth. The chuck must be set at the proper angle which is 30 degrees.

The instructions of the manufacturer of the valve refacer being used should be carefully followed.

To test for perfect contact, mark lines with a lead pencil about  $\frac{1}{4}$ " apart on the beveled edge of the valve head and replace the valve.

Give the valve one-half turn to the right and one-half turn to the left, using a little extra pressure on the valve. If all pencil marks are removed, the grinding is perfect. If, on the other hand, one line or part of one remains untouched, this fact indicates an uneven spot, and the valve must be reground until it seats properly.

Before replacing the valves in the cylinder head, clean the valves and the cylinder head. A good valve job is frequently ruined by failure to properly clean all of the parts.

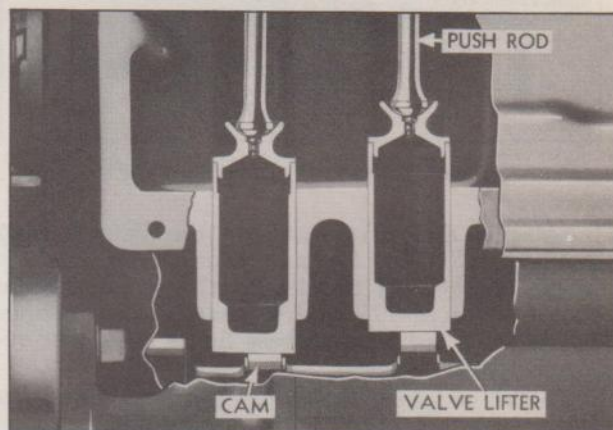


Fig. 51—Cross-Section of Valve Lifters

### Valve Lifters and Push Rods

Chevrolet Valve Lifters are made in two parts. The lower part of the lifter is machined from a casting, the bottom of which is chilled during the casting operation to produce a hard wearing surface. The upper part of the lifter which incorporates the push rod seat is machined and hardened to pro-

duce a smooth, long-wearing seat. The lifter unit is completed by brazing the steel seat into the cast part of the lifter. Fig. 51 shows the construction of the lifter in cross-section.

The Push Rods are made from a solid piece of steel with the two ends forged to form the contacts with the lifter and rocker arm adjusting screw. These ends are carefully machined and hardened to produce a smooth hard surface that will give thousands of miles of service with the minimum amount of wear.

When assembling the valve lifter to the engine, it should be a free fit, and the end that contacts the camshaft should be smooth. If the end shows signs of wear or roughness, it is good practice to replace it.

### Valve Springs, Caps and Covers

Valve springs are made from a special analysis steel wire. They are accurately coiled and, after being made, each spring is checked to be sure that it comes within the limits for tension. Any springs that fail to pass this inspection are immediately scrapped.

Weak valve springs affect the economy and power of the engine; therefore, each time the valves of an engine are ground, the valve springs should be checked to be sure they have not been weakened from the heat of the engine. This can easily be done



Fig. 52—Valve Spring Tension Gauge

by placing the valve spring in the Valve Spring Tester—U15 (Fig. 52) and compressing it to a length of  $1\frac{1}{2}$ ". At this length the spring tension should be from 125 to 133 pounds. Any springs that do not test within these limits should be replaced with new ones.

The valve spring is retained to the valve with a cap and a key. It is necessary to compress the spring with the spring compressor shown in Fig. 53, which is a part of the cylinder head holding fixture, far enough to allow the key to be inserted in the valve stem.

The valve springs are assembled with the close coiled end toward the cylinder head.

**NOTE—The round valve caps must be installed on the intake valves and the hexagonal caps on the exhaust valves.**

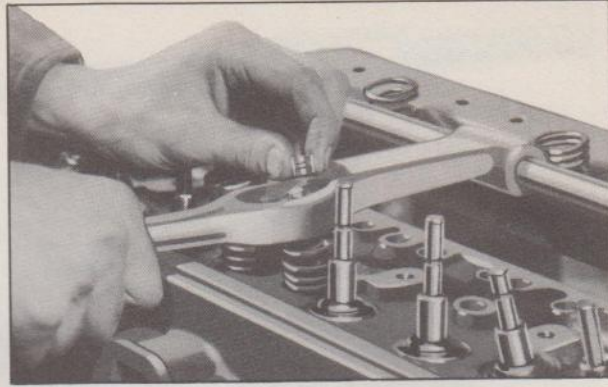


Fig. 53—Valve Spring Compressor

Valve spring cap covers are installed on the inlet valve stems. This is an umbrella type of cover designed to carry the oil which has flowed down the rocker arm to lubricate the valve end of the rocker arm out over the valve spring, thereby reducing the amount of oil which reaches the valve stem for guide lubrication to only that required to properly lubricate the valve stem.

### Installing Cylinder Head Assembly

It is good practice to install a new cylinder head gasket each time the cylinder head is removed.

**CAUTION—The cylinder head gasket must be installed with the side marked "This side up" on top, Fig. 54.**

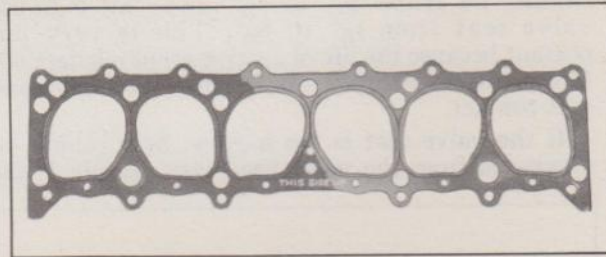


Fig. 54—Cylinder Head Gasket

To properly align the cylinder head to the cylinder block and keep the cylinder head gasket in place and free from damage while replacing the cylinder head, guide pins N-344 should be used. They screw into the cylinder block at the front and rear holes on the manifold side and guide the head into position.

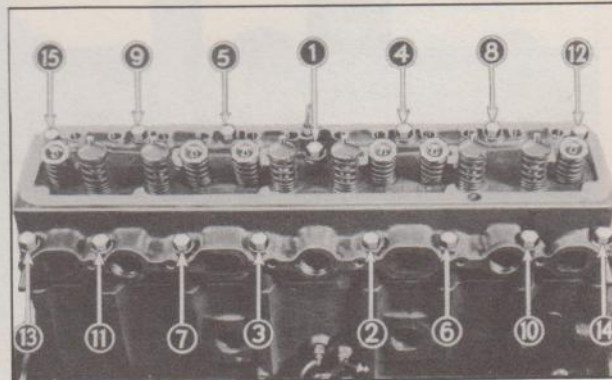


Fig. 55—Cylinder Head Bolt Tightening Sequence

After the head has been properly aligned, insert and tighten the cylinder head bolts with a wrench, tightening each one evenly a little at a time in the order shown in the cylinder head bolt tightening diagram, Fig. 55. The order in which the bolts are tightened is important, as many water leaks between the cylinders are caused by improper tightening of cylinder head bolts.

When torque wrenches are used to tighten cylinder head bolts to secure uniform tension on all bolts, the recommended tension is from 75 to 80 foot pounds.

**Rocker Arms and Shafts**

The rocker arms are made of Armasteel, the ends which contact the valves are hardened, the bearings for the rocker arm shaft are diamond bored. After boring, the rocker arms are "granodized" for protection against scuffing or scoring during the break-in period.

Four different rocker arms are used—right- and left-hand intake and right- and left-hand exhaust.

Each type arm carries a different part number and for identification purposes a number is cast on the side of each arm, Fig. 56.



Fig. 56—Rocker Arm Identification

Number on Rocker Arm	Type Rocker Arm	For Cylinder	Part No.
1 or 9	L.H. Exhaust	1-3-5 Exhaust	839459
0 or 2	R.H. Exhaust	2-4-6 Exhaust	839460
3 or 5	L.H. Intake	2-4-6 Intake	839463
4 or 6	R.H. Intake	1-3-5 Intake	839464

The proper order in which the rocker arms should be assembled according to the numbers on the arms is shown in Fig. 57. Care should be taken when replacing rocker arms to insure having each arm in the proper location for the valve and cylinder.

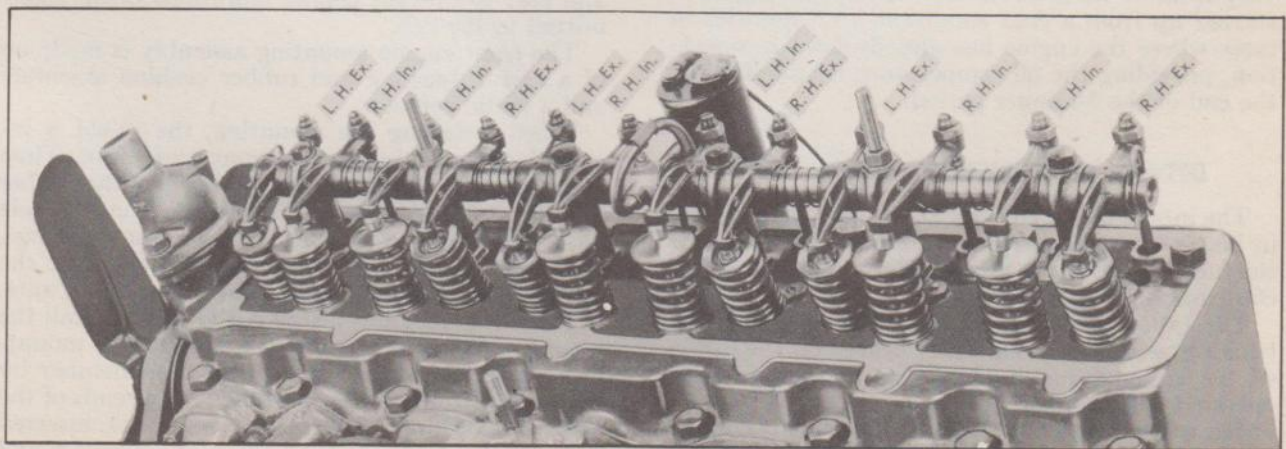


Fig. 57—Rocker Arm Installation Sequence

The rocker arm shafts are hollow and have holes drilled in them to allow oil to pass into the rocker arm bearings. Worn rocker arm shafts should be replaced.

The rocker arms, springs and shaft supports are assembled to the rocker arm shafts and locked in place with hair pin springs.

One end of each shaft is plugged and they must be installed to the cylinder head with the open ends toward the center. A stamped steel baffle is pressed into the open end of the rear rocker arm shaft. This baffle must be installed in the vertical plane. The rocker arm shafts are connected for oil feed at the center by the brass oil connector which slips over the end of each shaft. Therefore, when removing or replacing the rocker assemblies, they must be handled as one unit.

**VALVE ADJUSTMENT PROCEDURE**

Before adjusting Valve Clearance, the engine must be thoroughly warmed up to normalize the expansion of all parts and stabilize the oil temperature. This is very important because during the warm-up period, the valve clearance varies considerably.

Tests have shown that during the warm-up period, when starting with a cold engine and running idle, the following variations in valve clearance take place until the engine is normalized. These tests were made with the valve clearance adjusted at a base setting of—Intake .006" and Exhaust .013".

Time Minutes	Valve Clearance		Oil Temperature	Water Temperature
	Intake	Exhaust	Degrees F.	Degrees F.
0	.006"	.013"	70°	70°
3	.009"	.010"	95°	125°
5	.011"	.012"	115°	155°
10	.010"	.012"	160°	185°
15	.0075"	.0095"	180°	185°
20	.0065"	.008"	190°	185°
25	.006"	.012"	185°	185°
30	.006"	.013"	185°	185°

Covering the radiator with a blanket will not materially hasten the warming-up process because, even with the water temperature quickly raised to 185°, it does not change the rate at which the oil temperature increases.

The actual temperature of the oil is not as important as the stabilization of the oil temperature.

The expansion or contraction of the valves, rocker arm supports, push rods, cylinder head and cylinder block are relative to this oil temperature. Hence, after the oil temperature is stabilized, these parts have stopped expanding and no change in valve adjustment takes place, as shown in the above table.

**Normalizing the Engine**

To Normalize the engine, run it at a fast idle—(approximately 600 R.P.M.) and check the oil temperature with a thermometer at the overflow pipe on the valve rocker shaft connector. **WHEN A CONSTANT OIL TEMPERATURE IS REACHED FOR A PERIOD OF FIVE MINUTES, THE ENGINE IS NORMALIZED AND READY FOR VALVE ADJUSTMENT.**

The important factor is to eliminate all unequal expansion of engine parts before adjusting the valves, and this occurs only after the oil has reached a constant temperature.

Before adjusting the valve clearance, lubricate valve stems to insure free movement of the valves in their guides. Adjust the valve clearance as follows:

Normal Operation	Heavy Duty Operation
Intake .006" to .008" .....	.010"
Exhaust .013" to .015" .....	.020"

On severe truck operations it is advisable to adjust the valves to the high setting.

Sometimes, a truck is brought into the Service Station to have the valves adjusted after having been driven for some distance and the engine is already warm. However, the oil temperature may vary considerably, depending on the type of operation and the length of time the engine has been subjected to such operation. On jobs of this kind considerable time may be saved by following the procedure described below:

Run the engine at a fast idle (approximately 600 R.P.M.) and check the oil temperature with a thermometer at the overflow pipe on the valve rocker shaft connector. When a constant oil temperature is reached for a period of five minutes, the engine is normalized and ready for valve adjustment.

The stabilization of the oil temperature may take place between 150° and 225° depending on how the truck has been driven before being brought into the service station. From the foregoing it can be readily seen that the time necessary to run the engine may vary from 30 minutes in cases where the engine is started up from a cold condition, to 5 minutes in cases where the engine has already been in operation, providing the oil temperature is stabilized at the end of the 5-minute period.

**INTAKE AND EXHAUST MANIFOLDS**

The intake manifold is a "D" shape which results in better atomizing and more even distribution of the fuel to each of the six cylinders. This is another contribution to smooth engine performance.

The exhaust manifold is designed to reduce the back pressure to a minimum. Located on the inside of the exhaust manifold is the thermostatically operated heat control valve.

The thermostatically controlled heat control valve in the exhaust manifold directs the hot exhaust gases against the center of the intake manifold

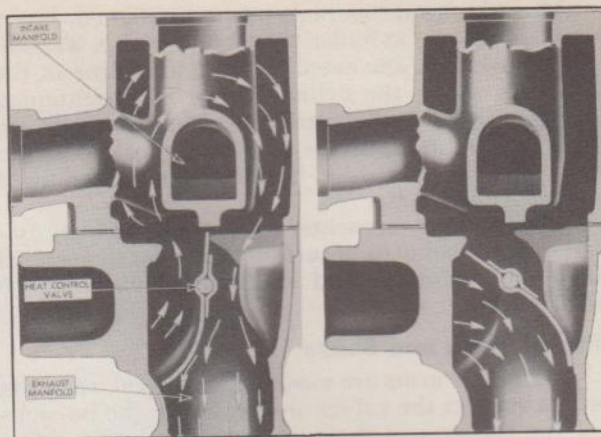


Fig. 58—Manifold Heat Riser

when the engine is cold (Fig. 58-Left). As the engine warms up, the thermostatic spring closes the valve and directs the exhaust gases away from the intake manifold (Fig. 58-Right). This thermostatic control results in the proper temperature of the incoming gases under all operating conditions. The tension of the thermostatic spring is very important—if it is too tight, the exhaust manifold heat will not be turned off the intake heat riser as the engine warms up, with the result that the incoming gases are expanded several volumes and a full charge cannot be forced into the cylinders. This, of course, reduces power and top speed, makes the truck lazy on acceleration, etc. Therefore, it is most important that the thermostatic spring be wound up just enough to slip it over the anchor pin in the manifold and no more. This is approximately 1/2 turn of the spring, at 70° F.

Whenever the manifolds are removed from an engine, the gaskets should be examined to be sure that they are in good condition, as leaky gaskets will make the engine miss. Worn gaskets should be replaced with new ones.

In assembling the manifolds to the cylinder head, the bolts should be drawn up evenly until they are all tight. A special wrench is necessary to properly tighten these bolts.

**Engine Mountings**

Rubber engine mountings are used at the front and rear to prevent engine vibrations being transmitted to the cab.

The front engine mounting assembly is made up of a shield, bushing and rubber cushion assembly and a metal retainer.

When installing the mounting, the shield is installed next to the engine front end plate. Then install the bolts through the end holes in the rubber mounting, starting the bolts through from the side having the large diameter hubs on the bushings, thread the mounting over the bolts staked into the engine front end plate, install the washers and nuts. Tighten the nuts and install cotter pins. Install the mounting cover. The complete engine with mounting is attached to the frame front crossmember by the two bolts which were installed in the ends of the rubber mounting. After these bolts are inserted through the crossmember, install the washers and nuts.

The rear engine mountings are made up in a unit which consists of two steel stampings with reinforcing plates welded on the inside. Each plate is drilled and tapped for mounting to the frame and engine support bracket. A rubber cushion is located between the two plates and vulcanized to them.

When installing these mountings the plate with the greater width is bolted to the engine support bracket with a bolt and lockwasher, making sure that the dowel on the lower plate of the mounting is toward the front. The mounting is attached to the frame bracket by a spacer, lockwasher and bolt.

**CAUTION:** When installing the bolt which attaches the rear engine mounting to the frame bracket, make sure the locating dowel in the bottom of the mounting fits into the forward dowel hole in the frame bracket on each side.

### ENGINE TUNE-UP

One of the most important operations in the maintenance of an engine is proper tuning of the engine. This operation more than any other determines whether or not the engine delivers the maximum in performance and economy.

Only by performing the following operations and adhering to the limits and clearance specifications are you able to get the performance and economy that have been built into the engine.

#### Compression

Before making any checks on an engine it should be run for several minutes to warm it up and lubricate the valve mechanism. The compression of the engine should be checked first because an engine with uneven compression cannot be tuned successfully.

1. Remove all spark plugs from the engine. The ignition should be turned off and the throttle valve in the open position.
2. Insert the compression gauge in a spark plug hole and hold it tightly. Crank the engine with the starting motor until the gauge reaches its highest reading, which requires only a few turns of the engine. Repeat the same test on all cylinders and make a note of the compression on each cylinder.

The compression on all cylinders should be 110 pounds or better, and all cylinders should read alike within 5 to 10 pounds for satisfactory engine performance.

Should you have a low compression reading on two adjacent cylinders, it indicates a possible inter-cylinder leak, usually caused by a leak at a cylinder head gasket.

If the compression readings are low, or vary widely, the cause of the trouble may be determined by injecting a liberal supply of oil on top of the pistons of the low reading cylinders.

Crank the engine over several times, and then take a second compression test. If there is practically no difference in the readings when compared with the first test, it indicates sticky or poorly seating valves. However, if the compression reading on the low reading cylinders is about uniform with

the other cylinders, it indicates compression loss past the pistons and rings.

Naturally, the cause of low or uneven compression would have to be corrected before proceeding with an Engine Tune-Up Job.

#### Spark Plugs

Clean the spark plugs thoroughly, using an abrasive type cleaner. If the porcelains are badly glazed or blistered, the spark plugs should be replaced. All spark plugs must be of the same make and heat range.

Adjust the spark plug gaps at .040", using a round feeler gauge. DO NOT BEND THE CENTER ELECTRODE.

Care must be used when installing the AC-104 10 Millimeter spark plugs or the setting of the gap may be upset. If a tension wrench is used when installing the plugs, the proper tension is 15 foot pounds. If a tension wrench is not available, the following procedure should be used:

Install a new gasket on the plug, screw the plug in finger tight and then tighten with a wrench  $\frac{1}{2}$  to  $\frac{3}{4}$  turn.

#### Battery Test

Connect the negative terminal of a voltmeter to the starting switch terminal and the positive terminal of the voltmeter to a good ground.

Close the starting motor switch and crank the engine for 15 seconds. If the starting motor cranks the engine over at a good rate of speed with the voltmeter reading 5 volts or better, it indicates a satisfactory starting circuit, which includes the condition of the battery terminals and cables. However, if the cranking speed is slow, or the voltmeter reading is under 5 volts, the starting motor, battery, and battery cable terminals should be checked individually to locate the source of the trouble.

#### Distributor

Remove the spark plug wires from the distributor cap and examine the terminals for corrosion. The wires should also be checked for damaged insulation and the wires for being oil soaked.

Remove the distributor cap and check the cap and distributor rotor for cracks or burned contacts.

Check the automatic advance mechanism by turning the distributor cam in a clockwise direction as far as possible, then release the cam and see if the springs return it to its retarded position. If the cam does not return readily, the distributor must be disassembled and the cause of the trouble corrected.

Examine the distributor points. Dirty points should be cleaned, and pitted or worn points should be replaced. Check the points for alignment, and align them if necessary.

Hand-crank the engine until the cam follower rests on the peak of the cam. Adjust the point gap to .018", using a feeler gauge. This operation must be performed very accurately because it affects point dwell. Hand-crank the engine until the cam follower is located between the cams. Hook the end of a point scale over the movable point and pull steadily on the spring scale until the points just start to open. At this point the reading on the scale should be between 17 and 21 ounces.



Set the octane selector at "zero" on the scale. Reassemble distributor cap and spark plug wires. Make sure that the terminals of the primary wire from the ignition coil to the distributor are clean and tight.

#### **Coil and Condenser**

The ignition coil and condenser should be checked following the instructions given by the manufacturer of the testing equipment being used.

#### **Fuel Pump**

Remove the filter bowl and screen and wash them thoroughly in cleaning solvent. When reassembling make sure that the cork gasket is in good condition and properly seated. Tighten all fuel pump connections.

#### **Air Cleaner**

Remove the air cleaner from the carburetor. Remove the wing nut from the top and remove the cover. Remove the filter element assembly.

**CAUTION:—Do not pry this part loose if it sticks. It must be removed by hand because you may damage the filter element flange, which must lie flat against the body to insure a tight seat at this point to prevent air leaks when the cover is assembled.**

Empty the oil out of the cleaner and clean out all oil and accumulated dirt. Wash body with cleaning solvent and wipe dry. Wash filter element by slushing up and down in cleaning solvent. Dry thoroughly, either with an air hose or by letting it stand until dry. Fill the body of the cleaner with oil of the proper viscosity.

It is not necessary to re-oil the filter element as this is done automatically when the car is driven.

Reassemble the filter element to the body of the cleaner, being sure that the flange sets flat against the top flange of the body.

Reassemble the cover, making sure that the gasket is clean and in good condition over its entire surface so that a tight seal is obtained at this point. Put on wing nut.

Reassemble the cleaner to the carburetor. The cleaner must be put on tight so that it rests against the carburetor to assure a good seat at this point. Tighten clamp.

#### **Carburetor**

Remove the carburetor from the engine. Disassemble and clean all parts thoroughly. Check the condition of the needle valve and seat, main nozzle, low-speed jet, metering rod jet, metering rod, and accelerating pump jet.

Assemble jets and plugs to carburetor body, making sure all gaskets are in place. Set the float level. This should be  $\frac{3}{8}$ " from the outer end of the float to the surface of the cover with the gasket removed. Then check the low level of the float by measuring from the outer end of the float to the surface of the cover with the needle valve in the maximum open position. This measurement should be  $\frac{7}{8}$ ".

Assemble the bowl cover to the carburetor. Synchronize the metering rod with the throttle valve on the Carter carburetor according to instructions contained in the Carburetor Section of this Manual.

Reassemble carburetor and air cleaner to the engine.

#### **Manifold Heat Valve**

Unhook the thermostatic spring from its anchor pin and check the adjustment. Proper adjustment requires only  $\frac{1}{2}$  turn of the spring to slip it over its anchor pin. Should the thermostatic spring be distorted in any way it should be replaced.

#### **Ignition Timing**

With the octane selector set at "zero," attach Neon Timing Light KMO-318 to No. 1 spark plug. Start the engine and run it at idling speed. Loosen distributor clamp and rotate distributor body clockwise or counterclockwise until the steel ball in the flywheel lines up with the pointer on the flywheel housing. Tighten the distributor clamp screw.

#### **Valve Adjustment**

Start the engine and while it is warming up, the cylinder head bolts, rocker arm shaft support bolts and nuts and the manifold bolts and nuts should be tightened. Where torque wrenches are available the cylinder head bolts should be tightened to 75 to 80 foot pounds, and the rocker arm shaft support bolts to 25 to 30 foot pounds.

Normalize the engine and adjust the valves according to the procedure given in this section of the manual under the heading "Valve Adjustment Procedure."

Install the rocker arm cover, using a new gasket and check for oil leaks.

#### **Idling Adjustment**

Adjust the carburetor idle and throttle stop screws in combination with each other to secure the best idling performance. Idling speed should be set at 500 to 550 R.P.M.

#### **Cooling System**

Tighten all hose connections and examine for any indications of water leaks. Check the fan belt for proper tension and adjust it if necessary.

#### **Current and Voltage Regulator**

Check the adjustment of the Current and Voltage Regulator according to the instructions given in Section 12 of this Manual.

#### **Road Test**

After the completion of the above operations, the truck should be road-tested for performance. During this time the octane selector should be adjusted for the grade of fuel being used. For peak performance and maximum gasoline economy, the octane selector should be set to produce a slight "ping" upon accelerating at wide-open throttle.

## ENGINE TROUBLES AND CAUSES

### Lack of Power

1. Low or Poor Compression.
2. Ignition System Defective—See "Distributor" Section.
3. Carburetor or Fuel Pump not Functioning Properly—See "Fuel System" Section.
4. Air Cleaner Restricted.
5. Low Octane Fuel.
6. Overheating—See "Cooling System."
7. Improper Grade and Viscosity of Oil.

### Poor Compression

1. Incorrect Valve Lash.
2. Leaky Valves.
3. Valve Stems or Lifters Sticking.
4. Valve Stems or Guides Worn.
5. Valve Springs Weak or Broken.
6. Valve Timing Incorrect.
7. Cylinder Head Gasket Leaking.
8. Piston Rings Broken, Worn or Stuck.
9. Pistons or Rings Improperly Fitted.
10. Piston Ring Grooves Worn.
11. Cylinder Scored or Worn Excessively.

### Excessive Cylinder and Piston Wear

1. Improper Grade and Viscosity of Oil.
2. Lack of Oil.
3. Dirty Oil.
4. Overheating—See "Cooling System."
5. Piston Improperly Installed and Fitted.
6. Piston Rings Not Properly Fitted to Piston Groove and Cylinder Wall.
7. Piston Rings Stuck in Piston Grooves or Broken.
8. Air Cleaner Not Clean, Allowing Dirt to Enter Combustion Chamber.
9. Carburetor Fuel Mixture too Rich.

### Crankshaft Bearing Failure

1. Crankshaft Bearing Journal Out-of-Round.
2. Crankshaft Bearing Journal Rough.
3. Crankshaft Oil Passage Restricted.
4. Bearings Loose.
5. Crankshaft or Bearings Out-of-Alignment.
6. Lack of Oil.
7. Low Oil Pressure.
8. Improper Grade and Viscosity of Oil.

### Connecting Rod Bearing Failure

1. Crankshaft Surface Rough.
2. Dipper Improperly Installed, Improper Oil Trough or Dipper Height, Oil Nozzle Improperly Aimed.
3. Bearings Loose.
4. Bent Connecting Rod.
5. Lack of Oil.

6. Low Oil Pressure.
7. Improper Grade and Viscosity of Oil.

### Burned Valves and Seats

1. Improper Valve Lash.
2. Weak Valve Springs.
3. Improper Valve Timing.
4. Excessive Carbon Deposits Around Seat and Valve Head.
5. Valves Sticking in Guides.
6. Improper Type Valves—Use Genuine Parts.
7. Valve Head too Thin Causing Hot Sections.
8. Valve Seats too Narrow.
9. Fuel Mixture Flow Restricted.
10. Overheating—See "Cooling System."
11. Rocker Arm Stuck, Holding Valve Open.

### Valves Sticking

1. Incorrect Valve Lash.
2. Insufficient Clearance Between Valve Stem and Guide.
3. Valve Springs Weak or Broken.
4. Valve Stems Scored or Dirty.
5. Valve Lifters Sticking.
6. Use of Fuel with High Gum Content.

### Overheating

1. See "Cooling System."
2. Improper Grade and Viscosity of Oil.
3. Fuel Mixture too Lean.
4. Air Cleaner Restricted.
5. Ignition System Defective—See "Distributor" Section.
6. Valve Timing too Early.
7. Damaged Thermostat.
8. Hose Connections Restricted.

### Excessive Oil Consumption

1. Piston Rings Broken, Worn or Stuck.
2. Piston Rings Improperly Fitted.
3. Piston Ring Oil Return Holes Clogged with Carbon.
4. Cylinder Bore Out-of-Round or Excessive Taper.
5. Cylinder Bore Scored or Badly Worn.
6. Engine Running too Cool.
7. Oil Level too High.
8. Oil Leaks at Gaskets and Seals.

### Popping, Spitting and Spark Knock

1. Manifold Heat Control Spring Not Properly Installed.
2. Defective Ignition System—See "Distributor" Section.
3. Carburetor Not Properly Adjusted—See "Fuel System" Section.

4. Valve Lash Adjusted too Close.
5. Exhaust Valve Head too Thin Causing Hot Sections.
6. Excessive Carbon Deposits in Combustion Chamber.
7. Weak Valve Springs.
8. Hot Spot in Cylinder Head, Usually Caused by Clogged Water Passages.
9. Valves Not Seating Properly.

10. Valve Timing Early.
11. Inferior Grade of Fuel.
12. Spark Plugs Glazed; Clean or Replace.

**Engine Surge or Roll — At Idling Speed**

1. Improper Carburetor Idle Adjustment.
2. Improper Governor Adjustment.

**Engine Surge or Roll — At High Speed**

1. Improper Governor Adjustment.

**TOOLS REQUIRED**

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling an engine:

Tool Number	Description
J-1000.....	Main Bearing Boring Machine
J-946.....	Camshaft Bearing Service Tool Set
T-126-R....	Crankshaft Gear Puller— $\frac{3}{4}$ " Screw
J-971.....	Camshaft Gear Press Plate
J-969-2.....	Oil Pan Trough Depth Gauge
J-969-1.....	Oil Pan Target
J-969-3.....	Oil Line Nozzle Depth Gauge
J-1287....	Harmonic Balancer Driver and Puller
KMO-318.....	Timing Light
J-793-3.....	Faucet Assembly
J-793-2.....	Oil Line Setting Tool
J-965.....	Piston Reamer and Fixture
KMO-357.....	Piston Inserter

Tool Number	Description
KMO-964.....	Inside-Outside Caliper
J-995.....	Timing Gear Cover Oil Seal Driver
J-966.....	Timing Gear Cover Centering Gauge
J-982-A.....	Cylinder Head Holding Fixture
J-267.....	Valve Guide Remover
J-1089.....	Valve Guide Replacer—Intake
J-1090.....	Valve Guide Replacer—Exhaust
KMO-122.....	Valve Guide Hole Cleaner
KMO-105-B.....	Valve Seat Cutter Set
KMO-341.....	Valve Guide Reamer (Roughing)
KMO-343.....	Valve Guide Reamer (Finishing)
U-15.....	Valve Spring Tester
N-344.....	Cylinder Head Guide Pin Set
J-1313.....	Torque Wrench
KMO-187-1.....	Torque Wrench Adapter
KMO-187-10.....	Torque Wrench Adapter

ENGINE SPECIFICATIONS

Type.....	Valve-in-Head	Torque Wrench Pull (Foot lbs.).....	(With Threads Oiled) 40 - 45
Number of Cylinders.....	6	Clearance Between Piston and Cylinder Bore.....	(Refer to Fitting Instructions in Engine Section) .0017" - .0023"
Bore.....	3 1/2"	Fit Piston with Feeler Shim on Thrust Side at Bottom and 90° opposite Piston Pin Holes	Pass on .002" Feeler 1/2" Wide Hold on .003" Feeler 1/2" Wide
Stroke.....	3 3/4"	Oversize Pistons Available.....	.003" - .010" - .020" - .030" - .040"
Piston Displacement.....	216.5 cu. in.	Piston Pin Hole.....	Slip Fit
Compression Ratio.....	6.5:1	Ring Groove Width:	
Horsepower.....	SAE 29.4	Compression.....	.1255" - .1265"
Firing Order.....	1-5-3-6-2-4	Oil.....	.1885" - .1895"
Maximum Torque.....	174 ft. lbs.	Piston Pin:	
Cylinder Block:		Diameter.....	.8645" - .8650"
Bore Size.....	3.4995" - 3.5015"	Oversize.....	.003" - .005" - .010"
Bore Out-of-Round.....	.0005" Max.	Compression Ring:	
Taper.....	.0005" in Bore Length	Quantity.....	2
Cylinder Head:		Type.....	Plain
Torque Wrench Pull (Foot lbs.).....	75 - 80	Width.....	.1235" - .1240"
Crankshaft:		Gap.....	.005" - .015"
Number of Bearings.....	4	Ring and Groove Clearance.....	.0015" - .0030"
Bearing Journal Diameter:		Oil Ring:	
Front.....	2.6835" - 2.6845"	Quantity.....	1
Front—Intermediate.....	2.7145" - 2.7155"	Type.....	Drilled
Rear—Intermediate.....	2.7455" - 2.7465"	Width.....	.1860" - .1865"
Rear.....	2.7765" - 2.7775"	Gap.....	.005" - .015"
Connecting Rod Journal.....	2.311" - 2.312"	Ring and Groove Clearance.....	.002" - .0035"
Thrust Taken.....	Rear Intermediate	Camshaft:	
End Clearance.....	.004" - .007"	Number of Bearings.....	4
Crank Pin Out-of-Round.....	.001" Max.	Bearing Journal Diameter:	
Run-Out—At Intermediate Journal.....	.002" Max.	Front.....	2.0282" - 2.0292"
Crankshaft Main Bearing:		Front—Intermediate.....	1.9657" - 1.9667"
Bearing Clearance.....	.0015" - .0025"	Rear—Intermediate.....	1.9032" - 1.9042"
Torque Wrench Pull (Foot lbs.) (With threads oiled) 100 - 110		Rear.....	1.8407" - 1.8417"
Connecting Rod:		Run-Out at Intermediate Bearing.....	.002" Max.
Center to Center Length.....	6 13/16"	Thrust Taken.....	Front
Upper Bearing.....	Locked on Pin	Thrust Plate Thickness.....	.184" - .189"
Lower Bearing.....	Cast Babbitt	Camshaft End Clearance.....	Free to .003"
Lower Bore.....	2.3130" - 2.3135"		
Connecting Rod Bearing—Lower:			
Bearing Clearance.....	.0004" - .0009"		
End Clearance.....	(Controlled by Upper Half of Bearing) .004" - .011"		

Camshaft Bearing:

Diameter—Line Ream:  
 Front..... 2.0307" - 2.0317"  
 Front—Intermediate..... 1.9682" - 1.9692"  
 Rear—Intermediate..... 1.9057" - 1.9067"  
 Rear..... 1.8432" - 1.8442"  
 Bearing Clearance..... .002" - .004"

Intake Valve: (Normal Operation) (Heavy Duty Operation)  
 Lash—Hot | .006" - .008"  
 Seat Angle..... 30°  
 Diameter Head..... 1<sup>11</sup>/<sub>64</sub>"  
 Length—Over-all..... 6.205" - 6.235"  
 Stem Diameter..... .3407" - .3417"  
 Guide Ream..... .3427" - .3437"  
 Stem to Guide Clearance..... .001" - .003"  
 Intake Opens..... 3° B.U.D.C.  
 Intake Closes..... 35° A.L.D.C.  
 Intake Period..... 218°  
 Width of Seat (In Head)..... <sup>3</sup>/<sub>16</sub>" to <sup>1</sup>/<sub>16</sub>"

Exhaust Valve: (Normal Operation) (Heavy Duty Operation)

Lash—Hot .013" - .015"  
 Seat Angle..... 30°  
 Diameter Head..... 1<sup>15</sup>/<sub>32</sub>"  
 Length—Over-all..... 4.839" - 4.869"  
 Stem Diameter..... .3397" - .3407"  
 Guide Ream..... .3427" - .3437"  
 Stem to Guide Clearance..... .002" - .004"  
 Exhaust Opens..... 46° B.L.D.C.  
 Exhaust Closes..... 5° A.U.D.C.  
 Exhaust Period..... 231°  
 Width of Seat (In Head)..... <sup>1</sup>/<sub>16</sub>" - <sup>3</sup>/<sub>32</sub>"

Valve Lifter:

Diameter..... .989" - .990"  
 Clearance—Block to Lifter..... (Selective Fit) 0 - .001"

Valve Spring:

Free Length..... 2<sup>1</sup>/<sub>8</sub>"  
 Lbs. Pressure at 1<sup>13</sup>/<sub>16</sub>"..... 55 lbs.  
 Lbs. Pressure at 1<sup>1</sup>/<sub>2</sub>"..... 128 lbs.

Valve Rocker:

Rocker Shaft Diameter..... .7910" - .7917"  
 Rocker Arm Diamond Bored (After Granodizing)..... .7922" - .7932"  
 Clearance—Rocker Arm to Shaft..... .0005" - .0022"

Timing Gears:  
 Backlash..... .002" - .005"  
 Crankshaft Gear:

Material..... Leaded Steel  
 Teeth..... 27  
 Run-Out..... .003"

Camshaft Gear:

Material..... Steel Hub—Gear Bakelite—Fabric Composition  
 Teeth..... 54  
 Run-Out..... .004"

Oil Pump:

Lbs. Pressure at 2000 R.P.M..... 14 lbs.  
 Gear Backlash..... .002" - .0085"  
 Gear Width..... .812" - .814"  
 Diameter:

Housing Bore..... .5585" - .5605"  
 Drive Shaft..... .5575" - .5580"  
 Driven Gear Shaft..... .5565" - .5570"  
 Drive Gear—Bore..... .556" - .557"  
 Driven Gear—Bore..... .5575" - .5585"

Clearance Between:

Drive Shaft and Housing..... .0005" - .0030"  
 Drive Gear to Shaft..... .0005" Press - .0020" Press  
 Driven Gear to Shaft..... .0005" - .0020"  
 Gear to Housing (Radial)..... .003" - .008"  
 Gear to Housing Lower Edge..... .002" - .008"  
 Relief Valve to Housing..... .002" - .009"

Pressure Relief Spring:

Free Length..... <sup>59</sup>/<sub>64</sub>"  
 Pressure at <sup>19</sup>/<sub>32</sub>"..... 109 oz. ± 5 oz.  
 Valve Opens at..... 15 lbs.

Oil Filter:

Make..... AC No. 1595178  
 Model..... Military Standard Jr.  
 Replacement Element..... Part No. 1595222

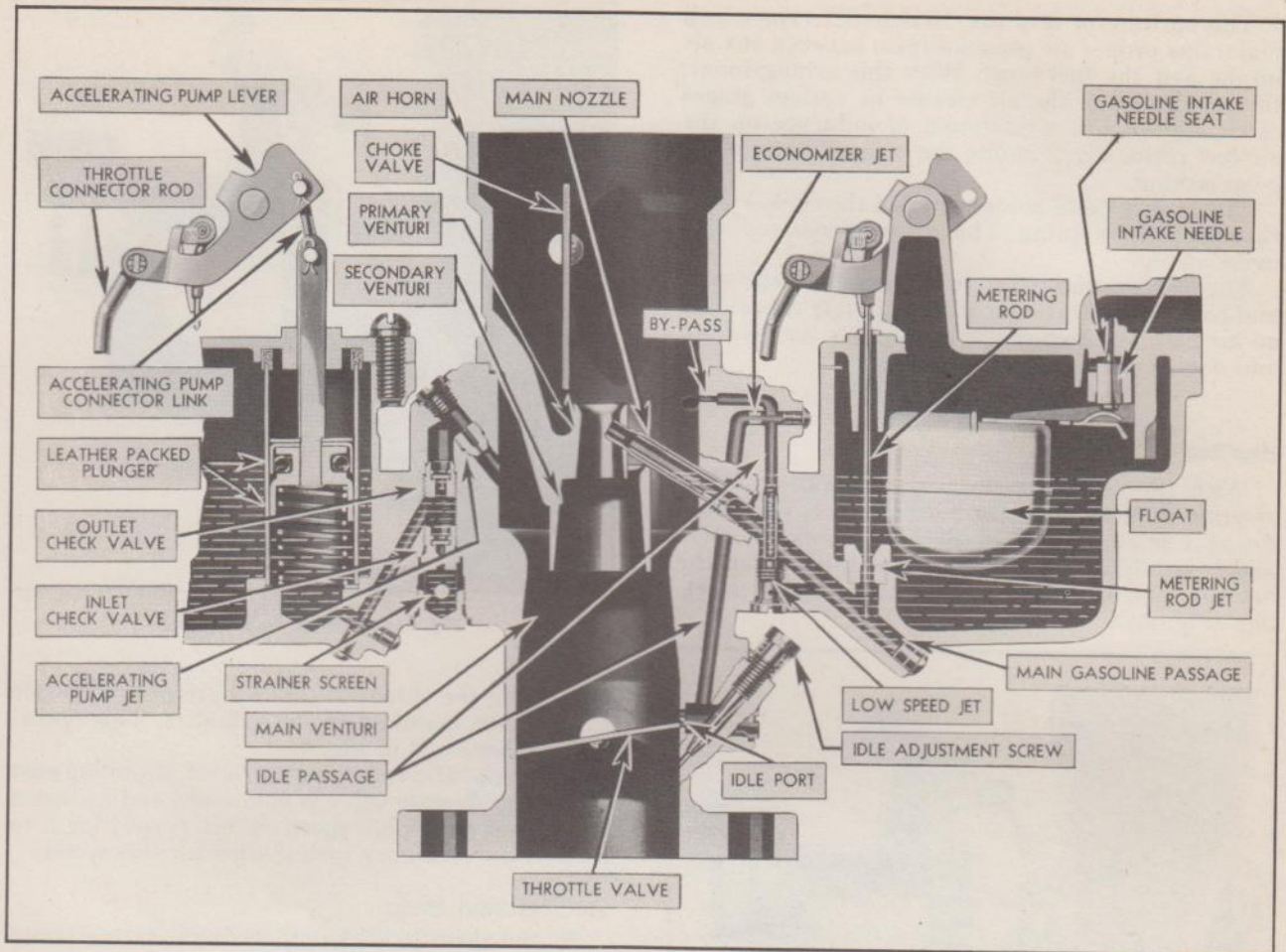


Fig. 1—Diagrammatic View of Carburetor

## CARBURETOR

The down-draft carburetor contributes to the smooth, quiet operation and power of the Chevrolet valve-in-head engine. Down-draft, as its name implies, eliminates the necessity of lifting air and gasoline from the carburetor, thus improving the breathing ability of the intake system without affecting its flexibility.

This carburetor embodies a principle which employs three venturis, one located above and two below the level of the fuel in the float chamber. This triple venturi has the effect of increasing the suction on the first or primary venturi, causing the nozzle to start delivering fuel at very low air speeds. The nozzle enters the primary venturi at an angle, discharging upwardly against the air stream. This angle secures an even flow of correctly proportioned and finely atomized fuel.

The fuel thus atomized in the primary venturi is kept centrally located in the air stream by the surrounding blanket of air passing into the second venturi and this process is repeated by the air in the main venturi. By this means, the fuel is carried to the cylinders in a more perfectly atomized condition. This insulated atomization results in increased smoothness of operation at both low and high speeds.

The mixture quality is controlled by a metering rod which operates within the metering rod jet, and

is operated by the throttle lever. There are two steps of different diameters on this metering rod. The large diameter, or economy step, is tapered and controls the fuel flow to about seven-eighths throttle, when the smaller diameter, or power step, becomes effective, giving full power for either high speed or hard low speed pulling. By this simple means, both maximum power and greater economy can be had without changing the carburetor adjustment. Fig. 1 shows the diagrammatic view of the carburetor showing the various passages.

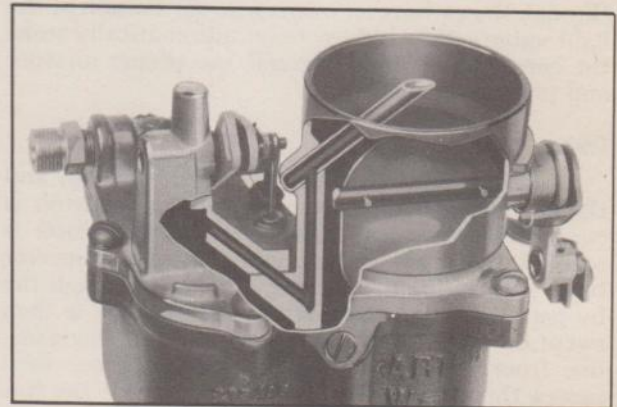


Fig. 2—View Showing Balance Passages

This carburetor is of the "Balanced" type which maintains proper air pressure ratio between the air intake and the fuel bowl. With this arrangement, the restriction of the air cleaner in various stages of cleanliness has a minimum of influence on the air fuel ratio. Fig. 2 shows the balance passages in cross section.

The choker valve is connected to the choker lever through a light spring. This arrangement prevents overchoking.

The accelerating pump is of the pneumatic type and consists of a cylinder with a plunger containing an air bell, and two check valves, one on the inlet and one on the outlet side. See Fig. 1.

**OPERATION**

**Starting**

With the choke valve in closed position when starting, suction from the down stroke of the piston draws a small amount of air past the choke valve and it is mixed with the gasoline drawn from the main nozzle, forming a rich mixture for easy starting. (Fig. 3.)

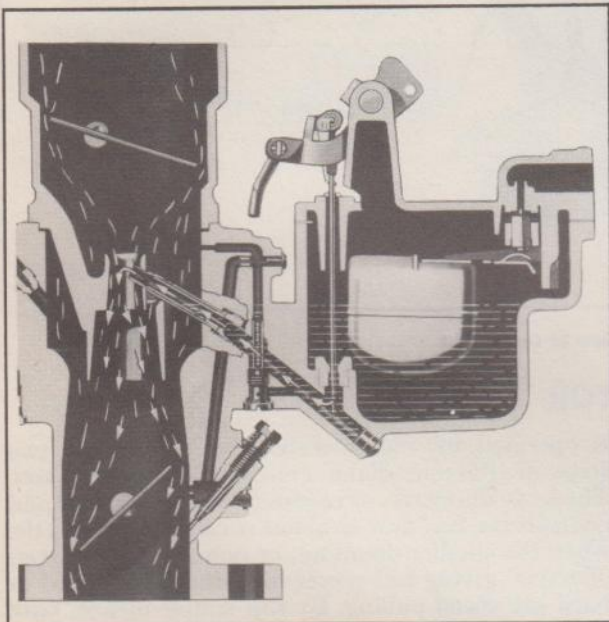


Fig. 3—Operation During Starting

When the engine starts, the incoming rush of air through the carburetor overcomes the tension of the light valve spring and the valve automatically seeks the correct position to provide the proper mixture and prevent overchoking.

**Idling**

At idling speed the throttle valve is closed, and the suction from the down stroke of the piston is concentrated on the idling port. This suction is applied to the low speed passage in the carburetor body and results in air being drawn in through the by-pass hole in the carburetor body. The air is then swept over the top of the low speed jet, lifting gasoline from the jet. The gas and air mixture then passes through the economizer and down the low speed passage to the idling ports, where it is dis-

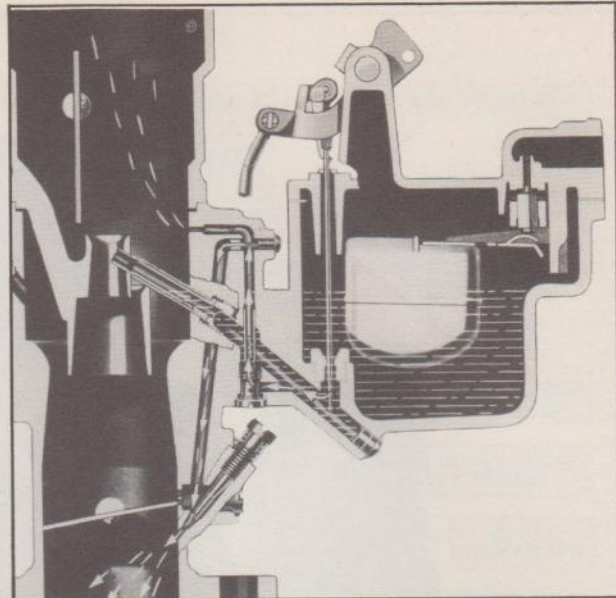


Fig. 4—Operation During Idling

charged in the throat of the carburetor and thence through the manifold to the cylinders. This operation is illustrated in Fig. 4.

As the throttle valve starts to open, the idling port above the throttle valve is uncovered and increases the suction on the low speed circuit, permitting it to furnish the necessary fuel mixture for this speed.

**Accelerating Pump**

As the throttle is closed, the accelerating pump piston is drawn upward by the accelerating pump lever, displacing the cylinder. This results in closing the outlet check valve and opening the inlet check valve. Gasoline then flows from the bowl through

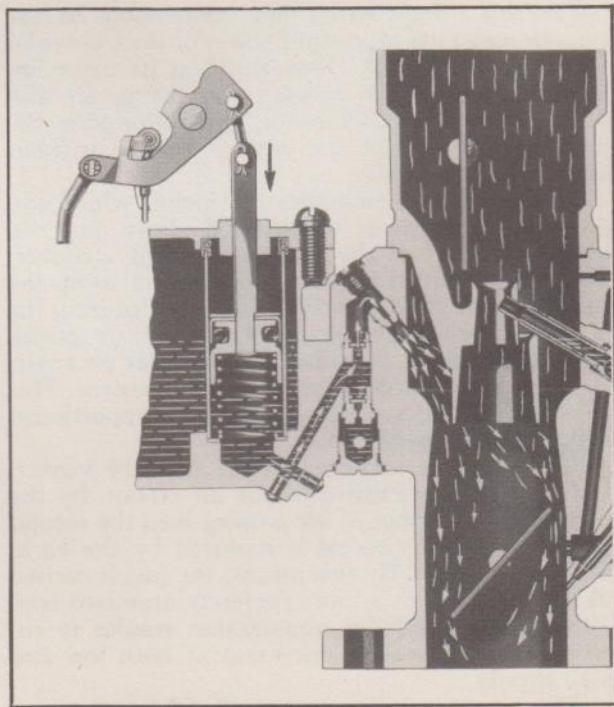


Fig. 5—Accelerating Pump Operation

the inlet check valve and into the pump cylinder. When the throttle is opened quickly, the pump plunger is pushed down in the cylinder by its link connection to the pump lever, compressing the air above the gasoline in the cylinder. This pressure closes the inlet check valve and opens the outlet valve. The gasoline then flows from the cylinder through the outlet valve and accelerating pump jet into the main venturi where it meets and mixes with the air being drawn in through the air horn, forming the gas and air mixture for acceleration. Fig. 5 illustrates the accelerating pump operation.

**Low Speed**

At low engine speed the throttle is partially open, and suction from the down stroke of the piston draws air in through the air horn. The air, in passing through the main venturi, increases in velocity with the result that the suction is increased in the secondary venturi. The increased air speed through the secondary venturi in turn steps up the suction on the primary venturi and thereby increases the air speed in the primary venturi. The air, passing through the primary venturi, draws gasoline from the main nozzle where it is mixed with the air passing through the primary, secondary and main venturi, forming a finely atomized mixture which then passes to the manifold and cylinders (Fig. 6).

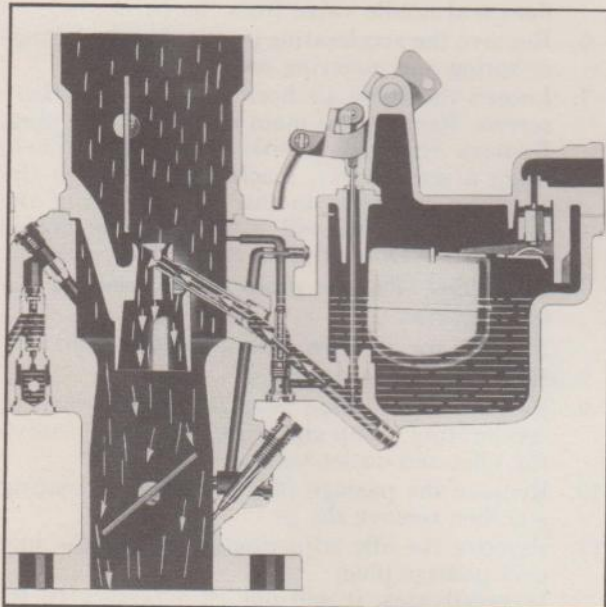


Fig. 6—Operation During Low Speeds

**High Speed**

The operation at higher speeds is similar to the low speed operation with the exception of raising the metering rod in the metering rod jet. This is equivalent to increasing the size of the jet and thereby furnishes the additional gasoline required for high speeds and wide open throttle power operation.

**Adjustments**

The carburetors are carefully tested and adjusted to the engine, before leaving the factory. Too often adjustments are made on the carburetor, when in reality, something else is causing uneven running, or the engine has not thoroughly warmed up.

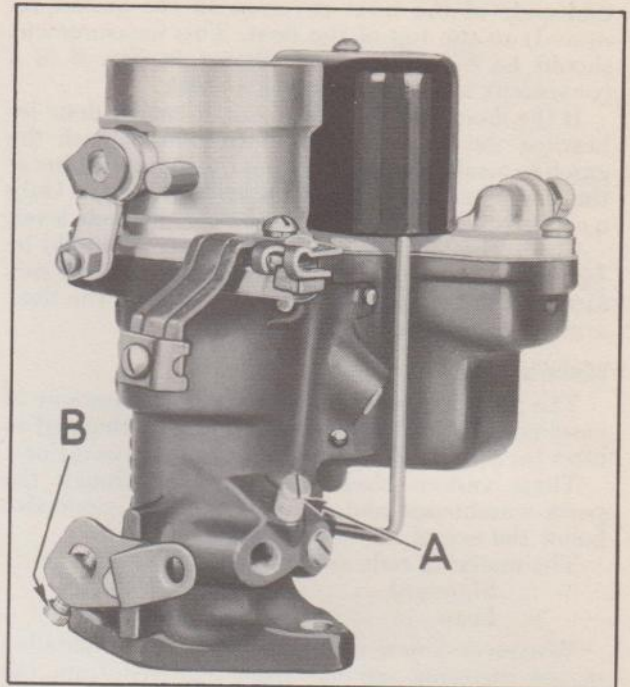


Fig. 7—Idle Adjustment

There are two adjustments on the carburetor, one for idling mixture and the other for idling speed. Both of these adjustments should be made together.

To adjust the idling mixture, proceed as follows: Open the idle adjustment screw, "A," Fig. 7, 1½ turns. Start the engine and let it run at idling speed. Then adjust the idle and throttle stop screw, "B," Fig. 7, in combination with each other to secure the best idling performance. Idling speed should be set at 500 to 550 R.P.M.

**Float Level**

Float level is one of the most important adjustments on the carburetor. This adjustment is checked by measuring from the machined surface on the

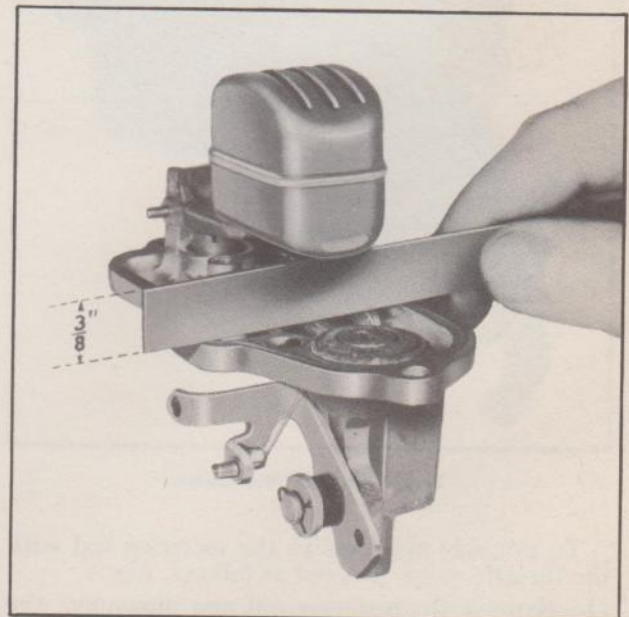


Fig. 8—Checking Float Level



underside of the bowl cover (with the gasket removed) to the top of the float. This measurement should be  $\frac{3}{8}$ ". The gauge shown in Fig. 8 is a convenient tool for making this check.

If the float level must be reset, it can be done by bending the lip that comes into contact with the gasoline intake needle. Bending the lip up will lower the float level and bending it down will raise it. Only a slight bend is necessary to change the float level.

Check the low position of the float. It should be  $\frac{7}{8}$ " from the top of the float to the machined surface on the bowl cover. Bend the ears on the float arm to secure this measurement.

### Metering Rod

The metering rod, which controls the amount of gasoline passing through the jet, can be changed to meet the various climatic, fuel or driving conditions.

These various sizes are available through the parts warehouses and are marked with their size below the eye of the metering rod.

The metering rods are marked as follows:

Standard.....	67-46
Lean.....	68-49

Whenever a new metering rod is to be installed or the metering rod has been removed from the carburetor, the metering rod gauge should be used to check the relationship between the metering rod and throttle valve. This gauge can be procured from any Chevrolet Parts Warehouse under part number 600996.

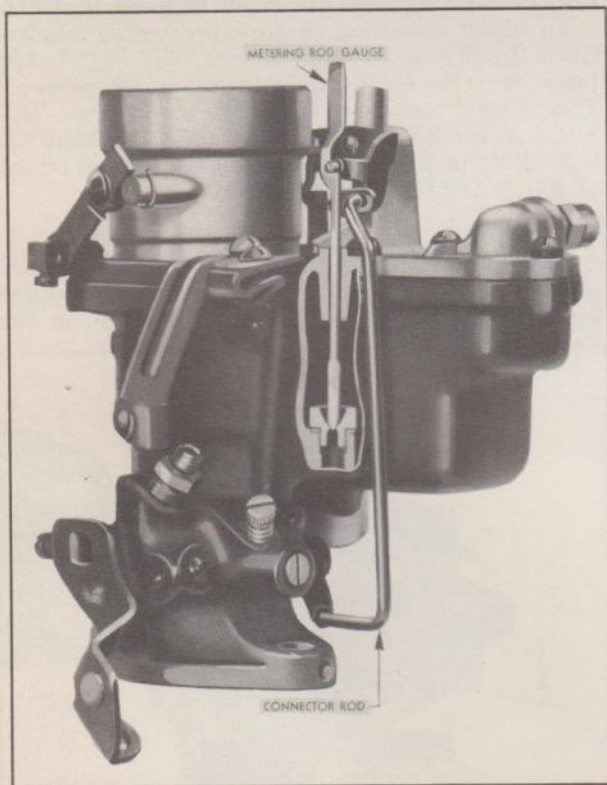


Fig. 9—Metering Rod Gauge

To properly synchronize the metering rod with the throttle valve, proceed as follows, Fig. 9.

1. Remove the metering rod and disconnect the connector rod from the lever.

2. Back off throttle stop screw until throttle valve is closed tightly.
3. Install metering rod gauge, allowing the metering rod pivot pin on the lever to rest on the gauge.
4. Bend connector rod at throttle valve end until connector rod will enter hole in the lever freely.
5. Remove metering rod gauge, assemble metering rod and readjust the throttle stop screw.

### REPAIR OPERATIONS

#### Disassembly

The following instructions cover the repair operations on the Down-draft Carburetor:

1. Remove the dust cover from the carburetor body.
  2. With the throttle valve in the open position, remove the stamped retainer from the accelerating pump end of the connector rod, by pushing in on the end of the retainer and turning it 90 degrees. Then remove the anti-rattle spring.
  3. Disconnect the metering rod spring and remove the metering rod.
  4. Remove the spring retainer from the accelerator pump connector link and remove the link.
  5. Remove the four bowl cover screws and remove the bowl cover. Then disassemble the float and needle valve from the cover.
  6. Remove the accelerating pump plunger, plunger spring and metering rod jet.
  7. Loosen the three air horn to carburetor body screws. Remove the main nozzle passage plug. Remove the main nozzle screw plug. Then, using a screwdriver, reach down through the air horn and press on the "D" section of the main nozzle—this will force the main nozzle out of the "D" section in the primary venturi.
- CAUTION—Do not press on the end of the main nozzle.**
- Remove the air horn screws and air horn.
  8. Remove the low speed jet.
  9. Remove the passage plug and screen for the accelerating pump check valves. Then remove the inlet and outlet valves.
  10. Remove the passage plug for the accelerating jet, then remove the jet.
  11. Remove the idle adjusting screw and the idle port passage plug.
- In most cases, it will not be necessary to remove the choke valve or throttle valve.

#### Inspection

1. Wash all parts in clean gasoline or other cleaning solvent.
2. Check the idle ports and first by-pass for carbon deposits. Then blow out all drilled passages with compressed air.
3. Check the operation of the choke mechanism. If necessary it may be disassembled by removing the two screws which retain the choke valve.

**NOTE—These screws are upset on the underside of the valve shaft to prevent them from loosening. Therefore, it is recommended the upset portion be filed off before attempting to remove them.**

The choke lever and spring may be removed by first removing the snap ring which retains the lever to the boss on the air horn.

4. Inspect the main nozzle for burrs on the end fitting into venturi. Examine the small air bleed holes in the nozzle and blow out any carbon deposits. Blow out the low speed jet and make sure the metering hole is clean.
5. Check the operation of both the inlet and outlet check valves. Inspect the accelerating pump jet to make sure it is clean.
6. Inspect the accelerating pump plunger. If the leather or its expanding spring are damaged in any way, the plunger assembly should be replaced.
7. Inspect the metering rod jet and metering rod for wear or damage.

**Reassembly**

When reassembling the carburetor, it is recommended that all paper and copper gaskets be replaced.

1. If the throttle valve has been removed, care must be used to make sure the letter "C" stamped on the valve is toward the idle port when reassembling as shown in Fig. 10.

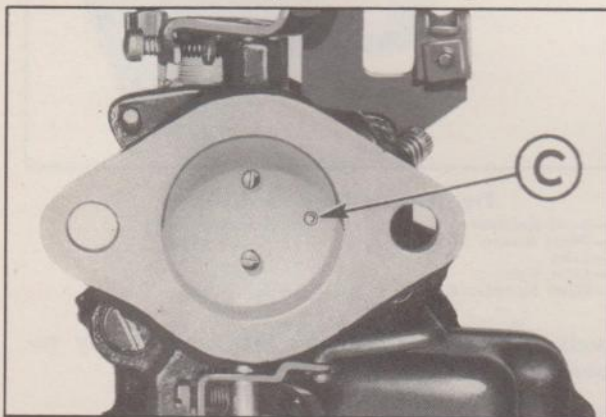


Fig. 10—Correct Assembly of Throttle Valve

2. If the choke valve assembly has been removed, the valve must be assembled to the shaft with the letter "C" stamped on the valve toward top of air horn.
3. Assemble the air horn loosely to the carburetor body, making sure the small gasket is in place at the balance passage.
4. Assemble the copper gasket on the main nozzle, (4) Fig. 11. Hold the carburetor with the air horn down, line up the flat part of the "D" section on the nozzle with that in the primary venturi and drop the nozzle (5) into the opening. Install the nozzle screw plug (3) and tighten it securely. Tighten the three air horn screws. Install the main nozzle passage plug (1) using a new copper gasket (2).
5. Install the low speed jet (13) and gasket (12) in the carburetor body, then again remove the jet and check the bearing on the top end of the jet. If there is a complete bearing around the top of the jet indicating a full seat, it may be

reinstalled. If the bearing is incomplete, a new jet should be installed. See Fig. 12.

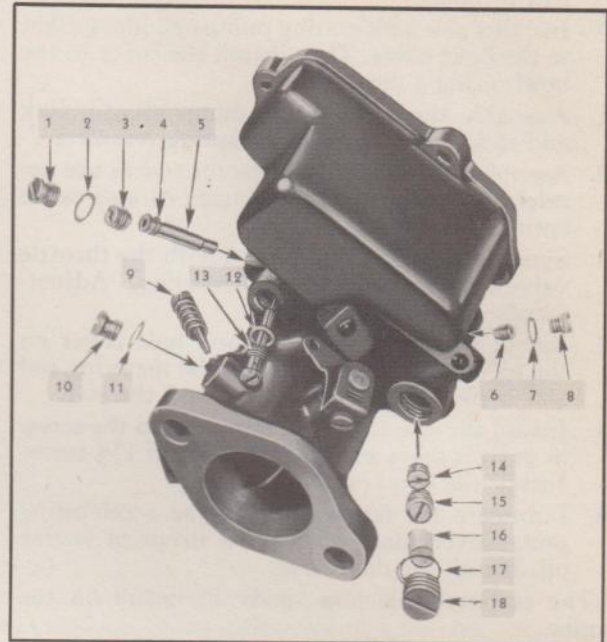


Fig. 11—Down-draft Carburetor Valves and Jets

- |   |  |
|---|--|
| 1—Passage Plug                            | 10—Passage Plug                          |
| 2—Passage Plug Gasket                     | 11—Passage Plug Gasket                   |
| 3—Nozzle Screw                            | 12—Low Speed Jet Gasket                  |
| 4—Main Nozzle Gasket                      | 13—Low Speed Jet                         |
| 5—Main Nozzle                             | 14—Pump Outlet Check Valve               |
| 6—Pump Jet                                | 15—Pump Inlet Check Valve                |
| 7—Passage Plug Gasket                     | 16—Pump Strainer Screen                  |
| 8—Passage Plug                            | 17—Passage Plug Gasket                   |
| 9—Idle Adjusting Screw and Tension Spring | 18—Pump Screen Retainer and Passage Plug |

6. Install the outlet and inlet check valves (14) and (15), Fig. 11, in the carburetor body. Then install the screen (16), passage plug (18) and gasket (17).
7. Install the accelerating pump jet (6), plug (8) and gasket (7).

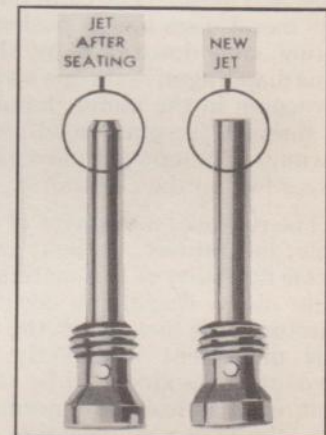


Fig. 12—Low Speed Jet

7. Install the metering rod jet and gasket. Place the accelerating pump spring in the cylinder. Slip the accelerating pump plunger assembly sleeve over the leather, then with the assembly sleeve centered over the cylinder, push the pump plunger into the cylinder.
  8. Install the needle valve and seat in the bowl cover, then install the float and lever pin.
  9. With the cover turned upside down, check the float level by measuring from the cover to the float. This distance should be 3/8". See Fig. 8.
- CAUTION—When making float level adjustments, do not press on the float proper.**
- Check the low position of the float by measuring from the cover to the top of the float. This

distance should be  $\frac{7}{8}$ ". Adjustment may be made by bending the two stops with a small pair of pliers.

10. Install a new accelerating pump cylinder gasket to the bowl cover. Then install the cover to the bowl, using a new gasket.
11. Assemble the accelerating pump plunger link and lock it in place with its spring retainers.
12. Assemble the throttle connector rod to the accelerating pump arm, then install its anti-rattle spring and retainer.
13. Synchronize the metering rod with the throttle valve as explained under the heading, "Adjustments—Metering Rod."
14. Install the metal metering rod hole cover on the metering rod, then install the metering rod and hook metering spring around the rod.
15. Install the idle adjusting screw. Turn the screw in until it seats and then back it off  $1\frac{1}{2}$  turns. Install the idle port passage plug.
16. Lubricate the felt washer on the accelerating pump lever shaft with a few drops of engine oil. Install the dust cover.

The carburetor is now ready to install on the engine.

### FUEL PUMP

The fuel pump, Fig. 13, is of the diaphragm type and is attached to the crankcase and is operated from an eccentric on the camshaft.

The diaphragm is composed of several layers of specially treated cloth which is impervious to gasoline and benzol. The cloth material is held between two metal discs and is pushed upward by a pump spring, and downward by the arm on camshaft. This diaphragm, in its downward movement, causes a vacuum in the pump chamber and fuel is drawn in through the glass bowl and strainer to fill this vacuum. The upward movement of the diaphragm forces fuel to the carburetor.

The repeated movement of the diaphragm is possible, indefinitely, without injury, due to the extreme flexibility of this material. Further, the movement of the diaphragm occurs only when the carburetor needs fuel. When the carburetor needs fuel, this movement is directly proportional to the amount of gasoline used by the engine. This means that in practically all normal driving conditions this diaphragm is pulsating in a movement of a few thousandths of an inch.

This movement is controlled by linkage because, when the diaphragm is in the depressed position, due to sufficient fuel in the carburetor, the up and down movement of the fuel pump link ceases and the rocker arm spring keeps the rocker arm in contact with the eccentric on the camshaft.

The fuel pump has a large reservoir and surge chamber. The glass filter bowl is clamped to the cover assembly, making it a simple matter to detect the presence of sediment in the fuel pump. The inlet and outlet valve assemblies are interchangeable, and each assembly is a self-contained unit made up of a valve cage, a fibre valve, and a valve spring. Both valve assemblies are held in place by

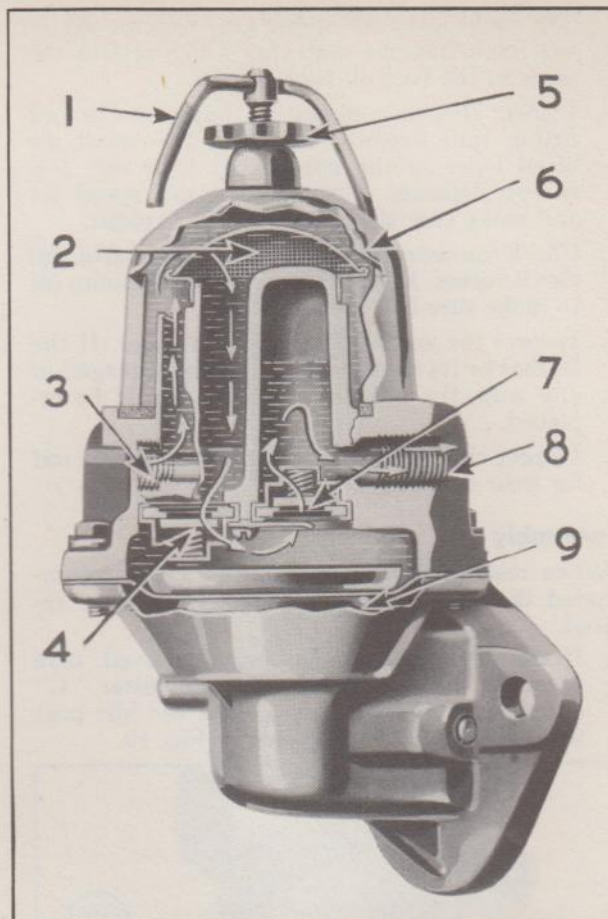


Fig. 13—Fuel Pump Cross-Section

- |                     |                 |
|---------------------|-----------------|
| 1—Bowl Retainer     | 6—Sediment Bowl |
| 2—Filter Screen     | 7—Outlet Valve  |
| 3—Inlet             | 8—Outlet        |
| 4—Inlet Valve       | 9—Diaphragm     |
| 5—Bowl Retainer Nut |                 |

a valve retainer, permitting easy and speedy removal of the assemblies.

#### Disassembly of the Fuel Pump

1. Remove the filter bowl, screen, top cover screws and top cover assembly.
2. Raise the edge of the diaphragm and, using a thin-bladed screwdriver, lift the spring and oil seal over the edge of the boss in the fuel pump body.
3. Unhook the diaphragm from the link by pressing down and away from the rocker arm side.
4. Remove the valve assembly retainer screws and remove the valve retainer.
5. Remove the valve assemblies and gaskets, noting that the inlet valve is assembled in the cover so that the valve opens downward, the valve spring being visible at the bottom of the valve cage. The outlet valve is assembled in the cover so that the valve opens upward, the valve spring not being visible when the valve is assembled in the cover in this position.
6. Inspect the valves to make sure they are clean.

#### Assembling the Fuel Pump

1. Install the oil seal to the diaphragm push rod in the following manner: Assemble the oil seal

spring, upper retainer, two leather seals, and the lower retainer with the convex side out. This is extremely important in order to seal the fuel pump from any oil that might come up from the crankcase.

2. Raise the fuel pump link with a screwdriver, Fig. 14, install the diaphragm spring and hook the diaphragm pull rod over the end of the link.

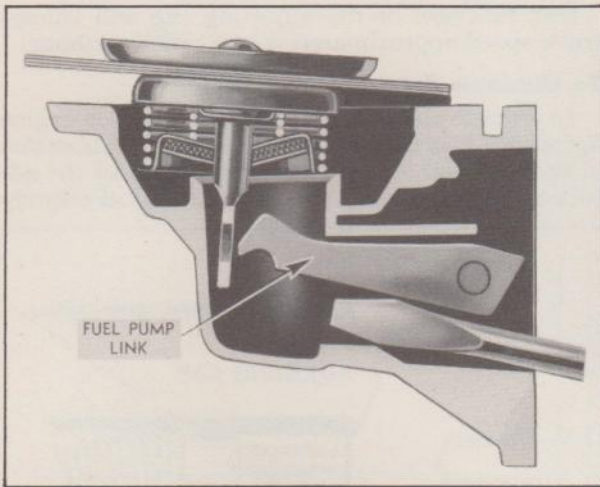


Fig. 14—Installing Diaphragm Spring

3. Install the valve assemblies and paper gaskets, making sure to install the inlet valve with the spring down and the outlet valve with the spring up. The inlet valve is assembled in the cover assembly next to the tapped passage marked "INT."
4. Install the valve retainer with the convex side up, and install the two retainer screws.
5. Assemble the top cover assembly to the fuel pump body and tighten the cover screws alternately and securely.
6. Assemble the screen on the cover and assemble the glass filter bowl to the cover, making sure that the cork gasket is in good condition and that the bowl nut is tight to prevent air leaks at this point.

**Air Cleaner**

The air which is taken into the carburetor, to mix with the fuel, is thoroughly cleaned in passing through an air cleaner of the oil bath type. This cleaner is filled to the oil level mark with an oil of not less than S.A.E. 50 viscosity in summer months and a lighter oil in winter. Viscosity of the oil used in winter months will be governed by the temperature.

Servicing of this cleaner is an important operation and must be performed as follows:

Remove the air cleaner from the carburetor. Remove the wing nut from the top and remove the cover. Remove the filter element assembly.

**CAUTION—Do not pry this part loose if it sticks. It must be removed by hand because you may damage the filter element flange, which must lie flat against the body to insure a tight seat at this point to prevent air leaks when the cover is assembled.**

Empty the oil out of the cleaner and clean out all oil and accumulated dirt. Wash body with clean gasoline and wipe dry. Wash filter element by slushing up and down in clean gasoline. Dry thoroughly, either with an air hose or by letting it stand until dry. Fill the body of the cleaner with oil of the proper viscosity.

It is not necessary to re-oil the filter element as this is done automatically when the car is driven.

Reassemble the filter element to the body of the cleaner, being sure that the flange sets flat against the top flange of the body. Reassemble the cover, making sure that the gasket is clean and in good condition over its entire surface so that a tight seat is obtained at this point. Put on wing nut.

Reassemble the cleaner to the carburetor. The cleaner must be put on tight and set down so that it rests against the carburetor to assure a good seat at this point. Tighten clamp.

**ENGINE MAXIMUM SPEED GOVERNOR**

The Handy Vari-Speed Governor used on Chevrolet truck engines is installed between the carburetor and the intake manifold and automatically governs the maximum speed at which the truck engine may be operated, which in turn limits the maximum speed at which the vehicle may be operated.

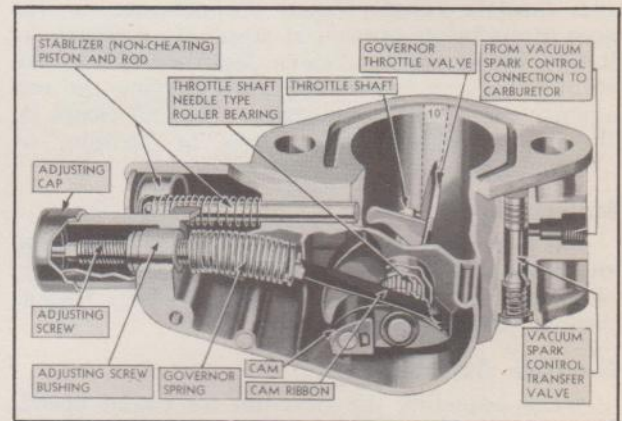


Fig. 15—Engine Governor

The governor, Fig. 15, is operated by the vacuum existing in the intake manifold under varying conditions of engine operation and the flow of air past the governor valve. A shaft carried on needle type roller bearings extends through the body of the governor and this shaft is offset from the center line of the throat. On the shaft is mounted a throttle plate, or throttle valve. The valve is slightly offset on the shaft and in its wide open position is about 10 degrees from vertical as indicated in Fig. 15.

The gas mixture rushing from the carburetor through the governor throat strikes the offset throttle valve and tends to draw it closed. This action is opposed by the governor spring which is attached to the valve shaft through a cam ribbon and cam. By adjusting the pull of this spring, the governor valve can be made to remain open, and then close at a predetermined engine speed. Adjustment of the spring pull is accomplished by changing the number of spring coils operating.

**Non-Cheating Stabilizer**

When the engine speed is being controlled by the governor, the top side of the governor throttle valve is exposed to atmospheric or comparatively high pressure, while the lower side, being on the suction side, is under low pressure. This difference in pressure is counterbalanced by the governor spring. If the carburetor valve is closed and the restriction becomes the same, or nearly so, as that of the governor throttle valve, a low pressure is then created between the governor and carburetor throttle valves. The force of the governor spring will then tend to open the governor throttle valve creating an increase in engine speed beyond the maximum desired. This condition is known as "cheating" or "stealing." However, this governor is equipped with a "non-cheating" stabilizer as shown in Fig. 15.

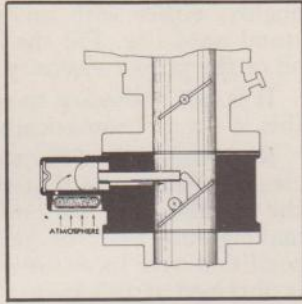


Fig. 16—Action of "Non-Cheating" Stabilizer

The stabilizer consists of a spring-loaded piston one side of which is open to outside atmospheric pressure, through an air cleaner as shown in Fig. 16, and the other end open to the area between the two throttle valves. When the pressure in this area drops below outside atmospheric pressure, as it does under the conditions described above, the stabilizer piston is drawn inward, forcing the rod against the governor throttle valve and closes it, thereby preventing the "cheating" or "stealing" of additional engine speed.

**Maintenance**

The governor should be cleaned at the same time the carburetor is cleaned. Placing the entire governor unit in a bath of gum solvent is the recommended method to follow.

**Governor Adjustment**

When adjusting the governor for engine speed, changes are always made in the number of operating coils of the governor spring and not by increasing or decreasing the tension of the spring.

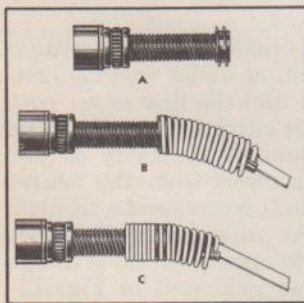


Fig. 17—Governor Spring Positions on Adjusting Screw

"A," Fig. 17, shows that the right hand end of the adjusting screw has a large diameter, fine pitch thread. This part of the adjusting screw acts as the spring anchor by being threaded into the first few coils of the spring, "B," Fig. 17. The correct position of the

adjusting screw in the spring coils and the correct position of the adjusting screw in the bushing is originally determined by careful test. In making adjustment for engine speed, the adjusting screw is screwed in or out of the spring coils, in this way adding to or subtracting from the effective length in direct relation to engine speed. This is illus-

trated in "B," Fig. 17, where the adjustment is unscrewed so as to use more coils and in "C" where it is screwed in to reduce the number of coils operating.

**To Adjust Maximum Engine Speed**

Remove seal and turn adjusting cap, Fig. 15, clockwise to lower engine speed; anti-clockwise to increase engine speed. Replace seal.

One full turn of the adjusting cap will change truck speed approximately 4 to 5 miles per hour.

**To Eliminate Surge or "Flat Spot"**

In order to eliminate a surge or flat spot in engine operation, it is necessary to change the calibration of the governor spring tension by means of the adjusting screw bushing (Fig. 18). Unless absolutely

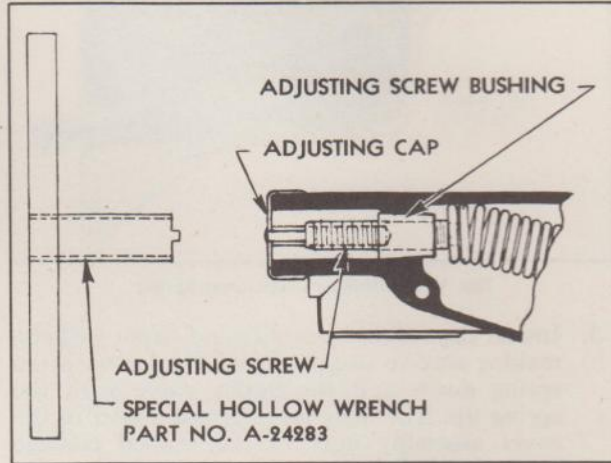


Fig. 18—Points of Governor Adjustment

necessary, it is not recommended that this adjustment be made in the field due to the fine calibration necessary for proper operation. However, if adjustment is to be made, the following instructions should be carefully followed:

1. If the governor is too sensitive, or on the point of surging, remove seal. Remove adjusting cap by pulling straight out (do not unscrew from adjusting screw). Place the special hollow wrench, Handy governor part No. A-24283, Fig. 18, in the slots of the adjusting screw bushing. (This hollow wrench is obtainable from the King-Seeley Corporation, Ann Arbor, Michigan.) Turn adjusting screw bushing clockwise  $\frac{1}{4}$  turn. Replace adjusting cap and with it, turn adjusting screw clockwise one full turn. Repeat this adjustment until desired regulation is obtained.
2. If a more sensitive adjustment is desired to eliminate a flat spot, remove the seal. Remove the adjusting cap as described above, and using the hollow special wrench, turn the adjusting screw bushing  $\frac{1}{4}$  turn to the left, or anti-clockwise. Replace adjusting cap and turn the adjusting screw one full turn to the left, or anti-clockwise. Repeat this adjustment until desired regulation is obtained. Replace seal.
3. Each time adjustment of the adjusting screw bushing is made, tap lightly on the end of the hollow wrench so that the bushing will seat properly.

## FUEL SYSTEM TROUBLES AND REMEDIES

Symptom	Probable Remedy
<b>Excessive Fuel Consumption</b>	
<ol style="list-style-type: none"> <li>1. Improper Adjustment</li>   <li>2. Dirty Air Cleaner</li> <li>3. Fuel Leaks</li>   <li>4. Sticking Controls</li>   <li>5. Excessive Idling</li>   <li>6. Improper Engine Temperature</li> <li>7. Dragging Brakes</li> <li>8. Tires Under Inflated</li> <li>9. Engine Improperly Tuned</li>   <li>10. Vehicle Overloaded</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust idling and stop screws.</li> <li>2. Improper float level adjustment.</li> <li>3. Metering rod not synchronized with throttle valve.</li>   <li>1. Clean air cleaner.</li>   <li>1. Check carburetor, fuel pump, fuel tank and all lines and connections for leaks.</li> <li>2. Choke not returning to off position.</li> <li>2. Throttle not returning to off position.</li> <li>3. Manifold heat control thermostatic spring improperly installed.</li>   <li>1. Stop engine when vehicle will not be moving for long periods.</li>   <li>1. Refer to Cooling System of this manual.</li>   <li>1. Refer to Brake Section of this manual.</li>   <li>1. Inflate to recommended pressure.</li>   <li>1. Tune engine—Refer to Engine Tune-Up in this manual</li>   <li>1. Load only to rated capacity.</li> </ol>
<b>Fast Idling</b>	
<ol style="list-style-type: none"> <li>1. Improper Adjustment</li> <li>2. Carburetor Controls Sticking</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust idling and throttle stop screws.</li> <li>1. Free up controls and lubricate linkage.</li> </ol>
<b>Engine Dies</b>	
<ol style="list-style-type: none"> <li>1. Will not idle below 15 miles per hour</li> </ol>	<ol style="list-style-type: none"> <li>1. Low speed jet or idle passages plugged with dirt (clean carburetor).</li> </ol>
<b>Engine Misses</b>	
<ol style="list-style-type: none"> <li>1. Engine misses on acceleration</li> </ol>	<ol style="list-style-type: none"> <li>1. Improper spark plug adjustment.</li> <li>2. Improper tappet adjustment.</li> <li>3. Accelerating pump jet plugged.</li> <li>4. Accelerating pump check valves sticking or leaking.</li> <li>5. Flat spot—adjust governor.</li> </ol>
<b>Engine Surges</b>	
<ol style="list-style-type: none"> <li>1. Will not maintain steady speed</li> </ol>	<ol style="list-style-type: none"> <li>1. Adjust governor.</li> </ol>

### TOOLS REQUIRED

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling a carburetor.

Tool Number	Description
KMO-268-G.....	Carburetor Tool Kit
Handy Governor A-24283....	Adjusting Wrench

FUEL SYSTEM SPECIFICATIONS

Carburetor:

Type..... Downdraft  
 Make.....Carter No. W1-483-S  
 Part Number.....Chevrolet 839500  
 Model..... W1  
 Pump Jet (Marked)..... 72  
 Needle (Marked)..... 76  
 Low Speed Jet (Marked)..... 35  
 Metering Rod Jet (Marked)..... 93  
 Metering Rod (Marked)..... 67-46  
 Main Venturi..... 1¼"  
 Economizer Jet..... 54  
 Float Level.....¾"

Fuel Pump:

Make..... AC  
 Model..... AF  
 Type..... Mechanical  
 Lbs. Pressure..... 3¾ lbs. Max.  
 Drive..... From Camshaft

Governor:

Make..... Handy  
 Model..... V55-113  
 Type..... Velocity

Air Cleaner:

Make..... AC  
 Type..... Oil Bath

Service Data

Air Cleaner:

Clean Element and Change Oil as  
 Operating Conditions Require—  
 See Instructions.

Carburetor

Float Level..... ¾"  
 Float Adjustment..... See Instructions

## COOLING SYSTEM

The efficient operation of the cooling system is beyond a doubt one of the most important factors in the satisfactory performance of an engine. The cooling system has been designed with two purposes in mind; first to carry off a certain amount of the heat created in the engine so that it will not operate at too high a temperature; and second, to maintain the engine heat at that temperature which makes for the most efficient and economical operation of the engine.

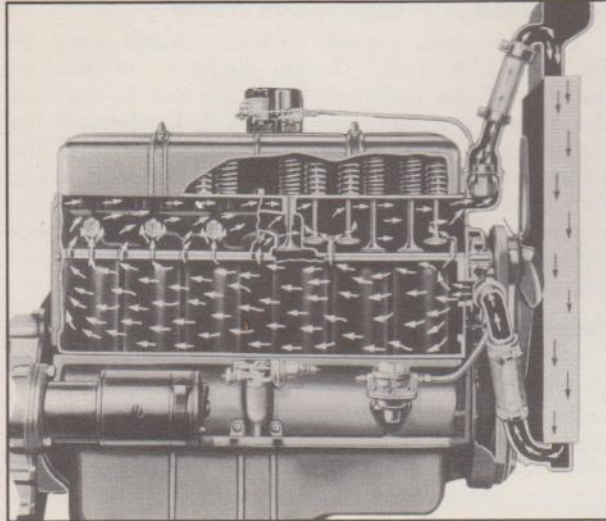


Fig. 1—Water Circulation

### Draining Cooling System

To drain the radiator, open the valve located at the bottom of the radiator on the right side. The valve may be reached from the front of the truck.

To drain the cylinder block, open the valve located on the right side of the block toward the rear.

### Filling the Cooling System

Close the valves on both the cylinder block and at the bottom of the radiator. Fill the radiator with clean water or during cold weather with an anti-freeze solution. Do not overfill the radiator while anti-freeze solution is being used, because the solution expands when heated and an appreciable amount of liquid would be lost through the overflow. When the engine is stopped and the solution cools off, it contracts and might give the impression that the solution is low. If the solution is visible through the filler neck after the engine has warmed up, it will not be necessary to add any solution.

Should water be lost from the cooling system and the engine overheats, do not add water immediately—allow the engine to cool down while running at idling speed. Then add water slowly while the engine is still running.

If water is poured into the radiator while the engine is hot, there is danger of cracking the cylinder head.

### Water Circulation

While the engine is running, water is drawn from the bottom of the radiator by the water pump and passes from the pump into the two openings in the front of the cylinder block, thence around each cylinder and upward through passages and water nozzles into the cylinder head and around the valve guides and seats. Circulation continues upward through the thermostat to the top of the radiator core. The water then passes down through the passages in the radiator where the air stream cools the water and it is again ready to be circulated through the cooling system. Fig. 1 illustrates the cooling system in cross section.

### Water Pump

The water pump (Fig. 2) is of the Ball Bearing Type and requires no care except to check to make certain the air-vent on top of the housing and the drain holes on the bottom do not become plugged with dirt or grease.

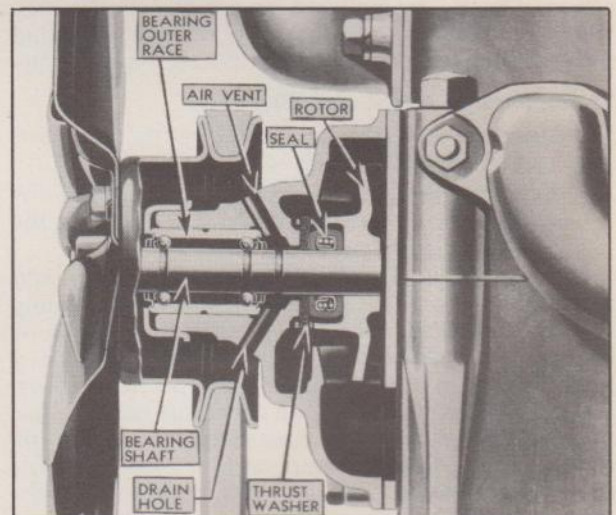


Fig. 2—Water Pump

The shaft and the double-row ball bearings are integral and the bearings are packed with a special high-melting point grease at the time of manufacture and require no further lubrication.

The ends of the bearings are sealed to retain the lubricant and prevent dust and dirt from entering.

The shaft and bearing are retained in the housing by a metal cap which is a press fit on the housing. The thrust washer has two lugs which fit into two slots in the end of the rotor. One side of the thrust washer bears against the ground thrust surface of the pump housing and the other against the seal. The rubber seal bears against the machined surface on the inside of the rotor and also against the thrust washer. A coil spring mounted inside, and an integral part of the seal, maintains a constant pressure against the thrust washer and rotor, assuring a positive seal. An air vent on the top of the housing and drain holes on the bottom prevent any water seepage past the thrust washer from entering the bearing.



**Water Pump Replacement**

Due to the construction of the water pump, it will be serviced only as an assembly.

To replace the water pump, proceed as follows:

1. Drain the radiator and disconnect the hose connection from the pump.
2. Remove the four cap screws which attach the fan blades and remove the fan.
3. Loosen the fan belt adjustment.
4. Remove the four cap screws which attach the pump to the cylinder block and remove the pump.

When replacing the pump, use the above operations in reverse, making sure to readjust the fan belt tension.

**Thermostat**

To obtain maximum efficiency, operating temperatures of the engine must be held within a certain range. The cooling system is designed to provide adequate cooling under the most adverse conditions; however, it is necessary to employ some device to prevent overcooling during normal operations. This is accomplished by use of a thermostat, which, in addition to maintaining efficient operating temperature, reduces the time required for warm up.

**Thermostat Removal and Checking**

1. Drain the radiator and disconnect the hose connection from the water outlet.
2. Remove the two cap screws which attach the water outlet to the cylinder head and remove the outlet and thermostat.

If upon removal and inspection the bellows and valve appear to be in good condition, the assembly should be checked. Place the thermostat in a pan or bucket with sufficient water to cover it. Place a thermometer in the container with the thermostat. Heat the water gradually and check the temperature at which the thermostat commences to open. Stir water when taking temperature readings—this should be between 142 and 145 degrees. Do not attempt to repair a thermostat that does not function properly. When reinstalling the thermostat, use a new gasket between the water outlet and cylinder head.

**Fan**

The four blade fan is bolted directly to the water pump pulley which is driven from the crankshaft by means of a "V" type endless fan belt. The spacing of the fan blades is based on the well known harmonic principle and reduces noise to a minimum. These two pairs of blades set up vibrations of different frequencies, each canceling or dampening out the other.

**Fan Belt**

Fan belt is of the "V" type, it passes over the crankshaft, water pump and generator pulleys. Provision is made for adjusting the belt tension by a slotted brace attached to generator and cylinder block.

To adjust the fan belt tension, loosen the bolt at the generator end of the brace and rock the generator on its mounting bracket. Moving the generator away from the engine tightens the belt, while

moving it closer to the engine loosens the belt. The belt tension may be checked by pushing down on the belt midway between the fan and generator pulleys. The belt is in correct adjustment when it can be pushed 1½ inches below a straight line midway between the fan and generator pulleys.

To replace a fan belt, remove the bolt from the generator brace and rock the generator toward the engine as far as possible. Then thread the new belt over the crankshaft pulley, through the fan blades and over the water pump pulley, then over the generator pulley. Then adjust the belt as described above.

**Fan Shroud—¾- and 1½-Ton Trucks**

The ¾- and 1½-ton truck radiator may be equipped with a fan shroud which is mounted at the rear of the radiator. Its purpose is to increase the efficiency of the fan in drawing air through the radiator and thereby improving the efficiency of the cooling system, particularly during low speed heavy duty operation. This shroud prevents re-circulation of the hot air from the engine compartment back through the core where it would greatly reduce cooling efficiency.

**Radiator Core**

The radiator core, used on all truck models, is an all copper, ribbed cellular construction. The core is supported in steel anchorage; bolted in a rugged support that is bolted in turn to the front cross member through a rubber cushion. This construction prevents shocks and frame distortions being transmitted to the core.

A heavy duty radiator core, used on some ¾- and 1½-ton trucks, is equipped with the fan shroud as indicated above. This larger core is especially suitable for more severe truck operations where higher cooling system temperatures are encountered.

**Radiator Core Removal**

1. Raise the hood and hold it in the up position by its brace.
2. Remove the two bolts which attach the radiator brace to the radiator support, then loosen nuts on brace rod at the dash. Raise the brace rod when core is lifted out.
3. Drain the radiator and remove all hose connections.
4. Remove the four cap screws which attach the fan blades to the water pump pulley and remove the fan blades.
5. Remove the headlamp wiring loom from the clips at the radiator.
6. Remove the cap screws which attach the radiator core to the support. These cap screws are located at the sides of the support.
7. (When heavy duty radiator with fan shroud is used on ¾- or 1½-ton trucks, perform the following operation.) Push the fan shroud to one side and thread it past the bolt which attaches the radiator support brace and then lift it upward.
8. The radiator core may then be removed by lifting it upward away from the support.

Replacement of the radiator core is the reverse of the removal operations.

**Care of Cooling System**

All hose connections should be inspected regularly for any indication of leakage which might be caused by loose clamps or deteriorated hose connections.

Rust and scale forms in every cooling system—therefore, we recommend that the cooling system be flushed out twice a year, preferably before and after using anti-freeze. There are a number of flushing solutions on the market and the instructions of the manufacturer should be closely followed when using.

When a cooling system is being conditioned, it is good policy to tighten the cylinder head bolts to prevent the possibility of water leaks into the cylinders and lubricating oil.

**Anti-Freeze Solutions**

The following information is given as a guide to the operator in selecting an anti-freeze and the proportions to use in order to make one gallon of anti-freeze solution for various temperatures.

**Alcohol**

Denatured alcohol and methanol are used extensively for anti-freezing solutions. The various types of alcohol anti-freeze afford protection against freezing and have the advantage of wide distribution and low first cost.

There are, however, two important disadvantages. Alcohol is lost, especially on warm days and on hard driving, and, unless the solution in the radiator is tested periodically and sufficient alcohol added to replace the loss, the engine or radiator, or both, are likely to be damaged by subsequent freezing. The car finish is softened and damaged by contact with alcohol solutions or vapors. Alcohol accidentally spilled on the finish should be flushed off immediately with a large quantity of cold water without wiping or rubbing.

Directions for preparing Anti-Freezing Solutions from Denatured Alcohol 94% (188° proof) and from "GM Anti-Freeze" (Methanol).

Freezing Point	Proportion of Denatured Alcohol and Water to make one gallon of Anti-Freezing Solution	Proportion of "GM Anti-Freeze" and Water to make one gallon of Anti-Freezing Solution
+10° F.	2½ pints denatured alcohol, 5½ pints water	2 pints "GM Anti-Freeze," 6 pints water
0° F.	3 pints denatured alcohol, 5 pints water	2½ pints "GM Anti-Freeze," 5½ pints water
-10° F.	3½ pints denatured alcohol, 4½ pints water	3 pints "GM Anti-Freeze," 5 pints water
-20° F.	4 pints denatured alcohol, 4 pints water	3½ pints "GM Anti-Freeze," 4½ pints water
-30° F.	5 pints denatured alcohol, 3 pints water	4 pints "GM Anti-Freeze," 4 pints water

Other alcohol anti-freezes should be diluted in accord with the instructions issued by the anti-freeze manufacturer.

**Ethylene Glycol**

Ethylene glycol is, in first cost, more expensive than alcohol. Ethylene glycol anti-freezing solutions have the distinct advantage of possessing a somewhat higher boiling point than alcohol anti-freezing solutions and, consequently, may be operated at a higher temperature.

Ethylene glycol has the further advantage that in a tight system only water is required to replace evaporation losses. However, any solution lost mechanically through leakage or foaming must be replaced by additional new solution. Under ordinary conditions, ethylene glycol solutions are not injurious to the car finish.

"GM Ethylene Glycol" is especially treated and compounded for use in the cooling system. Other ethylene glycol preparations are available, but only those containing suitable corrosion inhibitors and compounded for use in automobile cooling systems should be used.

Directions for Preparing Ethylene Glycol Anti-Freezing Solutions from "GM Ethylene Glycol."

Freezing Point	Proportion of "GM Ethylene Glycol" to make one gallon of Anti-Freezing Solution
+10° F.	2 pints "GM Ethylene Glycol," 6 pints water
0° F.	2½ pints "GM Ethylene Glycol," 5½ pints water
-10° F.	3 pints "GM Ethylene Glycol," 5 pints water
-20° F.	3½ pints "GM Ethylene Glycol," 4½ pints water
-30° F.	4 pints "GM Ethylene Glycol," 4 pints water

Other ethylene glycol anti-freezes should be diluted in accord with the instructions issued by the anti-freeze manufacturer.

**Glycerine**

Radiator glycerine, which is chemically treated, in accord with the formula approved by the Glycerine Producers' Association, to avoid corrosion, is satisfactory for use in the cooling system.

**Servicing the Cooling System**

Before installing anti-freezing solution, the cooling system should be inspected and serviced for winter operation. The system should be thoroughly cleaned and all loose scale and iron rust removed.

Cylinder head gaskets should be tightened, or replaced if necessary, to avoid the possibility of anti-freezing solutions leaking into the engine or exhaust gas blowing into the cooling system. Anti-freeze, or water, mixed with engine oil may form sludge, which will interfere with lubrication and, in some cases, may form varnish-like deposits which will cause gumming and sticking of the moving parts.

It may be advisable to install new radiator and heater hose, especially when ethylene glycol or glycerine anti-freezing solutions are used. Ethylene glycol and glycerine have a tendency to shrink rubber that previously has been swollen by the absorption of water, and leaks may develop.

The water pump seal must be leaktight, not only to avoid loss of liquid, but to prevent air from being drawn into the cooling system. Aeration of

the cooling liquid causes foaming and promotes oxidation, which may result in serious corrosion.

After the anti-freezing solution has been installed, the entire system, including the hose connections, cylinder head gasket and pump, should be inspected regularly to insure that no leaks have developed.

The use of additional rust preventives, or inhibitors, is not recommended with "GM Anti-Freeze," "GM Ethylene Glycol," or with other anti-freeze preparations that have been chemically treated or compounded for use in automotive cooling systems.

**Testing**

Some devices, used for testing anti-freezing solutions, will indicate the correct freezing point only when the test is made at a specific temperature. Other testers, provided with thermometers and tables, indicate the freezing points corresponding to readings made at various temperatures. Disregarding the temperature of the solution, when tested, may cause an error as large as 30° F.

Some testing devices are made to test only one kind of anti-freezing solution. Others have several scales and may be used for the corresponding kinds of anti-freeze.

The freezing point of a solution containing both alcohol and ethylene glycol cannot be determined accurately by means of a hydrometer.

**COOLING SYSTEM TROUBLES AND REMEDIES**

**Symptom and Probable Cause**

**Probable Remedy**

**Overheating**

1. Lack of water.
2. Fan belt loose.
3. Fan belt oil soaked.
4. Thermostat sticks closed.
5. Water pump inoperative.
6. Cooling system clogged.
7. Incorrect ignition timing.
8. Brakes dragging.
9. Manifold heat valve thermostatic spring damaged.

1. Refill system.
2. Adjust.
3. Replace.
4. Replace thermostat.
5. Replace pump.
6. Clean entire system.
7. Retime engine.
8. Adjust brakes.
9. Replace spring according to instructions in Section 6.

**Overcooling**

1. Thermostat remains open.

1. Replace thermostat.

**Loss of Cooling Liquid**

1. Loose hose connections.
2. Damaged hose connections.
3. Leaking water pump.
4. Leaks in radiator core.

1. Tighten all connections.
2. Replace the damaged hose.
3. Replace pump.
4. Remove core and repair leaks.

## COOLING SYSTEM SPECIFICATIONS

### COOLING CAPACITY (QUARTS)

1/2-Ton .....	14
3/4-Ton—Regular Core .....	14
3/4-Ton—Heavy Duty Core .....	16
1 1/2-Ton—Regular Core .....	14
1 1/2-Ton—Heavy Duty Core .....	16

### FAN AND WATER PUMP

Type .....	Centrifugal
Location.....	Front of Cylinder Block
Drive .....	Belt
Impeller Location.....	Pump Body
Bearings.....	Permanently Sealed and Lubricated Ball
Pulley Run-Out Installed .	.018" Total Indicator Reading on Rear Flange and .013" on Front Flange.

### FAN BELT

Deflection .....	3/4"
Adjustment .....	Moving Generator

### THERMOSTAT

Starts to open at .....	140° - 147°
Fully opened .....	170°

### FAN BLADES

Diameter .....	18"
Number of Blades .....	4

### RADIATOR CORE

Type .....	Ribbed Cellular
Frontal Area .....	405 Sq. In.
Thickness—Regular .....	2"
Thickness—Heavy Duty .....	3"

### FAN SHROUD (3/4- and 1 1/2-Ton Trucks With Heavy Duty Radiator)

Type .....	Box
Location .....	Rear Face of Radiator Core
Function..	To prevent recirculation of heated air into radiator core or fan stream.

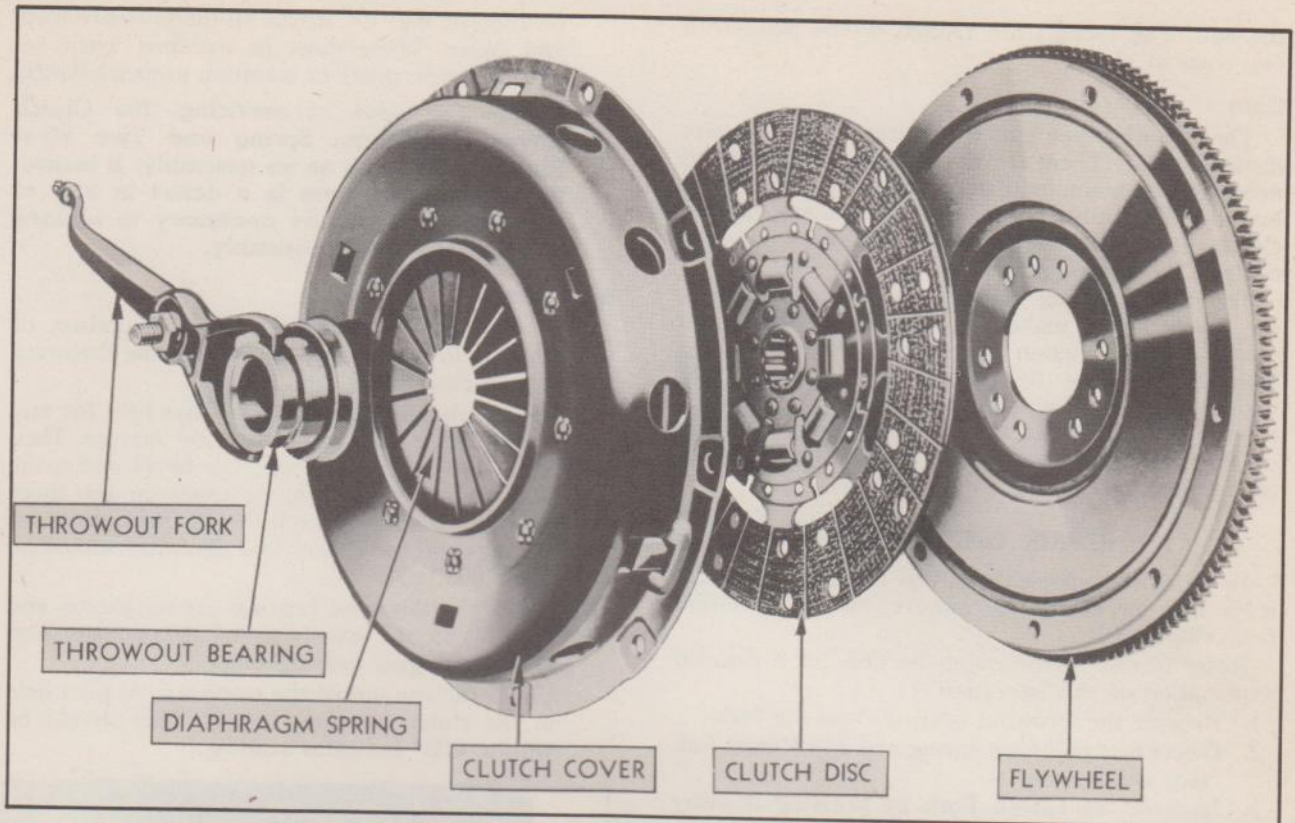


Fig. 1—Layout of Clutch Parts

## CLUTCH

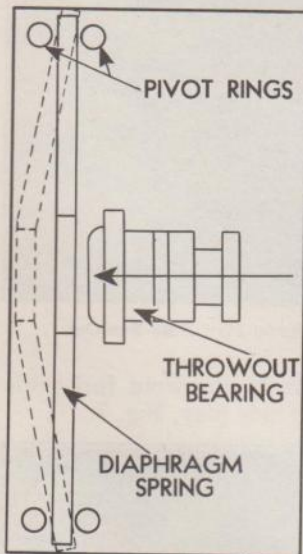


Fig. 2—Diaphragm Spring Action

pivot on the pivot rings (Fig. 2).

When the clutch is engaged, the fingers are flat while the entire rim of the diaphragm spring exerts pressure against the pressure plate (Fig. 3). When the clutch pedal is depressed, pressure of the throwout bearing on the inner ends of the fingers causes a diaphragm action and the outer ends of the fingers, near the rim, pivot on the inner pivot ring (Fig. 4). This action causes the rim of the spring

The clutch is of the single plate dry disc type, designed around a diaphragm spring which has the shape of a dished washer with eighteen tapering fingers pointing inward (Fig. 1). The spring is made from a very high quality steel, carefully heat-treated and shot-blasted to assure long life. The action of the diaphragm spring may be compared to the flexing action of the bottom of an ordinary oil can. By depressing the clutch pedal, the throwout bearing is forced against the diaphragm spring fingers, causing the diaphragm spring to

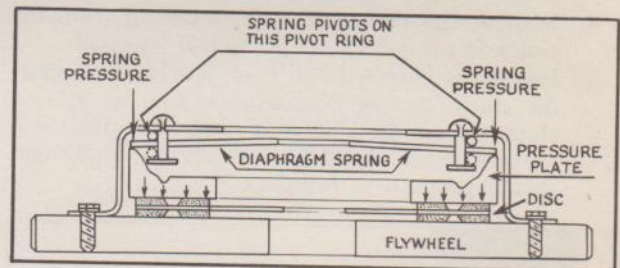


Fig. 3—Engaged Position

and the pressure plate to move away from the clutch disc, disengaging the clutch. When the clutch pedal is released and the throwout bearing no longer contacts the fingers, the "spring" in this material causes the fingers to pivot about the near pivot ring and the rim to bear against the pressure plate.

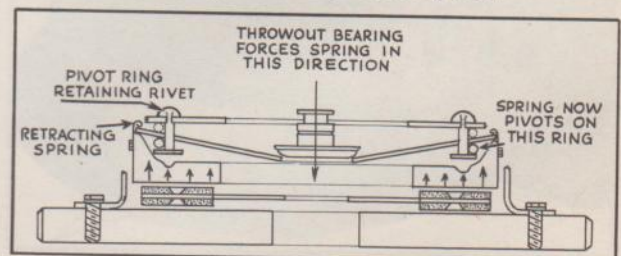


Fig. 4—Disengaged

The clutch disc is a built-up assembly which incorporates cushion springs to pick up the torque load and a torsional vibration dampener built into

the hub. The facings are riveted to the plate with two rows of rivets.

**Care**

The dry disc type clutch requires very little care during its life. There is only one simple adjustment necessary to maintain clutch efficiency and assure long life. This adjustment is for the amount of free clutch pedal travel before the throwout bearing contacts the clutch fingers.

The ball throwout bearing, in conjunction with the clutch spring makes a simple construction and results in little friction and wear in the mechanism. The bearing is of the sealed type and is packed with a high melting point lubricant which makes further lubrication unnecessary except for packing the inner and outer grooves of the throwout bearing collar when assembling.

**REPAIR OPERATIONS**

In order to remove the clutch from the flywheel, it is first necessary to remove the transmission from the chassis.

Refer to the Transmission Section for a detailed explanation of this operation.

1. Remove the throwout bearing from the fork.
2. Disconnect pull back spring and adjustment link from clutch fork.
3. Remove the Clutch Fork by pressing it away from its mounting with a screwdriver until the fork snaps loose from the ball.  
The spring retainer may be removed from the groove in the fork by prying one end out at a time with a small screwdriver.
4. Remove the throwout fork mounting from the clutch housing with a 7/8" and 3/4" wrench.
5. Install the Clutch Pilot Tool, K-411, to support the clutch during disassembly. Loosen the six clutch retaining bolts one turn at a time (to prevent cover distortion) until the diaphragm spring pressure is released.

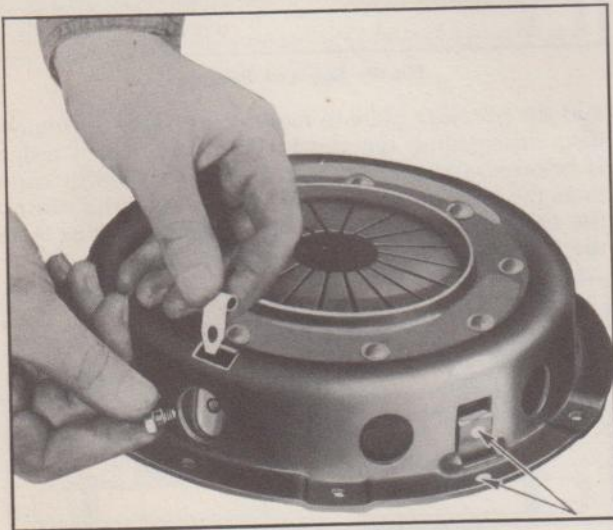


Fig. 5—Removing Retracting Springs

6. Remove the three clutch pressure plate retracting springs, then remove the pressure plate from the Clutch Cover Assembly, Fig. 5. Note the

position of the "O" marks on the pressure plate and cover. These must be matched when re-assembling in order to maintain proper balance.

**NOTE**—For ease of servicing, the Clutch Cover, Diaphragm Spring and Two Pivot Rings are built up as an assembly. If inspection shows that there is a defect in any of these parts, it will be necessary to replace the complete cover assembly.

**Inspection**

The first step in connection with inspection of the clutch is to wash all parts (except the throwout bearing) in cleaning solvent.

1. Inspect the pressure plate and flywheel for any indication of scores on the contact surface. Then check the three drive lugs for burrs and make sure that these lugs move freely in the three slots in the cover. Check the clearance between the lugs and the cover; this clearance should be from .002" to .008".
2. Check the throwout bearing for roughness and free fit on the extension of the transmission main drive gear bearing retainer.
3. Check the run-out of the transmission pilot hole in the clutch housing, Fig. 6. This should be within .008" indicator reading.



Fig. 6—Checking Transmission Pilot Hole Run-Out

4. Check fit of the ball in the throwout fork; this should be snug without side play, Fig. 7.

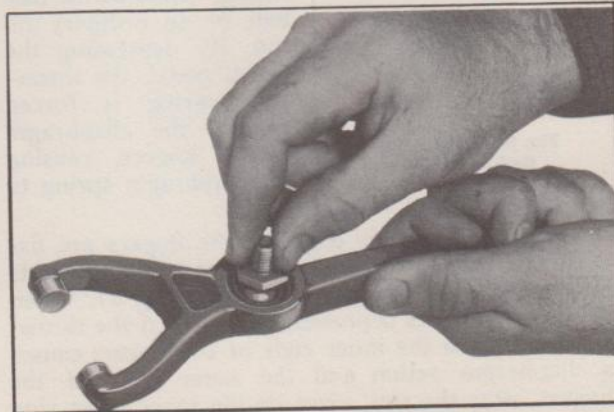


Fig. 7—Checking Fit of Ball in Throw-Out Fork

5. Inspect the clutch disc for worn, loose or oil soaked facings, broken springs or rivets loose on hub. Examine the splines and check to see that they move freely on the splines of the transmission clutch gear. If the splines are worn, the clutch disc should be replaced.

To assure a job that will perform smoothly and effectively for many thousands of miles, all of the foregoing inspections and adjustments must be made.

#### Pilot Bearing

The clutch pilot bearing is a cage roller type Hyatt Bearing. This bearing requires attention only when the clutch is removed from the car, at which time it should be removed, cleaned, inspected, and replaced, if necessary.

To remove the bearing from the end of the crankshaft, it is first necessary to remove the bearing retainer. Special Puller, K-455-B, is required in order to remove the retainer without damaging the Hyatt Roller Bearing.

This Puller is designed with a small diameter which centers into the clutch pilot bearing. A large aligning bushing on the puller can be moved forward and centered in the transmission pilot hole in the clutch housing so that the retainer will be pulled out straight, and there will be no possibility of the lip of the retainer digging into the bore in the crankshaft. When installing this tool, the tool head should be threaded into the retainer two full turns, and with the clamp in position as shown in Fig. 8, turn the large nut against the clamp, pulling out the retainer.

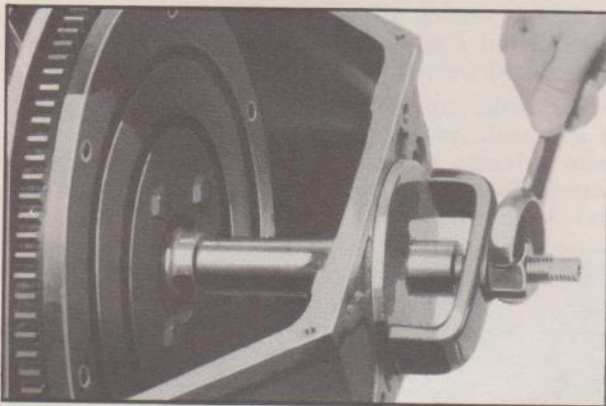


Fig. 8—Pilot Bearing Retainer Remover

The roller bearing may now be removed with the fingers.

Before installing the bearing, it should be packed with a special high temperature grease.

The bearing may then be installed in place at the end of the crankshaft.

The special driver, K-410, shown in Fig. 9 should be used when installing a new retainer.

This driver is constructed with a centering collar which fits in the pilot hole in the housing and has a pilot on its end which centers in the bearing.

In operation a retainer is placed on the end of the driver with the flat side of the retainer toward the bearing and the tool placed into position with the centering collar in the transmission pilot hole

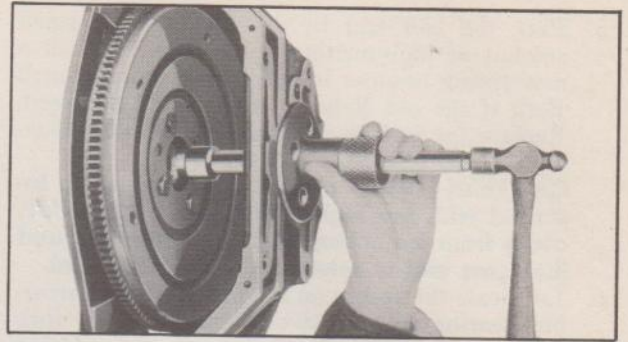


Fig. 9—Installing Clutch Pilot Bearing Retainer

in the flywheel housing. The handle is then moved forward until the retainer begins to enter the hole in the flywheel. Tap the end of the driver lightly with a hammer until the retainer is seated.

#### Clutch Reassembly

1. Install the throwout fork mounting ball in the clutch housing.
2. Install the pressure plate in the cover assembly, making sure to mate the two "O" marks as indicated by the arrows shown in Fig. 5—one on the driving lug of the pressure plate and the other on the flange of the cover. This must be done in order to keep the clutch in proper balance.
3. Install the three pressure plate retracting springs. (Refer to Fig. 5.) The clutch is now ready to reassemble to the engine.
4. Hand-crank the engine until the "X" mark on the flywheel is at the bottom. Now install the clutch disc, pressure plate, and cover assembly and support them with the clutch pilot tool. Turn the clutch assembly until the "X" mark on the clutch cover registers with the "X" mark on the flywheel. (Fig. 10.) Then install the bolts, tightening them each a turn at a time to prevent distorting the cover as the spring pressure is being taken up. Remove the clutch pilot tool.

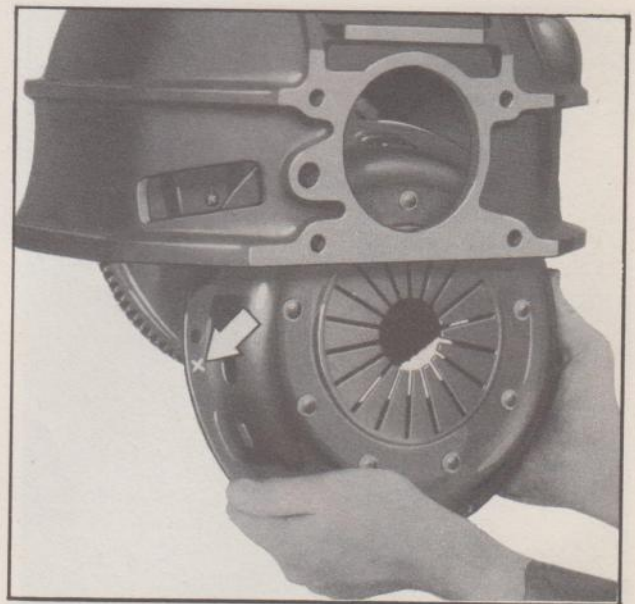


Fig. 10—Installing Clutch Assembly

5. Pack the ball seat in the fork with a small amount of high-melting point grease. Install a new spring retainer in the groove in the Clutch Fork if the old Retainer is worn or damaged. Replace the fork in position in the clutch housing and snap the fork onto the ball.

**CAUTION—**Make certain the retainer is installed with the high side of the retainer UP, away from the bottom of the ball bearing, and the open end of retainer on the Horizontal.

6. Lubricate the recess on the inside of the throwout bearing collar and coat the throwout fork groove with a small amount of high-melting point lubricant. (Fig. 11.) Then install the ball throwout bearing assembly to the throwout fork.

**CAUTION—**Be careful not to use too much lubricant.

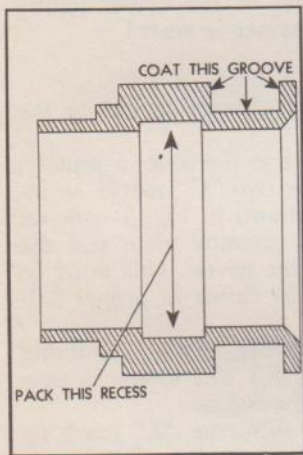


Fig. 11—Lubrication Points on Throw-Out Bearing Collar

the pedal and not with the foot as the adjustment is sensitive.

To make the above adjustment, loosen the check nut "A" and turn the adjusting nut "B" (Fig. 12) until the free pedal travel is from  $\frac{3}{4}$ " to 1".

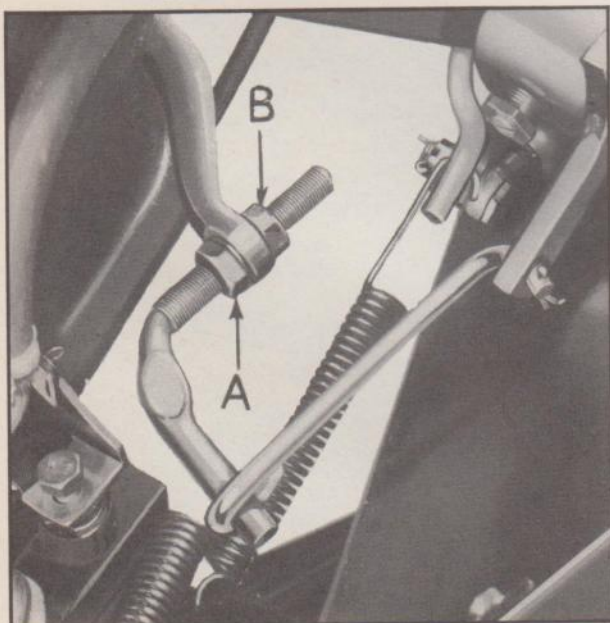


Fig. 12—Clutch Pedal Adjustment— $\frac{1}{2}$ -Ton Trucks

7. Install the adjustment link and pull-back spring.
8. The assembly of the transmission and connecting of the universal joint is described in detail in Section 7 of this Manual.

**Clutch Pedal Adjustment— $\frac{1}{2}$ -Ton Trucks**

Adjust the clutch pedal to obtain  $\frac{3}{4}$ " to 1" free travel of the pedal before the throwout bearing contacts the clutch fingers. (Fig. 12.)

**NOTE—**Check this free travel with a finger on

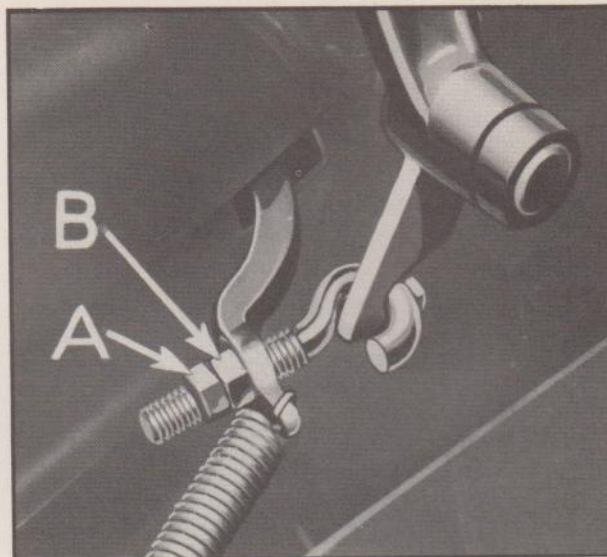


Fig. 13—Clutch Pedal Adjustment— $\frac{3}{4}$  and  $1\frac{1}{2}$ -Ton Trucks

To make the clutch pedal adjustment on  $\frac{3}{4}$  and  $1\frac{1}{2}$ -ton trucks, loosen the check nut "A" and turn the adjusting nut "B" (Fig. 13) until the free pedal travel is from  $\frac{3}{4}$ " to 1".

**CLUTCH AND BRAKE PEDAL MOUNTING**

**$\frac{1}{2}$ -Ton Trucks**

The pedals and master cylinder unit are mounted in the box section second cross member brace to the left side rail. Each pedal has its own individual shaft riveted and welded to it.

The pedal arms have a pin type bearing welded to its shank, and turning in a bushing in the brake main cylinder housing, which is equipped with a removable plug and holes for lubricating the brake and clutch pedal shafts at the same time. (Fig. 14.)



Fig. 14—Clutch and Brake Pedal Mounting— $\frac{1}{2}$ -Ton Trucks

Each shaft has a groove machined in it to lock the pedals in position. A key fits into the groove and it is retained by a tapered plug.



**Disassembly**

To disassemble the brake pedal shafts from the brake main cylinder housing, remove the pipe plug and screw the threaded end of the special tool No. J-1441 into the key and remove the key. (Fig. 15.)

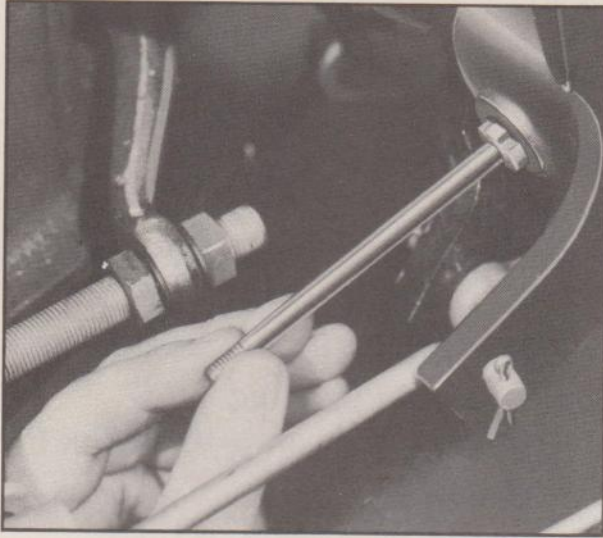


Fig. 15—Removing Clutch and Brake Pedal Key

The pedal shafts can then be removed from the housing.

To replace the pedals, install the pedal shaft in the housing, then insert the key end of the special tool into the opening in the housing to line up the key grooves in the shafts.

Remove the tool and install the key. Assemble the plug and tighten it securely.

**Lubrication**

The shaft bearings are lubricated during assembly and ordinarily should not require additional lubrication. Should it become necessary to lubricate these bearings remove the brass plug in the center of the key retaining plug and install a lubrication fitting. Lubricate the bushings and replace the plug.

**NOTE**—Care should be used not to overlubricate the pedal shaft bearing, because the excess grease would drip down on the rubber boot on the front of the brake main cylinder and damage the boot.

**Clutch and Brake Pedal Removal  
¾ and 1½-Ton Trucks**

If it should become necessary to replace either of the bronze bushings in the clutch or brake pedals, proceed as follows:

1. Disconnect the brake pedal pull rod from the brake pedal.
2. Disconnect the clutch pedal adjusting link.
3. Remove the three cap screws attaching the cross shaft to the flywheel housing (one through the shaft and two through the sleeve).
4. The clutch pedal, brake pedal, and cross shaft may then be removed as an assembly.
5. The collar on the end of the cross shaft may be removed by driving out the tapered pin, but this is not normally necessary as the clutch and brake pedals may be removed from the opposite end of the shaft.
6. After removing the worn bushings, new ones may be pressed into place and then reamed to allow from .002" to .003" clearance between the bushing and the shaft.

**CLUTCH TROUBLES AND REMEDIES**

Symptom	Probable Remedy
<b>Slipping</b>	
1. Improper adjustment.	1. Adjust pedal free travel.
2. Oil soaked.	2. Install new disc.
3. Sticking pressure plate.	3. Check fit of drive lugs on pressure plate in slots in cover (if necessary, replace pressure plate).
4. Worn splines on clutch gear.	4. Replace transmission clutch gear.
5. Lining torn loose from disc.	5. Install new disc.
<b>Grabbing</b>	
1. Oil on lining.	1. Install new disc.
2. Worn splines on clutch gear.	2. Replace transmission clutch gear.
3. Sticking pressure plate.	3. Check fit of drive lugs in cover.
4. Worn shackles.	4. Replace shackle pins and bushings.
5. Loose engine mountings.	5. Tighten or replace mountings.
<b>Rattling</b>	
1. Weak retracting springs.	1. Replace springs.
2. Excessive clearance at driving lugs.	2. Replace pressure plate or cover.
3. Throwout fork loose on ball stud.	3. Check ball stud and retaining spring and replace if necessary.

## TOOLS REQUIRED

The following tools, manufactured by the Kent-Moore Organization, or their equivalent are recommended for use when overhauling a clutch:

<i>Tool Number</i>	<i>Description</i>
K-445-B.....	Clutch Pilot Bearing Retainer Puller
K-411.....	Clutch Pilot Tool
J-1441.....	Pedal Shaft Aligning Tool
K-410.....	Clutch Pilot Bearing Replacer

## CLUTCH SPECIFICATIONS

Type.....Single Dry Plate

**FACINGS:**

Area—Sq. In. (Total):  
 1/2-ton.....71.86 Sq. In. Each  
 3/4, 1 1/2-ton.....104.6 Sq. In. Each

Outside Diameter:  
 1/2-ton .....9 1/8"  
 3/4, 1 1/2-ton .....10 3/4"

Inside Diameter:  
 1/2-ton .....6 1/8"  
 3/4, 1 1/2-ton .....7"

Thickness:  
 1/2-ton ..... .132-.138  
 3/4, 1 1/2-ton ..... .137-.143

**SPRING:**

Number and Type.....Single - Diaphragm

**CLUTCH THROWOUT BEARING:**

Type...Sealed Ball Bearing—Mounted on Sleeve

**CLUTCH PILOT BEARING:**

Type.....Hyatt Roller, 99004

**SERVICE DATA:**

Clutch Pedal Adjustment 3/4" to 1" Free

Travel before Release Bearing Contacts

Clutch Fingers.

Clearance Between:

Driving Lugs and Cover..... .002" -.006"

Splined Hub and Shaft..... .0005"-.0055"

## Section 7

### TRANSMISSION

#### THREE-SPEED SYNCRO-MESH TRANSMISSION

##### ½ and ¾-Ton Trucks

The Three-Speed Selective Syncro-Mesh transmission used on ½ ton and ¾ ton trucks, incorporates helical cut gears and splines.

The case is made of cast iron, accurately machined to give proper alignment of the gears and their shafts. All gears are machined from drop forged steel gear blanks and are heat treated for strength and long life. The shafts are machined from high grade steel, are heat treated and ground to close limits. The surfaces of the shifter yokes are "granodized" to prevent scoring during the break-in period and provide greater resistance to wear.

The clutch gear is supported by a heavy duty New Departure ball bearing. The forward end of the main shaft is supported by needle bearings, while the rear end receives its bearing from a New Departure ball bearing. The reverse idler gear is bronze bushed to provide bearing surface, whereas the counter gear is supported at both ends by needle bearings. Fig. 1 shows the construction of this transmission in cross-section, as well as the relative position of the parts.

#### REMOVAL FROM CHASSIS

##### ½-Ton Truck

1. Remove the floor mat and floor board.
2. Remove the cap screws which attach the universal ball collar to the end of the transmission housing and slip the ball and collar back on the propeller shaft housing.
3. Remove the four cap screws which fasten the universal joint front trunnion bearings to the front yoke. Remove the trunnion bearings and split the universal joint.
4. Remove the bolts which attach the transmission rear support.
5. Remove the bolts which attach the second crossmember to the frame side rails. Then remove the crossmember.
6. Remove the flywheel underpan and remove the two lower transmission to clutch housing cap screws.
7. Remove the two top transmission to clutch housing cap screws, then slide the transmission on straight back until the clutch gear shaft is free of the splines in the clutch disc and lift it out through the cab door.

##### ¾-Ton Truck

1. Remove the floor mat and floor board.
2. Remove the cap screws which attach the universal ball collar to the rear end of the transmission and slip the ball and collar back on the front propeller shaft housing.

3. Split the intermediate universal joint by removing the two trunnion bearing "U" clamps from the front yoke of the universal. Wrap a piece of tape endwise over the trunnion bearing to keep them in place and also prevent dirt from entering them.
4. Remove the bolts which attach the support bracket to the frame crossmember. Then pull the front propeller shaft assembly toward the rear to clear the splines of the front universal joint.
5. Remove the flywheel underpan and remove the two lower transmission to clutch housing cap screws.
6. Remove the two top transmission to clutch housing bolts, then slide the transmission straight back until the clutch gear shaft is free of the splines in the clutch disc and lift it out through the cab door.

#### DISASSEMBLY OF THE TRANSMISSION

The illustration, Fig. 2, shows an exploded view of the transmission. The reader should study this illustration and note the relative position of all parts before disassembling one of these units.

1. Mount the transmission in the transmission holding fixture, J-934, as shown in Figure 3.
2. Remove the four cap screws from the gear shift lever housing.

**CAUTION**—These screws should be backed off evenly, or two of the screws should be removed and replaced with longer ones, in order to relieve the tension of the gear shift lever spring before removing the retainer.

3. Remove the retainer, lever, ball seat, spring and gasket.
- NOTE**—Under ordinary circumstances it is not necessary to remove the shifter assembly from the cover.
4. Remove the four cap screws from the transmission cover and remove the cover and gasket. It will be noticed that the two front screws are special screws that also lock the shifter shafts in the transmission case.
5. Lift out the shifter interlock.
6. Drive the shifter shafts from the case with a soft steel drift, driving them from the rear of the case to the front. Both of these shafts are .003" larger in diameter where they fit into the front of the case. Both front and rear diameters are ground to close limits so that the shafts will fit snugly in the case.
7. Remove the shifter yokes, lock balls, and springs from the case.
8. Place the transmission in two gears at once to lock the mainshaft, and remove the universal

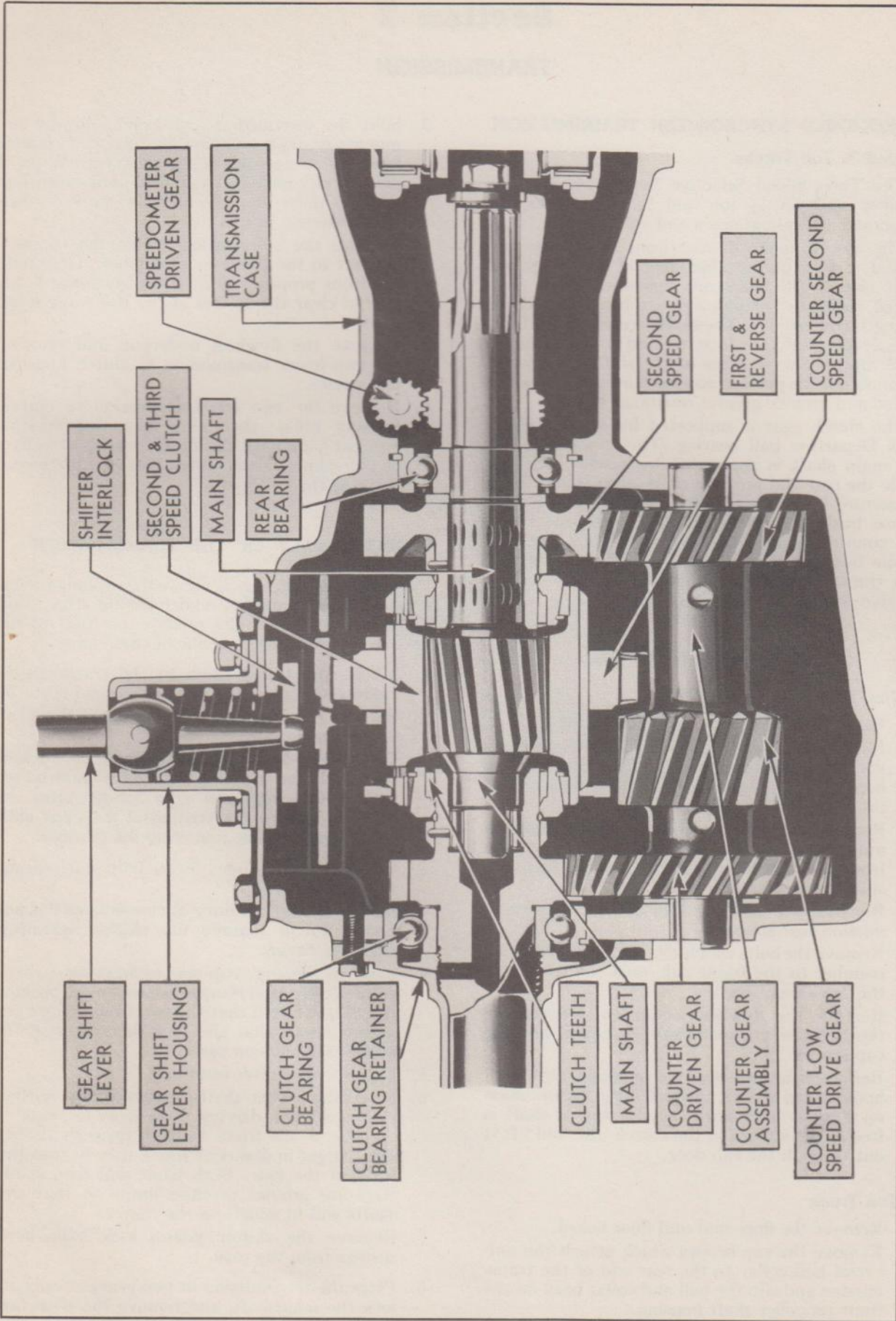


Fig. 1—½ and ¾-Ton Synchro-Mesh, Three-Speed Transmission

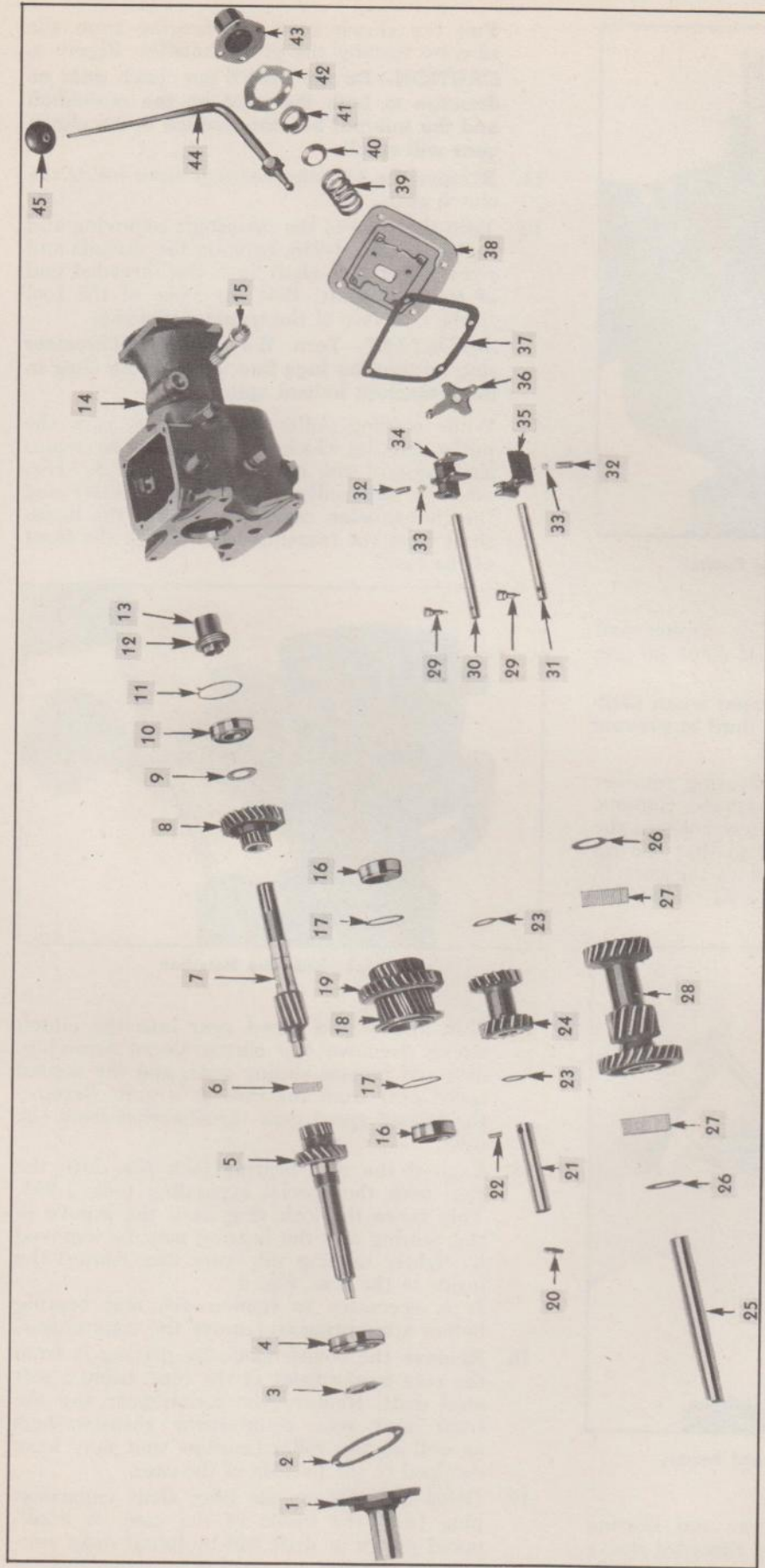


Fig. 2—Layout of Transmission Parts

- 1—Clutch Gear Bearing Retainer
- 2—Clutch Gear Bearing Retainer Gasket
- 3—Clutch Gear Bearing and Oil Slinger
- 4—Clutch Gear
- 5—Clutch Gear
- 6—Mainshaft Pilot Bearing (14)
- 7—Mainshaft
- 8—Second Speed Gear Washer
- 9—Second Speed Gear Thrust

- 10—Mainshaft Rear Bearing
- 11—Mainshaft Rear Bearing Lock Ring
- 12—Speedometer Drive Gear
- 13—Universal Joint Spacer
- 14—Transmission Case
- 15—Speedometer Driven Gear
- 16—Synchronizing Ring Retainer
- 17—Synchronizing Drum
- 18—Synchronizing Drum
- 19—First and Reverse Sliding Gear

- 20—Expansion Plug
- 21—Reverse Idler Shaft Lock
- 22—Reverse Idler Shaft Pin
- 23—Reverse Idler Gear Thrust Washer
- 24—Reverse Idler Gear
- 25—Countershaft
- 26—Counter Gear Thrust Washer
- 27—Countershaft Bearing (25 each end)
- 28—Counter Gear

- 29—Shifter Shaft Lock and Front Cover Screw
- 30—First and Reverse Shifter Shaft
- 31—Second and Third Shifter Shaft
- 32—Detent Spring
- 33—Detent Ball
- 34—First and Reverse Shifter Yoke
- 35—Second and Third Shifter Yoke

- 36—Shifter Interlock
- 37—Transmission Cover Gasket
- 38—Transmission Cover
- 39—Gearshift Lever Spring
- 40—Gearshift Lever Spring Seat
- 41—Gearshift Lever Fulcrum
- 42—Gearshift Lever Ball Retainer
- 43—Housing Gasket
- 44—Gearshift Lever Ball Housing
- 45—Gearshift Lever Knob

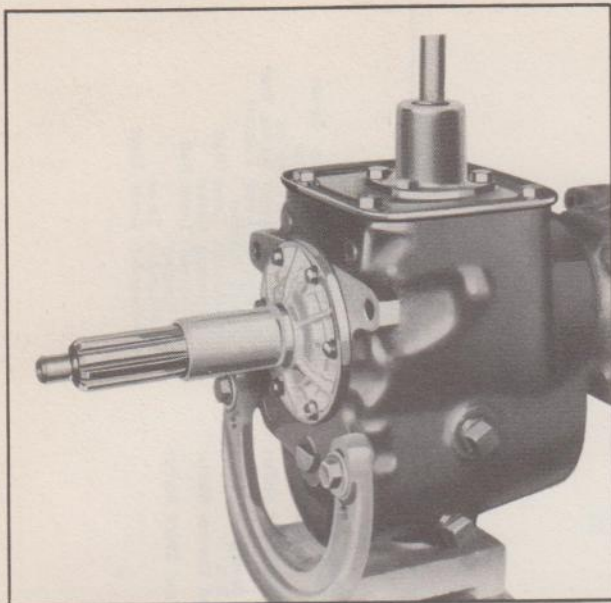


Fig. 3—Transmission in Holding Fixture

joint retaining cap screw, plain washer and lockwasher. Slide the universal joint off the mainshaft.

**CAUTION**—Care should be used when shifting the gears into second or third to prevent damage to the wedge angles.

9. Remove the six clutch gear bearing retainer screws and shakeproof lockwashers. Remove the retainer. Note that the screw holes in the retainer are unevenly spaced so that the retainer may only be assembled to the case in one position, matching up the oil return slot with the hole in the case.

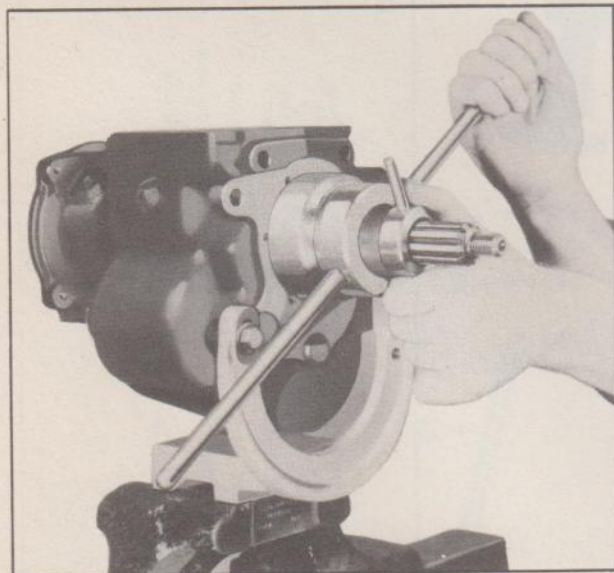


Fig. 4—Removing Clutch Gear and Bearing

10. Install the special clutch gear and bearing puller, J-937, by screwing the threaded sleeve (left-hand thread) onto the clutch gear shaft.

Pull the clutch gear and bearing from the case by turning the puller handles, Figure 4.

**CAUTION**—Do not **DRIVE** the clutch gear as damage to both the pilot on the mainshaft and the internal bearing surface in the clutch gear will result.

11. Remove the 14 roller bearings from inside the clutch gear.
12. Turn the yoke of the mainshaft removing and replacing tool, J-938, back on the threads and screw the puller shaft into the threaded end of the mainshaft. Bolt the yoke of the tool to the rear face of the transmission case.

**IMPORTANT**—Turn the front synchronizer ring so that the lugs line up with the slots in the mainshaft helical spline.

13. While holding puller shaft handle, turn the puller handles clockwise to force the mainshaft out of the rear bearing, Fig. 5. Disassemble the puller from the mainshaft and the transmission case, and remove the mainshaft from the transmission through the front of the case.



Fig. 5—Removing Mainshaft

14. Shift the second speed gear into the clutch sleeve. Remove the clutch sleeve assembly, first and reverse sliding gear, and the second speed gear from the case as a unit. Remove the second speed gear thrustwasher from the case.
15. Expand the rear bearing lock ring into the case with the special expanding tool, J-935. This raises the lock ring from the groove in the bearing and the bearing may be removed by lightly tapping the outer race toward the inside of the case, Fig. 6.  
It is necessary to remove the rear bearing before attempting to remove the countergear.
16. Remove the countershaft by driving it from the rear to the front of the case, using a soft steel drift. Remove the countergear and the front and rear countergear thrustwashers as well as any roller bearings that may have dropped to the bottom of the case.
17. Drive out the reverse idler shaft expansion plug from the inside of the case. A hook-nosed punch or drift will be found most suitable for this job.

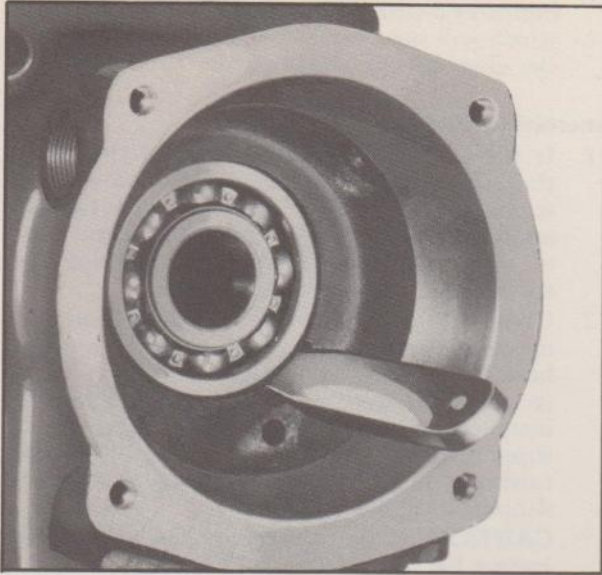


Fig. 6—Removing Rear Bearing

18. Drive the idler shaft lock pin into the shaft. This pin is shorter in length than the diameter of the shaft, so that the shaft may be slipped out when the pin is driven in. **DO NOT** turn the shaft while removing as the lock pin may drop down between the idler shaft bushings.

**NOTE**—It is necessary to remove the counter-gear before removing the idler shaft, otherwise the idler shaft will strike the counter-gear.

19. Remove reverse idler shaft and thrust washers.

#### Disassembly of the Clutch Gear

1. Place the clutch gear in a vise and remove the bearing retaining nut and oil slinger, using special wrench J-933, Fig. 7. The retaining nut and oil slinger is a one-piece steel casting machined with a left-hand thread and is locked in place on the clutch gear shaft by being staked into a hole provided for that purpose.

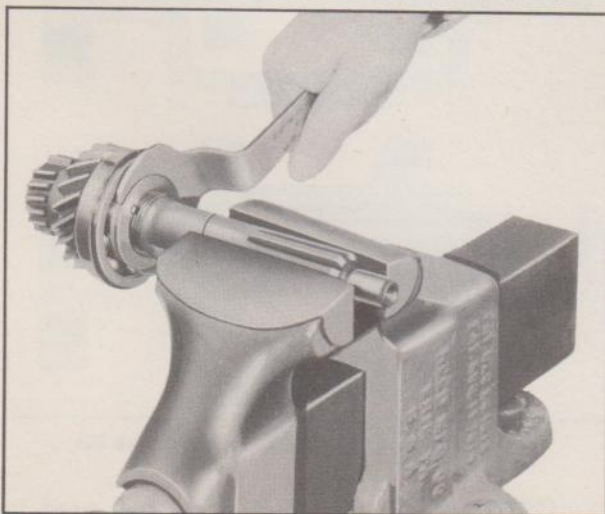


Fig. 7—Retaining Nut and Oil Slinger Removing Tool

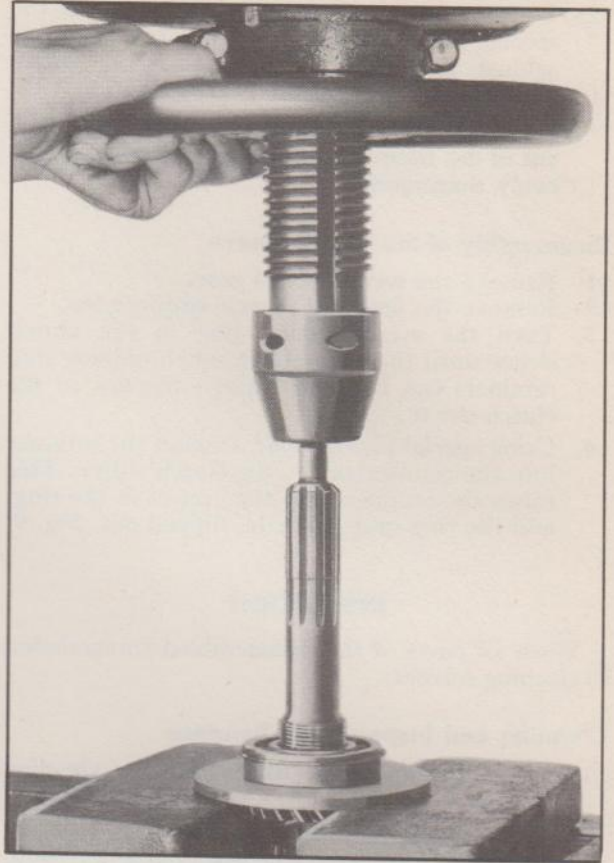


Fig. 8—Removing Clutch Gear Bearing



Fig. 9—Removing Synchronizing Ring from Second and Third-Speed Clutch

2. To remove the clutch gear bearing, place the special press plate, J-936, over the gear and against the bearing. Using an arbor press, press the shaft out of the bearing, Fig. 8.

**CAUTION—Do not attempt to DRIVE the shaft out of the bearing or the bearing will be seriously damaged.**

#### Disassembly of the Clutch Sleeve

1. Remove the second speed gear.
2. Remove the first and reverse sliding gear.
3. Turn the synchronizing ring in the clutch sleeve until the ends of the synchronizing ring retainers can be seen through the slot in the clutch sleeve.
4. Using special pliers, J-932, expand the retainer into the counterbore in the clutch sleeve. This raises the retainer from the groove in the ring, and the ring may easily be slipped out, Fig. 9.

#### INSPECTION

Wash all parts of the disassembled transmission in cleaning solvent.

#### Cleaning and Inspection of Bearings

1. Wash the bearings thoroughly in cleaning solvent.
2. Blow out the bearings with compressed air.

**CAUTION—Do not allow the bearings to spin, but turn them slowly by hand. Spinning bearings will damage the races and balls.**

3. After making sure the bearings are *clean*, lubricate with light engine oil and check them for wear or roughness. Roughness may be determined by slowly turning the outer race by hand.

#### Transmission Case

Wash out the transmission case and inspect for cracks. Inspect the front face which fits against clutch housing for burrs and if any are present, dress them off with a fine cut mill file.

#### Gears

1. Inspect all gears and, if necessary, replace any that are worn or damaged.
2. Check the first and reverse sliding gear to make sure it slides freely on the clutch sleeve.
3. Check the clutch sleeve to see that it slides freely on the mainshaft.
4. Check the synchronizing cones for wear or for being loose in the clutch sleeve. If the cones are damaged in any way, it will be necessary to replace the clutch sleeve assembly and both synchronizing rings.

#### Synchronizer Rings

1. Inspect the synchronizer rings for smoothness.
2. Place the synchronizer rings in the synchronizing cones and check with the thumbs to see that the rings do not rock. Excessive rocking

indicates a poor fit between the ring and cone, which will not permit proper synchronizing of the gears during shifting.

#### Energizing Springs

1. It will be noticed upon examining the spring that one of the ends is slightly offset. The spring is assembled in its groove with this offset between the fourth and fifth clutch teeth of either bank of teeth, thus keeping the spring from turning in its groove.
2. Under normal operation it should never be necessary to replace the energizing springs; however, should an energizing spring be removed for any reason, a new spring should be installed. The spring may be removed by slipping a thin blade under the spring and raising it over the clutch teeth on the gear and slipping it off over the teeth.

**CAUTION — In replacing the energizing spring, be very careful not to distort the spring when expanding it over the clutch teeth.**

#### Countergear

Inspect the countergear rollers and the bearing surfaces inside the countergear and on the countershaft carefully for scoring or other damage. Replace any parts found damaged.

#### REASSEMBLY

##### Reverse Idler

1. Lubricate the reverse idler gear thrustwashers and install the gear and thrustwashers in the case with the gear having the chamfered teeth to the rear of the case.
2. Install the idler shaft, making sure that the lock pin hole in the shaft lines up with the hole in the case at the same angle. (See Fig. 10.)

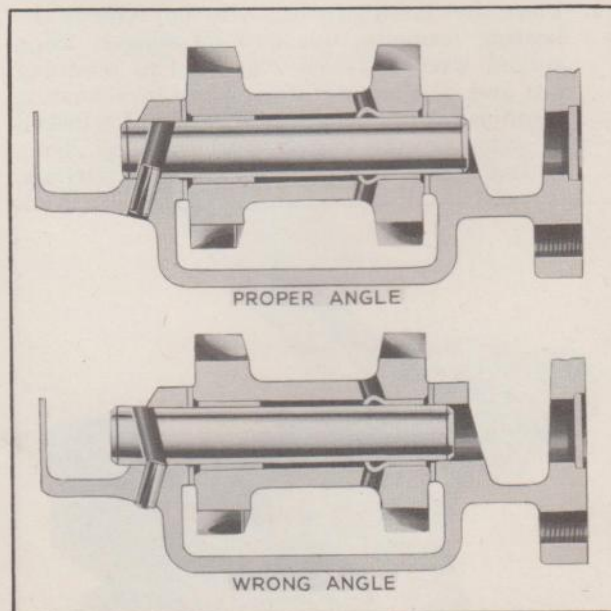


Fig. 10—Reverse Idler Gear, Shaft and Lock Pin

**CAUTION—A pin punch should be used to make sure that these holes line up, for if the**



lock pin is driven into the case and shaft with the hole in the shaft at the wrong angle serious damage will result.

3. Use a new idler shaft lock pin and drive it in approximately  $\frac{1}{16}$ " beyond flush with the case, and peen the hole slightly. This lock pin must be a tight fit in the case to prevent oil leaks.
4. Install the idler shaft expansion plug in the case.

### Countergear

1. Coat the roller bearing area in each end of the gear with cup grease. Insert countershaft in the gear, and place gear and shaft on the bench with the large diameter end of the shaft down. Insert twenty-five rollers in this end of the gear, then reverse the position of the counter gear on the bench and insert twenty-five rollers at the opposite end as shown in Fig. 11. Remove countershaft (note that the rollers remain in place and flush with the ends of the gear).

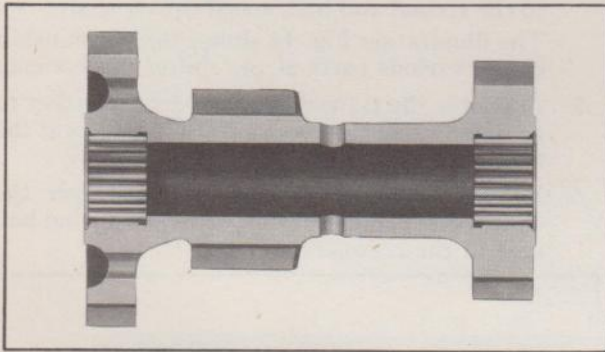


Fig. 11—Countergear Roller Bearings

2. Install counter gear in transmission case. Lubricate the front thrust washer and assemble it between the gear and the case; then, sighting through the front hole in the case, roughly align the thrust washer and gear.
3. Push the assembly tool (taper end first) into the front countershaft hole in case. The taper on the assembly tool will align the thrust washer and counter gear for easy assembly of the shaft.
4. Push the countershaft into the front hole in the case, pushing the assembly tool ahead of it until the taper on the tool just enters the rear roller bearing.
5. Lubricate the rear thrust washer and assemble it between the gear and the case. Sighting through the rear hole in the case, align the thrust washer, then continue to push the countershaft into the case. The assembly tool will now properly align the gear and thrust washer at the back end while it is being pushed out of the case ahead of the shaft. The flat on the forward end of the countershaft engages the clutch housing when the transmission is installed in the chassis, and keeps the countershaft from turning. This flat must be hori-

zontal and at the top; otherwise the transmission cannot be assembled to the clutch housing.

**NOTE**—The step at the end of the countershaft should be driven in flush with the case, or approximately  $\frac{1}{64}$ " below the face, to maintain proper transmission alignment.

### Rear Bearing

1. Install the rear bearing lock ring in the case.
2. Start the bearing in from the rear, and use the lock ring expanding tool, J-935, to expand the ring into the case. Refer to Fig. 6.
3. Using a soft steel drift, tap the bearing on the outer race until it is in about halfway; then remove the lock ring expanding tool and continue to tap the bearing until the lock ring seats in the groove in the bearing.

### Synchronizing Clutch Sleeve Assembly

1. Install the synchronizer ring retainers in the counterbores in the ends of the clutch sleeve.
2. With the special pliers, J-932, expand the retainer, at the same time holding it flush with the back face of the cone. Install the synchronizer rings making sure that the retainers seat in the groove all the way around the rings, Fig. 9.
3. Install the first and reverse sliding gear on the clutch sleeve.
4. Install the second speed gear in the rear end of the clutch sleeve, meshing the clutch teeth on the gear with the internal teeth in the clutch sleeve.
5. Coat the grooved side of the second speed gear thrustwasher with transmission lubricant and place the washer on the back face of the second-speed gear. Then install the clutch gear assembly in the transmission case.

### Mainshaft

1. For initial lubrication, place transmission lubricant on the second-speed gear bearing area of the mainshaft. When installing the mainshaft, the lugs on the front synchronizer must slide through the slots in the mainshaft

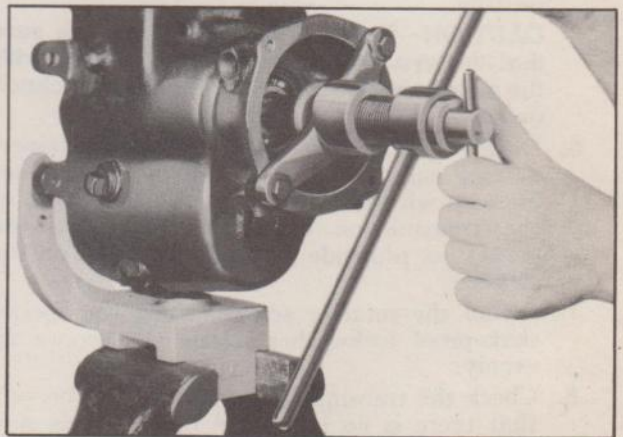


Fig. 12—Installing Mainshaft

spline. Push the shaft into the clutch sleeve as far as possible by hand, picking up the second speed gear and thrustwasher.

2. Turn the yoke of the mainshaft removing and replacing tool, J-938, down on the threads and screw the tool shaft into the threaded end of the mainshaft. Bolt the yoke of the tool to the rear face of the transmission case.
3. Turn the tool handles counterclockwise until the mainshaft is seated in the rear bearing, Fig. 12. The proper seating of the shoulder on the shaft against the inner race of the bearing may be determined by checking the end play of the second speed gear which should be approximately .010".

**Clutch Gear**

1. Using an arbor press, press the clutch gear bearing onto the clutch gear with the locating ring toward the front end of the gear shaft so that the bearing will enter the case to the maximum possible depth.
2. Install the combination clutch gear bearing retaining nut and oil slinger on the clutch gear shaft and draw it up tight, using the special wrench, J-933.
3. Lock the retaining nut and oil slinger in place by staking it into the hole with a center punch. Care must be used not to damage the thread on the shaft.

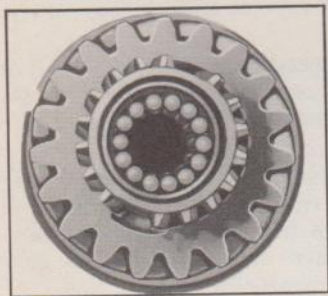


Fig. 13—Mainshaft Pilot Bearing Rollers in Clutch Gear

4. Place some cup grease in the mainshaft pilot hole in the clutch gear and install the 14 roller bearings, Fig. 13. After being assembled in the pilot hole, these bearings will lock themselves in place and cannot fall out. Install the clutch gear in the transmission case.

5. Using a soft steel drift, tap the clutch gear bearing on the outer race until the bearing locating ring seats against the case, being careful to drive the assembly straight to prevent damage to the mainshaft pilot and pilot bearing.

**CAUTION—**During this operation make sure that the synchronizer ring lugs line up with the slots between the clutch teeth on the clutch gear.

6. Install the clutch gear bearing retainer, making sure that the oil slot in the retainer lines up with the oil slot in the front face of the transmission case. Do not allow the gasket to protrude beyond the edge of the retainer.
7. Install the retainer screws, using the special shakeproof lockwasher. Draw the screws up evenly.
8. Check the transmission in all gears to be sure that there is no indication of a bind in any position.

**Universal Joint**

1. Install the spacer and speedometer drive gear on the mainshaft and slide the front yoke of the universal joint on the main shaft.
2. Install the washer and cap screw. Tighten the cap screw securely.

**Shifter Mechanism**

1. Install the shifter yoke lock balls and springs in the side of the transmission case.
2. Install the shifter yokes in the sides of the case, placing the first and reverse yoke over the first and reverse sliding gear, and the second and high yoke over the ring on the clutch sleeve.
3. Install the shifter shafts from the front of the case, the longer of the two being the first and reverse shaft. Line up the lock holes in the shafts with the two front cover holes in the top of the case.
4. Lay the shifter interlock in slots in the shifter yokes, with the pins upward. The interlock shifter lies in the slots so that the hole is closer to the second and high speed shifter shaft. The illustration Fig. 14 shows the relationship of the various parts of the shifter mechanism.
5. Assemble the transmission cover and gasket to the case, using the two special cap screws at the front.
6. Place the gear shift lever housing over the shift lever; install the shift lever spring and ball seat in the retainer.

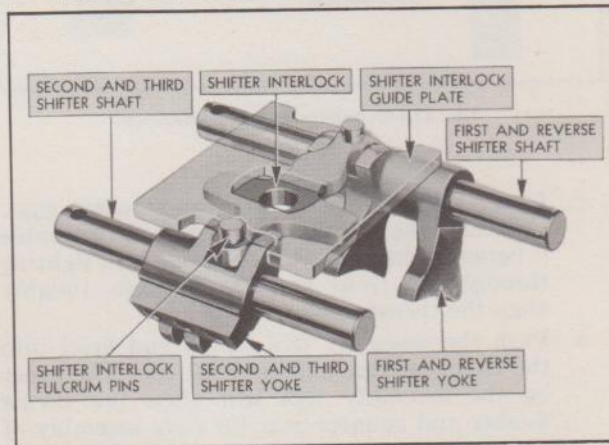


Fig. 14—Shifter Mechanism

7. Assemble the retainer and gasket to the transmission cover with the four cap screws, drawing the screw down evenly to prevent the shift lever spring from exerting a strain on the die cast retainer, or using two longer cap screws in opposite holes to aid in compressing the spring enough to start the short screws in place; then remove the two long screws and replace them with the other two regular screws.
8. Check the operation of the transmission by shifting into all gears.
9. Install the transmission in the truck.

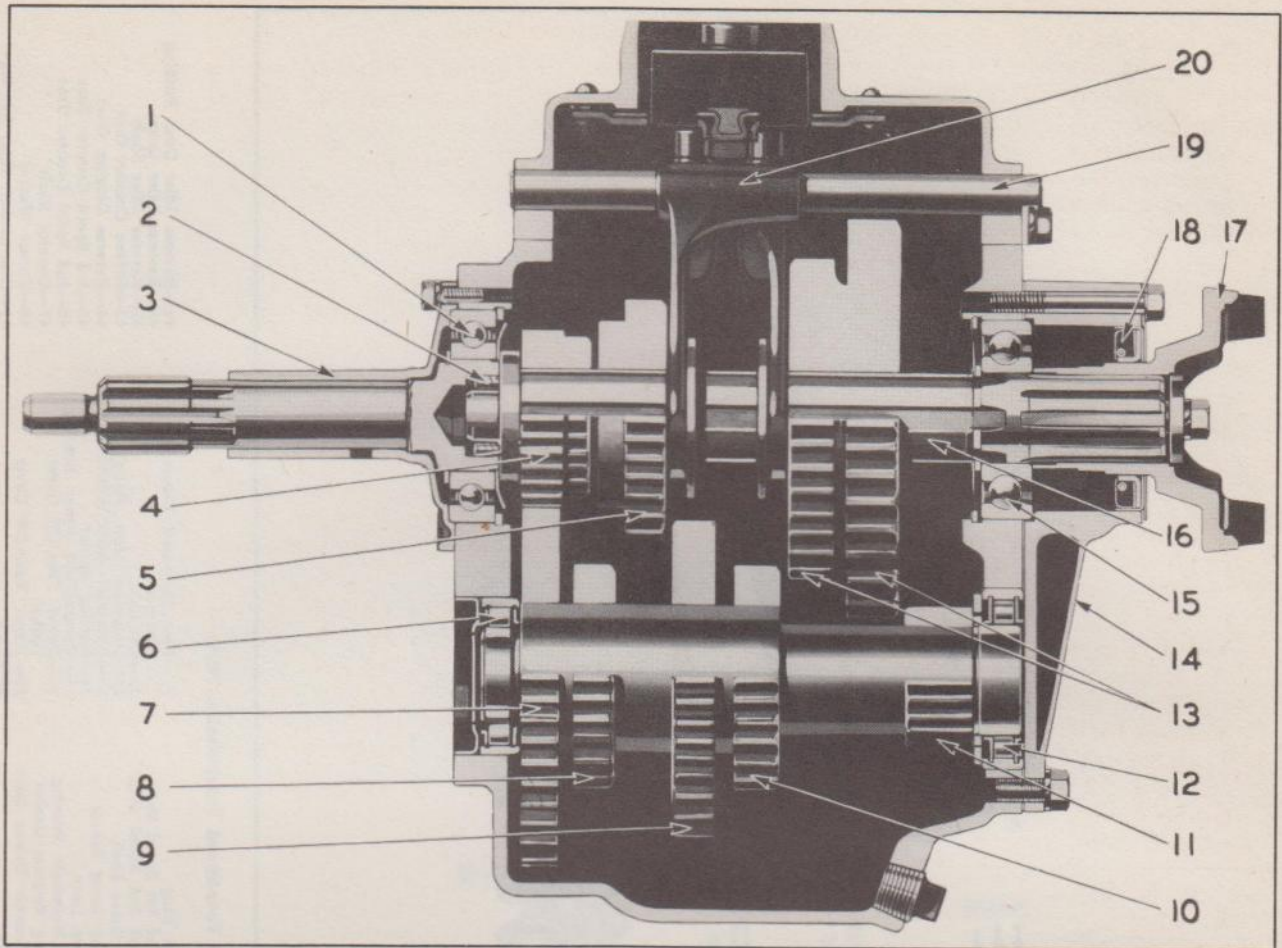


Fig. 15—Four-Speed Transmission Construction

- |                                |                                   |   |                           |
|--------------------------------|-----------------------------------|---|---------------------------|
| 1—Clutch Gear Bearing          | 7—Countershaft Drive Gear         | 11—Countershaft Low Speed Gear                | 15—Mainshaft Rear Bearing |
| 2—Mainshaft Pilot Bearing      | 8—Countershaft Reverse Gear       | 12—Countershaft Rear Bearing                  | 16—Mainshaft              |
| 3—Clutch Gear Bearing Retainer | 9—Countershaft Third Speed Gear   | 13—Low, Second and Reverse Speed Sliding Gear | 17—Universal Joint Flange |
| 4—Clutch Gear                  | 10—Countershaft Second Speed Gear | 14—Rear Bearing Retainer                      | 18—Oil Seal               |
| 5—High Speed Sliding Gear      |                                   |   | 19—Gear Shifter Shaft     |
| 6—Countershaft Front Bearing   |                                   |   | 20—Shifter Forks          |

### FOUR-SPEED TRANSMISSION

#### Construction

The four-speed transmission is a heavy-duty transmission of sturdy construction and is designed to give efficient service in every type of truck operation.

The case is made of cast iron, accurately machined to give the proper alignment of the gears and their shafts. All of the gears are machined from drop forged steel gear blanks, and are heat treated for strength and long life. The shafts are machined from high grade steel, and are heat treated and ground to close limits.

The main drive gear is supported by a heavy-duty New Departure ball bearing. The forward end of the spline shaft is supported by a Hyatt roller bearing, while the rear end receives its bearing from a New Departure ball bearing. Both ends of the countershaft run in heavy-duty Hyatt roller bearings.

Fig. 15 shows the sturdy construction of this transmission and the relative positions of all of the parts.

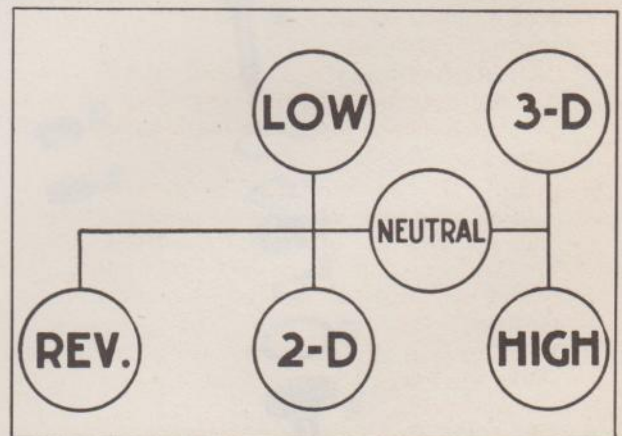


Fig. 16—Gearshift Lever Positions

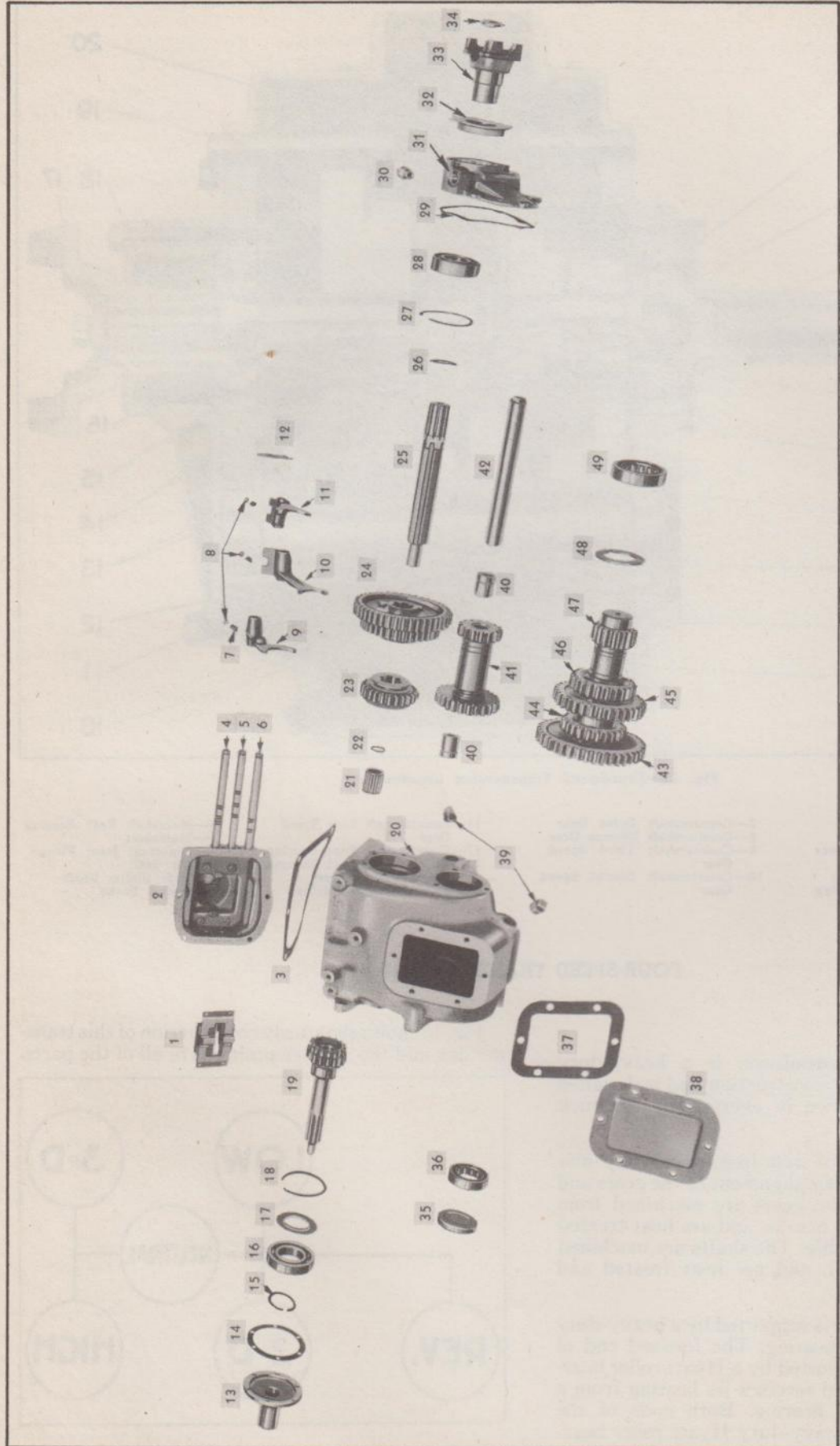


Fig. 17—Layout of Four-Speed Transmission Parts

- |                             |                            |                               |                               |
|-----------------------------|----------------------------|-------------------------------|-------------------------------|
| 1—Shifter and Guide Plate   | 22—Thrust Ring             | 31—Rear Mainshaft Bearing     | 40—Reverse Idler Gear Bushing |
| 2—Case Cover                | 23—3rd and 4th Speed Gear  | 32—Oil Seal                   | 41—Reverse Idler Gear         |
| 3—Cover Gasket              | 24—1st and 2nd Speed Shaft | 33—Universal Joint Flange     | 42—Reverse Idler Shaft        |
| 4—3rd and 4th Shifter Shaft | 25—Main Drive Shaft        | 34—Universal Joint Washer     | 43—Driven Counter Gear        |
| 5—1st and 2nd Shifter Shaft | 26—Bearing Inner Spacer    | 35—Bearing Spacer             | 44—Reverse Counter Gear       |
| 6—Reverse Shifter Shaft     | 27—Bearing Lock            | 36—Countershaft Front Bearing | 45—3rd Speed Counter Gear     |
| 7—Yoke Lock Ball Spring     | 28—Rear Mainshaft Bearing  | 37—Power Take-Off Cover       | 46—2nd Speed Counter Gear     |
| 8—Yoke Lock Ball            | 29—Bearing Retainer Gasket | 38—Gasket Washer              | 47—Counter Shaft              |
| 9—Forward Shifter Yoke      | 30—Case                    | 39—Plug                       | 48—Thrust Washer              |
| 10—Reverse Shifter Yoke     | 31—Bearing Retainer Gasket |                               | 49—Countershaft Rear Bearing  |
| 11—Forward Shifter Yoke     | 32—Fitting                 |                               |                               |

## OPERATION

Due to the simplicity of construction of the four-speed transmission, there is no need to go into a lengthy discussion on its operation.

The gearshift lever positions for the various gears are clearly shown in Fig. 16.

## REPAIR OPERATIONS

### Removal from Chassis

To remove the transmission from the truck proceed as follows:

1. Remove the floor boards and disconnect the speedometer cable from the rear bearing retainer. Remove the hand brake lever from the transmission case.
2. Drain the lubricant from the transmission and remove the front propeller shaft assembly as explained under the Rear Axle Section of this Manual.
3. Remove the two top cap screws holding the transmission to the clutch housing and insert the two transmission guide pins in these holes.
4. Remove the flywheel underpan and remove the two lower transmission-to-clutch-housing cap screws.
5. Slide the transmission straight back on the guide pins until the clutch gear is free of the splines in the clutch disc. The guide pins support the transmission during this operation and prevent damage to the clutch disc.
6. Remove the transmission and place it in the transmission bench stand.

The illustration, Fig. 17, shows an exploded view of the transmission. Each part is given a key number and the legend gives the name of the part. The reader should study this illustration and the relative position of all parts before disassembling one of these units.

### Disassembling the Transmission

1. Mount transmission in holding fixture.
2. To remove the gearshift lever, slide the open side of K-353 gearshift lever remover, shown in Fig. 18, over the lever, engage the lugs in the

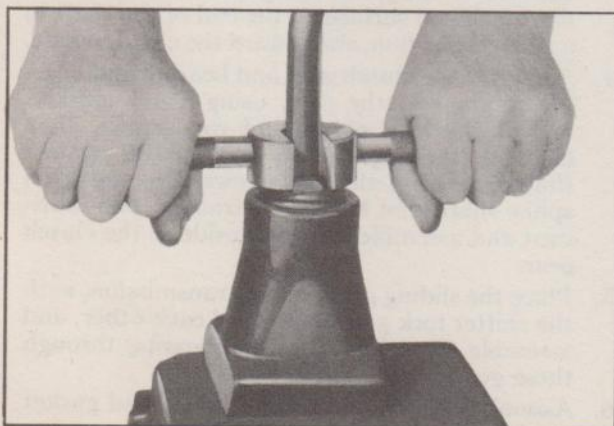


Fig. 18—Removing Gearshift Lever—Conventional Model

tool in the open slot of the retainer. Then press down on the tool and turn it to the left to disengage the lugs on the retainer. Lift the lever out of the cover.

3. Remove the transmission cover assembly and place the transmission in two gears at once to lock the mainshaft.
4. Remove the cap screw and washer which retain the universal joint front yoke to the mainshaft.
5. Remove the seven cap screws which attach the rear bearing retainer to the case.
6. Remove the clutch gear bearing retainer and drive out the clutch gear and bearing, using a soft steel drift to avoid damaging the teeth of the gear.
7. Remove the spline shaft pilot bearing and drive out the spline shaft and bearing through the rear end of the case. Remove the sliding gears.
8. Drive out the reverse idler gear shaft from the front to the rear and remove the reverse idler gear.
9. Drive the countergear to the rear to remove the rear bearing. Remove the countergear and drive out the countershaft front bearing and retainer by tapping lightly around the outer race of the bearing.
10. The bearings can be removed from the spline shaft and from the clutch gear by supporting the inner race of each bearing on an arbor press and pressing on the end of the shaft until it is free of the bearing.

### Inspection

After the transmission has been completely disassembled, all parts should be thoroughly washed in cleaning solvent and inspected for wear or damage.

All bearings should be thoroughly cleaned, oiled with light engine oil, and checked for scored races or worn balls or rollers. To check the bearings for

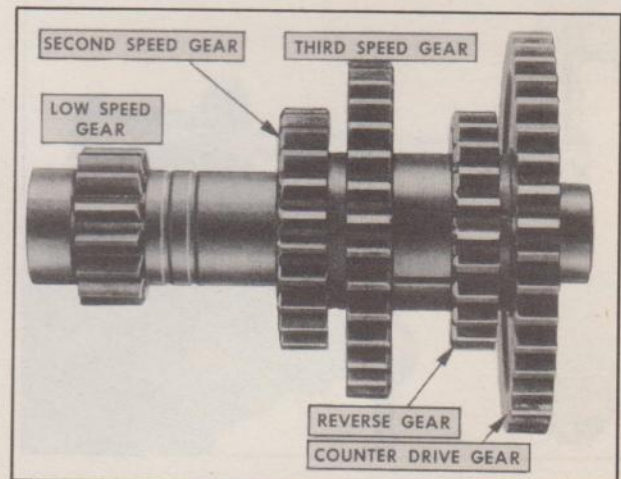


Fig. 19—Transmission Countershaft

excessive looseness or for roughness, hold the inner race in one hand and turn the outer race slowly in the other hand, DO NOT spin bearing with compressed air.

### Countershaft and Idler Gears

Should it be necessary to replace the gears on the countershaft, the old gears should be pressed off on an arbor press and the new gears pressed on the shaft. When reassembling the gears to the countershaft, care must be used to place the gears in correct position on the shaft and also to install the three spacers in their proper place between the gears. The chamfered side of the second speed gear faces the low speed gear. The chamfered side of the third speed gear faces the chamfered side of the reverse gear. The illustration, Fig. 19, shows the order in which the gears are pressed on the shaft.

The  $\frac{1}{4}$  inch wide spacer goes between the second and third speed gears. The  $\frac{7}{8}$  inch wide spacer is assembled between the third speed and reverse gears, and the  $\frac{5}{32}$  inch wide spacer between the reverse and countershaft drive gears.

When pressing the gears on the countershaft, the round keys should be used to keep the keyways lined up. After the gears are pressed into place, the round keys should be driven down  $\frac{1}{32}$  inch below flush with the gear. Any burrs set up should be filed down smooth.

If the bushings in the idler gear show signs of wear, they should be removed from this gear, with the special tool, J-1662. This same tool may be used to replace these bushings in the gear. After the new bushings have been installed, they should be reamed to size, using KMO-349 reamer, Fig. 20, leaving a minimum clearance of .002" between the bushings and shaft for proper lubrication.

### Oil Seal

A spring-loaded leather oil seal is pressed into the rear bearing retainer and the leather bears on the ground hub of the universal joint front yoke.

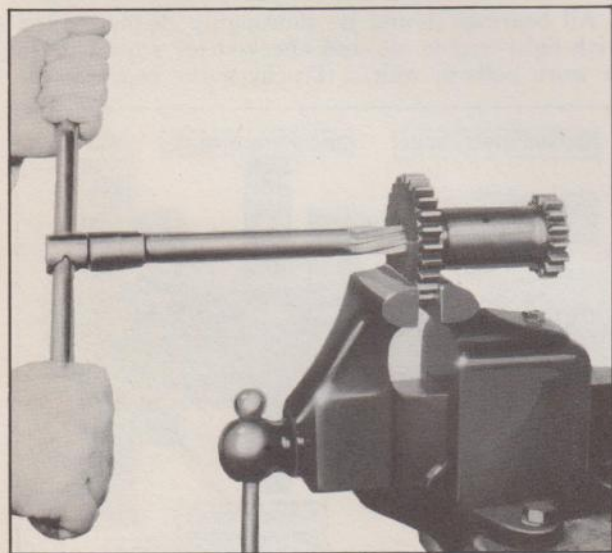


Fig. 20—Reaming Idler Gear Bushings

To replace an oil seal, the rear bearing retainer must be removed from the transmission. Then press the oil seal from the rear retainer.

Before installing a new oil seal, it should be thoroughly soaked in engine oil. When pressing the new

seal into the bearing retainer, care should be used to line up the bolt holes in the seal with the bolt holes in the retainer.

### Reassembling the Transmission

1. Assemble the countergear front bearing and retainer to the case. The open side of the retainer should be toward the outside and its edge flush with the case. Place the countergear and shaft in the transmission and assemble the thrust washer and rear bearing as shown in Fig. 21.

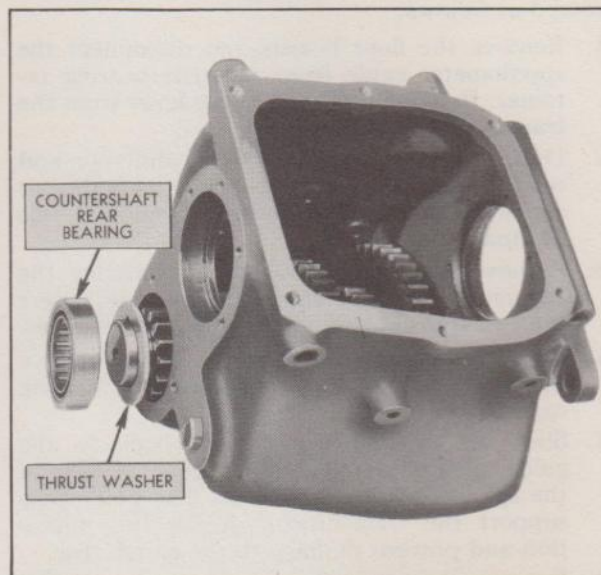


Fig. 21—Method of Assembling Countershaft

2. For the purpose of checking the end play between the countergear and the case without further assembly of the transmission, assemble the rear bearing retainer and gasket to the rear face of the case. Check the end play between the thrust washer and the shoulder on the countergear. This end play should be from .015" to .045". If it exceeds .045" shim between the front countershaft bearing and its retainer until the end play is within the above limits.
3. Place the idler gear in the transmission case and drive the idler gear shaft into position from the rear to the front, being careful to have the flat machined surface on the end of the shaft in a vertical position, and toward the countershaft.
4. Assemble the clutch gear and bearing and bearing retainer to the case, using a new gasket. Install the lock plates and cap screws, then bend up the edges of the lock plates against the hex head of the cap screws. Dip the main spline shaft pilot bearing in transmission lubricant and assemble it in the inside of the clutch gear.
5. Place the sliding gears in the transmission, with the shifter fork grooves toward each other, and assemble the spline shaft and bearing through these gears and into the case.
6. Assemble the rear bearing retainer and gasket to the case and tighten the seven cap screws securely.

7. Install the universal joint front yoke on the main shaft. Place the transmission in two gears at once to lock the mainshaft. Install the special flat washer (with the indentations toward the yoke) and lockwasher under the head of the cap screw which anchors the universal joint front yoke to the mainshaft. Then tighten the screw securely.

#### Transmission Cover Assembly

1. To disassemble the transmission cover, remove the two screws which attach the shifter shafts lock plate and remove the plate.
2. When removing the three shifter shafts from the cover, turn the shafts one-half turn to raise the shift lock balls out of the notches in the shafts, then push the shafts out of the cover and shifter forks, being careful not to lose the lock balls and springs which are located in the shifter forks.

Should it become necessary to replace the shifter interlock plate, cut the heads from the four rivets and remove the plate. A new plate may be installed by riveting it to the cover.

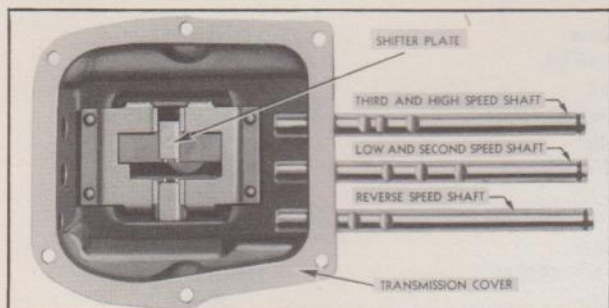


Fig. 22—Shifter Shaft Assembly

#### Reassembly

1. In reassembling the transmission cover, care must be used in installing the shifter shafts. They should be installed in the order shown in Fig. 22, namely reverse speed, low speed and high speed.

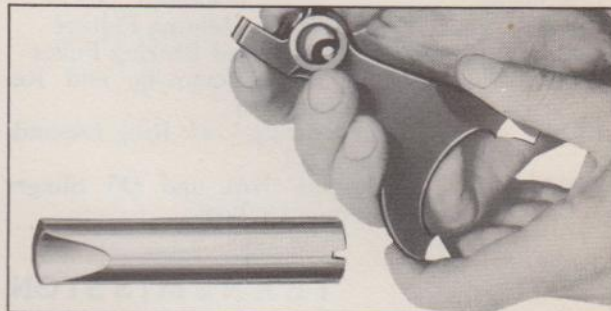


Fig. 23—Depressing Lock Ball

2. In assembling the shifter forks to the shafts, first place the shift lock spring and ball in the fork. With the special tool shown in Fig. 23 force the ball down on the spring in the fork, then turn the tool one-half turn to hold the ball in position. This tool holds the shift lock ball and prevents it from jumping out while the shaft is being installed.
3. Install the shifter shaft lock plate. Install the cover and gasket to the transmission case being sure that the shifter forks enter the shifter fork grooves in the gears. Install the gearshift lever using K-353 gearshift lever remover and replacer.

Replace the transmission in the truck.

## TRANSMISSION TROUBLES AND REMEDIES

Symptom	Probable Remedy
<b>Slips Out of High Gear</b> <ol style="list-style-type: none"> <li>1. Transmission loose on clutch housing.</li> <li>2. Shift lock spring weak or broken.</li> <li>3. Bent shifter fork.</li> <li>4. Damaged mainshaft pilot bearing.</li> </ol>	<ol style="list-style-type: none"> <li>1. Tighten transmission on clutch housing.</li> <li>2. Replace shift lock spring.</li> <li>3. Replace shifter fork.</li> <li>4. Replace main shaft pilot bearing. (Check bore in clutch gear and pilot end of mainshaft for wear or damage.)</li> </ol>
<b>Slips Out of Low Gear</b> <ol style="list-style-type: none"> <li>1. Shift lock spring weak or broken.</li> <li>2. Bent shifter fork.</li> <li>3. Worn low speed gears.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace shift lock spring.</li> <li>2. Replace shifter fork.</li> <li>3. Replace low speed sliding gear and low speed countershaft gear.</li> </ol>
<b>Noisy in Reverse</b> <ol style="list-style-type: none"> <li>1. Worn reverse idler gear bushings.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace idler gear bushings.</li> </ol>
<b>Difficulty in Shifting into Low Gear</b> <ol style="list-style-type: none"> <li>1. Worn reverse latch on lower end of gearshift lever.</li> <li>2. Worn gearshift interlock guide plate.</li> </ol>	<ol style="list-style-type: none"> <li>1. Replace reverse latch.</li> <li>2. Replace gearshift interlock guide plate.</li> </ol>
<b>Lubricant Leaks into Clutch Housing</b> <ol style="list-style-type: none"> <li>1. Transmission case overfilled with lubricant.</li> <li>2. Clutch gear bearing retainer loose.</li> </ol>	<ol style="list-style-type: none"> <li>1. Lower lubricant to proper level. (See Lubrication Section.)</li> <li>2. Remove transmission, replace gasket and tighten clutch gear bearing retainer.</li> </ol>

**TOOLS REQUIRED**

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the transmission:

Tool Number	Description
J-934.....	Transmission Holding Fixture
J-937.....	Clutch Gear and Bearing Puller
J-938.....	Main Shaft Removing and Replacing Tool
J-935.....	Rear Bearing Lock Ring Expanding Tool
J-933.....	Retaining Nut and Oil Slinger Removing Tool

Tool Number	Description
J-936.....	Clutch Gear Bearing Thrust Plate
J-932.....	Synchronizing Ring Retainer Pliers
K-386.....	Countergear Assembly Tool
T-1617.....	Countergear Assembly Tool
K-353.....	Gearshift Lever Removing Tool
J-1662.....	Idler Gear Bushing Remover and Replacer 1½ Ton, 4-Speed
KMO-34-G...	Idler Gear Bushing Reamer 1½ Ton, 4-Speed

**TRANSMISSION SPECIFICATIONS**

Type	Selective Synchro-Mesh	Selective Sliding Gear
Speeds	3 Forward, 1 Reverse	4 Forward, 1 Reverse
Mounting	Unit Powerplant	Unit Powerplant
<b>BEARINGS</b>		
Clutch Shaft—In Crankshaft	Needle	Needle
Type	Hyatt 99004	Hyatt 99004
Clutch Shaft—Rear	Ball	Ball
Type	New Departure ND-43027-C	New Departure ND-3209
Mainshaft—Front	Roller	Needle
Type	14 Chev. No. 590752	Hyatt 93424
Mainshaft—Rear	Ball	Ball
Type	New Departure ND-43305-C	New Departure ND-3307
Countergear—Front	Roller	Roller
Type	25—Chev. No. 591211	Hyatt C-1206
Countergear—Rear	Roller	Roller
Type	25—Chev. No. 591211	Hyatt C-1207
Reverse Gear	Bronze Bushing	Bronze Bushing
<b>GEAR RATIOS</b>		
First Speed	2.94 to 1	7.06 to 1
Second Speed	1.68 to 1	3.48 to 1
Third Speed	Direct	1.71 to 1
Fourth Speed	None	Direct
Reverse Speed	2.94 to 1	6.98 to 1



## Section 8

# FUEL TANK AND EXHAUST SYSTEM

### FUEL TANK

#### ½-Ton Truck (Except Cab Type)

The fuel tank of the ½-ton panel and chassis type truck is located on the right side of the chassis, just inside the frame side rail and between the second and third crossmembers. A strong mounting of two straps supports it underneath the floor, the front strap being attached to the steel floor at the front of the body and the rear one to a flanged channel which is used to reinforce the floor boards at this point, at the same time making possible a durable support for the rear strap.

The steel floor at the front strap has a large stiffening rib stamped crosswise in it, thus providing a support for the front of the tank similar to the cross brace at the rear. Metal-to-metal contact is prevented by anti-squeak material. The tank is also set far enough from the side rail to prevent any rubbing. A covered opening is provided in the floor for access to the tank gauge unit.

This tank is of heavy, leak-proof construction and has a capacity of sixteen gallons. It consists of two similar pans, welded together and reinforced with stiffening ribs around the sides. The filler neck extends through the body panel and is designed to permit rapid filling of the tank. A special vent tube extends the entire length of the filler neck into the top of the tank. A large baffle near the neck prevents surging. This fuel tank and its mounting is shown in Fig. 1.

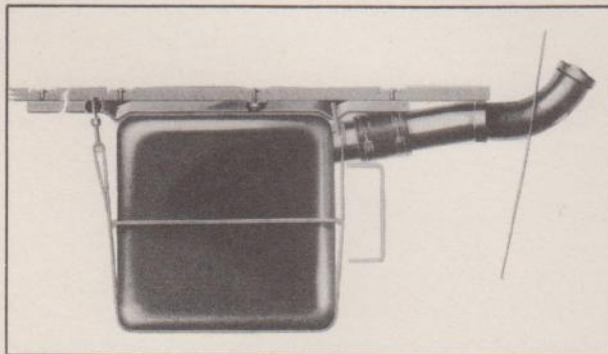


Fig. 1—½-Ton Truck Fuel Tank (Except Cab Type)

#### ¾-Ton Trucks (Except Cab Type)

The 18-gallon fuel tank used on the ¾-ton truck is located in the same relative position to the frame as on the ½-ton truck. The mounting is similar to the ½-ton truck except that instead of being attached to the load platform the tank is anchored to the frame side rail by two brackets and two straps. The brackets are bolted to the frame side rail and the straps, which go around the tank, are in turn fastened to the brackets.

The tank construction is also similar to the ½-ton truck except for the increased capacity of 18 gallons.

#### ½, ¾ and 1½-Ton Cab Type Trucks

An eighteen gallon fuel tank is used on all cab trucks and the 1½-ton single unit body trucks. The tank is mounted directly on top of the frame under the driver's seat. A riser formed across the top half of one end of the tank prevents air from being trapped by fuel entering the tank from the filler neck.

On all cab type trucks the filler neck emerges from the end of the riser while on the 1½-ton single unit body trucks, the filler neck projects from the side of the riser. In both cases, the filler neck extends outside the body. Where it goes through the body panel, a moulded rubber grommet seals the clearance hole and prevents spilled gasoline from entering the cab or body.

With the filler neck attached to the riser, which is the highest point of the fuel tank, rapid filling of the fuel tank is possible without the possibility of fuel being blown out again by trapped air.

### FUEL TANK FILLER CAP

To prevent spilling of gasoline when making sharp turns or traveling on rough roads, a device, consisting of a baffle cup and a vent pin is incorporated in the filler cap. Through this arrangement the vent area is reduced to a minimum, yet is large enough to serve as a breather for the fuel tank. The small vent area is accomplished by inserting a special pin in the breather holes which are kept open by the bouncing or "jiggling" action of the pin. This minute area, if pierced in the outer part of the cap as a separate hole, would soon be clogged by dirt or corrosion.

The device not only controls the flow of gasoline, but also traps in the baffle cup any that might escape through the lower vent. The chamber volume is adequate for the ordinary overflow, which subsequently returns to the tank. A small hole is provided at the top of the chamber to complete the breather system.

### GASOLINE TANK CAPACITIES

½-Ton Truck (Except Cab Types) . . . . .	16 Gallons
½-Ton Cab Type, ¾ and	
1½-Ton Trucks . . . . .	18 Gallons

### EXHAUST SYSTEM

The muffler is of integral construction employing the reverse flow and diffusion principles to obtain quiet operation. The gas flow from the engine reaches the muffler through the inlet tube, reverses at the rear end and flows back toward the front.

Gases again flow back, this time through a tube leading to the outlet. The flow, however, is not restricted to the tubes, since the gases pour out through perforations in the tubes, mixing with the gases from the adjoining tube. The resulting mixing and baffling, with velocity changes and reversals in direction of flow, aids in silencing.

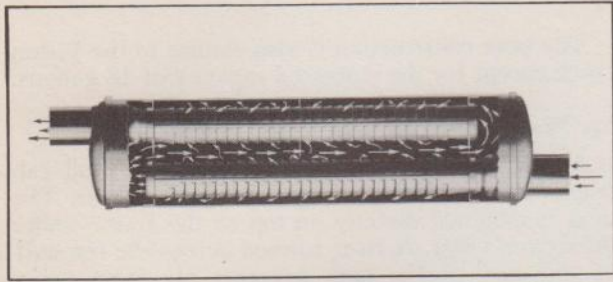


Fig. 2—Truck Muffler

The exhaust pipe from the manifold slides into the muffler inlet tube and is held in place by a clamp. Small projections on the exhaust pipe locate the proper depth in the muffler. A bracket extending from the frame, with its underside conforming to the curvature of the muffler, supports the muffler by a detachable strap at the center section of the muffler body. The tail pipe slides over the muffler outlet tube where it is held by a clamp. The outer end of the tail pipe is supported by a strap and bolt attached to the frame.

When assembling a new muffler and exhaust pipe assembly, all clamp bolts should be left loose until the parts are in correct relation to each other. Slight rotation of the muffler may be necessary to line up the inlet and outlet tubes properly. After correct position is obtained tighten the front muffler exhaust pipe clamp securely before tightening the muffler strap.

## Section 9

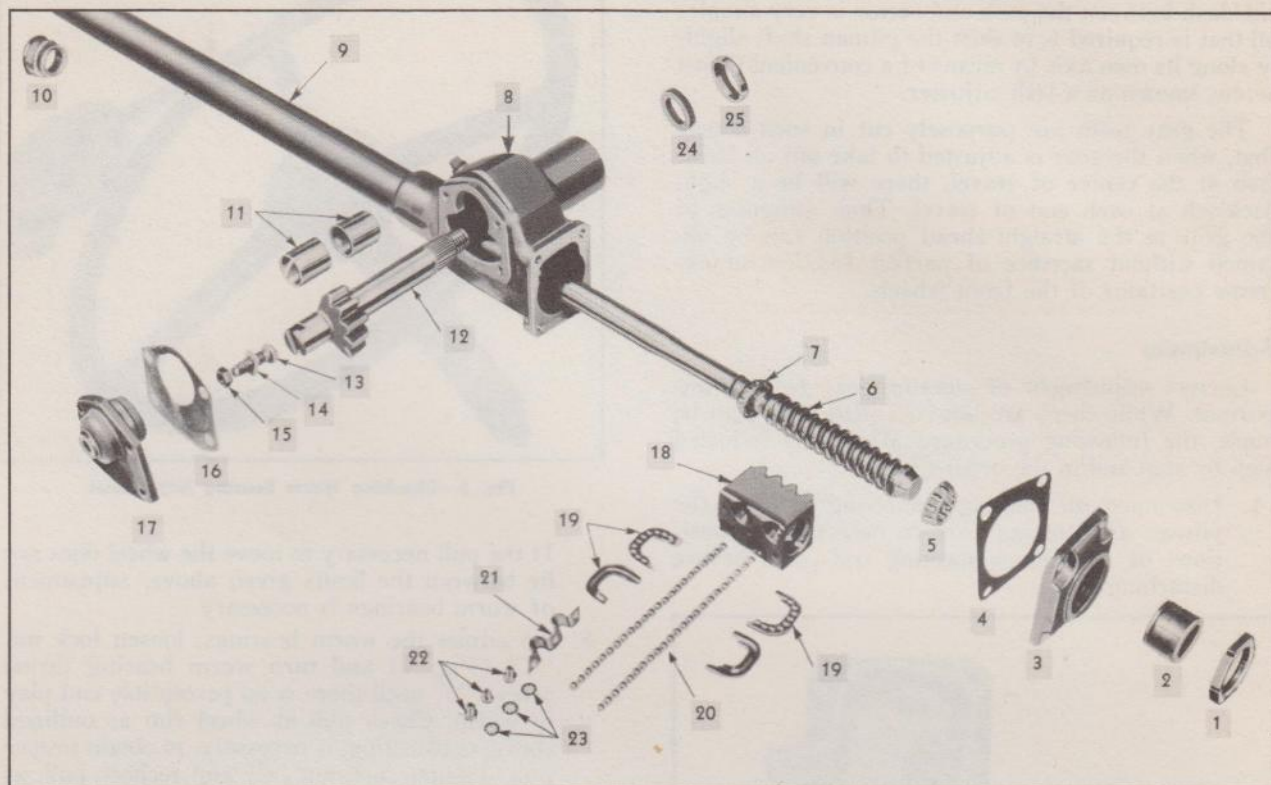


Fig. 1—Layout of Steering Gear Parts

- |   |  |  |                                  |
|---|--|--|----------------------------------|
| 1—Worm Bearing Adjuster Lock Nut        | 7—Hyatt Roller Bearing Assembly (Upper)  | 13—Lash Adjuster                           | 20—Ball                          |
| 2—Worm Bearing Adjuster                 | 8—Housing                                | 14—Lash Adjuster Shim                      | 21—Ball Return Guide Clamp       |
| 3—Housing End Cover                     | 9—Column Jacket                          | 15—Check Nut 7/16 — 20                     | 22—Bolt ¼—20                     |
| 4—End Cover Gasket                      | 10—Upper Steering Shaft Bearing Assembly | 16—Housing Side Cover Gasket               | 23—Lockwasher ¼ (Internal)       |
| 5—Hyatt Roller Bearing Assembly (Lower) | 11—Pitman Shaft Bushing                  | 17—Housing Side Cover and Bushing Assembly | 24—Pitman Shaft Packing          |
| 6—Steering Shaft Assembly               | 12—Pitman Shaft Gear                     | 18—Ball Nut                                | 25—Pitman Shaft Packing Retainer |
|   |  | 19—Ball Retainer Guide                     |                                  |

## STEERING GEAR

The steering gear used in this truck is of the re-circulating ball type, having a reduction ratio of 19.8 to 1. Fig. 1 shows an exploded view of the steering gear parts.

The principal working parts of the gear are the steering worm, the ball nut and the pitman shaft and sector. Each one of these parts is of heat-treated alloy steel.

The worm is integrally welded to the steering main shaft and is mounted between two barrel roller bearings, the lower one of which is adjustable toward the upper, for taking out end play in the worm shaft. Between the roller bearings, the worm is threaded with a precision-finished helical groove.

The ball nut is bored to clear the outside diameter of the worm, and the bore is threaded with a precision-finished helical groove corresponding to that in the worm.

Within the length of the nut, the helical grooves are filled with steel balls conforming to specifications specially drawn up for this gear. There are

two ball circuits in the nut. To keep the balls from running out of the ends, the nut is fitted with two tubular ball guides each of which deflects the balls from their helical path, and guides them diagonally across the back of the nut and returns them to the helical path in the nut. The two guides, together with the helical grooves in the worm and in the nut, thus confine the balls within two distinct closed circuits, one in each end of the nut.

The balls within the helical path constitute a thread between the worm and nut, so that when the worm is turned, the nut moves along the worm, as with an ordinary screw thread. At the same time the balls roll freely between the worm and nut, circulating within their closed circuits, so that screw motion is obtained with rolling instead of sliding contact between the parts.

Rugged rack teeth are cut in that portion of the nut which faces the pitman shaft sector. The pitman shaft is mounted in anti-friction bronze bushings. A grease seal is provided near the outer end of the pit-

man shaft gear. The sector portion of the pitman shaft is provided with rugged teeth which mesh with the rack teeth of the nut. The adjustment for backlash between the rack and sector is very simple; all that is required is to shift the pitman shaft slightly along its own axis by means of a convenient thrust screw, known as a lash adjuster.

The gear teeth are purposely cut in such a way that, when the gear is adjusted to take out all backlash at the center of travel, there will be a slight backlash at each end of travel. Thus, snugness of the gear in the straight-ahead position can be obtained without sacrifice of perfect freedom at extreme positions of the front wheels.

**Adjustment**

Correct adjustment of steering gear is very important. While there are but two adjustments to be made, the following procedure **MUST** be followed step by step and in the order given:

1. Disconnect the steering connecting rod from the pitman arm, taking care to note relative positions of steering connecting rod parts before disturbing them.

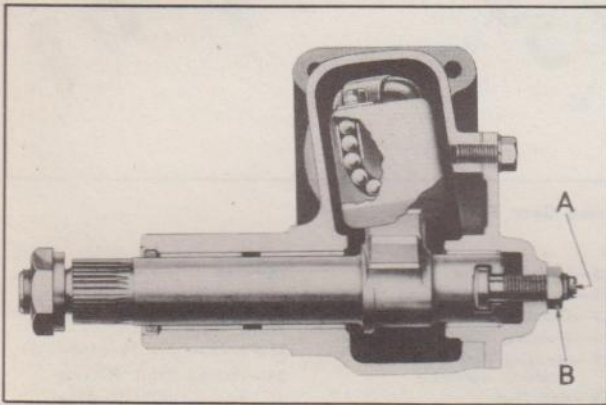


Fig. 2—Lash Adjustment

2. Loosen the mast jacket to instrument panel bracket, making sure there is no bind due to the anchorage.
3. Loosen the lock nut "B" (Fig. 2) and turn the lash adjuster "A" a few turns in a counter-clockwise direction. This removes from worm bearings the load imposed by close meshing of rack and sector teeth. Turn steering wheel gently in one direction until stopped by gear, then back away about one turn.

**CAUTION—Do not turn steering wheel hard against stops when steering connecting rod is disconnected, as damage to ball guides may result.**

4. Using J-544A Steering Gear Checking Scale, measure the pull at the rim of the wheel which is required to keep the wheel in motion (Fig. 3). This should be between 1 and 1½ pounds.

**NOTE—When making this check, it is important that the line of the scale be kept tangent to the rim of the wheel.**

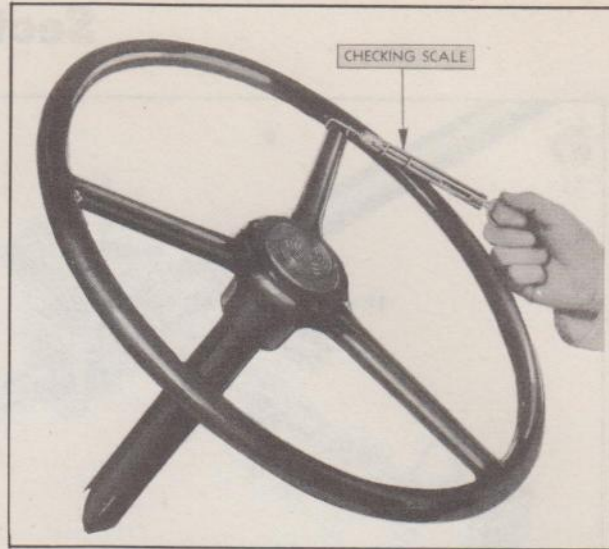


Fig. 3—Checking Worm Bearing Adjustment

If the pull necessary to move the wheel does not lie between the limits given above, adjustment of worm bearings is necessary.

5. To adjust the worm bearings, loosen lock nut "C" (Fig. 4) and turn worm bearing thrust screw "D" until there is no perceptible end play in worm. Check pull at wheel rim as outlined above, readjusting, if necessary, to obtain proper pull. Tighten lock nut "C" and recheck pull, as it must lie between the limits specified after the lock nut is tightened.

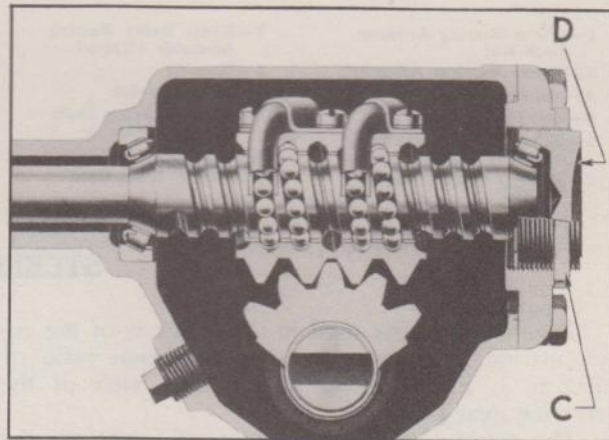


Fig. 4—Worm Gear Adjustment

If the gear feels "lumpy" after adjustment of worm bearings, there is probably damage in the bearings due to severe impact or to improper adjustment, and the assembly must be torn down for replacement of damaged parts. Instructions for disassembly follow under the heading "Repair Operations."

6. Make sure that it will not be necessary to spring the steering column in order to attach it to the instrument panel. It may be necessary to loosen the steering gear mounting bolts at the frame side rail and shift the gear slightly. Tighten mounting bolt nuts on the mast jacket clamp.

- Then recheck the pull at the wheel rim. If this has increased materially, there is still a sprung condition in the column, which must be corrected before proceeding with the adjustment.
7. After proper adjustment of worm is obtained, and all mounting bolts securely tightened, adjust lash adjuster "A" (Fig. 2). First turn the steering wheel gently from one stop all the way to the other, carefully counting the total number of turns. Then turn wheel back exactly half way, to center position. Mark wheel at top or bottom center with a piece of tape. Turn lash adjuster "A" (Fig. 2) clockwise to take out all lash in gear teeth, and tighten lock nut "B." Check pull at wheel rim with checking scale as before, taking the highest reading of the checking scale as the wheel is turned through center position. This should be between 2 and 2½ pounds. Readjust, if necessary, to obtain proper pull. Tighten lock nut "B" and recheck pull, as it must lie between the specified limits after the lock nut is tightened.
  8. Reassemble steering connecting rod to pitman arm.

## REPAIR OPERATIONS

### Steering Gear Removal

Repair operations on the steering gear require that it be removed from the chassis. To remove the steering gear from the chassis, proceed as follows:

1. Remove the floor and toe boards.
2. Remove the clevis pin from the brake lever pull rod at the idler lever.
3. Remove the steering wheel, using the steering wheel puller, J-1618. Remove mast jacket to instrument panel bracket and disconnect the horn wire.
4. Remove the steering connecting rod and pitman arm, using puller, J-1025, for the pitman arm.
5. Remove the housing mounting bolts.
6. Remove the two rear bolts and one side bolt which attach the left engine side pan.

The steering gear assembly can now be pulled up over the pedals and out the left door.

## REPAIR OPERATIONS

### Disassembly

DISASSEMBLY OF THE STEERING GEAR SHOULD NOT BE ATTEMPTED IN DIRTY SURROUNDINGS. AS WITH ANY OTHER MECHANISM CONTAINING BALL AND ROLLER BEARINGS, IT IS OF GREATEST IMPORTANCE TO KEEP THE PARTS ABSOLUTELY FREE FROM CONTACT WITH ANY DIRT OR FOREIGN MATTER DURING REMOVAL OF PARTS, WHILE DISASSEMBLED AND DURING REASSEMBLY. CLEAN NEWSPAPERS OR CLEAN RAGS SHOULD BE SPREAD OUT ON THE WORKBENCH TO RECEIVE THE PARTS AS THEY ARE REMOVED FROM THE GEAR.

1. Loosen lock nut "B" (Fig. 2) and turn lash adjuster "A" a few turns in counterclockwise direction. Next loosen lock nut "C" (Fig. 4) and turn worm bearing thrust screw "D" a few turns in a counterclockwise direction.
  2. Place a receptacle under gear to catch the lubricant. Remove bolts and lockwashers which attach the side cover to housing. Pull side cover and with it pitman shaft from housing. If pitman shaft sector does not leave housing easily, turn steering shaft back and forth with the fingers to line up sector with opening in housing.
  3. Remove bolts and lockwashers which attach the end cover to the bushing. Remove end cover and, with it, the lower roller bearing.
  4. Grasp lower end of worm and draw steering shaft, worm and nut assembly out of the housing.
- CAUTION—Be sure that nut is not allowed to rotate on worm until it reaches end of thread during this operation. Damage to ends of ball guides is almost certain to result if this precaution is not taken. Lay the assembly in a horizontal position on the bench while it is out of the housing so that the nut cannot rotate on worm.**
5. Remove lock nut from lash adjuster and unscrew lash adjuster from side cover. Slide the lash adjuster out of slot in end of pitman shaft, refer to cross section (Fig. 2).

### Disassembly of Ball Nut

As a rule, disassembly of the ball nut will not be necessary, if it is perfectly free while rotating the ball nut on the worm. However, if there is evidence that there is any damage, it should be disassembled and inspected.

Remove screws and clamp which retain the ball guides in place in the nut; draw guides out of nut. Turn nut upside down over a suitable receptacle for the balls. Rotate shaft and worm back and forth until all balls have dropped out of nut. The nut can then be drawn endwise off the worm.

### Inspection

Wash all parts in cleaning solvent, and thoroughly dry them with clean rags. Inspect roller-bearing cones, thread grooves of worm and nut, and surface of all balls for signs of any indentations due to severe impact, and for any signs of chipping or breakdown of the surfaces.

**NOTE—A magnifying glass will be of considerable value in making the above inspection.**

Any parts which show signs of damage should be replaced. Balls must be replaced only with genuine balls furnished by the manufacturer. No commercial balls should be used regardless of grade or quality. Inspect pitman shaft for wear and check the fit of the pitman shaft in the housing bushings. Worn bushings may be removed and replaced, using special driver, J-1614.

The bushings are machined to permit pressing them into the housing without reaming. Inspect fit of the pilot on the end of the pitman shaft in its bushing in the side cover. In the event this bushing

is worn, a new side cover and bushing assembly should be installed, as it is impractical to replace this bushing in the field.

**Reassembly of Ball Nut**

1. Place shaft and worm in horizontal position on bench, and slip the nut onto the worm with ball guide holes up. Align thread grooves in worm and nut by sighting them at bottom of ball guide holes.
2. Count 30 balls into a suitable container; this is the proper number for one circuit.
3. Drop balls from the count container into one of the ball guide holes, turning the worm gradually away from that hole, until the ball circuit is full, or until stopped by reaching end of worm thread. In the latter case, hold down those balls already dropped into the nut with the blunt end of a clean rod, and turn the worm in reverse direction for a few turns. The rod may then be removed, and filling the circuit continued until 20 balls are assembled in the nut.
4. Inspect the ball guides for any damage at the ends, where they deflect or pick the balls from their helical path. Any guides showing signs of such damage should be replaced.

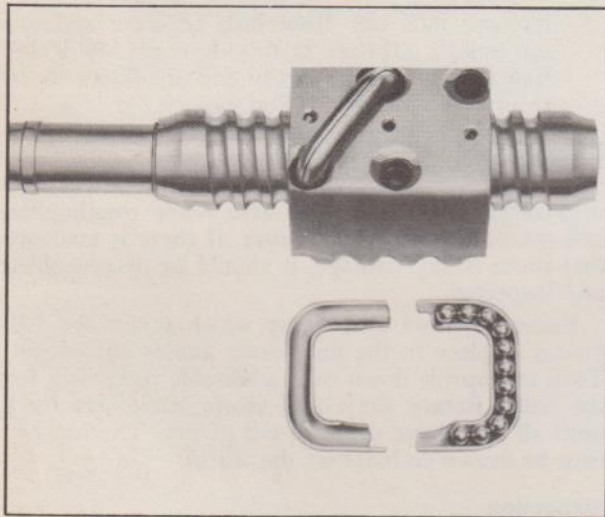


Fig. 5—Installing Balls in Nut and Guide

5. Lay one-half guide, groove up, on the bench, and place the 10 remaining balls from the count container in it (see Fig. 5). Close the guide with another half, hold the two halves together, and plug each end with grease, so that the balls will not drop out. Push the guide into the guide holes of the nut with the fingers, thus completing one circuit of balls. If the guide does not push all the way down readily, it may be tapped into place lightly with the wooden handle of a screwdriver.
6. Fill the second ball circuit in the same manner as described.
7. Assemble ball guide clamp to nut. Be sure to use lockwashers under clamp screws and set the screws up tight.
8. Rotate the nut on the worm to see that it moves freely, but take care that it does not move far enough to be stopped by the ends of the worm

thread. If there is any stickiness in the motion of the nut, it is possible that some slight damage to the ends of the ball guide has been overlooked. Lay the assembly in a horizontal position, to make sure that the nut does not run to the end of the worm thread of its own weight.

**Reassembly**

1. Thread the main shaft with the upper roller bearing into the housing.

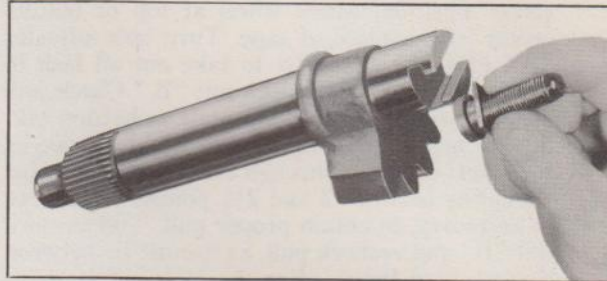


Fig. 6—Installing Lash Adjuster

2. Replace end cover with lower roller bearing, using a new gasket. After making sure that there is some end play in worm, assemble end cover bolts and lockwashers.
3. Assemble lash adjuster with shim in slot in end of pitman shaft, Fig. 6; check the end clearance, which should not exceed .002". For the purpose of adjusting this end clearance, a steering gear lash adjuster shim unit, Part Number 605142, has been released. It contains four shims of the following thickness: .063", .065", .067" and .069".
4. After the lash adjuster end clearance has been adjusted, start the pitman shaft pilot into bushing side cover. Then, using a screwdriver through the hole in cover, turn lash adjuster in a counter-clockwise direction to pull the pitman shaft pilot into its bushing.
5. Rotate mainshaft with fingers until ball nut is approximately in center of travel. Make sure that rack and sector will engage properly (that is, with center tooth of one entering tooth space of the other) and push side cover assembly, including pitman shaft and side cover gasket into place. After making sure that there is some lash between the rack and sector teeth, assemble and tighten side cover bolts and lockwashers.
6. Adjust steering gear according to instructions given under the heading "Adjustment."

**Mast Jacket Bearing**

The mast jacket bearing located at the top of the mast jacket is a spring-loaded ball bearing contained in a metal retainer. It will very rarely require any attention, however, it should be checked during a steering gear overhaul job. Should it require replacement, the old bearing may be driven out with a long rod working through the housing after the main shaft has been removed. To replace the bearing assembly, start it into the top of the mast jacket, then using a block of wood tap it down until the flange on the bearing retainer engages to top of the mast jacket.

**Replacement in Chassis**

1. Thread the steering gear over the clutch and brake pedals in through the left door, moving it downward to position at the frame side rail. Install housing mounting bolts loosely at frame.
2. Install mast jacket to instrument panel bracket, tightening the "U" clamp just enough to position the mast jacket. Align the steering gear and tighten the housing mounting bolts securely. Tighten "U" clamp at mast jacket to instrument panel bracket.
3. Install left engine side pan by replacing two rear bolts and one side bolt.
4. Assemble pitman arm, lockwasher and nut. Tighten the nut securely, using an 18-inch wrench. Assemble the steering connecting rod by following instruction given at the end of this section.
5. Set wheels in straight-ahead position and install steering wheel. Place one spoke toward driver; then tighten nut securely and stake end of shaft to keep nut from turning. Connect horn wire and adjust horn button blowing contact pressure.
6. Install clevis pin at the brake lever pull rod at the idler lever.
7. Install floor and toe-boards.
8. Lubricate the steering gear according to the instructions given in the Lubrication Section.

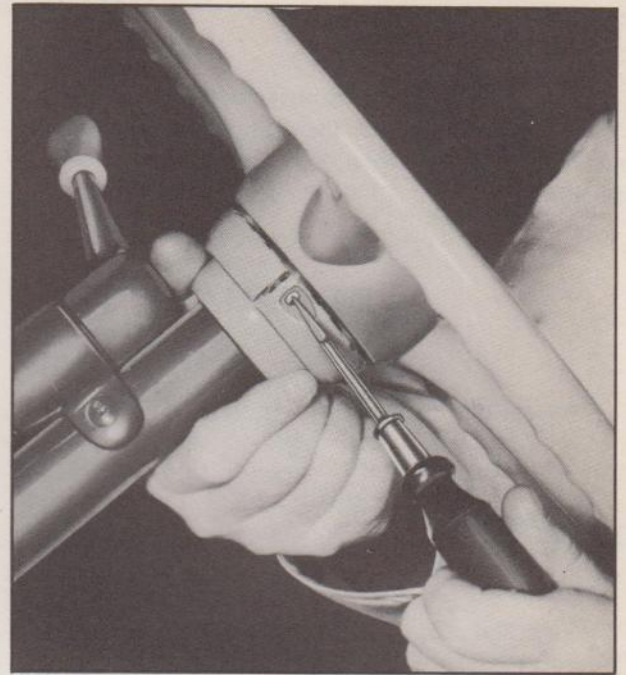


Fig. 7—Horn Adjusting Hub Clamp Screw

**Horn Blowing Button Adjustment**

Horn button contact is adjusted by loosening the lower hub housing clamp screw, and turning the housing until the desired horn button blowing pressure is secured; then tighten the clamp screw. Fig. 7 shows the location of the clamp screw.

**Steering Connecting Rod**

The steering connecting rod is a ball and socket type. Ball seats, springs and adjusting plugs are identical, the only difference being in the length of the safety plugs.

When assembling the parts in the rod ends, make sure they are assembled in the order shown in Fig. 8, as this method of assembly relieves road shocks from steering gear in both directions.

To adjust the ball joints, screw end plugs in tight, then back off one-half to one full turn. Lock the adjusting plugs with a new cotter pin.

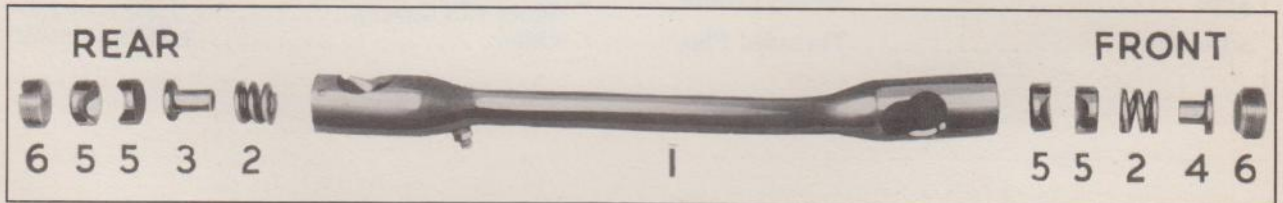


Fig. 8—Layout of Steering Connecting Rod Parts

- |                           |                             |                  |
|---------------------------|-----------------------------|------------------|
| 1—Steering Connecting Rod | 3—Rear (long) Safety Plug   | 5—Ball Seat      |
| 2—Tension Spring          | 4—Front (short) Safety Plug | 6—Adjusting Plug |

**STEERING GEAR TROUBLES AND REMEDIES**

Symptom	Probable Remedy
<b>Hard Steering</b>	
1. Lack of lubrication.	1. Lubricate steering gear, tie rod ends and steering connecting rod ball joints.
2. Tie rod end bolts too tight.	2. Readjust tie rod end bolts.
3. Under-inflated tires.	3. Inflate tires to recommended pressure.
4. Improper adjustment.	4. Adjust according to instructions.
<b>Loose Steering</b>	
1. Improper adjustment.	1. Adjust according to instructions.
2. Loose ball joints.	2. Adjust ball joints.
3. Worn steering arm bushings.	3. Replace steering arm bushings.

**TOOLS REQUIRED**

The following tools manufactured by the Kent-Moore Organization or their equivalent are recommended for use when overhauling the steering assembly :

<i>Tool Number</i>	<i>Description</i>
J-1025.....	Pitman Arm Puller
J-1618.....	Steering Wheel Puller
J-1614.....	Pitman Shaft Bushing Remover and Replacer
J-544-A.....	Steering Gear Checking Scale

**STEERING GEAR SPECIFICATIONS**

Type .....Ball Sector Type  
 Gear Ratio ..... 19.8 to 1

SERVICE DATA

BEARINGS

Worm .....Barrel Roller  
 Worm Nut .....Ball  
 Ball Diameter (Nominal) ..... 9/32"  
 Quantity of Balls ..... 60  
 Sector Shaft .....Bushings

STEERING GEAR

Worm Shaft Adjustment...Tighten adjusting nut to obtain 1 Lb. to 1½ Lbs. rim pull at steering wheel, with steering connecting rod disconnected.

Sector Shaft Thrust Adjustment...Tighten adjusting screw to obtain 2 Lbs. to 2½ Lbs. rim pull at steering wheel through center of travel, with steering connecting rod disconnected.

Sector Shaft End Play ..... .000"—.002"

STEERING WHEEL

Diameter ..... 17"

CLEARANCE BETWEEN

Sector Shaft and Bushing  
 Outer ..... .0035"—.0045"  
 Inner (In Cover) ..... .0015"—.0025"

STEERING CONNECTING ROD

Type .....Spring Loaded  
 Adjustment .....Threaded Plug

Sector Shaft Bushing Diameter  
 Inner (In Cover)..... 1.248"—1.250"  
 Outer ..... 1.248"—1.2495"



## Section 10

# WHEELS AND TIRES

### INFLATION PRESSURES

Maintaining the correct inflation pressures is one of the most important elements of tire care. The inflation pressure recommended for any model truck is carefully worked out as the best pressure to give an efficient balance of the following factors of good performance: comfortable ride, stability, steering ease, even tread wear, tire cord life and immunity from blowouts.

It is recommended that tires in ordinary use be checked for proper pressure once each week. This will result in added tire life as 2 pounds pressure will normally be lost in a week of ordinary driving. Trucks operated at high speeds or in more than ordinarily severe service should have the tires checked at more frequent intervals.

Inflation pressures are extremely important in truck tires. The tires should always be inflated so that the full width of the tire tread is in firm contact with the road and that a normal amount of bulge shows on the sidewall of the tire at the bottom. It is extremely detrimental to have the sidewalls of the tire bulge too much and it is also detrimental to tire life to have the sidewall bulge too little. The correct bulge for any tire is obtained by loading the tire to the maximum rated load and inflating it with the corresponding inflation pressure shown.

Truck tires are expensive and will deliver many more dollars worth of miles if they are properly inflated and proper care taken of all cuts and bruises.

### TESTING FOR TIRE NOISE

The determination of whether tires are causing a noise is relatively simple. The truck should be driven at various speeds and note taken of the effect of part throttle, sudden acceleration, and deceleration on the noise condition, as axle and exhaust noises show definite variations under these conditions, while tire noise will remain constant; however, the pitch of the noise will change with the speed. Tire noise is most pronounced at speeds of approximately twenty or thirty miles per hour.

The tire noise may be further checked by driving the truck over smooth pavements or dirt roads (not gravel) with the tires at normal pressure and again over the same stretch of road when the tires have been inflated to fifty pounds pressure. If the noise for which the test is being made is caused by tires, it will noticeably decrease when the tire pressure is increased, whereas, rear axle noise should show no change in volume as a result of changes in tire pressures.

If, on inspection, the tires on the front wheels are found to be creating most of the noise, the alignment of the front wheels should be checked, as excessive tire noise usually results from low tire pressure, incorrect alignment or from uneven tire wear.

### CORRECTION OF IRREGULAR TIRE WEAR

Since irregular tire wear is due to some action which causes certain places on a tire to wear more rapidly than others, the remedy is naturally to correct the condition causing the wear. However, after the adjustments have been made, it is wise to interchange the tires which will equalize the future normal wear which will occur.

Tires may be alternated several ways to even up irregular wear. However, the following method is the simplest and, in most cases, the most satisfactory.

Wheels should be changed without dismounting the tires, right front to left rear, and left rear to right front; left front to right rear, and right rear to left front.

### HEEL AND TOE WEAR

Heel and toe wear is a saw-tooth effect with one end of each tread block worn more than the other.

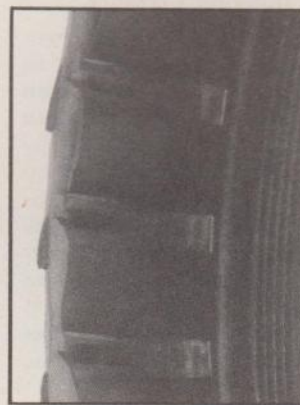


Fig. 1—Heel and Toe Tire Wear

The end which wears is that which first grips the road when the brakes are applied. High speed driving and excessive use of the brakes will cause this type irregular tire wear, on any type tread design. Heel and toe wear is not so general on the rear tires because of the propelling action creating a counteracting force which wears the opposite end of the tread blocks. These two stresses on the rear tires cause the tread blocks to wear in op-

posite directions and produces more even wear, while on the front tires, the braking stress is the only one effective. An example of heel and toe wear is shown in Fig. 1.

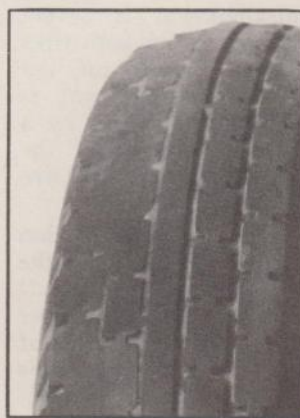


Fig. 2—Tire Wear Due to Improper Camber

### SIDE OR CAMBER WEAR

There are several reasons why tires wear more rapidly on one side of the tread than on the other:

1. Wheel camber causes the tire to run at a certain angle from the perpendicular, resulting in side wear. Fig. 2 shows an example of side wear caused by excessive camber. This condi-

tion may be corrected by correcting the camber and interchanging the tires.

2. High crown or high cambered roads cause an increased wear on the side of the right front tire.
3. Side thrust when rounding turns causes wear on the sides of the treads. In making a turn to the left, especially at high speeds, the outside shoulder of the right tire and the inside shoulder of the left tire take most of the wear. When making a right hand turn, the opposite shoulders of the tires are worn.
4. Excessively low inflation will also cause undue wear on the sides of the tires. Under no circumstances should the pressure be allowed to drop below the minimum pressure recommended for the particular truck and size of tire. In general, tires should be inflated a few pounds above the minimum pressure recommended. See "Inflation Pressure."



Fig. 3—Tire Wear Due to Under Inflation

manufacturer if normal loads only are being carried. If abnormally heavy loads are being carried, the inflation should be increased so that the tire shows only a normal amount of deflection or bulge at the point of contact with the road.

**TOE-IN OR TOE-OUT MISALIGNMENT WEAR**

When there is excessive toe-in or toe-out, tires will revolve with a side motion and scrape the tread rubber off. If the misalignment is severe the rubber on both tires will be scraped off, but if the misalignment is slight or is caused by a bent steering arm, the rubber on only one tire will be scuffed off.

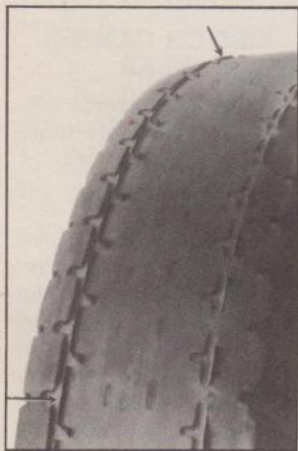


Fig. 4—Tire Wear Due to Improper Toe-In or Toe-Out

The scraping action against the face of the tire causes a small feather edge of rubber to appear on one side of the tread design. This feather edge is the evidence of irregularity as shown by the arrows in Fig. 4.

**UNEVEN TIRE WEAR**

Other types of uneven tire tread wear are due to some irregularities, such as uneven caster, bent axles, wobbly wheels, out-of-round brake drums, unequally adjusted brakes, or other mechanical difficulties, Fig. 5, and can be corrected only by correcting the conditions which are causing it. Too much toe-in or toe-out combined with under-inflation will also cause uneven tire wear.



Fig. 5—Wear Due to Mechanical Condition

In the case of dual rear wheels, when it is necessary to interchange tires, always place the tire showing the most wear on the inside dual, and the tire with the least wear on the front wheels. The reason for this is simply that the inside dual tire is the hottest running tire on a truck, the outside dual next, and the front tire is the coolest, and it goes without saying that the less rubber on a tire, the cooler it will run.

**TIRE BALANCE**

Original equipment tires and tubes are marked at source, so that the light portion of the casing is counterbalanced by the heavy portion of the tube.

Due to irregularities in tread wear, caused by sudden brake applications, misalignment, low inflation pressure, or tube and casing repairs, a casing and tube assembly can lose its original balance. If a disturbance is felt in the steering wheel due to the action of the front wheels, the first items to check are pressures and the balance of the tire and wheel.

**BALANCING WHEELS AND TIRES**

Wheel balance is the equal distribution of the weight of the wheel and tire assembly around the axis of rotation. There are two ways in which every wheel must be balanced—statically and dynamically.

**STATIC BALANCE**

Static balance (sometimes called still balance) is the equal distribution of the weight of the wheel and tire assembly about the axis of rotation in such a manner that the assembly has no tendency to rotate by itself, regardless of its position. For example: A wheel with a chunk of dirt on the rim will always rotate by itself until the heavy side is at the bottom. Any wheel with a heavy side like this is statically out of balance. Static unbalance of a wheel causes a hopping or pounding action (up and down) which frequently leads to wheel "flutter" and quite often to wheel "tramp."

**DYNAMIC BALANCE**

Dynamic balance (sometimes called running balance) means that the wheel must be in static balance and also run smoothly at all speeds on an axis which runs through the center line of the wheel and tire, and is perpendicular to the axis of rotation. To explain the principle of dynamic balance, let us first consider what happens when we swing a weight attached to a string. If we start to swing this weight slowly, it is apparent that the weight swings in a sharp angle with reference to the axis of rotation (the hand). If the speed is increased, the weight climbs until the weight mass is at right angles to the axis of rotation. Now, let us apply this principle to a spinning wheel.

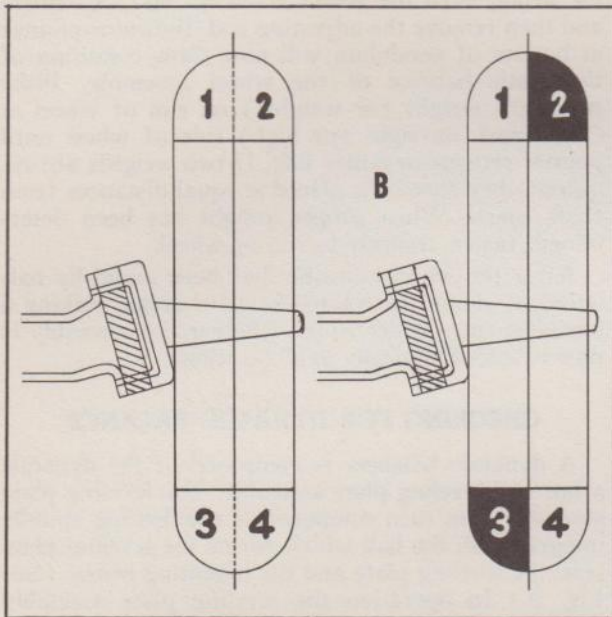


Fig. 6—Wheel in Static Balance

By referring to Fig. 6-A, it can be seen that when a wheel and tire assembly is in static balance, the sum of the weights of sections 1 and 2 is equal to the sum of the weights of sections 3 and 4; or, in other words, the weight is equally distributed about the axis of rotation. Fig. 6-B is a drawing of a wheel that is in static balance because the shaded heavy point 2 is balanced by the shaded heavy point 3. However, it can be seen that with reference to the center line, section 1 is lighter than section 2, and that section 4 is lighter than section 3.

When we start to spin this wheel (as in Fig. 7-A) the center line of the weight masses 2 and 3 tries to get at right angles to the axis of rotation, just as the weight on the string tried to get at right angles to its axis of rotation (the hand). This tendency to get at right angles exerts a force on the wheel (as shown by the arrows). This force, in turn, tends to move the center line of the wheel, and, in so doing, distorts the axis of rotation.

When the wheel has turned 180°, the forces exerted by the heavy sections 2 and 3 now tend to move the center line of the wheel in the opposite direction. In other words, the wheel tries to rock first in one direction, then in the other.

The result of the movement of these unbalanced forces causes the wheel to wobble or shimmy, and the condition becomes more violent with increased speeds.

To correct this condition we must add weight to sections 1 and 4, so they will be equal to the weight of sections 2 and 3. Notice that this addition of weight now distributes the total weight evenly about

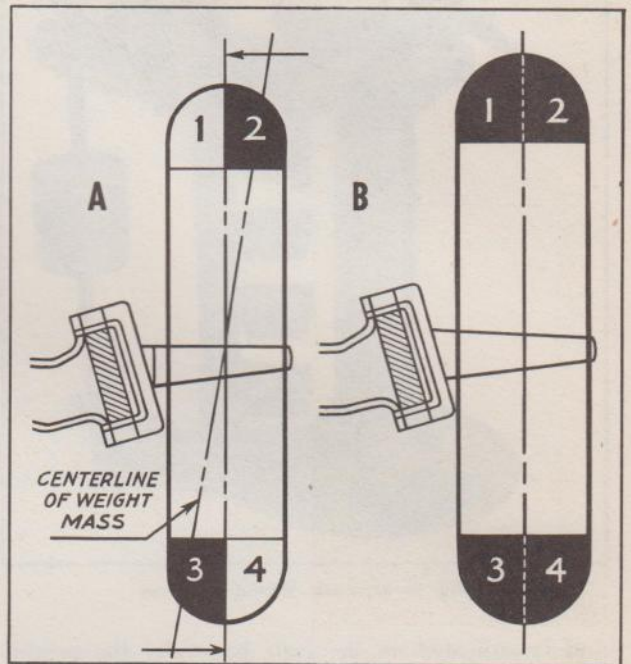


Fig. 7—Wheel in Static and Dynamic Balance

both the axis of rotation and the center line of the wheel as seen in Fig. 7-B. Therefore, this wheel is now both statically and dynamically balanced.

Wheels must be both statically and dynamically balanced to give maximum steering ease and stability at speeds where unbalance becomes noticeable. The wheels must be statically balanced before they can be balanced dynamically. To demonstrate the balancing of a wheel assembly we will use a combination of static and dynamic wheel balancer, as shown in Fig. 8.

Before the wheel assembly is balanced, the wheel and tire must be clean and free from all foreign matter. The tires should be in good condition and properly mounted, with the balance mark on the tire lined up with the valve stem in the tube. Bent wheels that have a run-out of over 3/16" should either be replaced or straightened before being balanced.

**CHECKING FOR STATIC BALANCE**

The static balancer operates on the principle of the pendulum and lever arm. The pendulum is mounted free to pivot, as shown in Fig. 8. An extension of the pendulum rod with suitable cones forms an arbor for the wheel which is to be balanced. Any unbalanced weight on the wheel assembly when mounted on the arbor acts through the wheel as a lever arm and tends to move the pendulum off center. The amount of movement depends upon the amount of unbalanced weight,

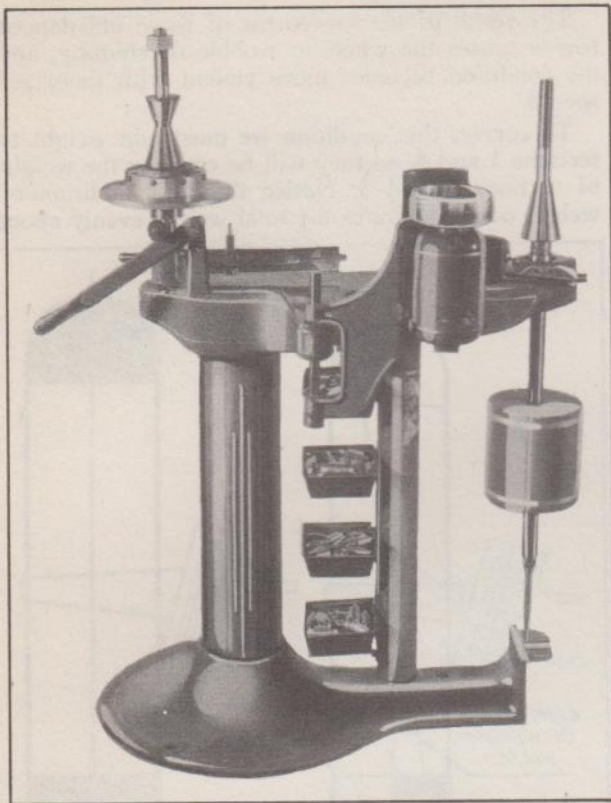


Fig. 8—Dynamic Wheel Balancer

and is indicated on the scale below by the pendulum pointer. Before placing a wheel on a static balancer, be sure that the pendulum pointer falls directly over the center mark on the scale. If it does not, the scale may be moved slightly to either side to compensate. To static balance a front wheel, place the wheel on the static arbor with the brake drum up. Using the regular wheel bearings between the special balancing cones, tighten the arbor nut (with fingers) sufficient to remove play and so that the wheel rotates easily.

When placed in a horizontal position, as in this test, every wheel and tire assembly will have a place where it balances statically. Obviously, this place will be through the center of the heavy section of the wheel. Therefore, with the wheel in position on the arbor, turn the wheel slowly until in balanced position (balanced position is determined when the pointer on the pendulum rests directly over the center line of the scale). Now place the adjusting rod (furnished with the machine) on the arbor so that the mark "1" is directly in line with the mark stamped on the end of the arbor. Now raise or lower the counterweight by turning right or left until the pointer on the pendulum swings over the line between the "poor" and "danger" zones. The adjusting rod and weight are used in connection with each other to calibrate the sensitivity of the machine.

**NOTE—The machine should be calibrated each time a different wheel is balanced.**

When the adjusting rod is removed from the arbor, the pointer should return over the center line. If it does not, turn the wheel a few inches in either direction until the pointer is directly over

the center line. With the pendulum weight properly calibrated, we are now ready to balance the wheel.

Replace the adjusting rod on arbor with mark "1" directly in line with mark on end of arbor and then chalk the tire directly below the rod. Without moving the wheel, turn the adjusting rod so that mark "2" is directly in line with the mark on the arbor, and again chalk the tire directly below the rod. Again, turn the adjusting rod 90° to the third position and make a third chalk mark on the tire. Repeat this operation and make a fourth chalk mark on the tire.

Now, with the adjusting rod still on the arbor with one of the marks lined up with the mark on the arbor, turn the wheel assembly 90° ( $\frac{1}{4}$  turn) and then remove the adjusting rod. Indicator pointer at bottom of pendulum will now show condition of the static balance of the wheel assembly. Place necessary weight (or weights) on rim of wheel at chalk mark on right (or high) side of wheel until pointer returns to center line. If two weights are required, they should be placed at equal distances from chalk mark. When proper weight has been determined, fasten securely to rim of wheel.

After the wheel assembly has been statically balanced, it should be rotated in short steps, making a complete turn to determine whether the assembly is now balanced statically in all positions.

#### CHECKING FOR DYNAMIC BALANCE

A dynamic balancer is composed of the dynamic arbor and leveling plate assembly. The leveling plate assembly is in turn composed of the floating spindle integral with the ball which forms the leveling plate seat, the leveling plate and the mounting cones. (See Fig. 9.) In operation the leveling plate assembly floats free of the dynamic arbor so that any wobble in the wheel will be shown. The leveling plate is a snug fit on its ball seat so that it rotates with the wheel, but may be tilted up or down in relation to the spindle.

After the wheel assembly has been statically balanced, it is ready for dynamic balancing. With the wheel bearings in place, lower the wheel assembly



Fig. 9—Installing Leveling Plate

onto the dynamic spindle with the brake drum down. Place the small cone over the spindle and adjust the nut snugly so the spindle will rotate with the wheel and not turn separately. Adjust motor height so that the drive pulley contacts the center of the tire; start motor and revolve wheel for 20 or 30 seconds, after which the motor can be switched off and the pulley released from contact with the tire.

When a wheel revolves at high speed on a floating spindle, any uneven weight distribution will cause the wheel and floating spindle to change its axis of rotation so that the center line of the weight mass becomes horizontal—or perpendicular—in relation to the dynamic arbor, just as the weight on the string became perpendicular in relation to the hand.

With the wheel still revolving at high speed, carefully raise the leveling handle until the fibre button contacts the leveling plate continuously and the plate runs true. Then lower the leveling handle and apply the brake to the tire in order to bring the wheel to a complete stop. When leveled in this manner, the leveling plate is brought into parallel with the center line of the wheel mass, but not necessarily in parallel to the wheel itself because, if the wheel was dynamically out of balance, the wheel and leveled plate are not in parallel.

Raise the indicator hub carefully into the arbor socket, lifting it as far as possible and holding it there firmly. This operation brings the wheel into perpendicular with the dynamic arbor, and at the same time tilts the leveling plate so that it now has the same tilt or wobble that was formerly in the spinning wheel. Thus, when a reading is taken from the leveling plate, it will show the amount and location of the dynamic unbalance in the wheel.

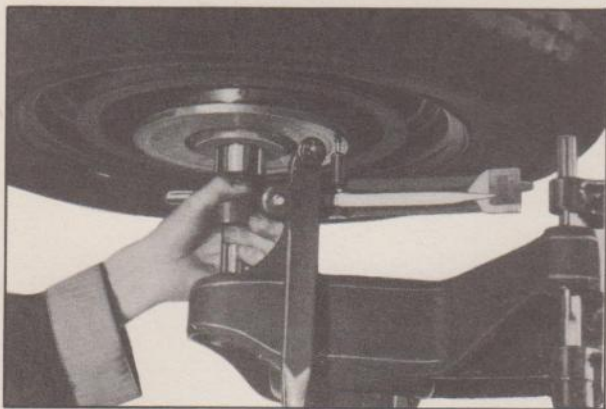


Fig. 10—Setting Indicator Pointer to "0"

**CAUTION—Do not disturb the leveling plate during this operation.**

With the indicator hub still raised, it will be found that the little brass pin which actuates the pointer on the indicator hub is in contact with the leveling plate. Now, revolve the wheel slowly by hand until the pointer on the indicator reaches its lowest position. Then set the scale so that the end of the pointer reads on "0." (See Fig. 10.)

Turn the wheel 180° (½ way), and read the total number of graduations that the pointer moves upward on the scale. At this position (the high point) chalk the tire directly above the pointer, but on the underside of the wheel. We are now ready to attach the weights.

The amount of weight required varies according to the size and weight of the wheel assembly. Heavy wheels require more weight than light wheels. Chevrolet wheels require about 1 ounce of weight for each graduation mark indicated on the scale. After the amount of weight has been determined, it must be remembered that one-half of the required weight is placed on the underside of the rim and the other one-half of the weight placed 180° away (opposite) and on the upper side of the rim. Correcting weights must be accurately divided in order to retain the static balance of the assembly.

Place one-half the amount of weight needed at the chalked position on the lower side of the rim. Place exactly the same amount of weight directly opposite (180°) the chalk mark, but on the upper side of the rim. Be sure the weights are tapped on securely as the tire bead rusted to the rim sometimes prevents complete contact.

In order to make sure that the wheel is in perfect dynamic balance, recheck for accuracy in accordance with the procedure outlined above. Should the pointer indicate that the wheel is still unbalanced, it is evident that incorrect weight was used to balance the wheel. If the pointer is at the extreme low position directly below the lower weight, it indicates that too much weight was used. Should the pointer be at the high position directly under the lower weight, it indicates insufficient weight. Should any changes in weight be found necessary, it is suggested that the wheel again be rechecked for accuracy after corrections have been made.

There may be some cases where it is necessary to statically balance rear wheels to correct a hopping condition at the rear end. To do this, the rear wheels may be adapted to the static arbor by use of face plates, or used in conjunction with a perfectly balanced front wheel hub and brake drum assembly.

**WHEEL AND TIRE SPECIFICATIONS**

TRUCK MODEL	TIRE SIZE	PLY	TIRE PRESSURE	
			FRONT	REAR
½ Ton	6.50-16	6	30	40
½ Ton	15"	6	20	35
¾ Ton	15"	6	20	35
1½ Ton	7.50-20	8	40	55

## Section 11

### CHASSIS SHEET METAL

The Front End Sheet Metal Assembly is attached to the radiator support at the front and to the running boards and cowl at the rear.

The radiator support is fastened to the frame front cross member by two bolts through a rubber mounting. This method of mounting prevents frame distortions from being transmitted to the front end sheet metal assembly when the vehicle is being driven over uneven terrain.

#### Removal as a Unit

1. Remove the hood and radiator brace rods.
2. Drain the radiator and disconnect all hose connections.
3. Disconnect electrical wiring at the junction block on each side.
4. Remove fender to running board bolts, also the fender to cowl bolts on each side.
5. Remove the front bumper at frame horns.
6. Remove the nuts from the bolts which attach the radiator support to the frame front cross member and remove the bolts.
7. Slide the front end sheet metal assembly forward until the fan shroud (on 1½-ton models only) clears the fan blades, then lift the assembly off the chassis.

#### Fender Removal

1. Raise the hood.
2. Disconnect electrical wiring at the junction block.

3. Remove bolts which attach fender to running boards.
4. Remove bolts which attach fender and fender skirt to cab cowl.
5. Remove bolts which attach fender to radiator grille and lift off the fender and skirt.

Replacement of the fender is the reverse of the removal operations.

#### Radiator Core Removal

1. Remove hood, and radiator brace rods.
2. Drain the radiator and disconnect all hose connections.
3. Remove wiring harness from clips that hold it to radiator support and also to top tank of radiator.
4. On models equipped with radiator shroud, remove fan blades.
5. Remove six cap screws (three each side) that hold radiator core to radiator support.
6. Tip top of radiator backward and work past fan (½-ton models) or past pump (on 1½-ton models), and lift up and out.

#### Headlamp Removal

1. Disconnect electrical wiring at junction block.
2. Reaching under fender, pull wiring out.
3. Remove three nuts from bolts holding headlamp to fender, two at front and one at rear.
4. Lift headlamp from fender.