B. W. Benedict

CONFIDENTIAL:
The contents of this handbook may be disclosed only to officers of the service and to enlisted men whose duties require them to be familiar therewith.

No. 1995

HANDBOOK OF THE

SIX-TON SPECIAL TRACTOR MODEL 1917

(*NINETY-FIVE - PLATES*)

JULY 15, 1918

ORDNANCE DEPARTMENT U.S.A.

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JULY 15, 1918

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
WASHINGTON, July 15, 1918.

This manual is published for the information and government of the Regular Army, National Guard, and National Army of the United States.

By order of the Secretary of War:

C. C. WILLIAMS
Maj. Gen., Chief of Ordnance, U. S. A.

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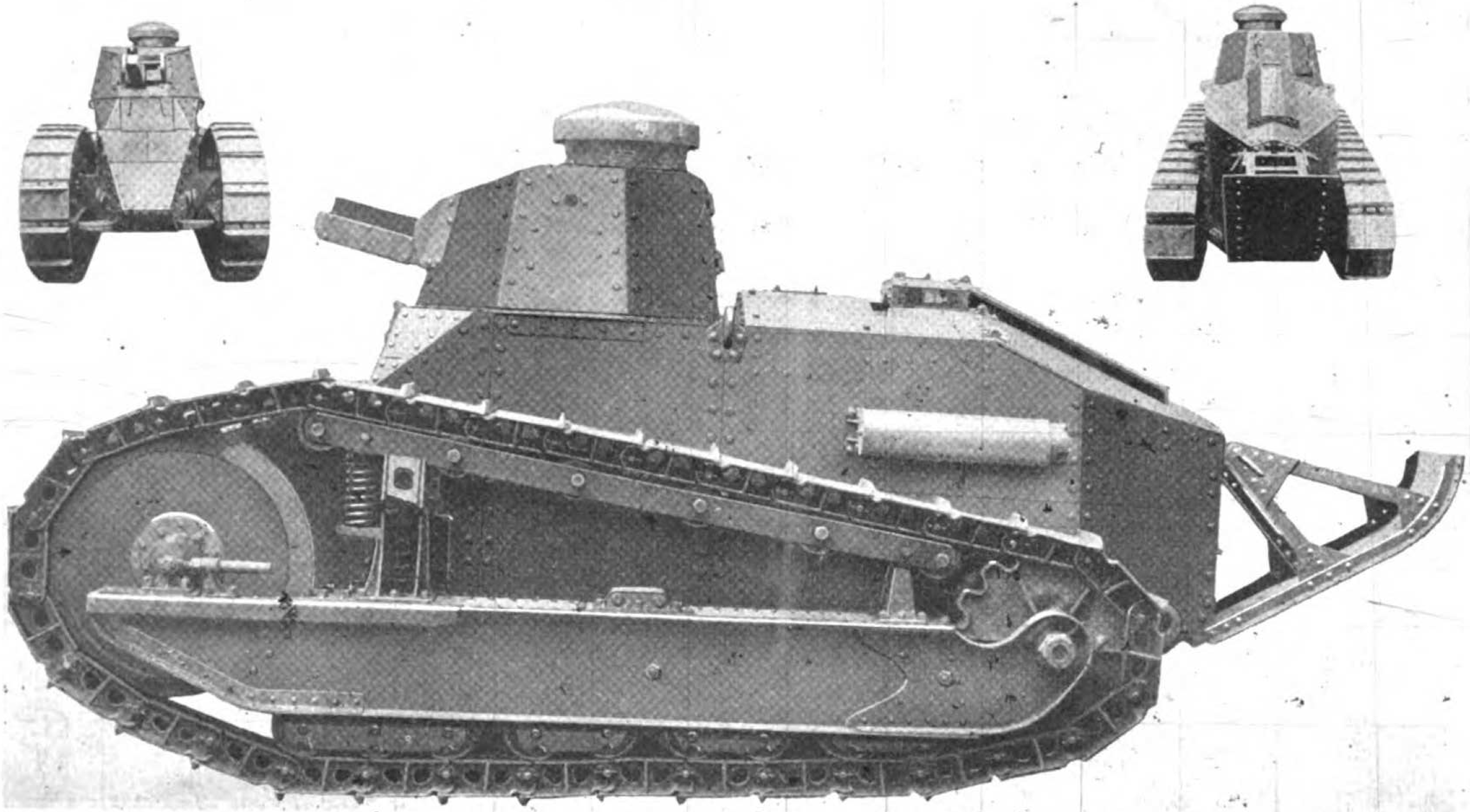
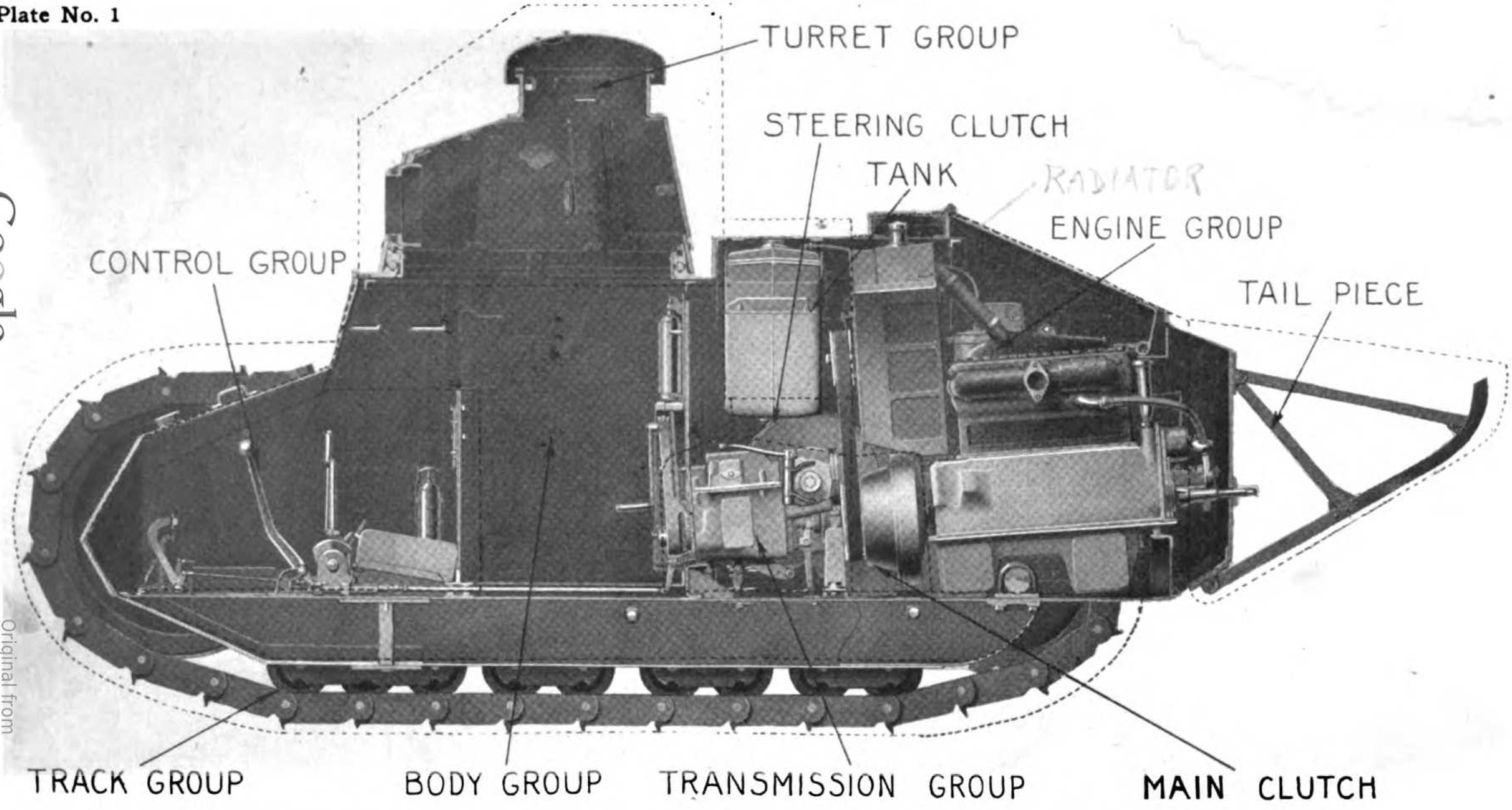


FRONTISPIECE—COMPLETE SIDE VIEW OF 6-TON SPECIAL TRACTOR MODEL 1917 WITH 37 m. m. GUN MASK IN POSITION. UPPER LEFT—FRONT VIEW. UPPER RIGHT—REAR VIEW.

LIST OF PLATES—Continued

Plate No. 1



SECTION THROUGH 6-TON SPECIAL TRACTOR MODEL 1917 SHOWING RELATIVE LOCATION OF PRINCIPAL PARTS AND THE MAIN GROUP ASSEMBLIES

HANDBOOK OF THE SIX-TON SPECIAL TRACTOR, MODEL 1917

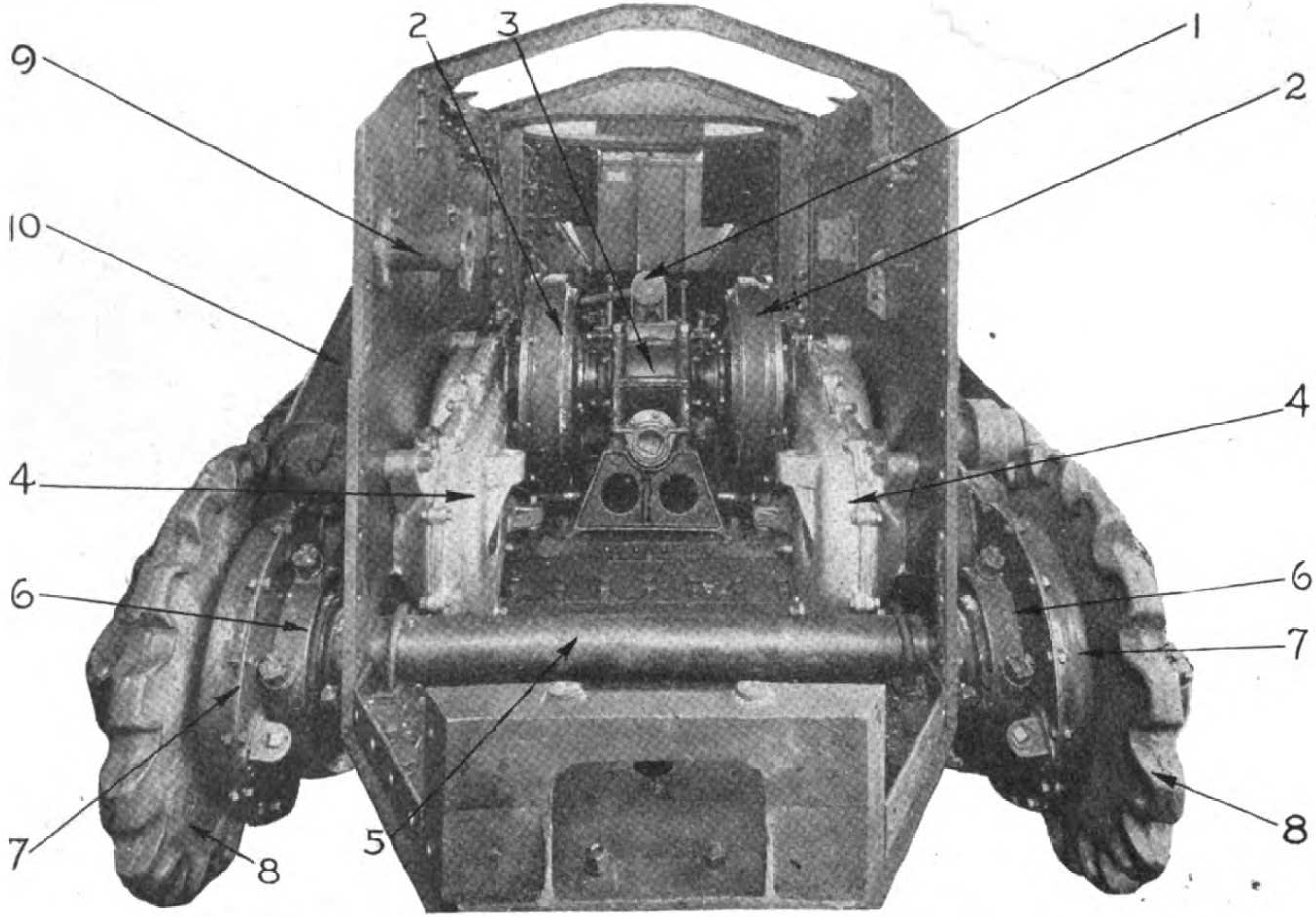
CHAPTER I

GENERAL DESCRIPTION AND INSTRUCTIONS

GENERAL WEIGHTS AND SPECIFICATIONS

Weight	6 tons
Length overall	15 ft. 7 in.
Height overall	7 ft. 6.5 in.
Width overall	5 ft. 9 in.
Type of drive	Track-laying or crawler
Type of engine	L-head gasoline type
Number of cylinders	Four
Bore	4¼ in.
Stroke	5½ in.
Main clutch	Inverted cone
Transmission gearset	Four forward speeds, one reverse, selective
Reduction gears	Spur train
Armament	One 37 mm. gun or Marlin machine gun
Personnel	Two, driver and gunner
Turning diameter	14 ft.
Width of single track shoe	13½ in.
Road clearance under body	16 3/16 in.
Height of towing hooks from ground	22 in.
Radiator	Tubular type mounted in front of engine in body
Ignition	Eisemann high tension variable spark magneto type G 4/2 driven by timing gear
Carbureter	Wheeler-Schebler Model A.
Gasoline feed	Vacuum system, 30 gal. tank hung in front of radiator
Governor	Flyball type mounted on magneto drive gear controlling throttle
Steering	By track control through inverted cone steering clutches
Control	Steering through steering clutch levers on either side of driver's seat. Left clutch pedal, right brake pedal, spark and throttle levers, accelerator pedal, gear-shift lever

Plate No. 2



1. Inside starter sprocket.
2. Brake on exterior of steering clutch.
3. Transmission housing.
4. Spur gear reduction case.
5. Rear axle.
6. Cap on extension of track frame.
7. Final reduction casing.
8. Track drive sprocket.
9. Exhaust extension.
10. Muffler.

This view shows the general layout of many of the assemblies.

SIX-TON SPECIAL TRACTOR MODEL 1917 WITH POWER PLANT AND SEVERAL OTHER BODY PARTS REMOVED

Equipment................Speedometer, Pyrene fire extinguisher, electric lantern, oil pressure gauge, kick switch, long handled shovel, short handled shovel, oil and kerosene cans, towing cable and hook, tools, including bolt clippers, 4 cleansing brushes, cope chisel, cold chisel, cotter pin extractor, drifts, 2 funnels, 3 files and handle, grease gun and extension, gasoline measuring stick, machinists' hammer, hoisting chain, jack, 2 oilers. punch, pliers, pick, 3 scrapers, 2 screw drivers, gasoline strainer, 24 wrenches, and valve lifter.

GENERAL DESCRIPTION

The 6-ton special Tractor Model 1917, is an armored two-man type equipped with a turrent and either a Marlin machine gun or a 37-mm. gun. It is driven by a four-cylinder gasoline engine which imparts the drive through a transmission gearset and reduction gearing to a track-laying or crawler traction mechanism.

The power plant is located in the rear and the operator is at the forward end in a compartment inside the main body of the tractor. The gunner's compartment is in the center and this is surmounted by the turret which is mounted on a ball race on which it is capable of rotation. The entire tractor is enclosed in armor plate capable of withstanding machine gun or rifle fire.

The engine delivers its drive through an inverted cone clutch housed behind the fly-wheel. From this point the drive is taken through a universal joint to a four speed selective sliding gearset and thence through bevel gears to a transverse shaft which carries the drive outboard to a set of spur reduction gears which operate the track. Interposed between the transmission gear and the spur gear reduction is a clutch on either side of the tractor. These clutches serve to free the track on either side desired thus acting as a means for steering.

Operation of the track is effected by a large driving sprocket actuated by the spur reduction train from within the body of the tractor. This driving sprocket is at the rear end and at the forward end there is a large idler blank sprocket which serves to maintain the tension on the track chain. The tractor has a nominal forward speed of between 6 and 7 miles an hour and due to its great gear reduction and the peculiarities of its track laying propulsion it is capable of obtaining traction up to any tractive angle and over ground of unusual difficulty such as would be encountered in territory marked by shell craters.

Structurally the tractor consists of a main armored body which is hung between two track-carrying frames. Surmounted on the body is the revolving turret supported on a ball-bearing raceway. The track structure includes the traveling track chain and consists of a built-up inverted U-beam, in which is carried the track roller mechanism. The track structure is bracketed to the armored body which forms the backbone of the structure.

INSTRUCTIONS CAREFULLY FOLLOWED

It is of the highest importance that the instructions in this manual be carefully followed if the tractor is to be maintained at its highest efficiency. Inspection in accordance with these rules should be made a matter of routine.

OPERATING INSTRUCTIONS

PREPARATORY TO RUNNING

Thoroughly clean entire machine with kerosene, removing grease or slush coat applied for protection in shipment.

Fill radiator with clean water.

Pour 4 gallons of cylinder oil into engine crank case through filler. (See page 19.)

Fill gasoline tank.

Lubricate entire tractor in accordance with chart and instructions. (See pages 20 and 21.)

Unpack and place all tools in proper locations.

TO START ENGINE

Put gear lever in neutral. (See page 105.)

Open throttle one third. (See page 107.)

Retard spark half way. (See page 108.)

Turn on ignition switch.

Pull air choke on carbureter.

Crank engine rapidly either with outside crank or inside starter. (See page 108.)

Prime engine through priming cups if starting is difficult.

AFTER ENGINE IS STARTED

Advance spark.

Retard throttle lever allowing engine to idle slowly.

TO START TRACTOR

Release brake, if it is engaged.

Depress left pedal releasing main clutch.

Increase engine speed slightly by depressing accelerator pedal.

Engage first speed. (See page 107.)

Slowly allow clutch to engage.

GEAR CHANGES

As tractor gains momentum depress main clutch pedal; close throttle, shift to second speed, release clutch and open throttle. Repeat operation to reach third and fourth speeds, after which speed can be controlled by foot throttle or hand gas lever.

GEAR CHANGES TO LOWER SPEEDS

In changing to lower speed, disengage main clutch, do not retard throttle, instantly shift to lower gear and open throttle to gain speed.

TO REVERSE TRACTOR

Reduce engine speed, release main clutch, apply foot brake.

When truck has stopped engage reverse gear, release brake and engage clutch.

Never engage reverse gear when tractor is moving forward.

TO STOP TRACTOR

Reduce engine speed, release main clutch, apply brake, place gear shift lever in neutral.

TO STOP ENGINE

Turn off ignition switch.

While engine still rotates, advance gas lever slightly to supply initial charge to assist starting.

GENERAL DRIVING INSTRUCTIONS

The spark control lever should be maintained in as advanced a position as possible without causing the engine to knock. It must be retarded under loads severe enough to cause a knock.

Since both the hand throttle control lever on the steering column and the foot accelerator on the floor plate control the throttle opening of the carbureter, either may be used, the choice being largely a matter of preference, although it is good practice to set the hand lever at the desired position when the tractor encounters a long hard pull, and to use the foot acclerator when roads or tractive conditions are such as to make necessary a more flexible means of control.

If the engine should be excessively stiff investigate before attempting to crank it to ascertain whether the pump has been frozen through failure to drain. Should it have frozen it will be necessary to thaw out the cooling system before attempting to start the engine.

Shift gears when necessary to prevent needless laboring of the engine. If the spark control lever has been retarded during the climbing of a hill, be sure to advance it after the hill has been negotiated, for to run with a retarded spark will cause the engine to overheat.

When steep depressions or ridges are encountered allow the tractor to enter them slowly, momentarily slipping the main clutch. As the track itself will climb the ridges it is not necessary to rush the hole. With very severe depressions it is best to enter low gear beforehand.

The same instructions as before given for climbing hills are applicable when the tractor must negotiate soft roads, mud, sand, or snow. Under these conditions shift to the lower gears before the engine begins to labor else the engine may overheat or stall.

Should there be great resistance when starting such as that due to an excessive grade or exceptionally soft ground, speed the engine by depressing the accelerator pedal just as the clutch is engaged, thus allowing the engine to utilize its fully energy to start the tractor.

TO NEGOTIATE STEEP GRADES

This tractor will readily negotiate either downward or upward grades, which are practically up to the limit of traction. For descending steep grades, put the tractor into low gear and let it take its own way over the edge of the shell crater or other hole, and it will readily manage itself in this manner. For negotiating a very steep grade, a little experience will teach the operator a great many valuable lessons, as to manipulation at the top of the grade. If the top comes up very steeply, the tractor will point vertically upward, and is apt to drop forward with a severe pitch if the operator is not skillful in manipulating it. After experience the operator will be able to slip the steering clutches slightly, letting the tractor resume a horizontal position easily instead of with a severe jolt. Care must be taken in slipping the steering clutches not to apply the brakes, as this would stall the engine and would allow the tractor to roll backwards down the hill, if the operator were not watchful.

CROSSING STEEP TRENCHES

Trenches too wide to be spanned and too steep to be descended can be negotiated by towing train formation. The tractors are connected by towing cable, the second tractor lowering the first over the edge gradually until it is able to secure traction on the bottom of the hole. The third tractor assists the second in the same way until the last tractor reaches the edge. The last will have to drop from the line allowing the others to go on, unless by that time the ground on the edge of the trench is worn to such a degree that it is able to go over the edge.

TRANSPORTING TRAILER

For transportation of the tractor from point of operations to another there is a 10-ton trailer which is briefly described on pages 129 to 131. For complete details see Ordnance Hand Book on 10-ton trailer.

LUBRICATION INSTRUCTIONS

Careful attention to the lubrication of the tractor is highly essential.

ENGINE LUBRICATION

For the engine, use the general specifications for engine oils and greases as specified by the Signal Corps and the Ordnance Corps. This oil will be specified as the medium grade and an allowance of 5 gallons is made for use in running in and testing the engines on 6-ton tractors. Any manufacturer's oil meeting these specifications will be accepted.

LUBRICANT SPECIFICATIONS

General

1. The oils for the lubrication of the gasoline engines of engine equipped vehicles must consist of refined and filtered mineral oils or mixtures of same and must be suitable in every way for satisfactory use in internal combustion engines.

Use

2. The medium oil shall generally be for use in winter and upon the engines of new tractors at other times. The heavy oil shall be for use in summer and for old engines.

Viscosity of Engine Oil

3. The viscosity in seconds on the Saybolt Universal Viscosimeter at 100 degrees F. shall come within the following limits:

Engine oil, medium	270 to 330 Sec.
Engine oil, heavy	470 to 530 Sec.
Engine oil, extra heavy	730 to 780 Sec.

Test

4. The engine oil medium must not congeal in a 4-oz. bottle at a temperature of 25 degrees F.

The engine oil heavy must not congeal in a 4-oz. bottle at a temperature of 35 degrees F.

The engine oil extra heavy must not congeal in a 4-oz. bottle at a temperature of 45 degrees F.

Carbon Content of Oil

5. The carbon residue test by the Conradson Method must be less than 0.4 per cent for the medium oil, 0.6 per cent for the heavy oil, and 0.8 per cent for the extra heavy oil.

6. The following characteristics of oil bid upon must be stated in proposal: Viscosity tests on the Saybolt Universal Viscosimeter at temperatures of 70 degrees F., 100 degrees F., 130 degrees F., 212 degrees F, and 300 degrees F., Gravity, Beaume at 60 degrees F.

TRANSMISSION LUBRICANT

For transmission and reduction gears will be governed by the specifications for non-fluid transmission lubricant as approved by the Signal Corps and Quartermaster's Department, also Medical Corps and U. S. Navy. Sixty-five pounds of this lubricant will be specified for the testing and running in of each 6-ton tractor and to remain in the transmission and reduction gear cases of this 6-ton tractor when shipped.

TRANSMISSION LUBRICANT SPECIFICATIONS

General

1. This lubricant shall be a well manufactured product composed of calcium soap and mineral oil, and must be suitable in every way for the lubrication of the axles and transmissions of engine equipment.

Consistency of Transmission Lubricant

2. The lubricant shall be equal in consistency to a standard sample of No. 00 non-fluid lubricant.

Moisture Content

3. The lubricant shall be of a boiled grease, containing not less than 1 per cent nor more than 1.5 per cent of moisture when finished.

Mineral Oil Base

4. The mineral oil used in reducing the soaps shall be at least 180 seconds viscosity at 100 degrees F. on a Saybolt Universal Viscosimeter.

Saponifiable Fat Base

5. Not over 10 per cent of either pure tallow oil, Neats Foot oil, lard oil or horse oil, singly or in combination, to be used as a fat base.

Acidity

6. When applied to polished copper, there shall be no reaction after a period of 48 hours.

Heat Test

7. When 2 oz. of the grease are heated to 212 degrees F. or until the entire mass becomes liquid and then allowed to cool, there shall be no separation of the soaps from the oil.

Fillers

8. The grease shall not contain fillers of any kind, such as resin, resinous oils, soap stone, wax, talc, powdered mica, lamp black, sulphur, clay, asbestos or any other artificial thickening.

CUP GREASES

Specifications for medium cup greases, as specified and approved by the Signal Corps, Ordnance Department, Quartermaster's Corps and U. S. Navy, are endorsed for use on this 6-ton tractor, 10 pounds of this grease herewith specified for use on 6-ton tractor. This grease will be left in cups and oiling devices when shipment is made.

CUP GREASE SPECIFICATIONS

General

1. This grease shall be a well manufactured product, composed of calcium soap and mineral oil and must be suitable in every way for the lubrication of such parts of engine equipment and other machinery as are lubricated by means of compression cups.

Consistency

2. The grease shall be a medium cup grease similar in consistency to a standard sample of No. 3 grease.

Moisture

3. The grease shall be a boiled grease, containing not less than 1 per cent nor more than 3 per cent of moisture when finished.

Saponifiable Fat Base

4. From 15 per cent to 20 per cent of either pure tallow oil, Neat's Foot oil, lard oil, or horse oil, singly or in combination, to be used as a fat base.

Mineral Oil Base

5. The mineral oil used in reducing the soaps shall be at least 180 seconds viscosity at 100 degrees F. on a Saybolt Universal Viscosimeter.

Acidity

6. When applied to polished copper, there shall be no reaction after a period of 48 hours.

Heat Test

7. When 2 ounces of the grease are heated to 212 degrees F. or until the entire mass becomes liquid and then allow to cool, there shall be no separation of the soaps from the oil.

Fillers

8. The grease shall not contain fillers of any kind such as resin, resinous oils, soapstone, wax, talc, powdered mica, lamp black, sulphur, clay, asbestos or any other artificial thickening.

TRACK

The following specifications on oils to be used on oiling track rollers, track links and track pins on the 6-ton tractor will be governed by the specifications for gear chain and wire rope lubricant as specified and approved by the Signal Corps and Quartermaster's Department. Six gallons of this lubricant are hereby specified for running in.

SPECIFICATIONS OF TRACK LUBRICANT

General

1. This lubricant must be a very adhesive, heavy bodied, straight mineral oil, suitable in every way for lubrication and protection.

Character

2. The oil must be a hydro-carbon product only, without the mixture of vegetable or animal oils, products or residues or fats of any kind, and entirely free from fillers such as talc, resin, tar or materials of similar or other nature not related to the original product.

Viscosity

3. The viscosity in seconds on the Saybolt Universal Viscosimeter at 212 degrees F. shall come within the following limits: 900 seconds to 1100 seconds.

Quality

4. The quality shall be similar to that of a standard sample of crater compound No. 1.

Adhesiveness

5. As this is one of the most necessary qualifications for this oil and there is no laboratory method for suitably indicating the value of this characteristic, the adhesiveness will be determined by applying the lubricant to a track operating under practical conditions, the effect produced by the lubricant as compared to the effect produced by the standard sample of Texaco crater compound to be taken as a basis of comparison.

Corrosion Test

6. When the lubricant is applied to a plate of polished steel, the steel is to be protected for a period of 30 days from vapors from chemicals and from the action of salt or fresh water and of solutions of water containing from 10 to 25 grains of sulphuric acid per unit, the water and solutions to be at 60 degrees F.

LUBRICATION INSTRUCTIONS

Every point indicated on the lubrication chart should be attended to with the frequency indicated in the following instructions.

After each part mentioned on the lubricating instructions and indicated on lubrication chart will be found a figure, which indicates the kind of oil or grease best suited to the lubricating needs of each part. The meaning of the various letters is as follows:

2—Gasoline engine oil, Specification 3502.
5—Non-fluid transmission lubricant, Specification 3505.
4—Transmission lubricant, Specification 3504
6—Medium cup grease, Specification 3506.

ENGINE

CAPACITY FOUR GALLONS—NO. 2, DAILY ATTENTION

The oil supply is carried in the crankcase which has a capacity of 4 gallons. The oil is poured in the combination breather and filler opening. There is a rod gauge on the right side of the engine which is pulled out by the handle, wiped off and re-inserted after which it is again pulled out to determine the oil level. There is an indicating mark for full, and another for empty. When full the crankcase contains 4 gallons. When the empty mark is indicated there are 1½ gallons in the crankcase.

In filling the crankcase open the upper try cock on the priming sump of the crank case and pour in oil until it starts to flow from this cock. Then shut cock and replace cap on filler opening.

Too much oil should be guarded against as well as too little. Too much will foul the cylinders and dirty the plugs causing misfiring and carbon formation in the combustion chamber.

Once a month the drain plug on the bottom of each of the two crank case sumps should be removed and all the oil allowed to drain out. Before refilling with fresh oil it is desirable that the crank case be flushed with kerosene. To do this, close drain plugs, pour in 3 gallons of kerosene through filler, run engine slowly for 15 seconds, *but not longer*, then drain crank case again and put in 4 gallons fresh oil.

MAIN CLUTCH

CAPACITY FOUR OUNCES—NO. 2 WEEKLY

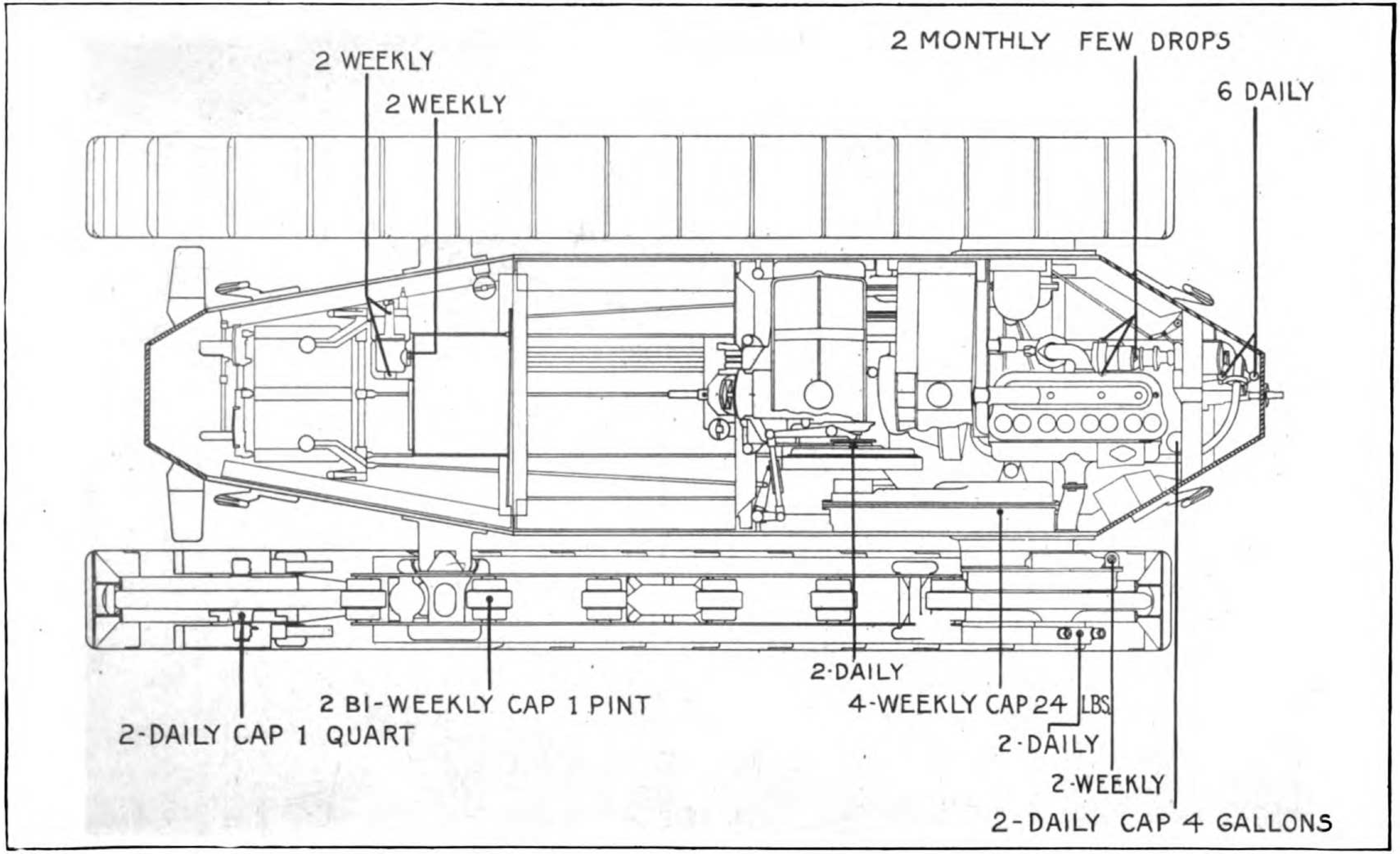
The main clutch has an oil opening in the housing or face which supplies a wick feed to the ball thrust bearing at the forward end. This should be kept supplied as this bearing takes the thrust load of the clutch spring. A thin wire inserted in the hole will aid in the injection of the oil. The driving member also rotates on this bearing in relation to the driven member when the clutch is slipped.

MAIN CLUTCH THROWOUT

PACK WITH NO. 6—MONTHLY

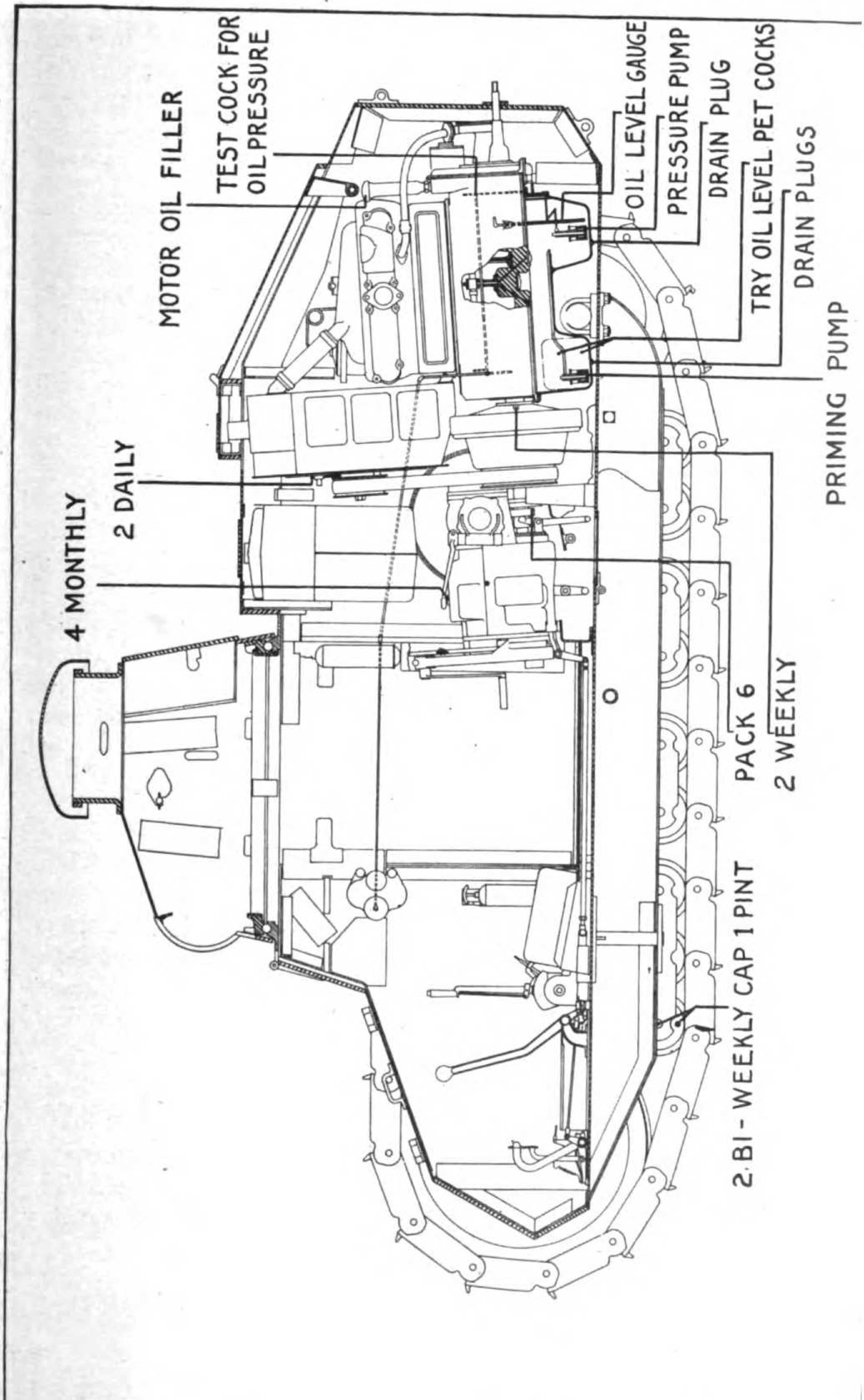
The clutch throwout should be kept packed in grease. It is located just behind the main clutch assembly and must take the load when the

Plate No. 3



OILING DIAGRAM, PLAN VIEW, SHOWING SPECIFICATION OF LUBRICANT TO BE USED AND FREQUENCY
FOR ADDITIONAL POINTS SEE ELEVATION

Plate No. 4


MOTOR OIL FILLER
TEST COCK FOR OIL PRESSURE
OIL LEVEL GAUGE
PRESSURE PUMP
DRAIN PLUG
TRY OIL LEVEL PET COCKS
DRAIN PLUGS
PRIMING PUMP
2 DAILY
4 MONTHLY
PACK 6
2 WEEKLY
2 BI-WEEKLY CAP 1 PINT

clutch is slipped. There is a ball thrust against which the throwout bears. To repack remove bolts holding universal in place and separate parts far enough to introduce grease with gun.

MAIN CLUTCH ALIGNMENT JOINT

This joint is located between the clutch and transmission. Its forward end is lubricated by the oil placed in the clutch lubricator which flows through the hollow shaft of the clutch and thence to the joint. The rear end is oiled by the lubricant which works its way from the forward end; hence a plentiful supply of oil applied in the clutch oilers will take care of these parts.

TRANSMISSION

NO. 4 MONTHLY

The gearset runs on ball bearings throughout which are lubricated along with the gears themselves by the distributing action of the rotating gears in the lubricant. The case is supplied by removing the plug in the cover plate. Fill to level of lower or main shaft.

If too much lubricant is used it will heat from the friction of churning and the oil will become thin and work out the ends of the bearings. Every month the lubricant should be drained out, the drain plug replaced, kerosene put in and the transmission run for five minutes in neutral to thoroughly wash it out, then drain and refill with fresh lubricant.

STEERING CLUTCHES

NO. 2 DAILY

The steering clutches are similar to the main clutch, being inverted cones and are lubricated in the same manner by means of oilers placed in the housing. The transverse shaft carrying the driving member of the clutch runs on ball bearings. The connection to the driving member is through a splined shaft. The oiler takes care of the entire unit.

SPUR GEAR REDUCTION

NO. 2 WEEKLY

Two oil holes are provided on the spur gear reduction which carries the drive from the steering clutches outboard to the track. The reduction gears operate in a case inside the armor plate and another outside and the oil holes take care of each of these cases.

TRACK SPROCKET

NO. 2 DAILY

An oil hole closed by a plug is provided on each track drive sprocket. The oil level should be kept just below the shaft which drives the track and which carries the sprocket. The oil takes care of the plain bearing upon which the sprocket is mounted and also the engaging faces of the sprocket wheel.

TRACK ROLLERS

NO. 2 BI-WEEKLY ATTENTION

A point for lubrication is provided on each track roller, at the center axis of the roller. These oil holes take care of the bearing about which the roller revolves.

Distribution on the roller is secured by a hole drilled to the center through the middle of the track gudgeon. A hole is then bored diametrically in the middle of the roller to meet the other hole. This provides ample lubrication and must be taken care of regularly because the entire weight of the tractor is distributed over these bearings.

TRACK RAIL

OIL BATH DAILY

No provision is made on the track itself for lubrication between the roller and the rail. At a base where a number of the tractors are permanently stationed or at an assembly base an oil pond makes a quick and advantageous method of handling the work efficiently.

TRACK OIL POND

The pond should be thirty feet in length and at least 7 feet wide and 8 inches deep. The tractors can be run through this in succession, thus cleansing and oiling in one operation. Where the pond plan is not possible swabbing will have to be relied upon. The specifications for track lubrication have been outlined on page 18.

TRACK IDLER

NO. 2 DAILY

Oil plugs are provided on the hubs of the front idler or blank sprocket. These are on the outside of the idler hubs and supply a reservoir surrounding the axle, providing a lubrication for the bearing which carries the wheel.

CONTROL UNITS

NO. 2 WEEKLY

Three oil holes are provided in the control set to the right of the driver's seat. These lubricate the shifter mechanism.

ENGINE ACCESSORIES

FAN

NO. 2 DAILY

The fan is oiled through a tube just above the upper fan pulley.

MAGNETO

2 DROPS, NO. 2 MONTHLY

Two drops only of a light, clean oil, injected into the oil wells every month or so will be sufficient. One of these oil wells is located on the distributor housing, oiling the armatus ball bearing, the distributor plain bearing and oil well in the timing lever body. The other oil well is located on the extension of the end plate near the driving shaft and lubricates the ball bearing on the end of the magneto.

WATER PUMP

NO. 6 DAILY

There is a grease cup located on each side of the water pump. These shoulo be given two turns daily and refilled when necessary.

MAINTENANCE ROUTINE

It is essential for the proper care and maintenance of the 6-ton tractor that the following maintenance routine schedule be rigidly adhered to. Preparedness for emergencies can only be obtained by keeping these tractors in excellent condition ano this necessitates a regular maintenance routine.

The following items refer only to inspection and adjustments. Repairs or replacements detected as necessary should be made at the earliest opportunity.

DAILY MAINTENANCE ROUTINE

ENGINE

Examine all wiring terminals for tightness.

Clean magneto externally.

Note tension of fan belt.

Inspect oil pump for performing its function, by means of pump pressure cock.

Inspect radiator water supply.

Inspect gasoline tank for proper fuel supply.

Inspect pipe line and all connections for leaks.

GENERAL

Inspect and thoroughly clean all track parts and exterior. See that tools are in place.

CONTROLS

Inspect controls for proper functioning.

WEEKLY MAINTENANCE ROUTINE

ENGINE

Inspect all wires for proper support and freedom from damage.

Thoroughly clean engine externally.

Inspect for oil leaks.

Try oil pressure cock for pump action.

Inspect control connections.

Try goverror for accurate functioning.

Inspect all water connections for leaks.

Keep engine free from carbon, inject a tablespoonful of kerosene into each cylinder through the spark plug holes. This should be inserted when the motor is hot and left standing over night.

Remove, clean and adjust all spark plugs.

Remove magneto distributor cover and clean with gasoline.

Operate engine at low speed and with one wire at a time separate it from spark plug, inspect the spark given for length and apparent hotness.

Drain water and dirt from water trap in gasoline line.

Inspect carbureter control connections and connections with governor.

Do not attempt to alter adjustment of carbureter or governor unless this is shown to be necessary when tractor is in service.

Inspect motor oil drain cocks and drain plugs for loss of oil.

BRAKES

Inspect and thoroughly clean all brake connections.

CLUTCH

Inspect main and steering clutches for wear and proper operation and adjustment.

MONTHLY MAINTENANCE ROUTINE

MAIN CLUTCH

Thoroughly clean and inspect all pedal connections.

TRANSMISSION

Clean externally and inspect for leaks, particularly in bearing covers at the front and rear ends in order to ascertain if undue leakage is occurring around shafts.

STEERING

Thoroughly clean and inspect all steering clutch linkage.

Try action to ascertain damage if any.

TRACK

Check over all track parts for tightness. See that rollers revolve freely and that the dirt is removed from shoes. Examine for pin wear.

GENERAL

Inspect speedometer drive for reliability, also gauges.

IGNITION

Clean magneto collector ring, drain and adjust breaker points.

Inspect cam spark lever for correct advance.

ENGINE

Inspect cylinders for carbon.

Inspect valves and grind if necessary.

If engine has had unusual amount of use, remove and inspect engine bearing.

Clean oil pump screens.

Drain carbureter and clean screen.

TURRET

See that turret rotates freely.

Inspect turret brake for wear.

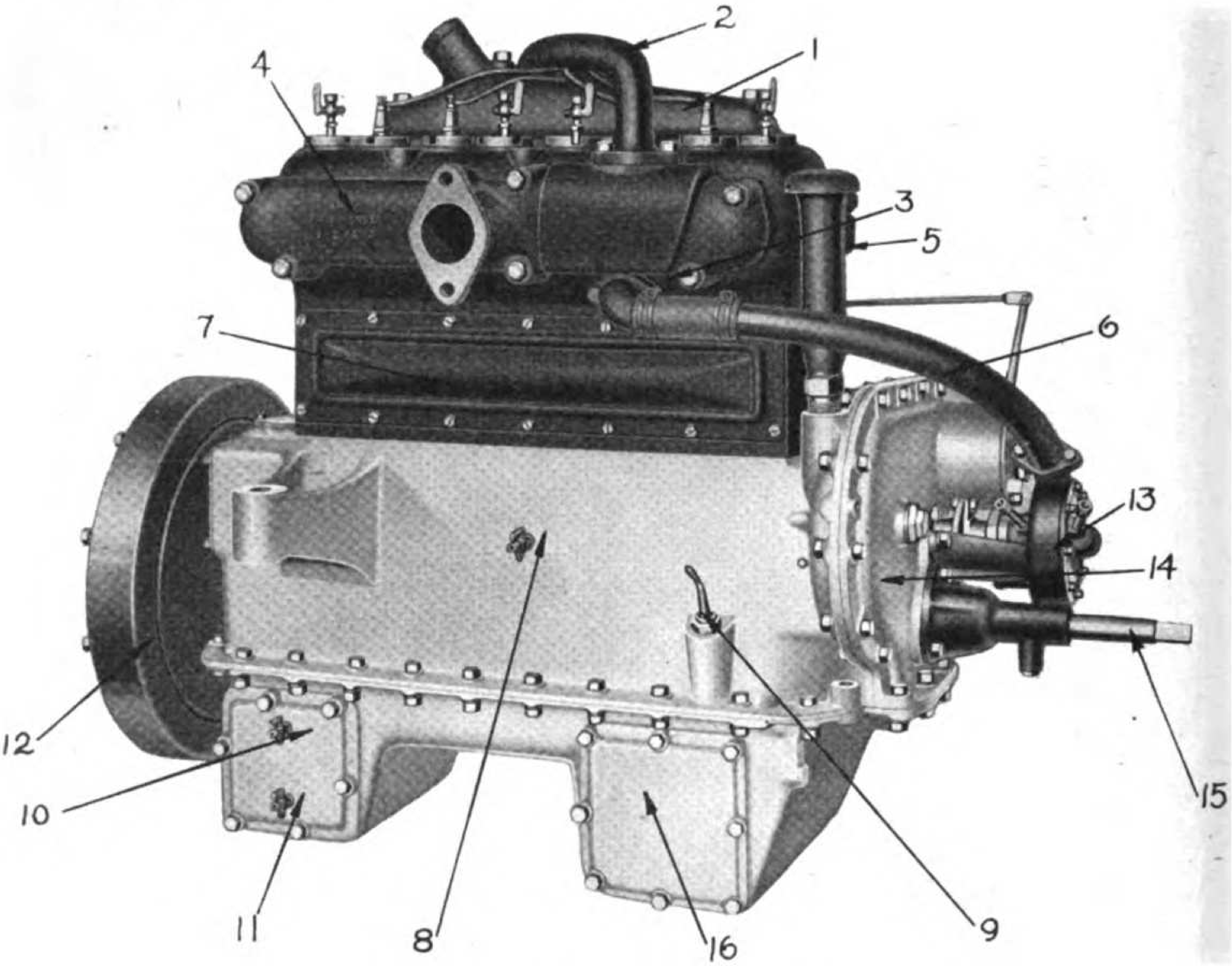
CHAPTER II

ENGINE GROUP

GENERAL SPECIFICATIONS

Engine type	Four cycle
Number of cylinders	Four
Cylinder shape	L-head
Bore	$4\frac{1}{4}$ inches
Stroke	$5\frac{1}{2}$ inches
Piston displacement	312 cubic inches
Brake horsepower	40 at 1300 r. p. m.
Cylinders cast	In block
Cylinder material	Grey iron
Piston material	Grey iron
Piston length	$5\frac{3}{8}$ inches
Piston clearance at top land	.02 inch
Piston clearance second land	.012 inch
Piston clearance at skirt	.004 inch
Spare pistons	.04 inch over size
Number of piston rings	Three per piston
Type of ring	Eccentric
Piston pin	Steel tube
Piston pin diameter	$1\frac{1}{8}$ inch
Piston pin length	4.3 inch
Connecting rod	I-beam forging
Connecting rod length	$12\frac{1}{4}$ inch
Upper rod bearing	$1\frac{1}{8}$ inch diameter x $2\frac{1}{8}$ inch length
Lower rod bearing	$2\frac{1}{8}$ inch diameter x $2\frac{1}{2}$ inch length
Camshaft	Drop forging
Number of camshaft bearings	Three
Front camshaft bearing	$2\frac{1}{2}$ inch diameter x $2\frac{1}{16}$ inch long
Center camshaft bearing	2.379 inch diameter x 1.5 inch long
Rear camshaft bearing	1.878 inch diameter x 1.5 inch long
Crankshaft bearings	Three
Front crankshaft bearing	$2\frac{1}{8}$ inch diameter x $3\frac{1}{8}$ inch long
Center crankshaft bearing	$2\frac{1}{4}$ inch diameter x $2\frac{3}{4}$ inch long
Rear crankshaft bearing	$2\frac{3}{8}$ inch diameter x 4 inch long
Valve material	Tungsten steel
Valve type	Poppet

Plate No. 5



EXHAUST SIDE OF ENGINE

1. Water outlet.
2. Hot air pipe.
3. Water inlet from pump.
4. Exhaust manifold.
5. Oil filler and breather.
6. Water inlet pipe.
7. Valve action cover plate.
8. Oil pressure cock.
9. Oil level gauge.
10. Oil level test cock, high.
11. Oil level test cock, low.
12. Flywheel.
13. Water pump.
14. Timing gear case.
15. Starting crankshaft.
16. Oil sump cover plate.

ENGINE GROUP

GENERAL SPECIFICATIONS—Continued

Valve diameter................	1 27/32 inch
Valve stems..................	7/16 inch diameter x 7 27/32 inch length
Oiling system.................	Pressure feed
Water circulation..............	Centrifugal pump
Gasoline feed................	Vacuum
Radiator.....................	Tubular type
Ignition.....................	High tension magneto
Magneto type................	Eiseman G4-2

ENGINE GROUP—GENERAL DESCRIPTION

ENGINE.

The engine is mounted longitudinally within the tractor body at the rear end. It is a specially designed four-cycle, four-cylinder type with block cast L-head cylinders having a bore of 4¼ and a stroke of 5½ inches. The brake horsepower is approximately 52 at 1900 r. p. m. The piston displacement is 312 cubic inches.

The cylinder block, water header, crankcase and oil pan are all separate, the latter two being aluminum. The cylinders and water header are cast from grey iron. The engine assembly includes a governor, water pump and Eisemann Magneto, all driven from the timing gears, and a Wheeler-Schebler Carbureter.

PRINCIPLE OF FOUR-STROKE CYCLE.

The engine is of the four-cycle type. The four strokes of the cycle are popularly termed as follows: suction stroke, compression stroke, expansion or working stroke, and scavenging stroke.

1. The intake stroke is the downward motion of the piston which sucks the explosive charge into the cylinder through the intake valve.
2. The compression stroke is the upward stroke of the piston which compresses the charge in the upper part of the cylinder.
3. Ignition is caused by the spark at the spark plug igniting, the compressed charge in the upper part of the cylinder known as the combustion chamber. The expansion of the exploded gases forces the piston down to the bottom center, this being the power stroke.
4. Near the bottom center on the exhaust stroke, the exhaust valve opens, and as the piston moves upward it forces out the burned gases, clearing the cylinder in preparation for a repetition of the cycle.

CYLINDERS.

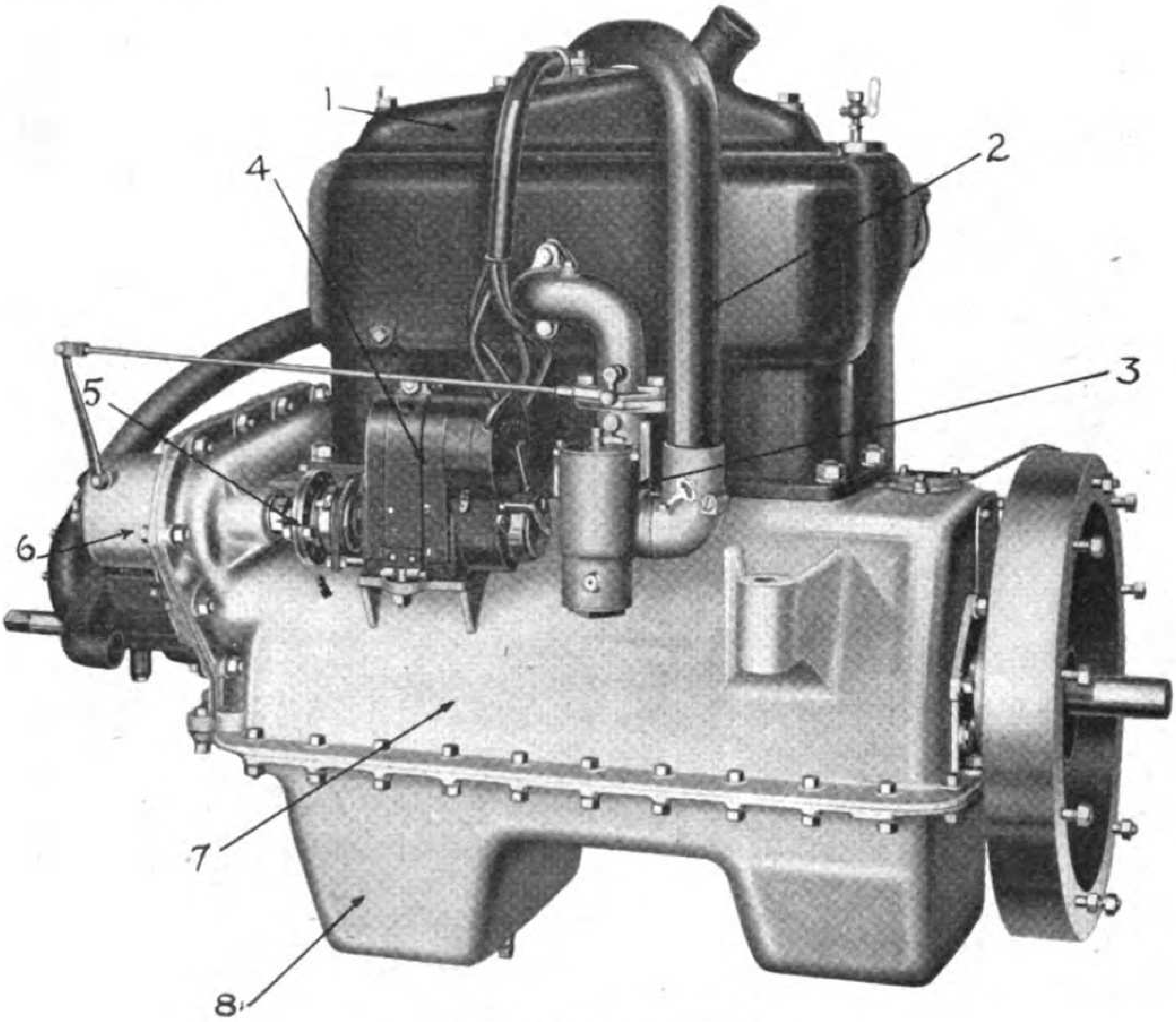
The cylinders are cast in block, and are of grey iron. They are provided with water jackets cast integral with them.

PISTONS.

The pistons, of which there are four, are of cast iron, and are each 4¼ inches in diameter at the bottom and 5⅜ inches long. The piston head is smaller in diameter than the piston skirt, because all the heat to which the piston is subjected is applied to the piston head, thus causing it to expand to a greater degree than the skirt.

The proper clearance between cylinder and piston at the top land is .02 inch at the second land .012 and at the skirt .004. The spare part pistons are .04 inch oversize.

Plate No. 6



ENGINE INTAKE SIDE

1. Water header.
2. Hot air pipe.
3. Carbureter.
4. Magneto.
5. Magneto drive coupling.
6. Governor case.
7. Crankcase.
8. Oil pan.

TO REMOVE PISTON

The pistons at the rear can be removed from the bottom through the engine crank case after taking off the oil pan by removing the flange bolts at the flywheel end; the front pistons can not be removed without first taking out the crankshaft. See page 46.

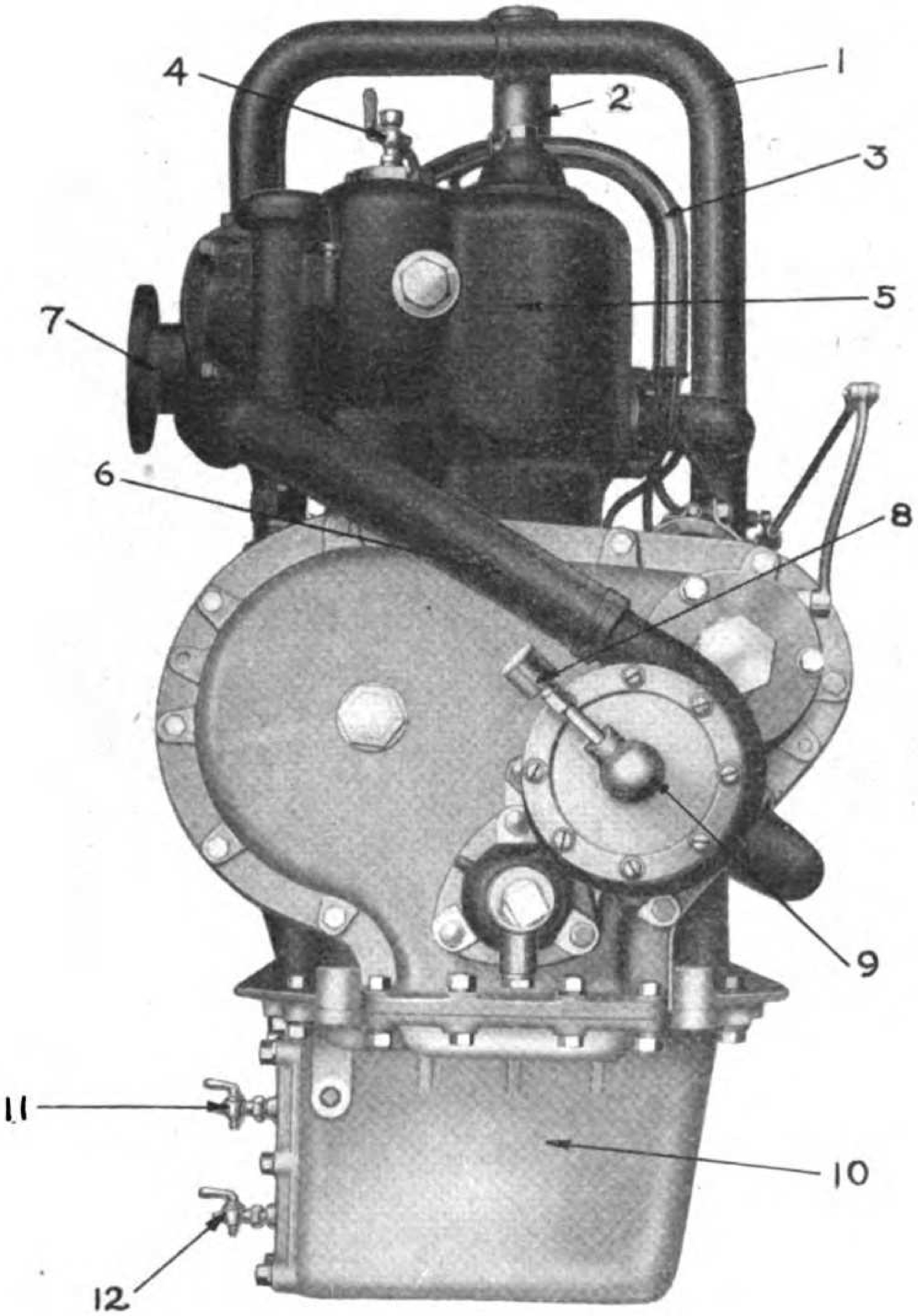
PISTON RINGS

To each piston there are three piston rings. These are of cast iron .249 inches wide, and are eccentrically machined. They are .1875 inches and .125 inches thick. They are split at an angle of 45 degrees.

The piston rings pack the piston, preventing the gases under pressure from leaking down into the crank case, between the cylinder and piston. They also prevent the lubricating oil from working up into the combustion chamber.

The proper gap between the ends of the top piston ring is .009 inch.

Plate No. 7



TIMING GEAR END OF ENGINE

1. Hot air pipe.
2. Water outlet pipe.
3. Wire conduit.
4. Petcock and priming cup.
5. Cylinder casting.
6. Water inlet pipe.
7. Exhaust pipe.
8. Water pump grease cup.
9. Water pump.
10. Oil pan.
11. Oil level cock, high.
12. Oil level cock, low.

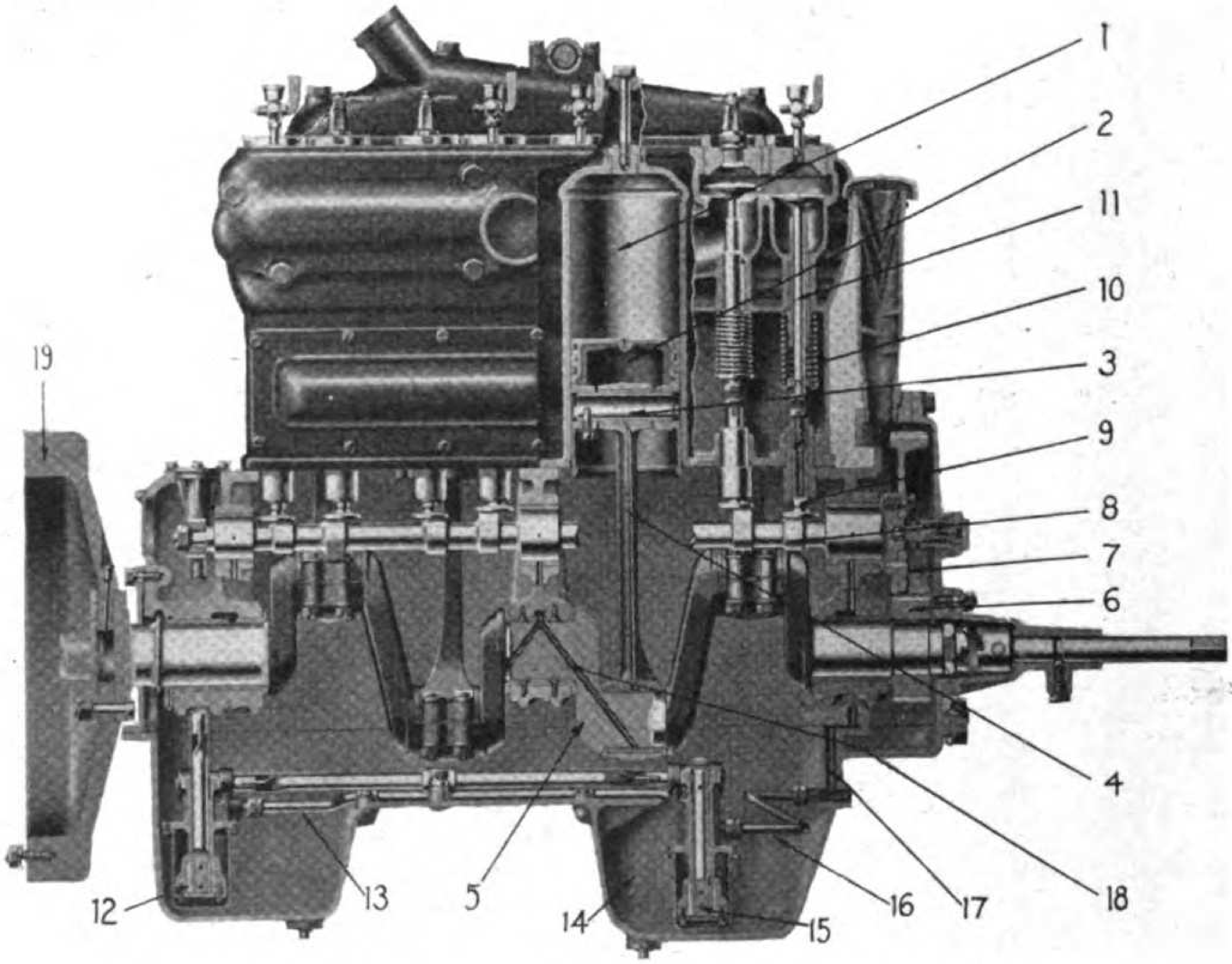
INSTALLATION OF PISTON RINGS

The piston rings should be placed up into the cylinder before they are applied to the piston, and fitted (filed) if necessary, to secure the proper gap between the ends of the ring.

Before the rings are installed on the piston they should be rotated around the piston in the piston ring groove to insure a proper clearance up and down which is about .001 of an inch.

The rings should be placed in grooves over skids made of three or four pieces of tin or very thin light gauge sheet iron about 2 inches long

Plate No. 8



PARTIAL LONGITUDINAL SECTION THROUGH ENGINE

1. Cylinder.
2. Piston.
3. Piston pin.
4. Connecting rod.
5. Crankshaft.
6. Timing gear (crankshaft).
7. Timing gear (camshaft).
8. Camshaft with cams integral.
9. Valve push rod.
10. Valve spring.
11. Valve stem.
12. Oil priming pump.
13. Oil priming lead.
14. Oil delivery sump.
15. Oil delivery pump.
16. Oil delivery pipe.
17. Oil delivery lead.
18. Oil lead through crankshaft.
19. Flywheel.

---

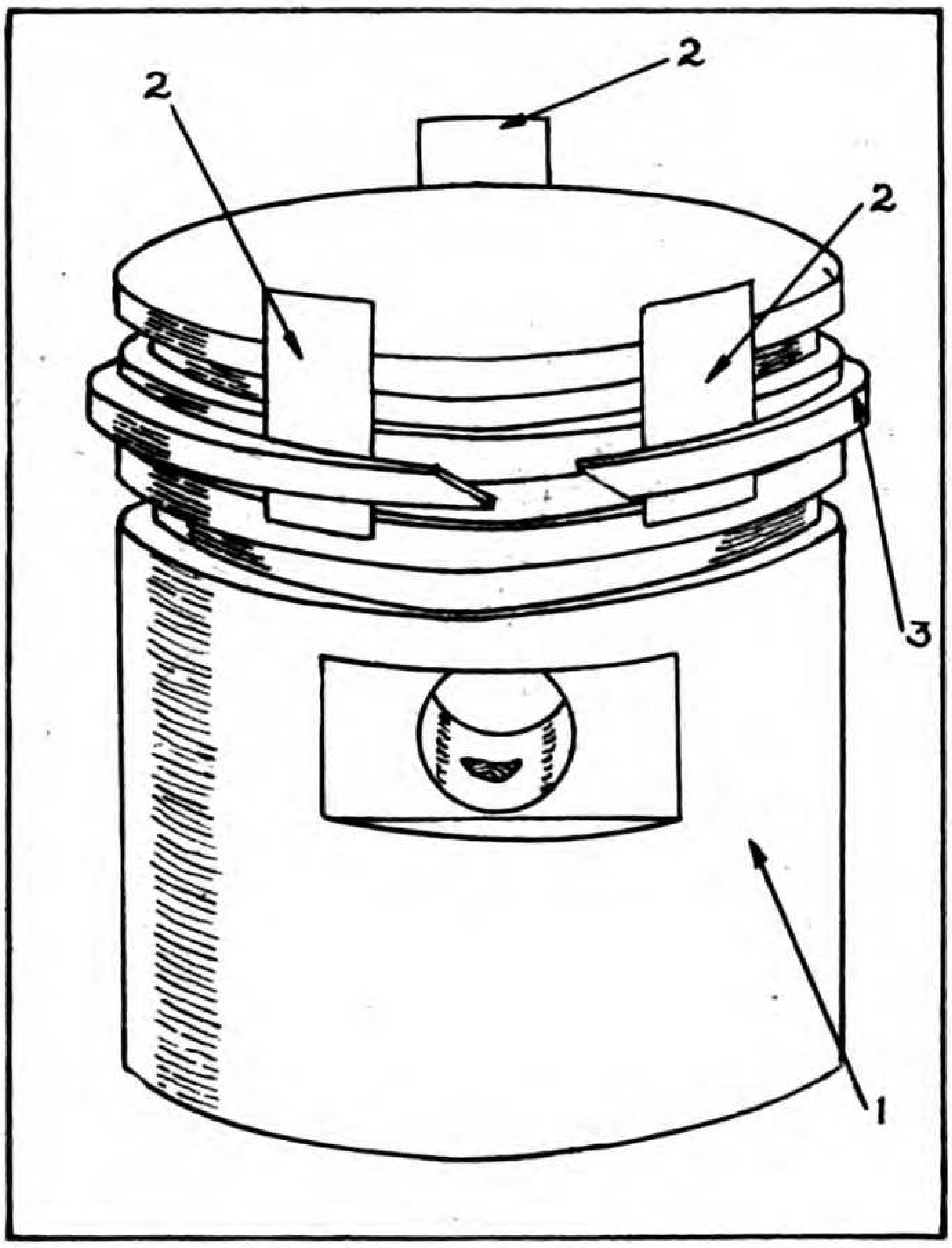
by 3/8 inches wide, the rings being pushed down evenly all around to prevent any twisting of the rings which might result in distortion and uneven bearing on the cylinder wall.

PISTON RING TROUBLES

In fitting the piston into the cylinder, caution should be exercised not to push up the piston too high into the cylinder, for if this is done, the top ring will expand out into the combustion chamber, and the piston cannot be pulled down again.

If this happens, both valve caps should be removed and the piston ring compressed as much as possible with the aid of screw drivers or similar tools until the piston can be pulled down. In case it is

Plate No. 9



METHOD OF REMOVING AND REPLACING PISTON RINGS

1. Piston. 2. Metal Strips. 3. Piston ring.
Strips are inserted beneath ring to enable ring to be slipped off readily.

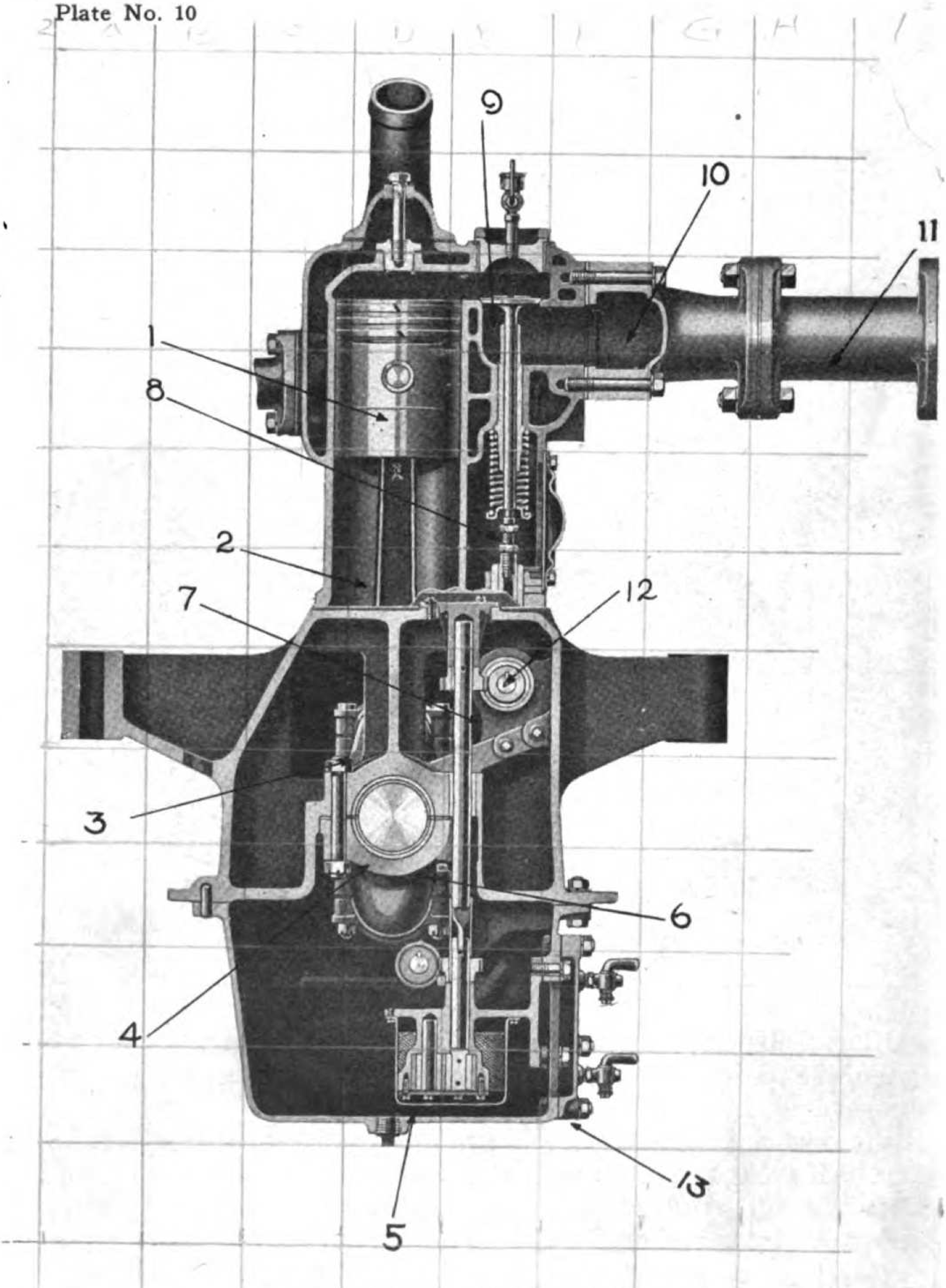
found impossible to compress the ring sufficiently to permit the removal of the piston down to its proper place again, the piston ring may be broken and the pieces removed.

If the rings are not stiff enough, or have insufficient wall pressure, the oil will work up past them into the combustion chamber. The bottom edge of the piston ring must in all cases be very sharp and square to scrape the oil off the cylinder wall as the piston comes down.

PISTON PIN

The piston pins are of steel tubing 1.125 inches in diameter and 4.3 inches long. In each piston boss there is 5/16 inch set screw which holds the piston pin about which oscillates the upper connecting rod bearing.

Plate No. 10



TRANSVERSE SECTION THROUGH ENGINE

1. Piston.
2. Connecting rod.
3. Connecting rod cap bolt.
4. Connecting rod cap.
5. Oil pan.
6. Crankshaft.
7. Oil pump driveshaft.
8. Valve adjustment point.
9. Exhaust valve and port.
10. Exhaust header.
11. Exhaust extension.
12. Camshaft.
13. Oil pump cover plate.

TO LOCATE WEAR IN THE PISTON PIN BEARING

If the piston is in place in the engine and the lower crank case is down, remove a valve cap, turn engine over so that piston is on top dead center in such a position that a screw driver may be inserted in the valve cap pocket, then pry down on top of the piston, while with a bar the piston may be pushed upward from under the side of case, then by alternately moving piston up and down, any play may be detected.

In case the piston and rod have been removed from the engine, place the connecting rod in a vise and hold the piston in the same position in which it has always worked on the pin, then by trying to rock the piston in the direction of the length of the pin, wear may be detected.

PISTON PIN BEARING

The upper end of the connecting rod contains a bronze bushing in which the piston pin fits. This acts as the bearing surface. The bushing is driven in the upper end of the rod.

TO ALIGN PISTON AT RIGHT ANGLES TO CRANKSHAFT

With the cylinder removed and the connecting rod and piston in position a level may be used to ascertain parallelism between the top of the piston and the top of the crankcase, which is parallel to the center lines of the crankshaft. Or a pair of calipers may be used to determine uniformity of distance between the top of the crankcase and the under side of a piston ring on all sides of the piston. Or with a straight edge laid across the top of the piston lengthwise of the engine, the distance to the crankcase may be measured at its ends.

CONNECTING ROD

The connecting rod through which the force of the explosion is transmitted to the crankshaft is an I-shaped steel forging, 12¼ inches long from center to center of the bearings. The upper bearing contains the piston pin as described. It has a diameter of 1⅛ inches and length of 2⅛ inches.

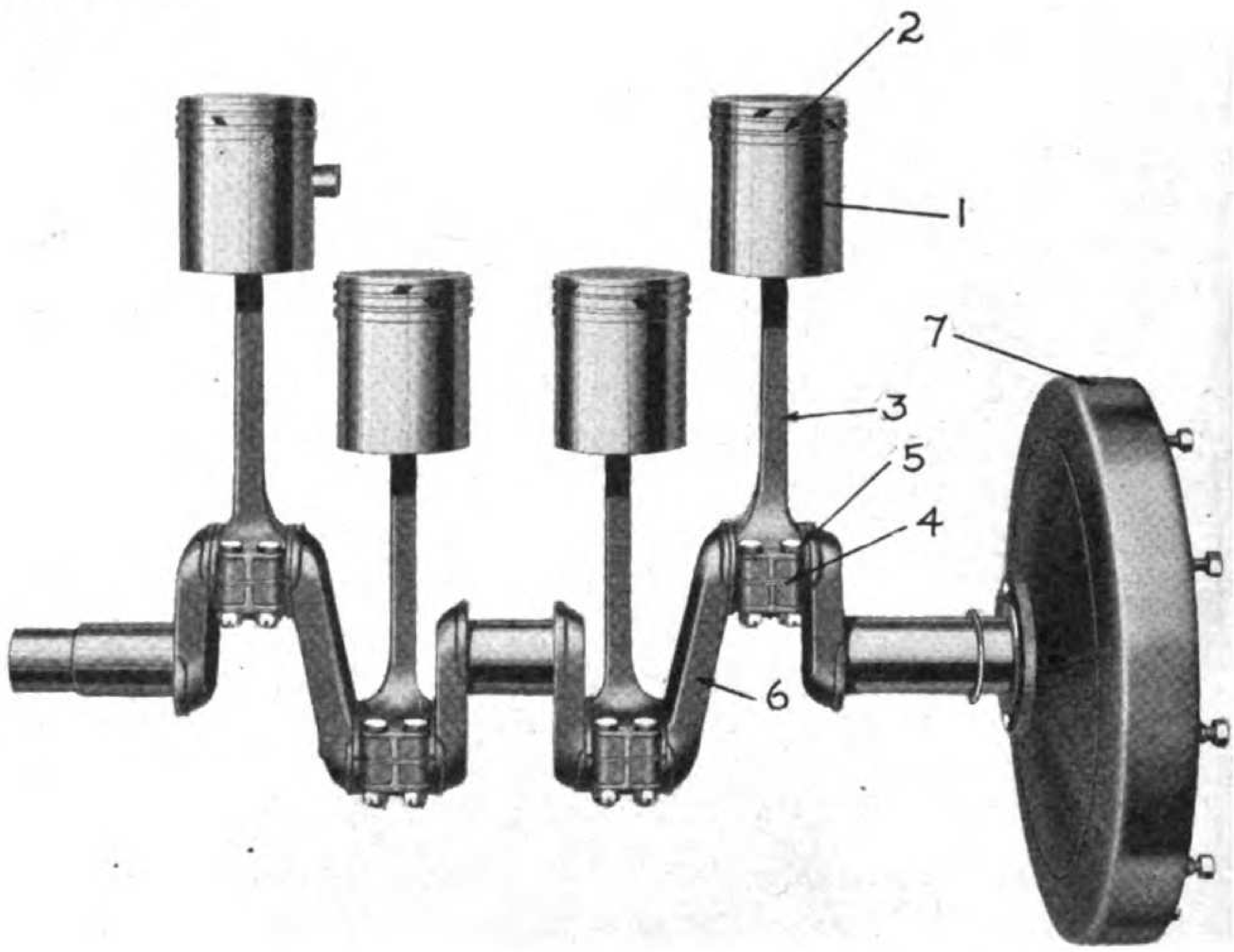
The lower bearing is 2⅛ inches in diameter and 2½ inches long, and is lined with a babbitt metal bushing. The cap of the bearing is held in place by four bolts each 7/16 inches in diameter.

TO ADJUST CONNECTING ROD BEARINGS

In replacing connecting rod bearings (if the crankshaft is out of the crankcase) it is best to place the crankshaft in a vise and adjust the bearings to the shaft while in this position, as the work can be done more readily.

The ends and round corners of the connecting rod bearings may be sized before they are placed in the rod or cap. In case an end flange

Plate No. 11



PISTON CONNECTING-ROD AND CRANKSHAFT ASSEMBLY

1. Piston.
2. Piston rings.
3. Connecting rod.
4. Connecting rod bearing shim.
5. Connecting rod cap bolts.
6. Crankshaft.

---

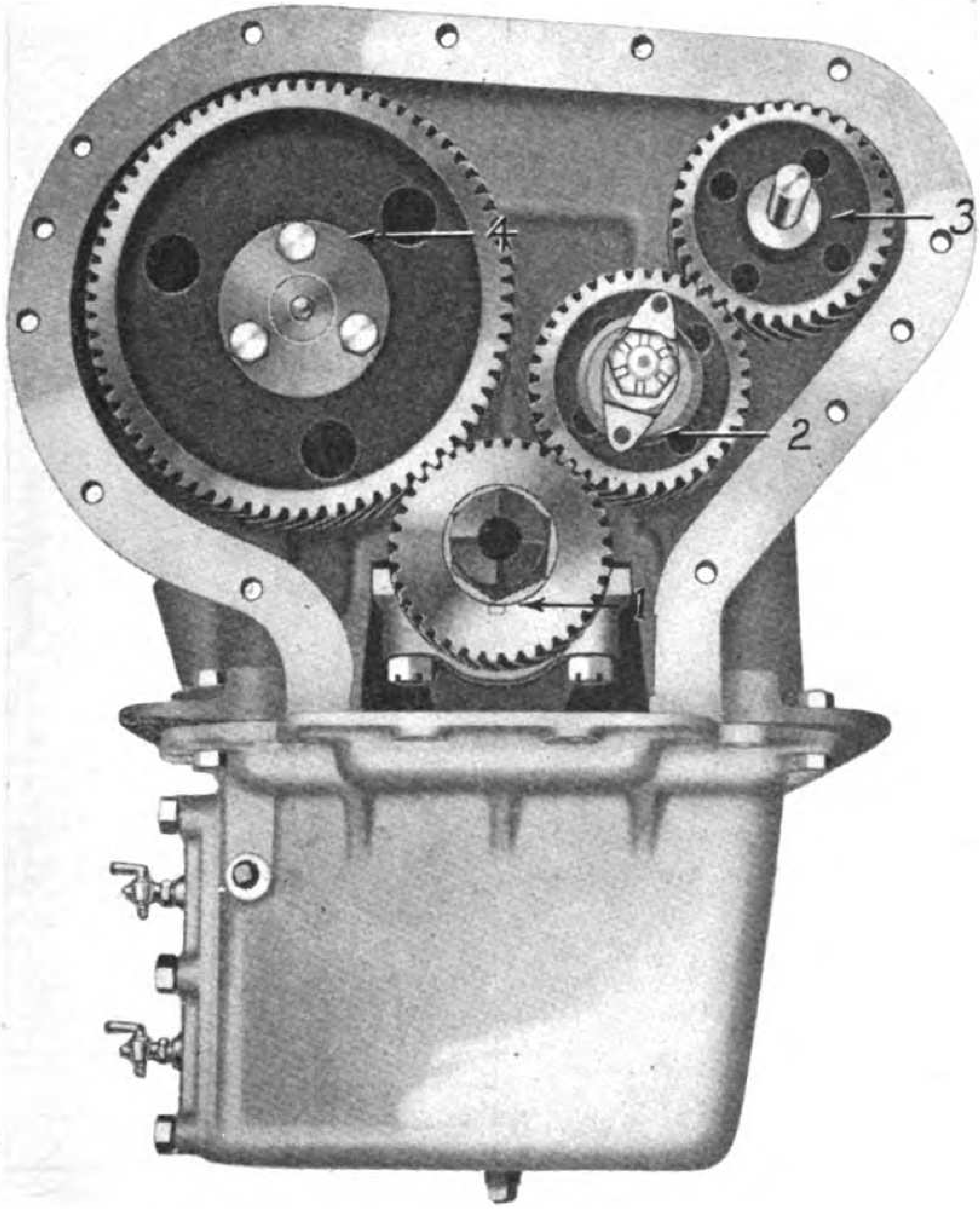
should be broken off the bearing liner, it may be soldered on with half and half solder, care being taken to prevent melting the bearing with the soldering iron.

The sides of the bearing liner next to the shaft should be filed or scraped down for a distance of about ¼ inch to ⅜ inch to prevent contact with crankshaft and prevent side pressure also to aid lubrication.

After the connecting rod has been fitted, the piston should be lined up with the top of crankcase. When the bearing has been scraped in and bears well all over, it should be adjusted just so tight that the piston and rod, when same are at an angle of 45 degrees to the vertical, will just maintain their position and slight pressure down will cause them to fall.

The tightness of the bearings is controlled by the thickness of the shims against which the caps are drawn up snug after a bearing has been properly scraped in and every nut must be tightened by drawing the caps against the shims solidly, but never strained. The shims are illustrated on page 41. If a castellated nut is tight when in such a position that cotter pin hole does not line up, the nut should be re-

Plate No. 12



TIMING GEAR SET

1. Crankshaft gear.
2. Water pump gear.
3. Magneto and governor drive gear.
4. Camshaft or half time gear.

---

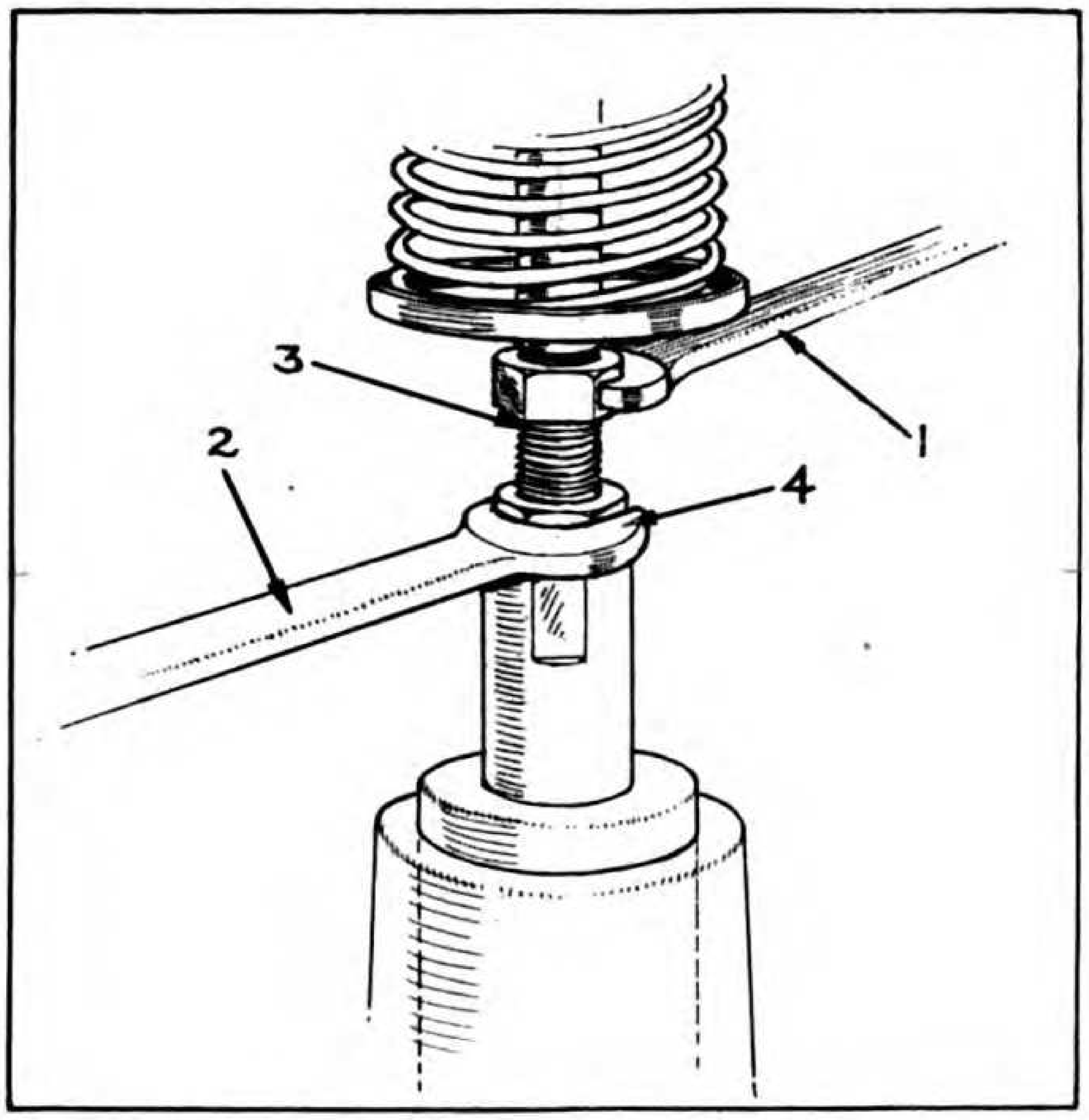
moved and light cut taken off face of nut with a file permitting its being turned to a proper position so that the cotter pin can be inserted when tight.

CAMSHAFT

There is one camshaft actuating all intake and exhaust valves. The camshaft is driven by means of helical gears from the crankshaft, and is of forged steel, heat treated, hardened and ground, with the cams made integral with the shafts.

The front bearing is 2½ inches in diameter by 2 1/16 inches long. The center bearing is 2.0312 inches in diameter and 1.5 inches long, while the rear bearing is 1.878 inches in diameter and 1.5 inches long.

Plate No. 13



METHOD OF VALVE ADJUSTMENT

1. Adjusting nut wrench.
2. Lock nut wrench.
3. Threaded adjustment.
4. Lock nut to hold adjustment.

CAMSHAFT BEARING WEAR

As a result of lack of support of the camshafts by center bearing, due to wear, there would be a tendency for the camshafts to spring down, as the high part of the cams passed under the tappet rollers because of the valve spring pressure. The valves would open a sufficient distance to permit of proper intake and exhaust. The bending of the shaft would cramp them at the end bearings, also wear and possibly cramp the teeth of the timing gears, on account of the misalignment.

TO REMOVE CAMSHAFT

It is first necessary to remove engine from the tractor, then remove the crankcase front cover, remove valve spring assemblies which relieves spring pressure on cams, then remove camshaft which is designed to come out of front end of engine as each bearing is smaller than the next allowing the shaft to come through.

VALVES

There are two valves of the poppet type in each cylinder, an intake valve and an exhaust valve, with functions as indicated by their names.

The valves are of tungsten steel, 1 27/32 inches in diameter.

The valve stems are of machine steel electrically welded on to the heads. They are 7/16 inches in diameter, and 7 27/32 inches long overall. The stems move in cast iron guides. The guides are forced into place in the cylinder block in a manner that permits of their being knocked out when it becomes necessary to renew them.

TO GRIND AND FACE VALVES

In grinding valves, the valve tappet should always be screwed down, insuring sufficient clearance. To prevent the end of valve stem riding on any carbon or dirt on top of valve tappet, and to allow for the amount ground away. The valves should never be rotated around a complete revolution, being turned back and forth about a quarter turn, occasionally being raised up and dropped down in another position for the purpose of quickening the action.

If no valve grinding compound is at hand, emery or carborundum may be mixed with heavy oil, or very light cup grease, and a thin coat applied, it being better to put three or four coats of valve grinding compound on than to use an excess at the start.

A high spot on the valve seat will permit the valve head being ground bright all around, though the seat may yet be in improper condition, and vice versa. Therefore, both seat and valve must be examined to see that both have been ground bright. After the valves have been ground all grinding compound should be washed away with gasoline.

In case the valves are very badly pitted, and grinding until the pits were removed would grind the valve seats down too deeply, the valves should be faced off. They should also be faced in case a groove has been worn in the valve face by constant operation.

In case the valves are so hard that facing with a tool is impossible, they may be adjusted by use of a fine tooth file wetted with water, or, preferably, with turpentine. They must not be filed down beyond the groove, it serving as a guide.

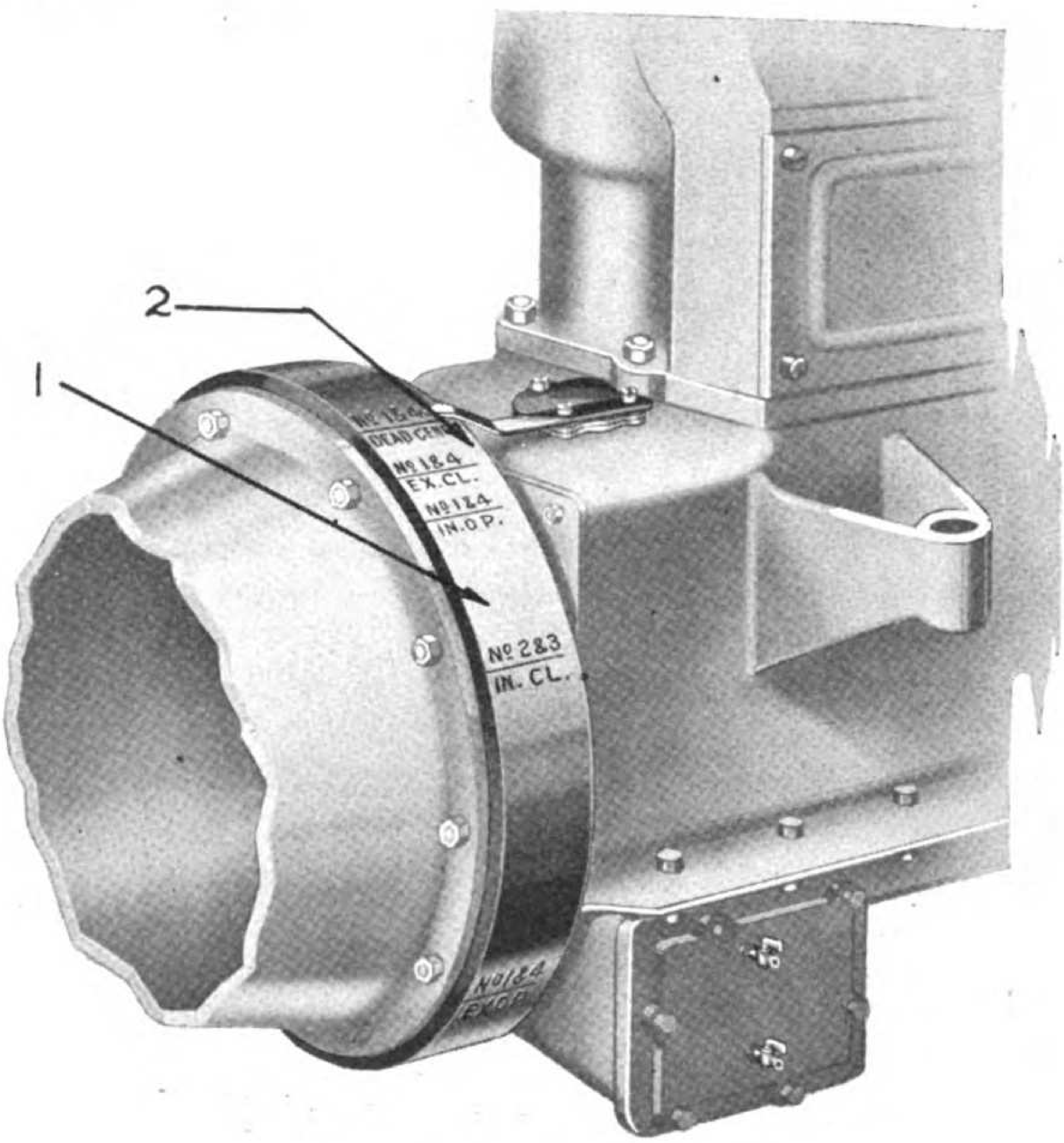
Unscrew the valve cap and with the valve lifted, raise the valve spring without raising the valve by holding the valve down from the top.

The valve spring seat is locked to the valve stem with a key held in place by the cupped spring seat which fits over it. After removing this the valves may be lifted out through the valve cap opening by looping a string under the valve head.

VALVE SPRINGS

On each valve there is a 60 pound coil spring 5 inches long when free and 1⅜ inches outside diameter, made of 12 coils of wire. These springs are slipped over the valve stems, the lower end being held against the valve spring cup, the other end against the cylinder casting.

Plate No. 14



TIMING MARKINGS ON FLYWHEEL

1. Flywheel. 2. Indicator.

VALVE TAPPETS

Each valve is actuated by a tappet. These are adjustable as to length, with a flat circular face under their bottom ends, which rides on the cams. Their outside diameter is 5/8 inches at the shank and 1 15/32 inches on the circular face. Each valve tappet is supported by a bronze bearing.

VALVE TAPPET CLEARANCE

The proper clearance between valve stems and the tappet is .005 inches, for the intake valve, and .007 inches for the exhaust valve tappet. For practical purposes the clearance should be the thickness of two sheets of paper, the same as that used in this book.

It is important that the valve clearance be ample. An insufficient amount of clearance would prevent them closing freely and cause loss of compression.

VALVE TIMING

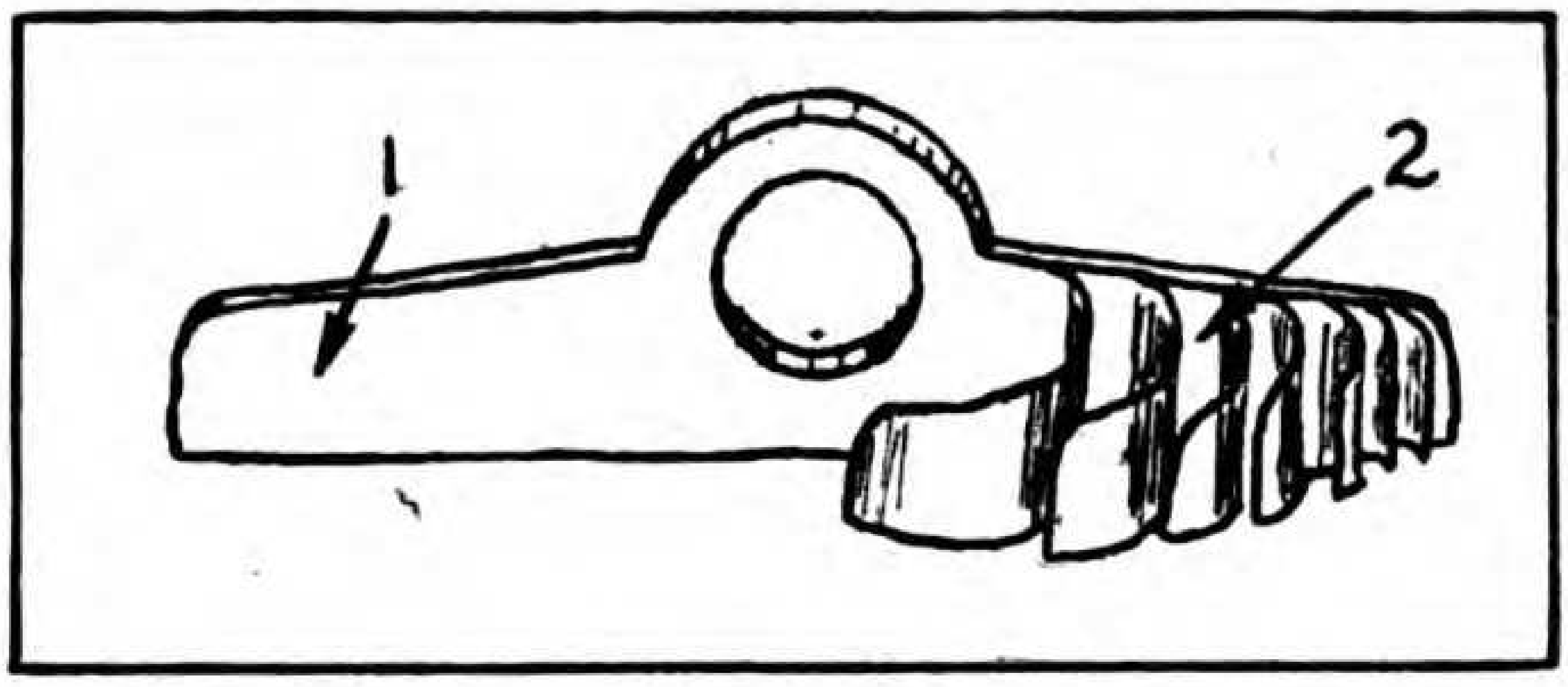
The proper operation of the engine demands that the valves open and close with reference to the location of the piston in its cycle of movement with considerable accuracy.

The rotation of the camshaft is timed with reference to the rotation of the crankshaft by means of a proper meshing of the gears which interconnect between the two. The inlet opens 15 degrees after top center and closes 40 degrees after lower center. Exhaust opens 45 degrees before lower center and closes 10 degrees after top center.

Timing the valves is accomplished, and also checked, by means of markings stamped into the periphery of the flywheel. When any one of these markings is put in alignment with the pointer which overhangs the top of the flywheel, a definite valve position as indicated by the following table should obtain:

"EX. OP 1 and 4" (Exhaust valve of cylinder 1 or 4 begins to open.)
"IN. CL 1 and 4" (Inlet valve of cylinder 1 or 4 finishes closing.)
"EX. CL 1 and 4" (Exhaust valve of cylinder 1 or 4 finishes closing.)
"IN. OP 1 and 4" (Inlet valve of cylinder 1 or 4 begins to open.)

Plate No. 15



ENGINE BEARING SHIM. THIS ILLUSTRATION SHOWS THE LAMINATED SHIM SYSTEM USED FOR ROD BEARINGS

1. Shim when solid. 2. Laminations to be peeled off for required thickness.

In case the camshaft gears are for any reason unmeshed from the idler gear, and crankshaft gear, the procedure of timing the camshafts is as follows:

Turn flywheel so that the marking "IN. OP 1 and 4" is in line with the flywheel pointer; then with the gear case cover of the engine and the idler gear removed, turn the intake camshaft in the direction it operates, until No. 1 intake valve is just beginning to open. This is determined by adjusting No. 1 intake valve tappet to just admit three thicknesses of paper loosely between it and the end of the valve, when the tappet is clear down, and then with but one piece of paper in place, turning camshaft until the paper is slightly gripped by the upward movement of the tappet. Replace idler gear, revolving the camshaft either to the right or the left (whichever direction will admit of least turning) until it is possible to replace idler gear in mesh with both the camshaft gear and the crankshaft gear.

The proper location on the flywheel of the 1 and 4 "center marking" is indicated by the pointer when 1 and 4 pistons are at the tops of their stroke. The dead center is offset on the flywheel due to the location of the timing marker as shown on page 40. This can be accurately obtained as follows:

With No. 1 intake or exhaust valve cap removed, insert some light tool such as a screw driver until same contacts with the top of the piston, and by oscillating the flywheel slightly to the right or left, a flywheel position can be ascertained, at which the piston is at the top of its stroke and motionless during a small movement of the flywheel. Bisecting the length of this movement determines the proper location of this center marking.

PROPER CLEARANCE BETWEEN TIMING GEAR TEETH

Just enough clearance shall exist between timing gear teeth to prevent humming when new and properly oiled; never more than about .001 inches. If too much clearance exists timing is rendered inaccurate; whereas, if the clearance is insufficient, a steady humming noise, rapid wear, and deformation of the teeth will result. Ends of meshing gear teeth should not bottom.

NOTE—The contact between the gear teeth is a rolling one.

The most frequent causes for noise indicating trouble in timing gears are: front crankshaft bearing lining broken out, which causes improper meshing of teeth, chips or dirt on teeth, meshing too deeply, wear of teeth giving excessive clearances, gears loose on camshaft.

FLYWHEEL

The flywheel is 17.5 inches in diameter. The width of its face is 2.5 inches. It is fastened to a flange on the crankshaft by six ½ inch bolts. In the face of the flywheel are the two oil holes for the clutch. If the oil will not enter readily, thrust in a thin wire and let it run down.

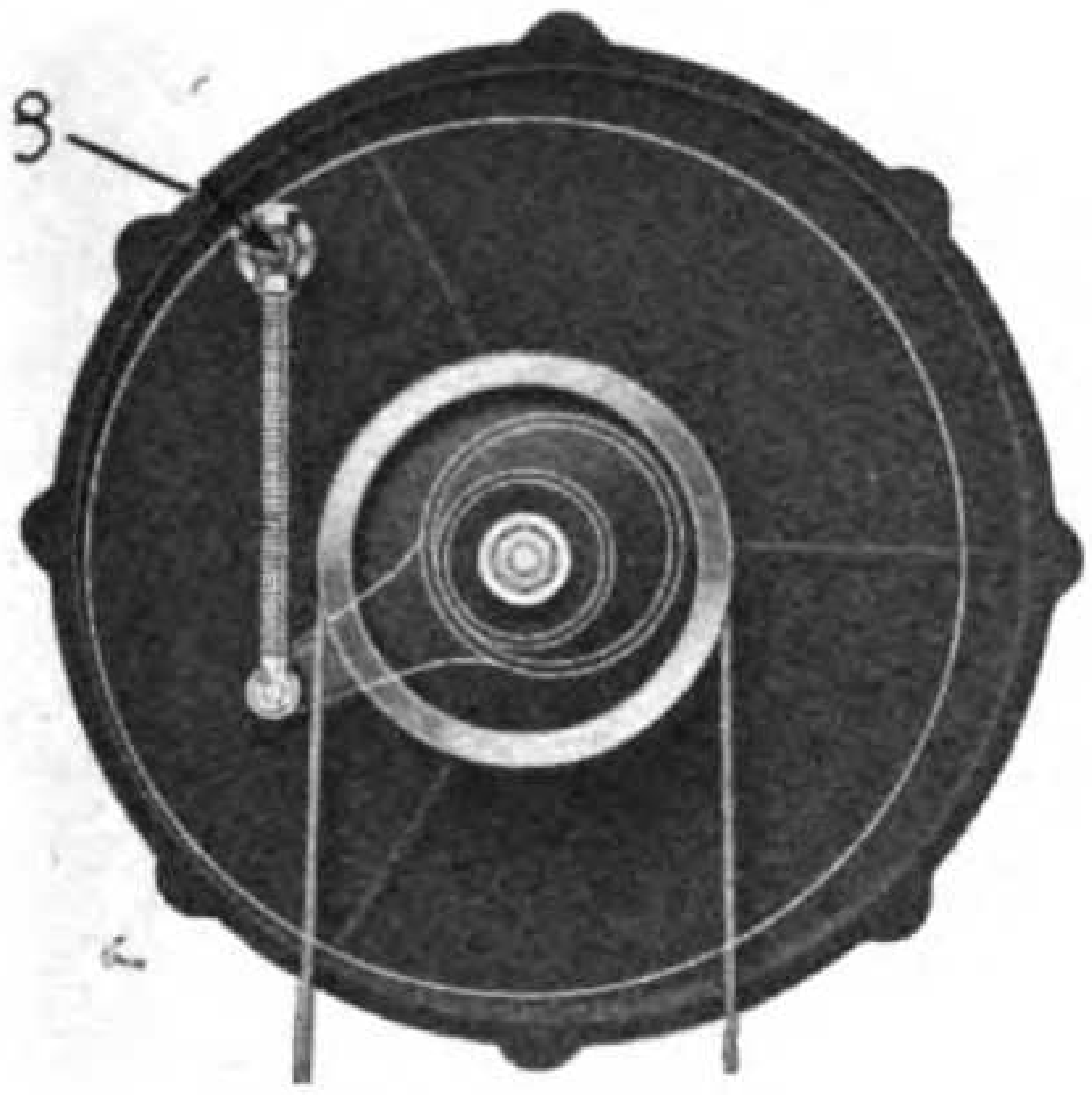
TO REMOVE ENGINE

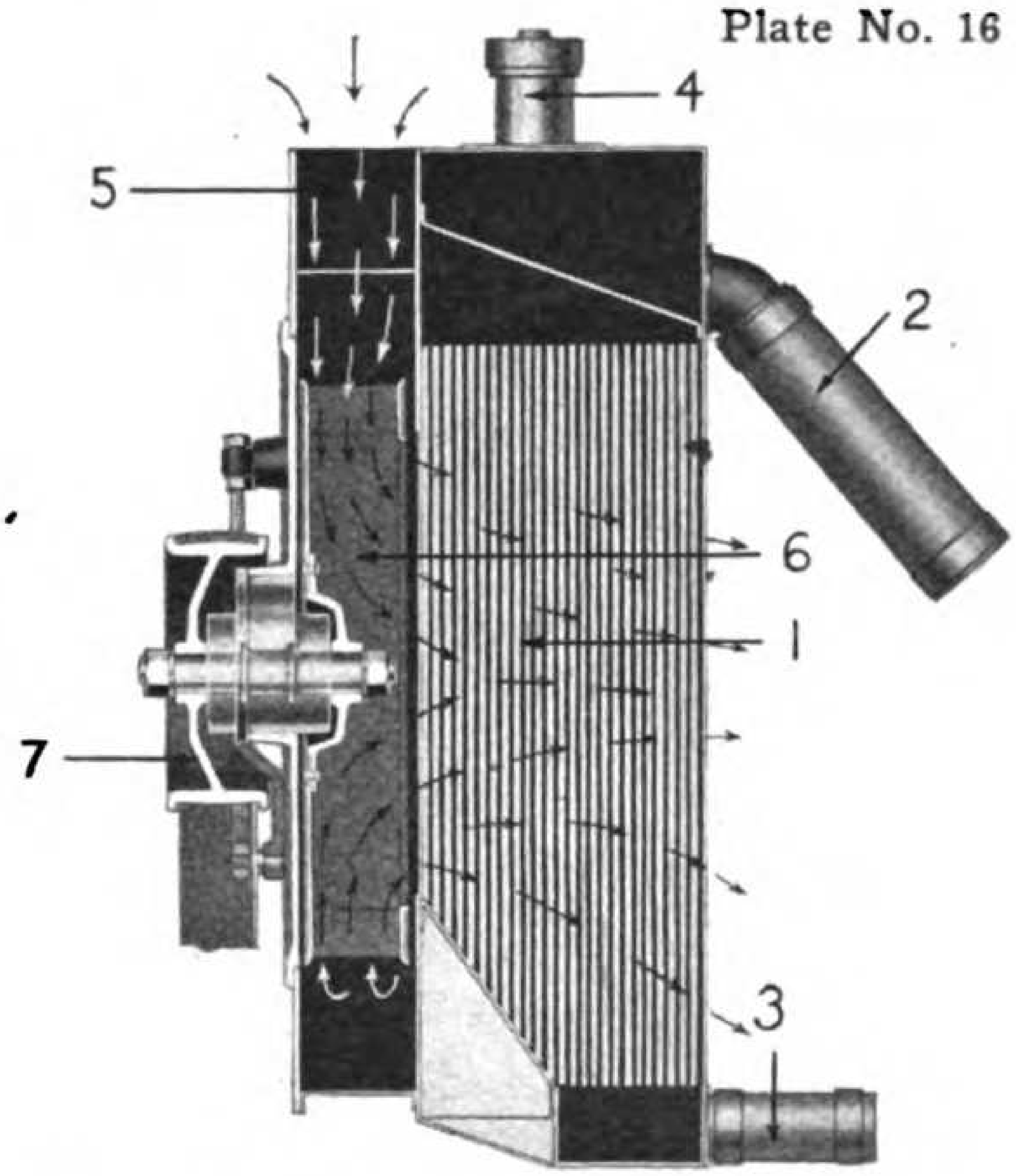
Take off the top armor plate, remove radiator and gasoline tank, unscrew the base bolts in the back and front of the engine, disconnect hose connections, control rods, etc., disconnect clutch and lift engine out.

FAN

The fan is of the 24 blade blower type. Each blade is of pressed steel. The outside dimension of the fan is 16 inches. It is driven by

Plate No. 16





RADIATOR AND COOLING SYSTEM

1. Radiator.
2. Radiator inlet.
3. Radiator outlet.
4. Radiator filler cap.
5. Fan housing.
6. Blower fan.
7. Fan pulley.
8. Fan pulley adjustment nut for taking up eccentric.

a flat leather belt 69 9/16 inches long and 2 inches wide by 1/4 inch thick. It is driven off a 10 inch pulley, forming part of the main clutch housing. The fan or driven pulley is 7 inches in diameter.

ADJUSTING FAN

Adjustment of the fan is provided by an eccentric held in place by a threaded rod and nuts. The lock nut is loosened as shown above. The play in the belt is taken up on the adjusting nut and the lock nut is then tightened.

TO LACE FAN BELT

A fan belt can be laced by punching three small holes in each end of the belt (directly opposite each other) and lacing with a rawhide lace or a shoestring if necessary.

The joints should be laced double in case a single row of lacing will not hold.

REASONS WHY FAN BELT JUMPS OFF PULLEY

The fan belt may jump off a pulley if it is too loose, if two pulleys are not parallel with each other, or if the ends of the belt are not cut squarely, thus causing the belt to be curved.

TO DETECT IF FAN IS RUNNING AT PROPER SPEED

A fan will not run at proper speed if the belt is oiled or greasy, if the belt is too loose, or if the fan shaft is too tight in the bearing.

CRANKSHAFT

The crankshaft is of alloy steel. It is mounted on three bearings, the front one of which is 2.125 inches diameter and 3.125 inches long, the center 2.25 inches diameter by 2.75 inches long, while the rear bearing has a diameter of 2.375 inches and length of 4 inches.

The caps for the main bearings of the crankshaft are held in place by four 7/16 inch studs.

Both bearings and caps are provided with bronze backed bushings of babbitt metal. This arrangement affords an easy means of renewing the bearings when they become worn.

The bushings are held in place by pins fitting in holes in the main bearings. The bearings at the lower end of the connecting rods are oiled by pressure through the drilled crankshaft. A copper tube up the side of the rod carries the oil to the wrist pin.

Crankshaft end play is taken up on the center bearing and all end play fitted from that point. An end play of .004 to .006 inch should be allowed. About 1/32 inch clearance is allowed on the front and rear bearings to take care of expansion in the crankshaft.

KNOCKS IN BEARINGS

The center bearing is that most likely to develop looseness, because of the fact that it carries a greater load than the two other bearings. The bearing next most likely to show signs of wear is the front one, while the rear bearing shows longest life in service.

Should the crank bearings knock, usually the removal of metal shims placed between the bearing and the bearing cap returns them to proper adjustment. In removing the shims it is necessary that an equal number be taken from each side of the bearing cap.

If the shims are laminated one or more layers should be removed. If that be too much substitute a thin shim of paper for one of the metal layers removed. If the shims are solid, file them to necessary reduced thickness.

If the above is not successful it will be necessary to replace the bushing and scrape to a perfect bearing. A perfect bearing surface is important.

TO SCRAPE CRANKSHAFT BEARINGS

In scraping the bearings, the first consideration is the proper meshing of the timing gears, the front bearing controls the position of the crankshaft and its gear, consequently, it should be fitted and scraped first, the other end bearing being lined up with it at the same time. Then the middle bearing fitted in line.

In scraping the crankshaft or connecting rod bearings, the area of contact of bearing surface is the important factor. If the shaft does not bear well, all over, the high spots are scraped and the cap will have to be tightened, but if the shaft bears well and evenly, the bearing need not clamp so tightly. One bearing should be adjusted at a time, then loosened and another bearing adjusted. In this way, any chance of one bearing being too tight and another too loose is avoided. Always relieve the bearings at the upper part at the sides to prevent binding. If a bearing must be raised up, thin shim stock or paper should be used. Bearing blue, in oil, should be rubbed on the shaft to mark its contact with the bearings while being scraped in. When the three main crankshaft bearings have been adjusted and tightened, one should be able to revolve the shaft by grasping firmly the flywheel.

CRANKSHAFT BEARING ADJUSTMENT

Because of the weight of the shaft, flywheel, and their inaccessibility it is not advisable to attempt to adjust crankshaft bearings from under the engine.

When the crankshaft bears evenly in its bearings, and a bearing cap becomes loose, the shaft will spring down and away under the impulse of the explosion, and on the return of the piston to the top dead center the shaft will spring back, hammering away or upsetting the bearing. The result of this is not only a wearing down or hammering out of the top bearing, but the wearing away and the hammering out of the bearing in the crankcase as well. This condition can only be remedied by the removal of the engine from the chassis. The shaft should be removed from the engine, the journals blued, scraped in and readjusted. Should it be found that a bearing is out of line, being high or low, shims may be removed or added under the bushings. The shaft should not be sprung when it is finally fixed in its bearings.

SHIMS MUST BE EVEN

If an equal thickness of shims is not always maintained on each side of the bearing cap, on refitting or readjusting, the shaft will not bear on the same place on which it bore before the adjustment. When the bolts are tightened the caps may be sprung and pinch the shaft.

CRANKCASE

The crankcase is of a cast aluminum and is made in two parts. The cylinders are bolted to the upper half which has four arms cast integral, providing means for fastening the engine to the frame. To the lower half there is bolted the oil base and oil pump.

PRIMING CUPS

A set of priming cups are placed on the engine, located above the cylinders, and used for priming the engine with gasoline.

They may be used to determine the compression stroke of the different cylinders to ascertain how the cylinder is firing.

REMOVING CRANKSHAFT

The crankshaft can be removed through the bottom of the case by dropping the pan and removing the starting crank bracket, which is bolted to the front of the timing gear case. Drop the oil pan, remove flywheel by taking out clutch, as described on Page 81, take out the six bolts which hold the flywheel and the crankshaft flange, remove the oil retainer plate at the flywheel end of the crank case, take off main connecting rod bearing caps and withdraw the crankshaft.

TIMING GEARS

Timing gears are contained in a case on the front end of the engine. There are four gears in the set—the driving gear being that which is attached to the crankshaft, which in turn drives the pump gear and finally the magneto gear. The camshaft gear is driven directly off the crankshaft gear.

All the timing gears are 10 pitch 20 degree pressure angle, involute teeth. Crankshaft gear is .20—.30 open hearth carbon steel. Water pump gear is cast iron. Magneto gear .20—.30 open hearth steel, and the camshaft gear cast iron.

The crankshaft gear has 35 teeth; camshaft gear 70 teeth; magneto gear 35 teeth, and the water pump gear 35 teeth.

LUBRICATION TIMING GEARS

The timing gears are lubricated by the internal lubricating system of the engine, a lead carrying the oil direct to the gears. The oil put in the filler pipe also flows over the gears on the way to the crank case.

REMOVAL OF GEARS

The crankshaft gear is keyed to the crankshaft. It can be removed by taking off the retaining nut and withdrawing key.

The pump gear comes off by removing the nut on the end of the stud which holds it in place. The magneto gear is keyed to the magneto drive shaft and carries the governor on the outside or forward end. To remove this gear it is necessary to take off the governor end plate, removing the entire governor assemblies, and then slipping the gear off the key. The camshaft gear is bolted to a flange on the end of the camshaft by three bolts, and can be removed by taking out these three bolts, as the spring thrust which bears against the gear comes off with the timing gear cover plate.

CAUSES OF KNOCKS

The following are the most common causes of knocks:

(a) Carbon
(b) Broken rings
(c) Loose piston pins
(d) Loose connecting rod
(e) Loose crankshaft bearings
(f) Loose flywheel
(g) Early spark
(h) Overheated engine
(k) Excessive valve tappet clearance
(l) Chipped or cam roller
(m) Burr or chip in gear teeth
(n) Crankshaft end play
(o) Camshaft end play

IDENTIFICATION OF ENGINE KNOCKS

(a) The carbon knock cannot be noticed when the engine is cold as it is entirely the result of carbon in the cylinders becoming heated to a temperature which will ignite the compressed charge prior to the occurrence of the ignition spark.

Carbon can be removed by speeding up the engine and pouring about one gallon of water into the air valve of the carbureter, a small quantity at a time, care being taken that the engine does not stop. After this is done it is a good plan to remove the spark plugs and see that they are clean, or the carbon can be scraped out through the valve plug holes.

(b) Broken piston rings will result in a lack of compression and permit oil to work up into combustion chamber. A light click at closed position of throttle may be noticed.

(c) The knock produced by loose piston pins is lighter than that of a crankshaft or connecting rod knock, and like a connecting rod knock is most noticeable when the engine is idling with a nearly closed throttle. This knock is not as indicative of danger as loose connecting rod or crankshaft bearing knocks. There is very little danger of bearings being rendered unserviceable by reasonable further use. Replacement of pin is necessary.

(d) The knock produced by a loose connecting rod, a rather heavy pound, is most noticeable at low engine speed with a closed throttle, but if the play is excessive this knock can be noticed at all speeds and loads. It is the most common and the easiest to identify. It should be remedied immediately.

(e) A loose crankshaft bearing will knock most noticeably when the engine is working under a heavy load. If the front crankshaft bearing is very loose it may be detected by the excessive noise in the timing gear case due to improper meshing of timing gears.

(f) If the engine is speeded up suddenly and the throttle closed quickly, a knock resulting at the instant the throttle is closed will usually indicate a loose flywheel.

(g) The spark knock is a result of too early ignition, the spark being timed or advanced too far. It can be corrected by retarding the spark. It sounds like a carbon knock.

(h) Pre-ignition caused by overheated engine cylinders will result in lack of power, a heavy knock and excessive vibration.

(k) A knock produced by excessive valve tappet clearance is very light, being more of a click than a knock.

(l) A chipped cam or tappet roller may be detected by placing one's finger on the valve tappet while the engine is running, to determine if the tappet movement is smooth.

(m) After the front end flanges of the crankshaft bearings have been worn by the thrust of the clutch being released, the crankshaft will move lengthwise through the bearings, producing a knock as the limit of travel is reached. This knock may be located by pushing down clutch pedal, thereby pulling shaft back and holding it against the front flanges of bearings.

(n) A camshaft moving endwise will produce a knock somewhat similar to a light connecting rod knock. As the engine speed is increased, the camshaft is held in one position by the additional power required to drive it and the knock usually ceases. The camshaft gear plate may be removed and pressure exerted on the end of the shaft holding it back against the front flange of camshaft bearing, thereby determining if end play is producing the knock.

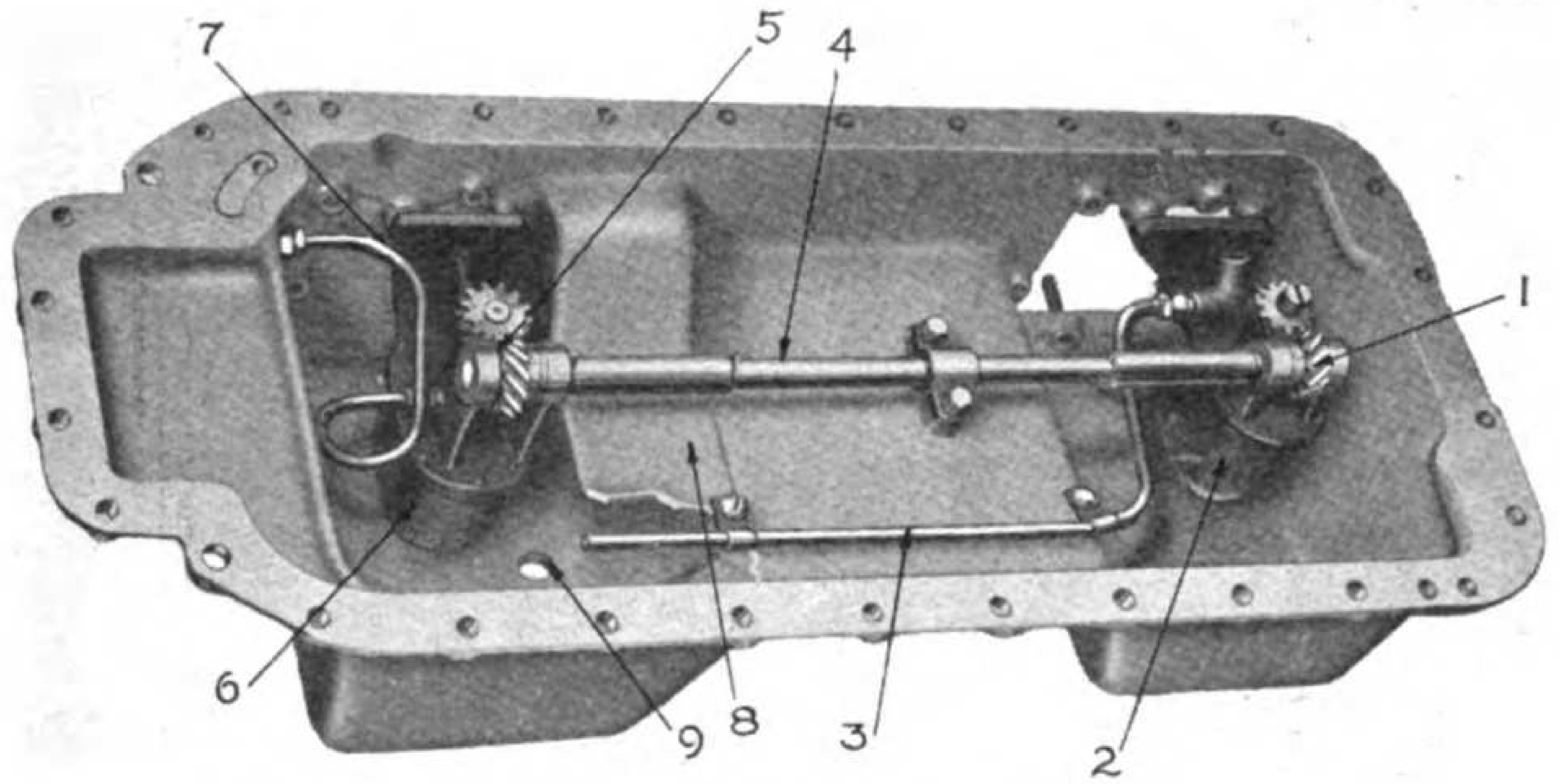
NOTE: The camshaft is driven by a helical gear.

(o) A burr or chip in the gear teeth will give a periodic knock.

OIL PUMPS

There are two gear oil pumps, one in each sump of the oil pan. The front pump is for priming and the forward pump delivers the feed to the pressure oiling system. The front pump is driven off the camshaft by a 45-degree spiral gear, 12-tooth, 12-pitch, through a vertical shaft. The drive for the rear pump is taken off this vertical shaft by a horizontal shaft through a set of spiral gears.

Plate No. 17



OIL PAN AND PUMPS

1. Drive gears for oil priming pump.
2. Screen for oil priming pump.
3. Oil priming pipe.
4. Oil delivery pump driveshaft.
5. Oil delivery pump drive gears.
6. Oil delivery pump screen.
7. Oil delivery lead.
8. Oil retaining wall in delivery sump.
9. Oil delivery sump drain hole.

ACTION OF OIL PUMPS

The oil pump in the sump at the flywheel end of the engine delivers the oil through a feed pipe to the rear sump which it keeps supplied. This second sump has a horizontal shelf which keeps oil in it in spite of a severe tilt of the tractor. This pump forces the oil through a main lead to the rear end main bearing, where it enters the bearing, and also the crankshaft, which is drilled to receive it. The oil is forced through the crankshaft to each main bearing and then through the drilled cranks to each lower rod bearing. Up the side of the rod is a tube which carries the oil to the piston pins. The camshafts are lubricated by separate leads at each bearing. The pistons and cylinder walls are lubricated by the spray from the ends of the connecting rods.

TO CLEAN OILING SYSTEM

To properly clean the oiling system, the lower half of the crankcase must be removed as the dirty oil and sediment in the troughs beneath each of the four connecting rods cannot be properly cleaned otherwise. Before removing the lower half of the crankcase, the two plugs in the base of the case should be removed and the oil allowed to drain out. Then replace the two plugs and pour two gallons of kerosene oil into the crankcase through the oil filler (at the left front end of engine), start the engine and run it slowly for only twenty seconds, thereby flushing the oil ducts, pipes, bearing oil grooves, and entire interior of case, pistons, rods, etc. Drain off and discard this kerosene and refill with 4 gallons of new cylinder oil.

Plate No. 18

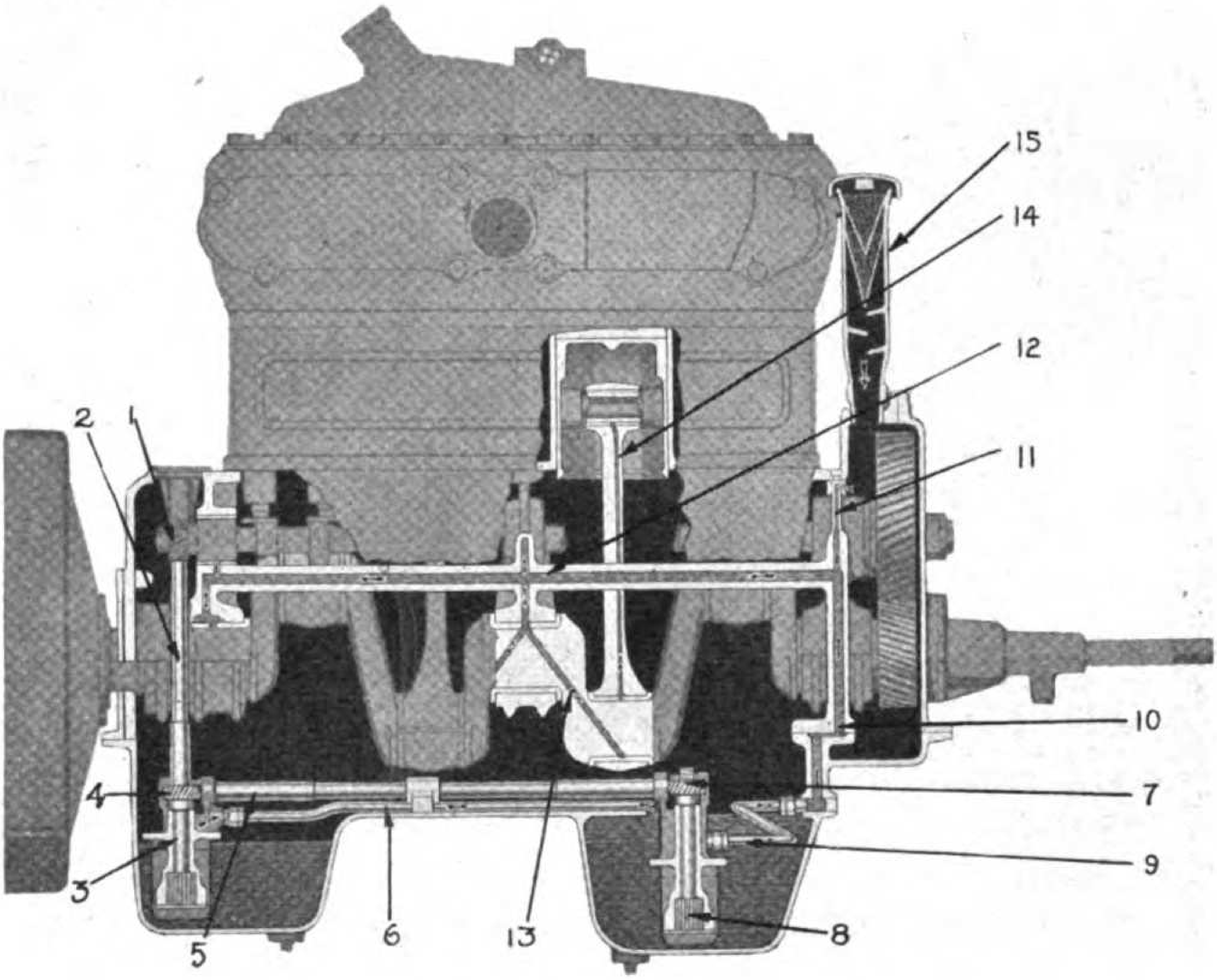


DIAGRAM OF OIL PASSAGE

1. Priming pump drive gear on camshaft.
2. Priming pump drive shaft.
3. Oil priming pump.
4. Oil delivery pump drive gear.
5. Oil delivery pump driveshaft.
6. Oil priming lead.
7. Oil delivery pump drive gear.
8. Oil delivery pump.
9. Oil delivery pipe.
10. Oil delivery lead.
11. Oil lead to timing gears.
12. Oil lead to main bearings.
13. Oil lead to lower rod bearings.
14. Oil lead to upper rod bearings.
15. Oil filler pipe.

If more extensive cleaning is advisable remove the base and oil pump intake screen, clean thoroughly, but before replacing same, examine all bearings, nuts, bolts and cotters. The oiling system should never be cleaned or flushed with gasoline, as it will destroy the glaze on the surface of the bearing and the shafts, causing friction and damage.

OIL LEVEL GAUGE

The oil level gauge permits the driver to conveniently ascertain the quantity of oil held in the oil base of the engine.

It is fastened to the crankcase between the cylinders on the exhaust side of the engine. It is a rod which can be pulled out. It is marked for full and empty levels. It shows full when there are 4 gallons in the case and empty when there are 1½ gallons.

BREATHER

The breather tube permits of the entrance of oil into the crankcase, and also affords a means of filling the oil base. It is aluminum casting bolted on to the top of the crankcase.

OIL TEST COCKS

Inasmuch as the outer end of the oil test cocks are in an exposed position, the outer end of the hole may become plugged with mud, preventing any oil being drained out to test oil level within the crankcase. The petcocks should be closed, and the mud then dug out with a wire. There is a cock for high, and another for low level on the priming pump sump. There is also a pressure test cock on the side of the case.

TO REMOVE OIL PUMPS

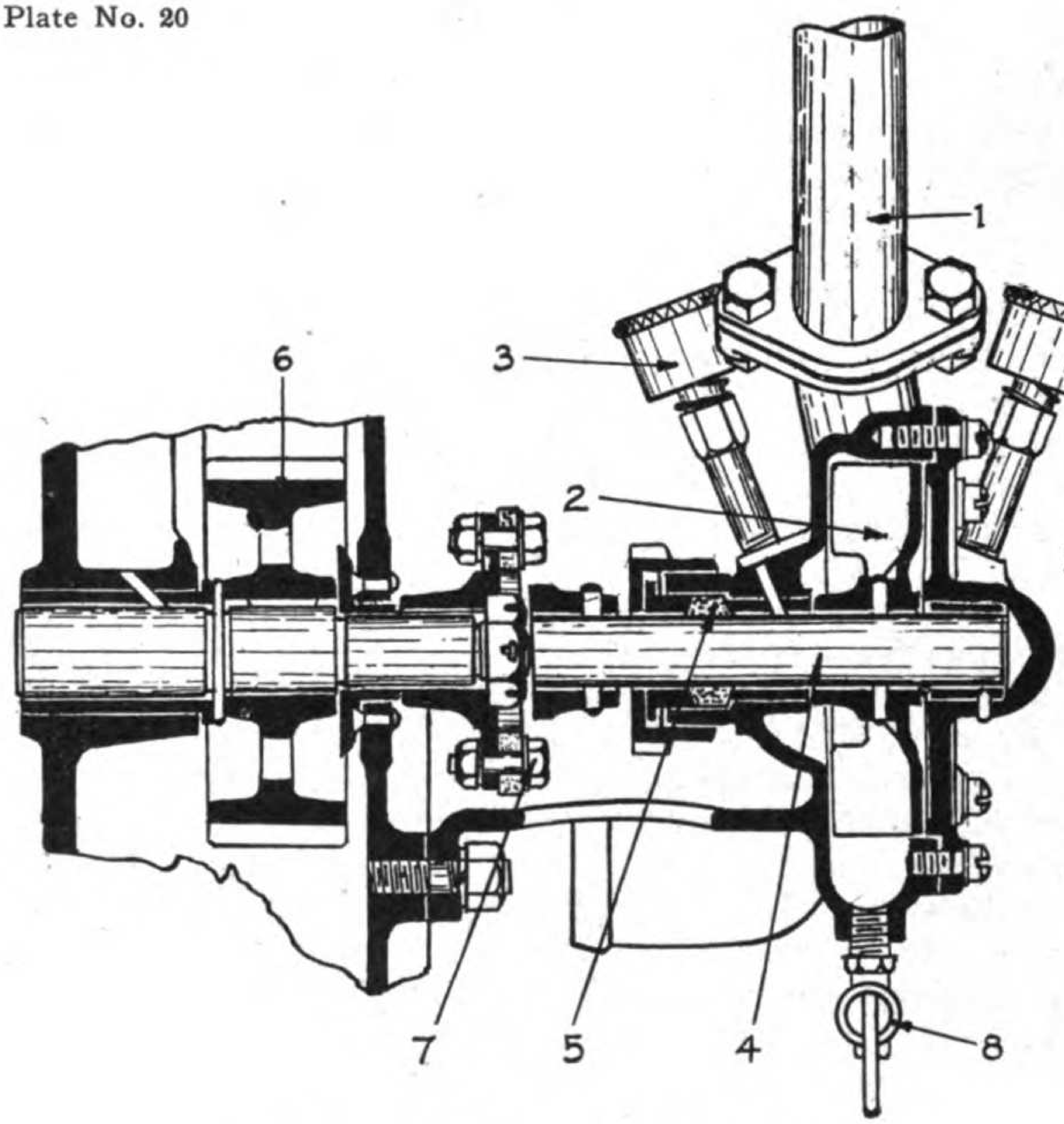
The oil pumps can be removed through the hand holes on the side of the sump. The six stud nuts which hold the cover plate in place are taken out, and the plate removed. This discloses the oil pump which is bolted to a web in the bottom pan. On removing the bolts from this web and lifting the vertical shaft which drives the pump, and also disconnecting the oil lead by loosening the union nut, pump can be taken out through the hand hole. To reinstall it, it is slipped back into place, the vertical shaft allowed to mesh into the driving notch or key way, the stud nuts replaced and finally the union to the pipe lead connected. The horizontal shaft which transmits the drive from the priming pump

Plate No. 19

OIL LEVEL GAUGE

1. Oil level gauge plug.
2. Oil level gauge handle.
3. Crankcase wall.

Plate No. 20



WATER PUMP AND WATER PUMP DRIVE

1. Water delivery pipe.
2. Water pump impeller.
3. Water pump grease cup.
4. Water pump shaft.
5. Water pump packing.
6. Water pump drive gear.
7. Water pump drive flange coupling.
8. Water pump drain cock.

to the oil delivery pump can be removed through the hand hole also, by pulling out the broached ends of the shaft which form the driving connection. The guide for this horizontal shaft is bolted to the pan between the two sumps, by means of two studs. To remove this it is necessary to drop the pan.

PRESSURE TEST COCK

A pressure test cock is located on the side of the crankcase, in communication with the main oil pressure. This can be opened to test the flow through the engine lead. It should be cleaned before it is used.

WATER COOLING SYSTEM, CENTRIFUGAL PUMP

Water is circulated through the jackets of the engine and through the radiator, by a centrifugal pump, located on the timing gear case, and driven off the timing gears. The pump impeller is a bronze casting 3 63/64 inches in diameter, with six blades, having a face width of 31/32 inch. The pump shaft is ¾ inch in diameter, driving the impeller through a key. The water pump cover is cast iron, held in place by eight bolts. A manila paper gasket .008 inch is used to keep the cover water tight. A stuffing box is located integrally with the bearing on the pump shaft, and there are two grease cups, one in front of, and one behind the pump, which should be given daily attention.

OUTLET MANIFOLD

The outlet manifold is a casting bolted to the top of the cylinder blocks, and connected through a hose to the top of the radiator.

This manifold conveys the water from out the cylinder jackets into the top of the radiator.

INLET WATER MANIFOLD

The water pump by centrifugal action draws the water from the bottom of the radiator through a hose connection, forcing it through the inlet water manifold, which is located underneath the valves, into the water jackets of the cylinders. It has an inside diameter of 1¼ inch.

The water leaves the water jackets of the cylinders through the outlet casting bolted to the tops of the cylinders, and then goes back into the radiator through a hose connection.

TO PACK WATER PUMP GLANDS

The water pump gland (packing box of the shaft) should be packed with a good grade of waterproof asbestos or compounded packing. If asbestos loose twisted rope packing is available, untwist one strand, soak it thoroughly with cylinder oil, and cover with as much fine graphite as it will retain.

Always coil the packing around the shaft in the direction of rotation of the packing nut, so it will not tend to unwind when the packing nut is screwed on.

If only square or round braided packing of too large size is available, cut off a piece of about the desired length, place it between the jaws of a bench vise, squeeze it out flat, and then cut off a strip of the desired width with a pair of thin snips or heavy scissors.

The gland nut should not be tightened any more than necessary to prevent leakage of water.

RADIATOR

The radiator is a vertical tube type, in which an L shaped nest of copper tubes is housed within a pressed casing. The width of the radiator is 32¼ inches. The total depth of the case, including the fan space, is 10⅞ inches, and the depth of the center tube space 7 11/16 inches. The number of tubes is 1324. The case is of 16 gauge terned plate, and the tubes are 3/16 inches overall diameter, by 20 B. W. G. seamless copper tubing. The vent tube is ⅜ inches by 26 B. W. G. seamless copper tubing. The radiator is mounted in the body on angle strips, on which a rubber pad or strip is mounted to assist in absorbing the shocks. The rubber hose connection at the top of the radiator is 2 x 9 inches, ordnance standard, and at the bottom 2 x 1½ inches, ordnance standard. The radiator inlet and outlet, on which the rubber hose is fastened, are cast brass.

TO REMOVE RADIATOR

To remove the radiator, first drain and disconnect the water leads, and then take out the bolts holding it to the two supporting angles. When these bolts are removed, the radiator can be lifted out of the tractor through opening made by removing the top armor plate.

TO FLUSH OUT COOLING SYSTEM

After an extended period of use, the entire cooling system must be flushed out by means of a forcible stream of water. This should flow through the system in the reverse direction from which water is forced through by the water pump during service.

To flush out the system, the connection from the water pump to the lower water pipe extension should be removed and a stream of water turned into the radiator through the unplugged hole in the front of the bottom radiator header. The water should flow upwards through the radiator and through the cylinders and pipes in the reverse direction from normal, thus flushing all loose sediment out through the water pump.

COOLING SYSTEM TROUBLES

A sheared water pump key, lack of sufficient water in cooling system, sediment, old hose lining obstructing the water passages, or a frozen water line, will all cause the engine to overheat.

TO TEMPORARILY REMEDY DEFECTIVE WATER PUMP

In case of a damaged or inoperative pump the water pump rotar should be removed from the pump to prevent its obstructing the passage as the water thermo syphons through the system. The cooling system must be full to insure circulation under these conditions, which are produced by the water boiling. Necessarily this is a temporary arrangement, as water is lost rapidly.

RUBBER HOSE CONNECTIONS

The two rubber hose connections between the water pump and water pipe and the water pipe and radiator, are 1.5 inches inside diameter and 4.5 inches long, with a wall .1875 inches thick.

The rubber hose connections between the upper water manifold and the top water pipe is 2 inches inside diameter by 9 inches long, with a wall .1875 inches thick.

A heavy walled hose is always used at the water pump intake to prevent the vacuum produced by the pump from pulling the hose in flat, thereby obstructing the flow of water and preventing the proper cooling of the engine. A brass tube No. 18 B. W. Ga. .049, 1⅛ inches diameter, and 19.825 inches developed length connects the pump with the rubber intake hose.

TO DRAIN THE WATER SYSTEM

The water cooling system should be drained by opening the pet cock on the water pump and the plug on the bottom of the radiator.

TO PREPARE RADIATOR PARTS FOR SOLDERING

Before soldering copper, (of which the radiator, tubes and tube headers are made) the parts must be cleaned until bright, with a wire scratch brush, scraper, file or emery cloth, then they must be coated with a "soldering flux" to remove all grease and foreign material.

Soldering flux is sometimes referred to as "Cut Acid," since a very satisfactory flux can be prepared by dissolving zinc (from an old dry battery if necessary) in muriatic acid, until all gassing ceases. If extra strength muriatic acid is used in making cut acid, it should be diluted with about an equal volume of water before adding the zinc. If the gassing does not occur at once, heating the acid will assist the action.

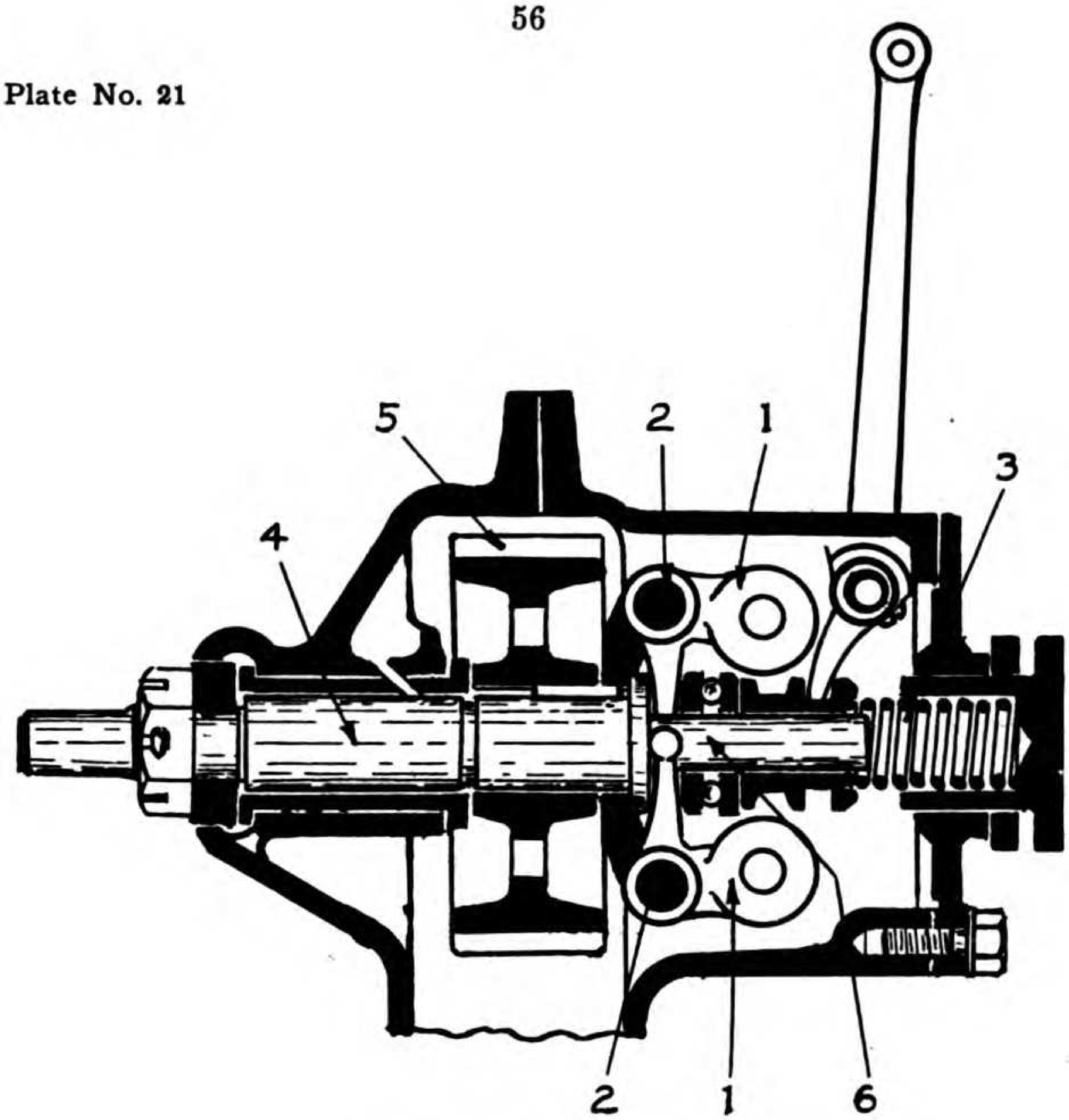
In this connection, always pour acid into water, but never pour water into acid, as, if the acid is very strong, a rapid sputtering may throw acid.

Clean, bright tin can be soldered by using powdered resin for a flux, or tallow.

Cast iron, malleable iron, steel and black iron, or sheet iron, should be scraped bright, then cleaned with sulphuric acid before applying the cut acid. This being done, solder as for copper. In the case of cast iron, the parts being soldered must be heated.

The essentials of good soldering are sufficient heat, cleanliness of the parts to be soldered and of the soldering copper, or "iron" as it is usually called, and purity of flux or cut acid.

Plate No. 21



GOVERNOR ASSEMBLY

1. Governor weights.
2. Governor weight pivot.
3. Governor adjusting spring.
4. Governor shaft.
5. Governor driven gear.
6. Governor shaft spindle.

The soldering iron should be filed bright, then tinned with solder, after being cleaned with salamoniac. If this is unavailable cut acid will work fairly well.

Always have the soldering iron hot enough to heat the work, but never permit it to get red hot, since that will cause the solder to attack the copper, producing hard solder which only melts at near a red heat, and is useless for soldering purposes. In case an iron is burnt, file it freely.

The best solder for most jobs is known as half-and-half, being composed of equal parts of tin and lead.

TO THAW FROZEN PUMP

During cold weather, after an engine has been stopped for a sufficient time to permit any water in the cooling system to freeze, the engine should not be turned over with a crank until it is ascertained that no water has collected in the water pump, and frozen the pump rotar to the pump housing. The pump may be warmed with a gasoline blow torch, hot water or cloths soaked with hot water may be applied to the pump.

GOVERNOR

The governor is a centrifugal type and is mounted on the magneto gear shaft, on the exterior of the timing gear case. Keyed to the magneto shaft is a spider, which revolves with it. Pivoted to this spider are bell cranks with weights on their extremities. As the speed increases the weights on these bell cranks tend to fly from the center, due to the influence of centrifugal force. As the weights move from the center, the bell crank swings about the pivot of the spider and the inner end of the bell crank moves along the shaft pushing a sleeve along the shaft, and in turn moving a lever which is linked to the throttle. This lever is pivoted and at its outer end is the linked connection to the throttle. The movement of the sleeve along the shaft is resisted by a coil spring, and the adjustment of this coil spring determines the speed at which the throttle is effected by the governor.

GOVERNOR DRIVE DETAILS

The magneto drive gear is a forging from .20 to .30 carbon steel. It is keyed to the magneto drive shaft, which is of .15 to .25 carbon open hearth steel 8¼ inches long. It runs in a phosphor bronze bushing, contained in the aluminum governor housing. The spider holds the lever weights on a pivot which is a drop forging. The weights are also forgings, and are heavy at their outside extremities, while at their inside extremities the bell crank arm works against a thrust bearing, which in turn pushes before it the lever sleeve. The lever sleeve is cast iron 1⅛ inches long. It has a collar form, upon which to carry the throttle lever. The lower lever link is 1½ inches long, and the upper 5¼ inches long. These throttle levers are forgings.

GOVERNOR ADJUSTMENT

Governor adjustment is secured by compressing the piano wire spring which resists the movement of the sleeve. The spring is under 30 pound load when compressed to 1 ½ inches. When under no load it has a free length of 1$\frac{15}{16}$ inches. It has a diameter of ⅞ inches. There is a plug which screws into the spring retainer and provides the adjustment of this spring. When the plug is turned to the right it compresses the spring and raises the speed at which the governor comes into operation. The plug is of cold rolled steel with 1⅜—16 thread and a 1¾ inch nut on the end for adjusting. A 1¾-inch cold rolled steel lock nut is also proveded to hold the adjustment.

The magneto shaft is coupled to the gear shaft by means of a flexible coupling. It revolves in a clockwise direction.

PLATINUM CONTACTS

The platinum contacts of the make and break mechanism should be occasionally cleaned with gasoline, and thoroughly dried before starting the engine.

The proper break or gap between the breaker platinum points when they are at the point of maximum separation is .012 inches. This distance should be measured with a thickness gauge, one of which is supplied with the magneto.

SPARK PLUGS

The spark plugs are located over the intake valve so that they will be cooled and cleaned by the incoming charge, and being so located the fresh charge will ignite more readily than would the foul gases surrounding the exhaust valve. Spark plugs are of standard size and thread.

The proper width of gap between the spark plug points (in the cylinder) is between 1/64 and 1/32 inch.

If the spark plug gap is less or more than this, uncertain ignition results.

With the engine running and the spark plug gap wider than it should be, the engine will miss fire when attempting to accelerate same rapidly, or when running slowly with a wide open throttle and heavy load. Inasmuch as the strength of the spark increases with the speed of the engine, a gradual opening of the throttle may not cause failure of ignition from too wide a gap.

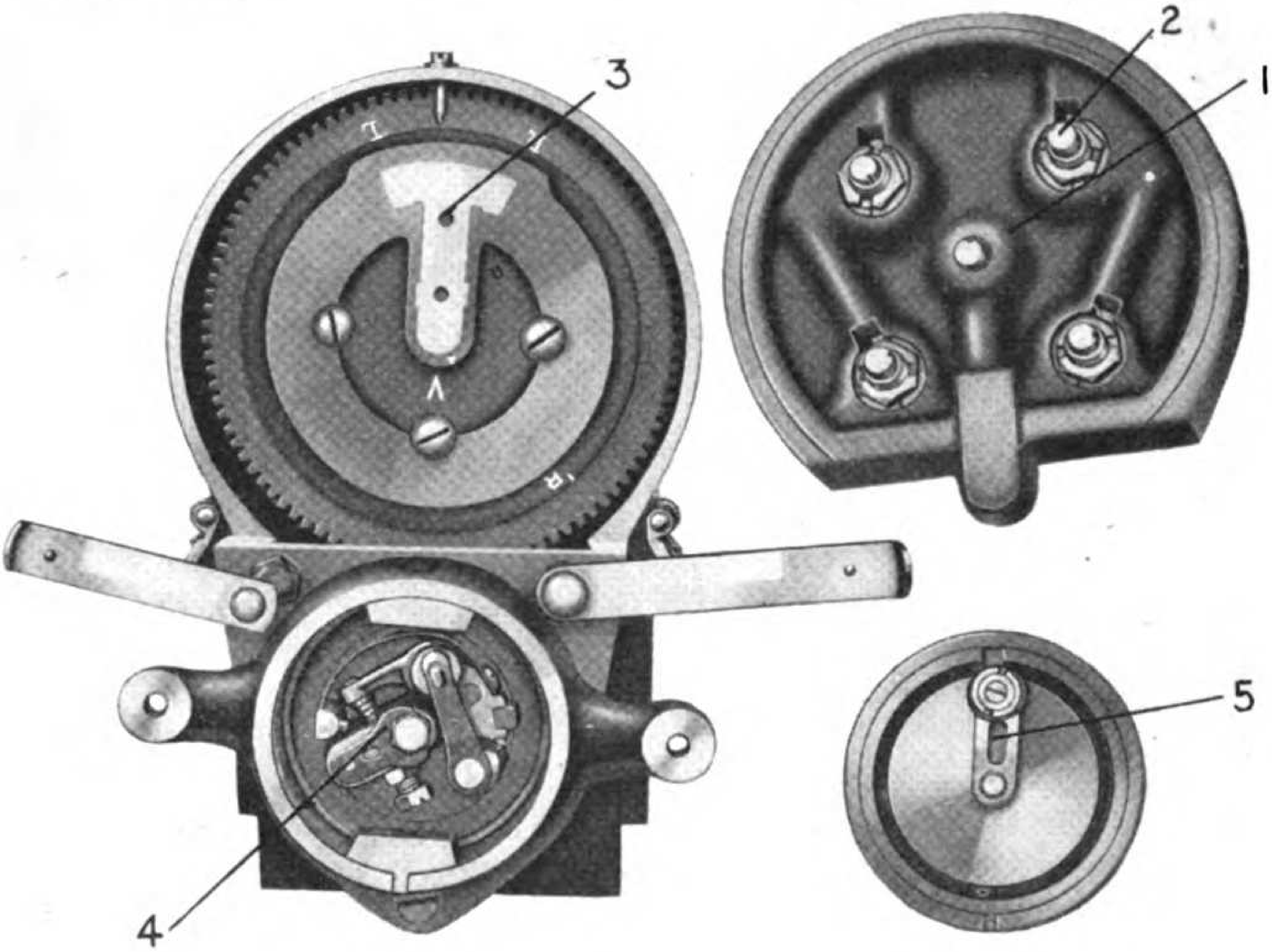
When the spark plug gap is too small the engine will probably start easily, but will apparently miss at extreme high speeds, especially if the load is light, as the spark though really strong is so short that it does not ignite the mixture properly. When the throttle is almost closed and the engine is idling, and the gas in the cylinder is not compressed, a comparatively larger spark is required to ignite the charge than at any other time.

TO CHARGE MAGNET

Ordinarily magnets will not become discharged except after a long period of service, or if they have been removed from the magneto without taking the precaution of placing an iron keeper or magnetic conductor across the two ends of the magnet.

When the magnet must be recharged and no electro-magnet for charging purposes is at hand, the work may be done with the aid of a storage battery and a length of insulated wire from 10 to 15 feet long, and of most any gauge between No. 8 and No. 18.

Plate No. 23



MAGNETO BREAKER AND DISTRIBUTOR

1. Distributor cover plate.
2. Distributor brush.
3. Distributor segment.
4. Breaker mechanism.
5. Breaker box cover plate.

Attach one end of the insulated wire to the positive terminal of the storage battery and wind half the wire in the clockwise direction around the North pole of the magnet, and in an anti-clockwise direction around the negative end of the magnet (looking at the free ends of the magnet).

To charge the magnet, the free end of wire should be touched to the (negative) battery terminal for about two seconds (not longer), then withdrawn, this operation being repeated about a dozen times. Striking the magnet severely when the current is on with a light weight piece of steel such as a bolt or small wrench will materially assist in increasing the degree of magnetization that will be attained.

A keeper or cross section about equal to cross section of the magnet should be put across the ends of the magnet while charging and removing the wire. Do not remove the keeper until the magnet is mounted on the magneto with the armature in place.

TO PREVENT REVERSAL OF POLARITY

If the magnet is charged by above method, there will be no danger of a reversal of polarity, but if the magnet is to be recharged with an electro-magnet it should be suspended above the electro-magnet by a string tied at the top or bend in the magnet so that the ends will hang down toward the ends of the electro-magnet. The magnet to be charged will assume its choice of position above the electro-magnet, the North pole of the electro-magnet attracting the South pole of the magnet to be charged. The current should be switched on and off about a dozen times. The magnet being tapped severely with a piece of steel as mentioned above.

TO TIME MAGNETO

To time the magneto, turn the crankshaft with the hand crank until the mark 1 and 4 top dead center appears under the pointer. Leave it in this position. As the spark occurs when the primary circuit is broken by the opening of the platinum contacts on the breaker mechanism, it is necessary that the magneto should be so timed that at full retard position of the timing lever body the platinum contacts just begin to open when the respective piston of the engine has reached its highest point on the compression stroke. Remove the distributor plate from the magneto and turn the driving shaft until the setting mark on the distributor disc is in line with the setting screw as shown on page 60. As magneto rotates clockwise use setting mark "R." With the armature in this position, the platinum contacts are just opening, and the metal insert of the distributor disc is in connection with carbon for No. 1 cylinder. The driving medium must now be fixed to the armature shaft without disturbing the position of the latter, and the cables connected to the spark plugs.

WIRING

The attaching of the cables to the spark plugs must be made in accordance with the firing order of the motor. For connection between switch and magneto, see page 58. The proper fastening of the cables is of great importance, in order to prevent water making a short-circuit between the connections. Page 58 illustrates how these cables should be attached. This internal method of attaching the cables is intended to protect the terminals and makes a watertight and solid connection.

THE CONDENSER

The condenser is constructed of two insulated series of layers of tinfoil, connected in parallel across the platinum breaker points; each series consists of about 250 sheets of tinfoil insulated from each other, and alternating with the layers of the other series, the whole acting as a reservoir for the primary current.

The action of the condenser results in intensifying the secondary current nearly 25 times by preventing an arc at the platinum breaker points when they are separated. An arc at the points acts as an electrical cushion to the interrupted flow of electricity, and thus the magnet would give a much weakened spark.

TO CLEAN DISTRIBUTOR

The distributor may be cleaned of carbon and dirt, with several drops of lubricating oil rubbed on, either with a finger or a bit of waste or cloth. This will loosen the carbon after which the distributor may be wiped clean with a small piece of waste.

TO TIME DISTRIBUTING FINGER

If the distributor wheel has been removed, it should be replaced with care. The distributing finger should be so timed that regardless of the amount of breaker box advance, or retard, the spark will always occur while the finger is under a carbon brush. This may be set by advancing the breaker box ½ of its full travel and rotating armature shaft in the direction of rotation (anti-clockwise) until the platinum breaker points just begin to separate. The distributor wheel should then be replaced so that the center of the distributor finger comes directly under the center of a carbon brush.

TO INSTALL NEW PLATINUM POINTS

When the platinum points have been worn down by service or excessive filing, and new ones must be installed, if it is possible to secure them already mounted, such should always be done.

If unmounted points only can be secured for replacement, they are usually supplied with a small round teat 1/16 inch diameter on the back of point. To mount point, drill a 1/16 inch diameter hole 3/32 inch deep in the mounting and solder point on (sweat on), filing off any excess solder. If soldering equipment is not at hand, the point may be mounted temporarily by squeezing teat out of round with a pair of pliers and forcing into hole.

The point should be soldered in at the first opportunity as it may work loose, and cause trouble which is very difficult to find. After the points have been mounted, they should be adjusted with a maximum break of .012 inches and the points must bear evenly all over on their face (i. e., in contact with each other), being filed if necessary to secure square contact.

If a platinum point cannot be obtained, a nickel or silver point produced from a coin will make it possible to run, but the engine will show very little power.

TO MAKE A TEMPORARY MAGNETO BRUSH

A temporary magneto brush can be made from a piece of carbon taken from the positive terminal of an ordinary dry battery or an old electric light carbon, or may be made from any soft metal or by rolling very tightly a small strip of brass wire cloth.

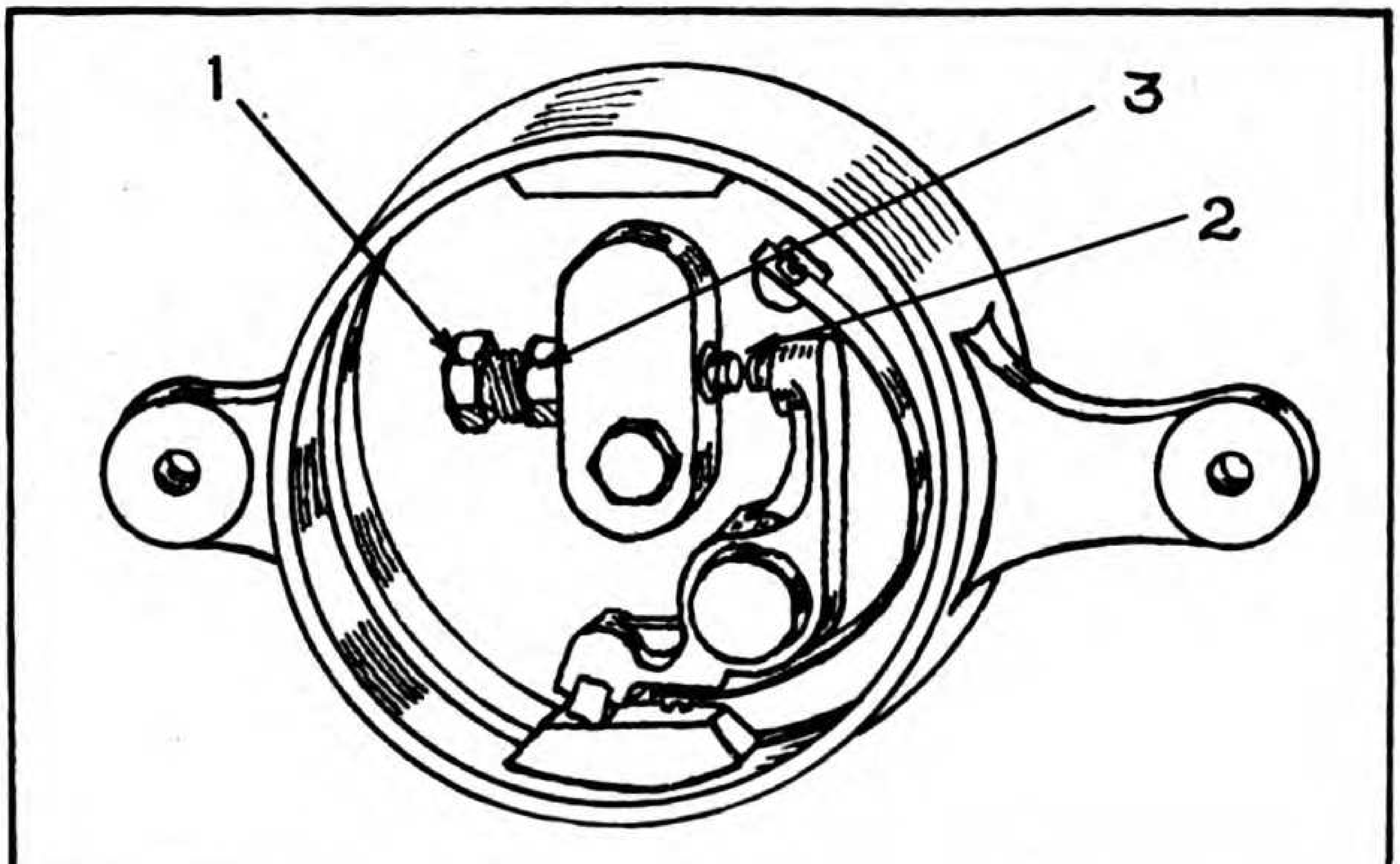
OILING MAGNETO

It is impossible to place too much importance on the judicious oiling of the magneto. Hence, remember that the following instructions are of vital importance to the efficiency of the instrument in general and to the life of the contact points in particular.

For lubricating the ball bearing at the breaker end, two oil wells with hinged covers are provided, one on each side of the housing, just back of the timing arm. Both of these lead to the same bearing and only the one which is the most accessible should be used. This well should positively not receive more than one drop every month or so. Good, clean cylinder oil will do, but DO NOT OVER-OIL AT THIS POINT if you wish to avoid trouble.

At the driving end two oil holes will be found. The larger one leads to the plain bearing carrying the distributor shaft and should be given about 15 drops every month or so. The smaller hole leads to the ball

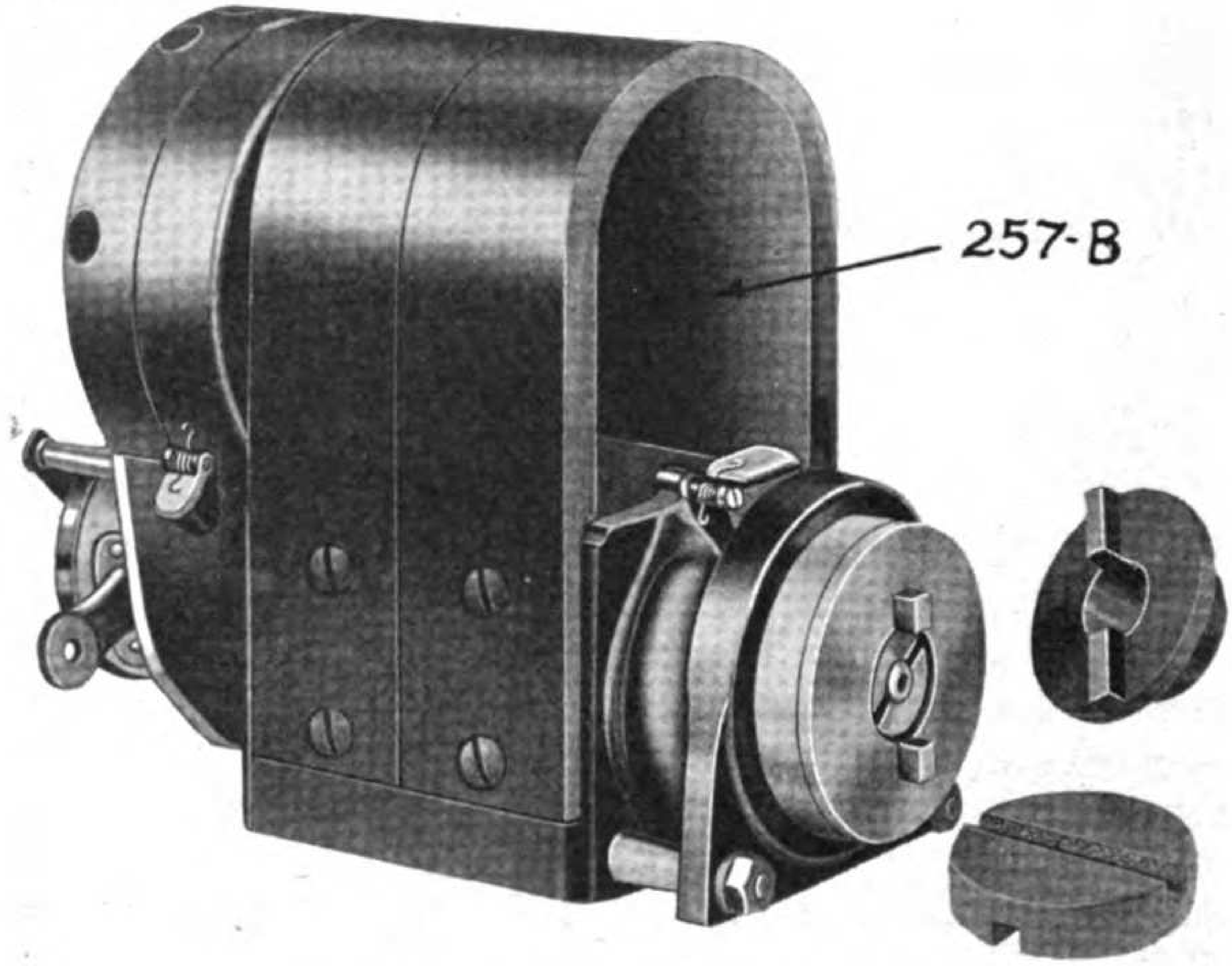
Plate No. 24



BREAKER ADJUSTMENT

1. Adjusting nut. 2. Breaker gap. 3. Adjustment lock nut.

Plate No. 25



MAGNETO WITH IMPULSE STARTER

bearing at the driving end, and should receive 4 or 5 drops in the same period.

CLEANING MAGNETO

The contact points of the breaker mechanism, and, in fact, the entire breaker itself, should be thoroughly cleaned with gasoline as often as they accumulate even a trace of oil or dirt. The distributor rotating disc, the carbon brushes and the collector ring should likewise be cleaned occasionally with a soft cloth moistened with gasoline. For obvious reasons all the parts should be allowed to dry before attempting to run. The contact points should be inspected occasionally to see that they are clean and flat, and also that the maximum gap between the points is in accordance with the gauge on the special adjusting wrench, or about 0.012 to 0.014 inch.

IGNITION TROUBLES

If the engine misfires or refuses to start, and the ignition is suspected, it should be found out first whether the trouble lies in the magneto or in the spark plugs. The latter should be examined first, as they are the most frequent cause of trouble.

SPARK PLUG TROUBLES

If the missing is in one cylinder only or in different cylinders, the corresponding spark plugs should be examined to see that the gap is not too large. This gap between the electrodes should be between 1/64 and 1/32 of an inch. In no case should it exceed 1/32 of an inch. On the other hand, a gap less than 1/64 of an inch is liable to cause missing at low throttle opening. Also, the spark plug may be short-circuited through carbon or oil, or the insulation may be cracked. Cleaning with gasoline or replacing is the remedy.

CONTACT POINT TROUBLE

Clean same with gasoline until the contact surface appears quite white, or, if pitted, use a fine file—but very carefully—so that the surfaces remain square to each other. For this purpose a special file may be procured from us at a nominal cost. The correct gap of the contact points is .012 inch. As these contacts wear away in time, they should be regulated by giving the adjustable screw a forward turn, care being taken to securely tighten the lock nut. This can be accomplished, without removing the timing lever or breaker mechanism, by means of the combination wrench which is furnished with each magneto and which includes a gauge for the regulation of the gap between the contacts. It is very essential that this gauge be used as the gap is very deceptive when judged by eye alone.

If the contact riveted to the rocker-arm, or that of the adjustable screw should be worn down entirely, it would necessitate a change of either or both. When the adjustable screw is replaced or adjusted, care must be taken that the lock nut is securely tightened in place.

WIRING CHECK

The wiring should be carefully examined and checked in accordance with the firing order of the engine. If cables are cracked or chafed, they should be replaced. All connections must be kept clean and tight.

IMPULSE STARTER

Starting is accomplished by automatically compressing and releasing a powerful spiral spring which is a part of the driving mechanism, and which gives the armature a sharp twist and thus causes the spark to occur at the proper moment. The device does not have to be set by hand, and above 180 R. P. M. is automatically drawn out of action.

All working parts are hardened and fully enclosed. The device incorporates, at its driving end, a composition flexible Oldham style coupling which, however, is not essentially involved in the action of the impulse starter proper.

The mechanism consists of but five essential members (page 64)—a housing, which is attached to the magneto shaft; a driving member, which is itself driven by the engine; a spiral spring, hooked to the housing and the shaft; a floating member or trigger; and a fixed bar which is mounted on the base of the magneto.

When the motor is slowly cranked, the trigger drops by gravity, engages with the bar and thus temporarily prevents rotation of the housing. As the cranking continues to turn, the spring is compressed or "wound up," until the cam strikes the wedge. This forces the trigger upwards until it slips off the lower bar, thus releasing the housing and allowing the heavy pressure stored in the spiral spring to give the armature a very sharp twist forward. This action causes the magneto to produce a powerful spark which should start the engine.

After the release and in the normal running position, stops are provided on the housing and the outer part for preventing the armature from being thrown past the normal position.

Should the impulse starter be rendered inoperative for any reason, an emergency locking device is provided for preventing the trigger from dropping into the notched bar and thus holding it locked into the driving notch. In this manner the engine may continue to operate with merely a temporary interruption, until repairs can be conveniently made.

CARE OF IMPULSE STARTER

The impulse starter needs no attention, beyond an occasional inspection to see that the notched cross bar at the bottom is free of dirt, gummed oil, etc.

Oiling is unnecessary for a period of almost two years, and, in any case, only a light, non-gumming oil, such as 3-in-One, should be used. *Under no circumstances must the internal mechanism be oiled with a heavy cylinder oil or packed with grease, as the device will immediately be put out of operation by such procedure.*

The emergency locking device may be engaged, when necessary, by proceeding as follows: Turn the engine until the heavy scratch mark, to be found on the edge of the driving member, comes to the top. Next, rotate the housing as far as possible in the normal running direction or until the hole for the trigger comes opposite the scratch mark). In this position the trigger should drop into the "locked" or running position. The screw fastening the small locking plate should now be loosened, the plate swung parallel to the center line of the magneto, and the screw securely tightened again. It will be found that the locking plate will now prevent the trigger from engaging with the notched bar and the impulse starter may be operated as an ordinary coupling.

MAGNETO TESTING

If, after following previous instructions, the engine refuses to start, the magneto should then be tested by removing the distributor plate and resting a screw driver on the gear casing, holding same about $\frac{1}{8}$ inch from the collector ring. Then, if upon rotating the armature, a spark jumps across the $\frac{1}{8}$-inch gap, it shows that the trouble does not lie in the magneto, but in some other part of the engine, possibly in the carbureter.

But if a spark *does not* jump across the $\frac{1}{8}$-inch gap previously mentioned, the magneto should be sent to the nearest base equipped to make complicated electrical repairs.

EFFECT OF OIL IN CIRCUITS

In the primary circuit of the magneto, oil acts as an insulator. If oil works onto the platinum points, it will very materially weaken the spark given by the magneto, due to its interfering with the electrical operation of the points.

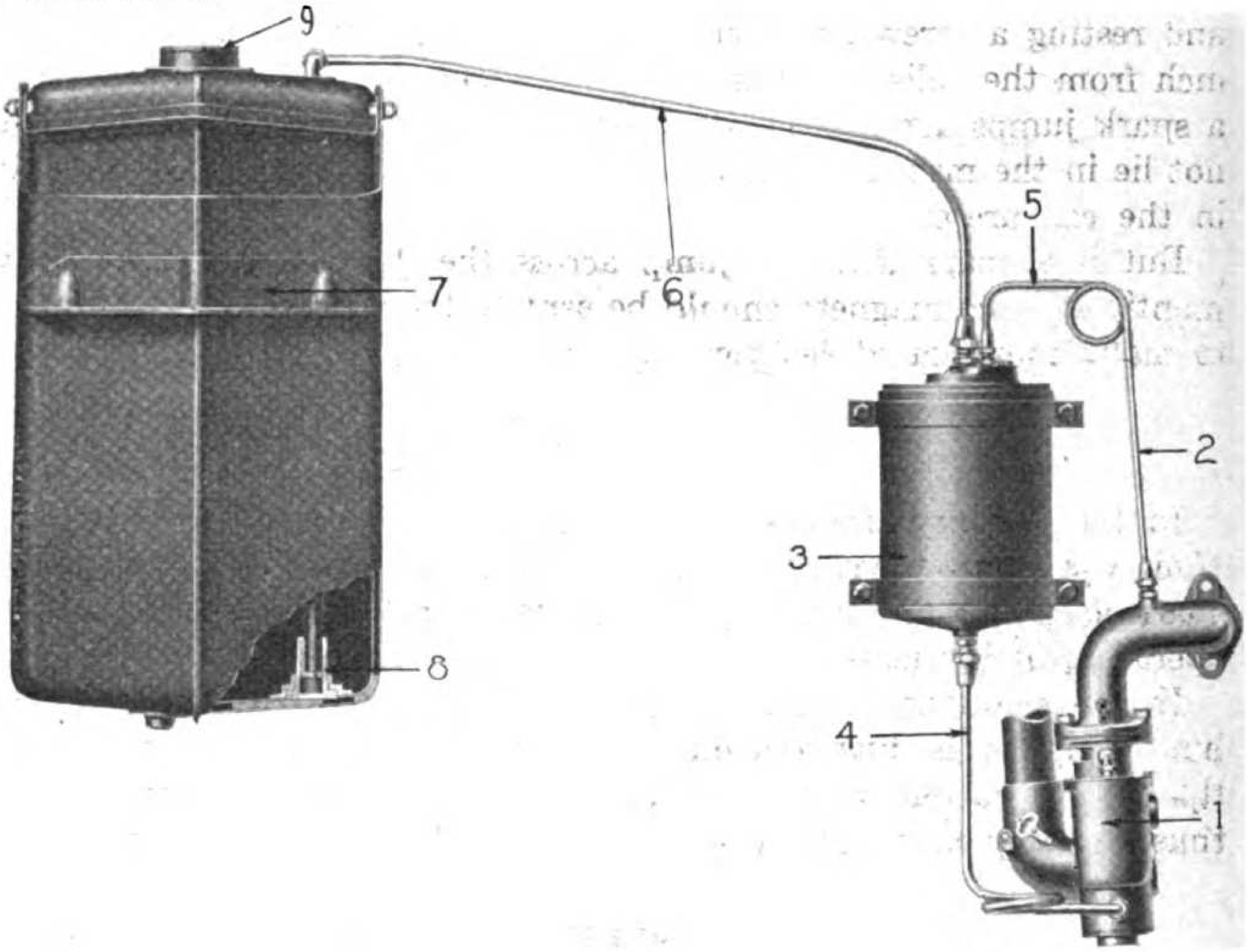
In the secondary circuit the oil itself will not act as a conductor, but inasmuch as dust and dirt is always collected on the surface of the oil, the current may flow over the dirt and dust held by the oil, thus effecting short circuit.

CARBURETER

The carbureter is a model A, Wheeler & Schebler, $1\frac{1}{2}$ inch type. The carbureter converts the gasoline into vapor, mixing it with the proper amount of air to produce a mixture that will rapidly ignite when in the combustion chamber of the engine. The air admitted to the carbureter is pre-heated by a stove surrounding the exhaust pipe, and then led through a pipe over the top of the engine to the carbureter intake. The gasoline is supplied through the carbureter by gravity from a vacuum tank, which will be explained later. (Explained in detail on page 73).

The carbureter is bolted to the intake manifold by means of a horizontal flange and two standard bolts. The gasoline feed in the carbureter itself is controlled by a float which holds the level of the gasoline to approximately $\frac{5}{16}$ of an inch below the jet level. Gasoline flows from the float chamber to the central jet, which projects upward into a venturi passage from the neck of the carbureter. By the suction of the engine a high vacuum is created in the venturi, which causes a spray of gasoline to issue from the jet, and a column of air to flow past the jet, picking up the spray of gasoline, and giving the desired mixture. The jet is so arranged that air enters the top, assisting in forcing the gasoline spray from the nozzle or jet. There is an idling jet in direct communication with the float chamber, which gives an additional supply of gasoline for idling as well as for high speed. This jet enters the neck of the carbureter above the throttle, and when the throttle is closed provides sufficient speed to allow the

Plate No. 26



DISTORTED DIAGRAM OF FLOW FROM GASOLINE TANK

1. Carbureter.
2. Vacuum pipe.
3. Vacuum gravity tank.
4. Gasoline feed pipe.
5. Vacuum pipe.
6. Tank feed pipe.
7. Gasoline tank container.
8. Gasoline pipe screen.
9. Gasoline tank filler.

engine to idle. There are two adjustment points of the carbureter, one controls the flow through the idling jet, and the other controls the flow through the main jet. The adjustment of the main jet controls the running or high speed mixture. The float level is fixed at the factory, and need not be changed.

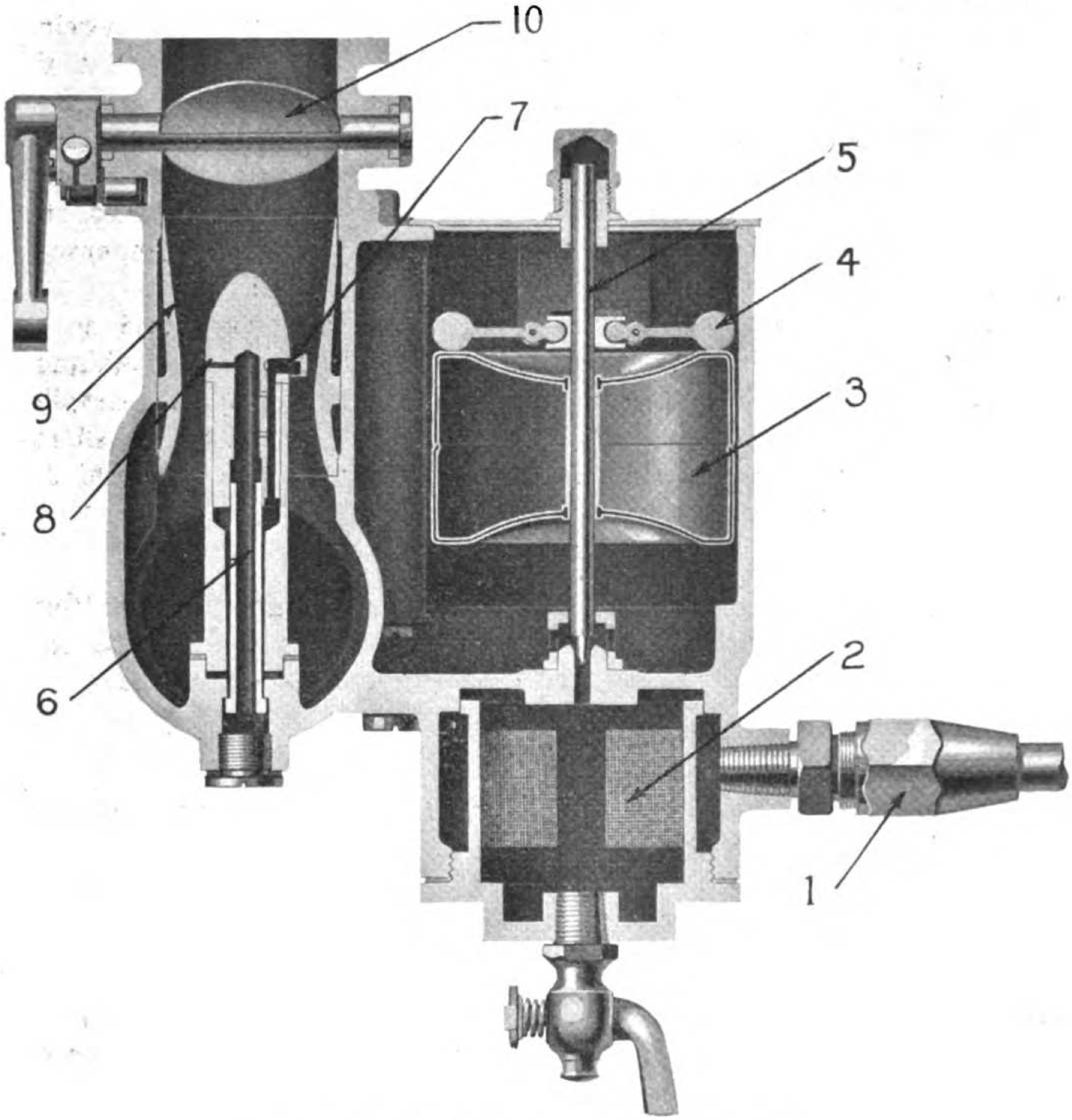
DUST CAP OUTLET

A small hole is drilled in the dust cap (over the float chamber) to allow free access of air above the gasoline or the escape of gasoline vapors in very hot weather. This hole must be kept free.

CAUSE OF FLOODING

The principal cause of the carbureter flooding is dirt or scale off the feed line or gasoline tank settling on the surface of the valve seat, preventing the valve from closing. This may be removed by un-

Plate No. 27



SECTION THROUGH CARBURETER

1. Gasoline feed pipe.
2. Gasoline strainer screen.
3. Float.
4. Float weights.
5. Gasoline feed needle valve.
6. Spray nozzle.
7. Air passage in nozzle.
8. Jet opening.
9. Venturi.
10. Throttle.

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screwing the dust cap and lifting needle valve, permitting the gasoline to flow in and wash the dirt off the seat. A less frequent cause of the carbureter flooding is a leaky float and the most infrequent cause is the float mechanism sticking.

TO DETECT AND REMEDY A LEAKY FLOAT

A leaky float will be detected by observing the low position of the float in the gasoline when the gasoline level is at a proper height. To remedy this, either a new float should be installed or an old float repaired. To repair heat the float slightly until the gasoline therein is expanded to a point where the pressure will force the vapor out of the very small hole, through which the gasoline has leaked into the float, thus identifying its location. As soon as this hole is found, enlarge same slightly so the gasoline may be drained out. After drying the float the hole should be soldered up, the outside filed off smooth. Avoid unbalancing or change of weight. For a temporary repair, soft soap or shellac may be used in place of solder.

If the float valve leaks, the trouble will probably be caused by a small dent in the float valve seat, preventing the float valve making contact over the entire surface of seat. To insure a good seat, simply remove dust cap and tap float valve one light fair blow. A short ½-inch bolt dropped ¾ inch is about the proper blow required to insure a good seat.

TO REMOVE NOZZLE

To remove the idling nozzle from the carbureter, first remove plug below it, then insert a screw driver up through the plug hole into the screw driver slot in the nozzle, and carefully unscrew the nozzle.

LOW SPEED CONTROL

The low speed adjustment of this type of carbureter is fixed by the idling nozzle aperture.

TO CORRECT HIGH SPEED ADJUSTMENT

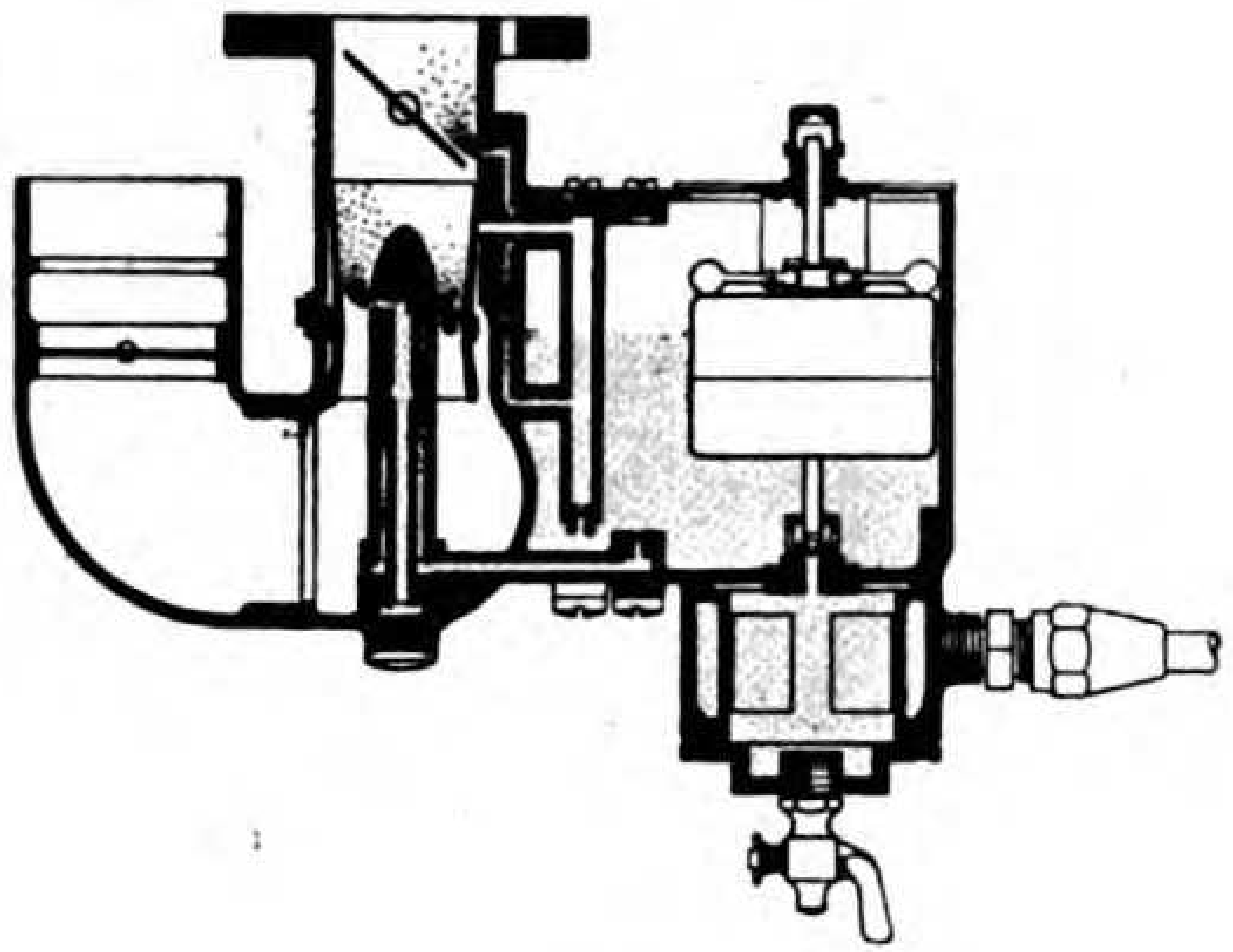
When the spark is advanced to the normal running position if the engine back-fires or hesitates when the throttle is opened suddenly. it indicates too lean a mixture (provided the engine is thoroughly warm), and the high speed adjusting nut should be screwed up notch by notch until the back-firing ceases. The high speed is fixed by the size of the nozzle or main jet. To alter, a new jet must be inserted. Extra jets are carried on a boss on the side of the float bowl.

If the engine will not operate with the carbureter adjustments made as directed above, and no leaks exist at any point on the manifold, it is likely that one of the nozzles is plugged up. In this case both should be removed and examined, but under no consideration should the upper end of the nozzle be tampered with, or burred, as such action will seriously effect the operation of the instrument.

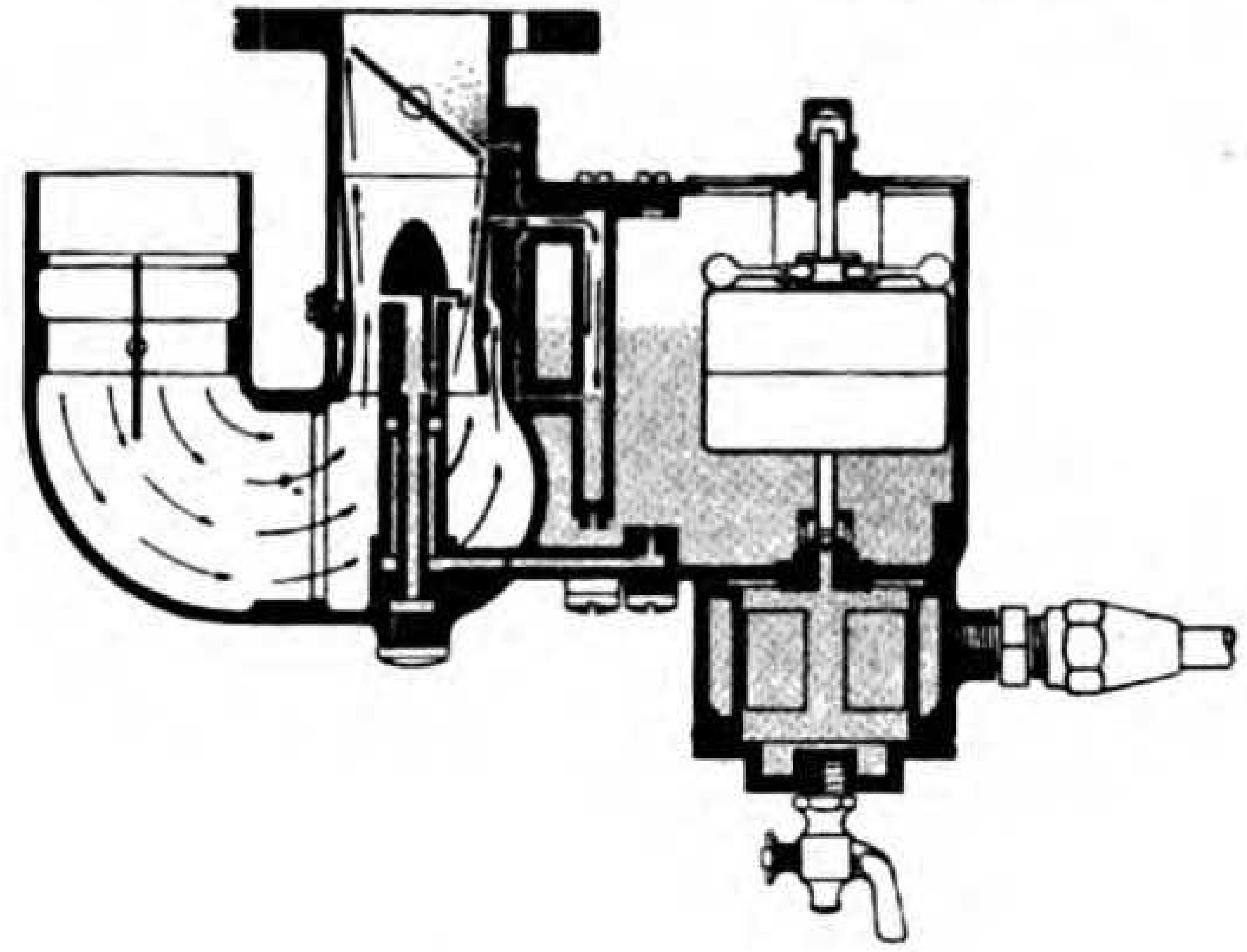
CAUSES OF BACKFIRE THROUGH CARBURETER WHEN MIXTURE IS TOO LEAN

A lean mixture is slow burning. If the gases lingering in the cylinder continue to burn after the intake valve has opened they will ignite the

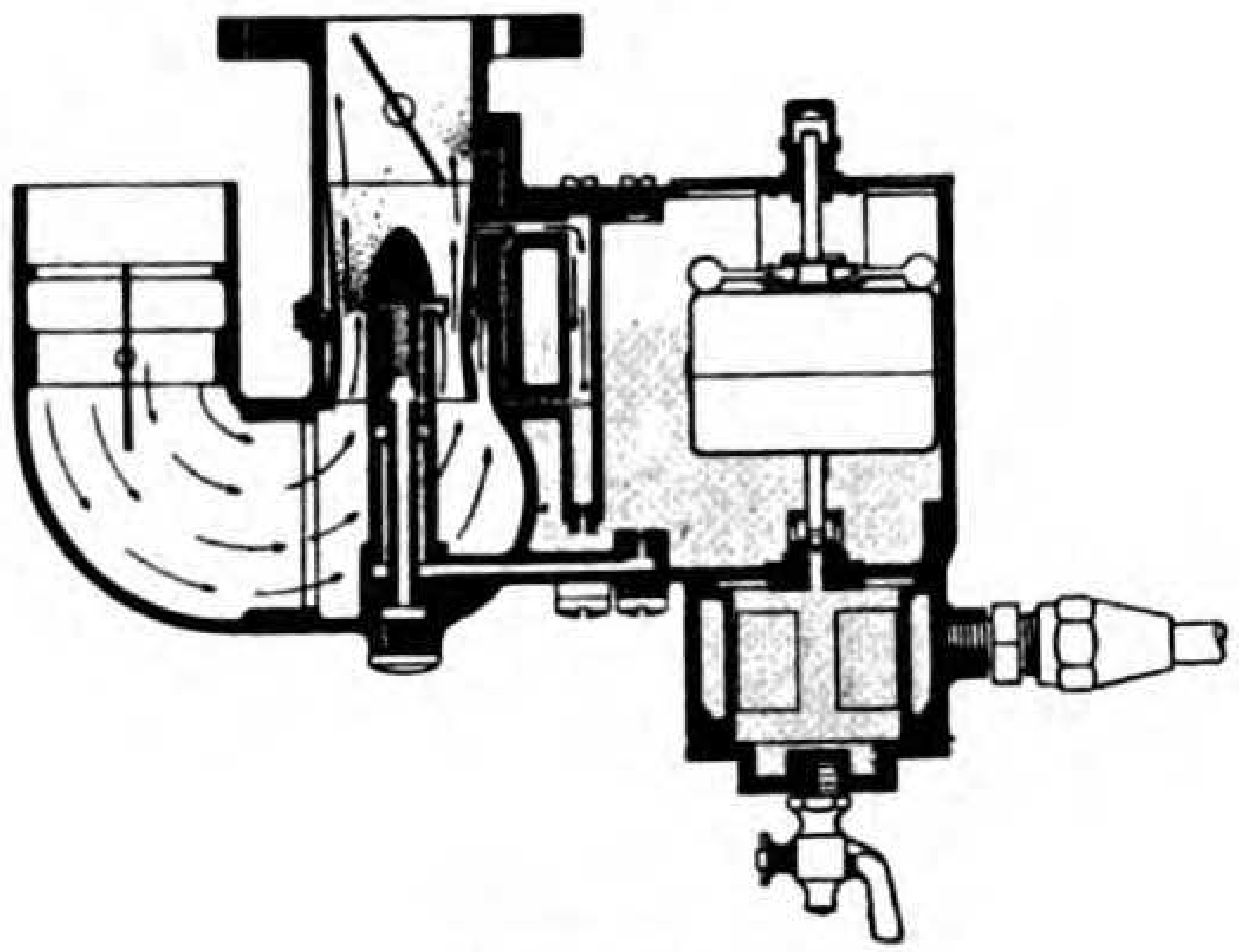
Plate No. 28



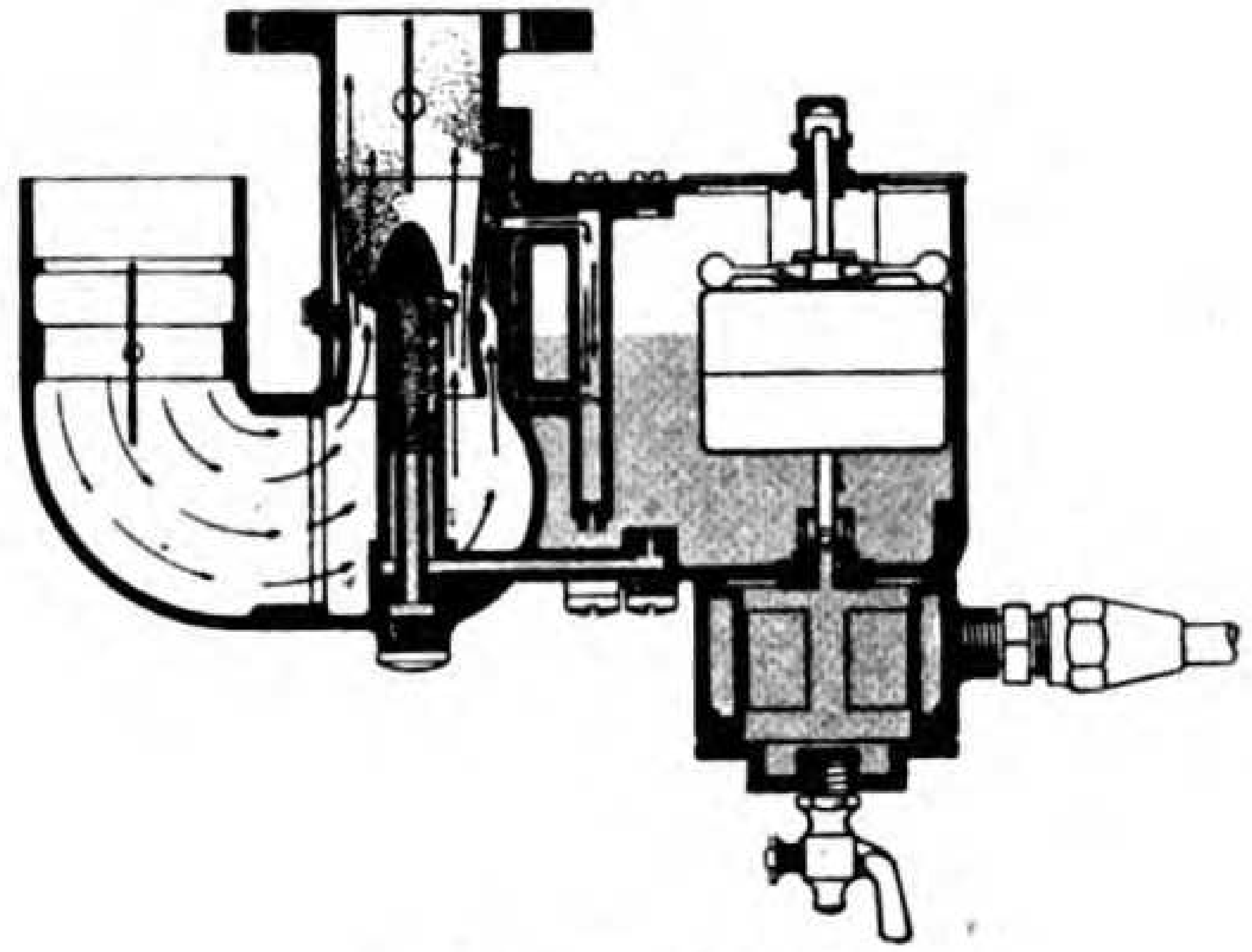
STARTING



IDLE RUNNING



PARTIAL LOAD



FULL LOAD

DIAGRAM OF CARBURETER. ACTION OF CARBURETER UNDER DIFFERENT OPERATING CONDITIONS incoming mixture and explosions occur back past the intake valve into the manifold and carbureter.

HOW A TOO RICH MIXTURE AFFECTS THE EXHAUST

A rich mixture is slow burning and will cause a high temperature of the exhaust, a dark red flame at the priming cocks, if opened, a black smoke at the muffler outlet.

TO DETECT AND REMEDY INTAKE MANIFOLD LEAKS

If gasoline is applied to the leak while the engine is running, with a squirt can or thoroughly saturated piece of waste, enough gasoline will be sucked in to indicate that the leak exists at that point. Oil put on the leak will be sucked in and disappear. Intake joint gaskets should be shellacked or soaped with resin soap on both sides.

DETECTION OF AND RESULTS FROM INSUFFICIENTLY HEATED AIR

The incoming air which enters the carbureter through the air bend should always be heated as the hot air passing around the gasoline well, below the primary nozzle, will increase the temperature of the well, the primary nozzle, and the gasoline contained herein, thereby assisting the vaporization of the gasoline.

The incoming air is heated by the stove which receives hot air from around the outside of the exhaust pipe. Insufficiently heated air acts in the same manner as a lean mixture.

DETECTION OF WATER IN GASOLINE

If the container is clean, the water will appear like large bubbles in the bottom of the container, as water and gasoline will not mix.

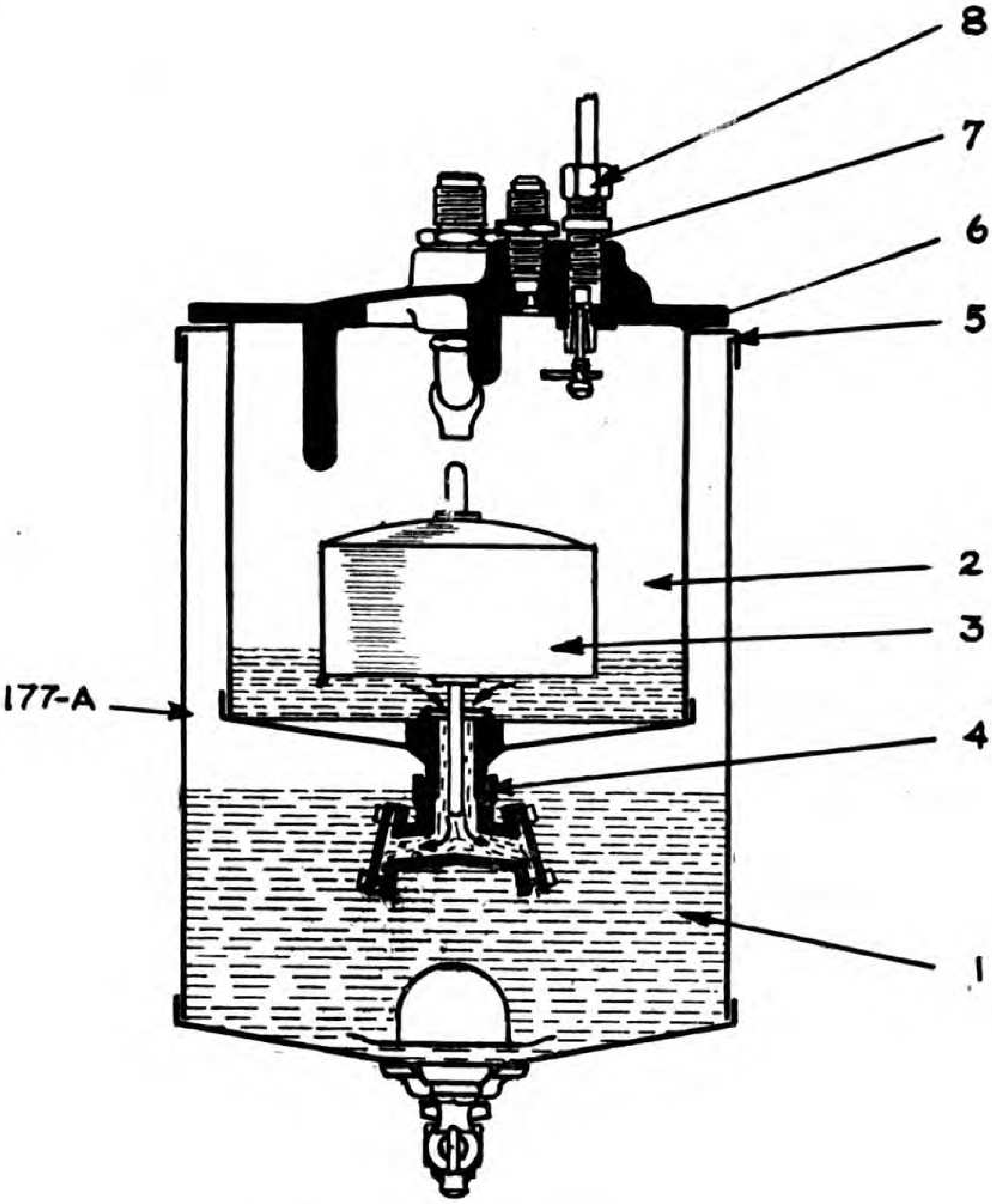
In the float chamber of the carbureter, water may be detected by the comparatively low gasoline level in the float chamber and on the float, as the float rides higher in water than in gasoline and closes the float valve quicker.

Any exposed iron in the gasoline tank will rust after a short time and discolor any gasoline coming in contact with it, aiding detection.

TO PREVENT WATER IN CARBURETER

The drain plug in the bottom of the carbureter should be opened occasionally, and any accumulated water drained out, preventing any possibility of trouble.

Plate No. 29



VACUUM TANK (PART 177 A)

1. Gasoline reservoir.
2. Vacuum chamber.
3. Float.
4. Inlet to reservoir.
5. Outer casing.
6. Interior casing.
7. Vent plug.
8. Feed pipe from main tank.

TO PREVENT WASTE OF GASOLINE BY CARBURETER FLOODING

Shut off the gasoline at the tank when the tractor is left standing on a steep grade, because the carbureter float may bind against the stud, due to the angle of the tractor and hold the needle valve open when the gasoline will leak out through the nozzles.

GASOLINE FEED SYSTEM

Gasoline is fed from a 30-gallon pressed steel tank, located within a felt strip lined housing mounted in the body between the fire screen and the radiator. The tank housing is supported by steel straps to the body and the tank fits into the housing. The gasoline is fed by vacuum system to a Stewart vacuum tank strapped to the right side of the body close to the engine. The feed from this tank to the carbureter is by gravity. A horizontal loop in the feed pipe compensates for pipe length and eliminates air locks.

TO REMOVE GASOLINE TANK

First shut off the gasoline at the tank, disconnect the gasoline line, remove the bolt holding the tank supporting assembly to the body, after which the tank can be removed through the top, after the upper armor plate has been removed.

CARE OF VACUUM SYSTEM

Three points must be observed when installing a Stewart vacuum system in order to assure correct operation. They are:

1. That the top of the tank is above the level of the gasoline in the main supply tank, even when the car is descending a steep hill.
2. That the bottom of the tank is at least 3 inches higher than the carbureter.
3. That the tank is not installed over any electric equipment or terminals in which gasoline could leak, and cause a fire.

CARE AND REPAIR

After the system has been installed, it may be necessary to readjust the carbureter, especially if the tank replaces a pressure feed system. The vacuum feed should show the same rate of consumption as the gravity feed, and an increased consumption in this case may be from vent tube overflow or from gasoline leakage.

If the engine gallops, speeding up when the vacuum tank is drawing gasoline from the main tank, either the mixture is too rich, or the connections are so loose that air is being drawn into the intake manifold. No perceptible change in engine speed should be noted when the tank is operating correctly.

VENT TUBE OVERFLOW

Occasional overflow from the vent tube is not serious, but regular overflow is dangerous and wasteful, and should be stopped. One of the following is usually the cause:

1. The air hole in the main filler cap is either too small, or else is plugged up.
2. The vacuum tank may be mounted too close to the engine, heat causing the overflow. The remedy is to carry the overflow up to the highest point beneath the body plates, or else to set the tank away from the engine a few inches.

3. The bottom of the tank may not have been installed at least 3 inches above the carbureter, as directed.

4. If a pressure system was formerly used, the air pump connection may not have been disconnected.

With the exception of the vent tube, the only other places leaks can occur are through a hole in the outer wall of the tank; or through the carbureter connection or tubing.

TO TEST THE VACUUM SYSTEM

If the engine does not operate properly, and the vacuum system is suspected, it may be quickly tested by:

1. Removing the inner vacuum tank, and leaving only the outer shell which then serves as an auxiliary tank. In removing the top of the tank, the screws are first removed; and a knife blade run around between the cover and the body of the tank, separating the gasket so that it is not damaged.

2. Partially fill the outside tank with gasoline, and crank the engine. If the engine still fails to operate, the vacuum system is not at fault. On the other hand, if the engine then runs all right, the system should be examined to find the difficulty.

CAUSES OF FAULTY FEED

A leaky float is indicated by the engine choking, as the float becomes too heavy to rise and close the vacuum valve, and permits gasoline to be drawn into the manifold.

Whether this is the case may be quickly determined by removing the top of the tank, and taking out the float. However, the leak may be so small that it is difficult to locate, and make the necessary repair.

REPAIRING LEAKY FLOAT

1. Place the float in a pan of hot water. Bubbles will mark the point of leakage. Scratch an X-mark intersecting at this point.

2. Enlarge the leak by drilling and drill another small hole at the top or bottom of the float, and drain all of the gasoline from it.

3. Using as small an amount of solder as possible, solder up the two holes. If an excess amount of solder is used, the float will be too heavy for proper operation.

Care should be taken in doing this work not to bend the float guide. When this has been done, the action will be the same as when the float leaks, namely, the float cannot rise and close the vacuum valve, and gasoline is drawn into the intake manifold, choking the engine.

When on the road, or for a temporary repair, the effect of a leaky float may be overcome by removing the plug shown at the top of the tank, page 73. Ordinarily enough suction remains to draw gasoline into the vacuum tank, but if not, the plug should be replaced until the tank is full, then removed, and the operation carried on until a repair can be effected. The car should run from ¼ to ½ mile between each operation.

INTERMITTENT OPERATION

An obscure cause of intermittent engine operation is that in installing or in working of the system, the bushing over the atmosphere valve is screwed down too far, preventing the atmosphere valve from operation. When this has happened the engine will run for a few minutes, and then backfire and stop. After a minute it will start easily, only to repeat, as the gasoline cannot feed to the carbureter when the engine is running. The remedy is simply to turn back the bushing until the atmosphere valve can open.

TANK INOPERATIVE

The vacuum system will be thrown out of operation if a particle of dirt lodges beneath the flapper valve, shown on page 73. The test for this is to remove the tubing from the bottom of the tank, connecting it with the carbureter, and start the engine. When one finger is placed over the air vent, and another over the opening at the bottom of the tank, continuous suction indicates that there is either a leak in the connection between the tank and the main gasoline supply, or else that the flapper valve is stuck open.

DISLODGING DIRT

By striking the side of the tank with the flat of the hand any dirt beneath the valve can usually be dislodged. If not, it will be necessary to remove the tank cover and lift out the inside tank.

Three other things can cause a tank to be inoperative. They are loose manifold connection, plugged tubing or dirty gasoline strainer. The strainer is generally the cause of the trouble, and it should be examined first.

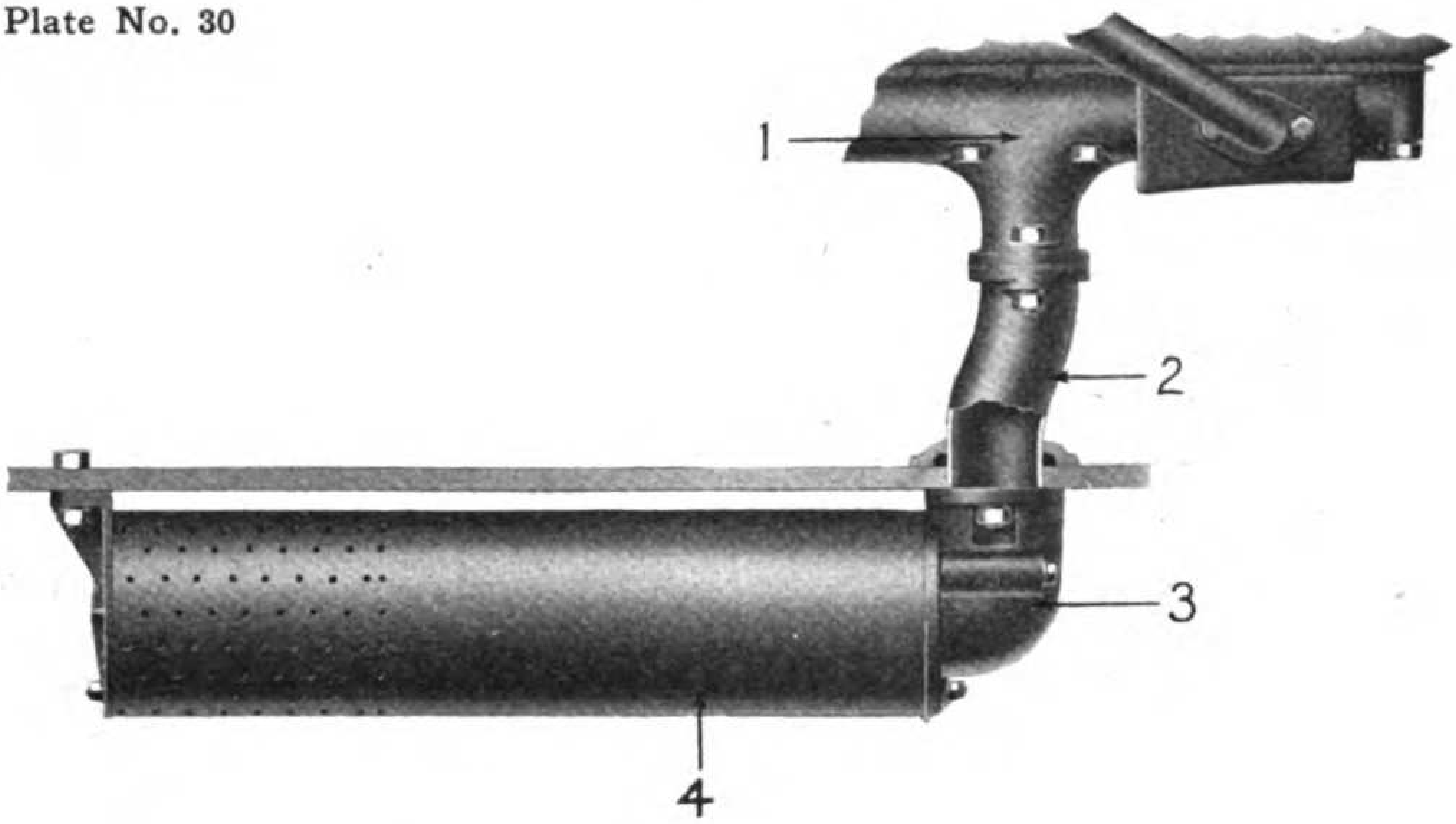
EXHAUST SYSTEM

The exhaust system conveys the exhaust gases from the engine and muffles the noise. It consists of a manifold, spacer, muffler, and their accompanying parts.

The spacer carries the exhaust from the manifold through the armor plate to the muffler by means of a stuffing box. The spacer is cast with a flange to attach it to the exhaust manifold.

The muffler is 27 inches long and 6.1 inches in diameter. It consists of a seamless steel tubing body, cast iron ends, and a series of interior

Plate No. 30



ENGINE EXHAUST PIPING

1. Exhaust manifold.
2. Exhaust extension.
3. Muffler header.
4. Muffler.

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baffle plates. The plates are made of perforated sheet steel, so arranged that the holes of one plate are in a staggered position with reference to holes of next plate.

The muffler is suspended from the side of the body.

EXHAUST MANIFOLD

The exhaust manifold connects the exhaust passage cast in the cylinder block with the exhaust spacer to the muffler, and so affords an outlet to the burned gas. The spacer has a brass plug which is removed for insertion of smoke screen nozzle.

CHAPTER XII

MAIN CLUTCH GROUP

GENERAL SPECIFICATIONS

Clutch type	Inverted cone.
Location	Bolted to flywheel.
Cone diameter, large	13 inches.
Cone diameter, small	11.4 inches.
Projected face, width	4$\frac{1}{8}$ inches.
Clutch facing	Woven Asbestos fabric.
Clutch spring, length	Under 1,000 lbs. load, 4$\frac{9}{16}$ inches.
Clutch alignment joint	Steel knuckle type.
Clutch brake, diameter	4 inches.

GENERAL DESCRIPTION

The drive from the engine is conveyed to the other tractor units through an inverted cone clutch. This clutch operates within the bell housing, which is bolted to the face of the flywheel, and which is the driving member. An extension of this rotating driving housing forms the fan pulley. The cone is an aluminum casting, carrying a facing of asbestos fabric. The frictional contact between this fabric faced cone and the cast iron housing causes the driving contact. The required amount of friction is maintained by means of a coil spring concentric with the clutch shaft. This spring bears against a retainer and a ball thrust at the engine end and against a flanged collar, connected with the clutch cone at the transmission end.

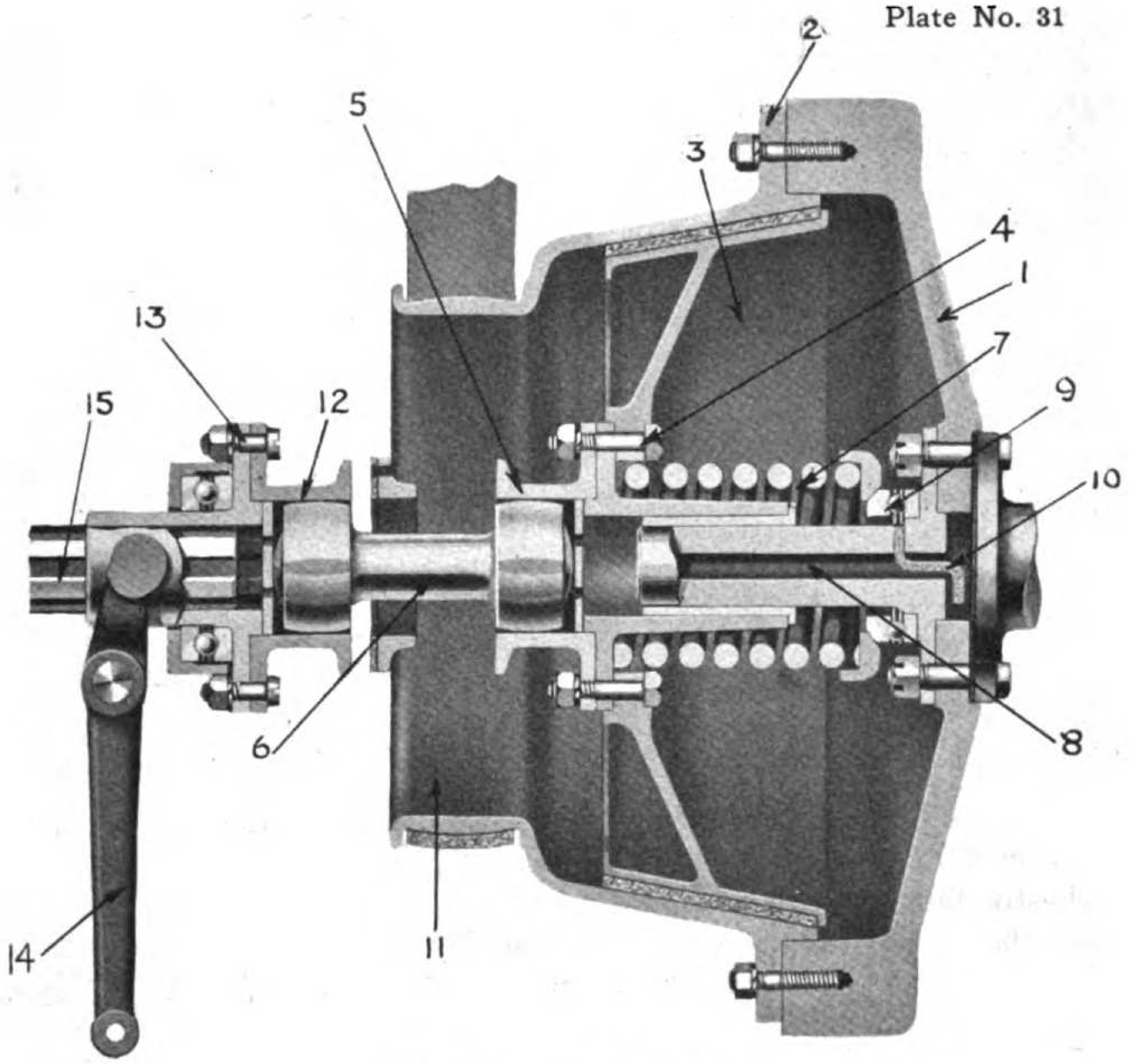
CLUTCH ALIGNMENT JOINT

In order to preserve alignment between the clutch and transmission, a knuckle joint is inserted, through which the drive passes on its way to the transmission members. This knuckle joint consists of a steel forging, of modified dumb bell shape, with squared ends, capable of imparting the driving torque to the transmission shaft. The joint is capable of operating under a slight misalignment, thereby equalizing any deviations or eccentricity of the clutch member.

CLUTCH ACTUATION

The clutch is actuated by a pedal from the driver's compartment, operated by the left foot of the driver. Depressing the pedal exerts a pull on the rod linkage, which in turn holds clutch throwout lever which slides the cone forward along the clutch stud shaft. This depresses the clutch spring and removes the clutch facing from contact with the surface of the housing which it drives. The clutch stud shaft

Plate No. 31



MAIN CLUTCH ASSEMBLY

1. Flywheel.
2. Clutch driving unit.
3. Inverted cone or driven unit faced with leather.
4. Flange connection between clutch driven-unit and clutch shaft.
5. Clutch alignment joint driving unit.
6. Clutch alignment joint driving dumb-bell.
7. Clutch spring.
8. Clutch stub shaft.
9. Ball thrust bearing.
10. Oil wick feed.
11. Fan belt pulley on clutch driving unit.
12. Alignment joint driven unit.
13. Flange connection of alignment joint to spline transmission shaft sleeve.
14. Clutch throw-out lever.
15. Splined transmission shaft.

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is 3¾ inches long and 1.498 inch in diameter, and has a flange 5⅛ inches in diameter through which pass the bolts which connect the clutch mechanism with the flange on the end of the engine crankshaft. The stud shaft is of .20 carbon steel case hardened. It supports at the engine end the ball thrust bearing which takes the thrust off the clutch spring. This is a No. 1109 thrust bearing against which rests the retainer or thrust bearing cage. This retainer or cage is malleable casting 4 9/32 inches in diameter, and forms a cup in which the clutch spring rests. There is a bronze bushing, containing an oil groove, which surrounds the stud shaft, giving a bearing surface for the cone hub when the clutch is disengaged.

The throwout mechanism is on the transmission side of the universal joint and contains a No. 1111 ball thrust, held in a cast iron retaining cage 3⅞ inches in diameter, 1⅛ inches wide, having a door of 2¼ inches. This truck or cage surrounds the sleeve which slides upon the splined shaft of the transmission. The sleeve is .20 carbon steel, 3¼ inches long, having a 5⅜ inch flange, through which the bolts pass connecting this part with the driven member of the universal joint.

ALIGNMENT JOINT DETAILS

The front driving member of the universal is .20 carbon steel forging case hardened, having a diameter across the curved face of 2 1/16 inches and across the flats, 2 inches. The dumb bell member, which transmits the drive in .20 carbon steel forging, is 1 3/32 inches deep, having an overall length of 5 9/16 inches, and diameter at the dumb bell end, across the curved surface, of 2.485 inches. The throwout lever, which operates the sleeve on the spline transmission shaft, is .25 carbon steel forging, 6½ inches between long centers and 2 3/16 inches between the short centers of the ball crank.

MAIN CLUTCH DRIVE

The way the drive is taken through the clutch, is first through the flange of the crankshaft to the flywheel, by means of the bolts through the crankshaft flange. The drive from the flywheel is transmitted to the cone housing by the studs in the flywheel face. From the housing it passes through the aluminum cone, by means of the friction facing, and thence through the bolts at the inner end of the cone through the driving member of the universal joint. It is then transmitted to the dumb bell through the driven member of the universal and then through a bolted flange to the sleeve which finally transmits the driving torque to the splined transmission shaft.

ADJUSTING MAIN CLUTCH BRAKE

No adjustment is provided on the clutch brake, but in case it engages too soon the driven member of the universal joint into the dumb bell bearings on the transmission side may be removed and faced off to the required distance. This will make the clutch brake engage later. In case the face of the clutch brake is too far away from that of its engaging face, this can be remedied by removing the driven member of the universal and placing the required number of shims, or paper leaves, between the universal member and the sleeve of the splined transmission shaft.

MAIN CLUTCH LUBRICATION

Lubrication of the clutch is provided by means of oil holes in the face of the flywheel. These are in direct communication with the space beyond the end of the crankshaft which forms an oil well, permitting the lubricant to flow through the clutch stud shaft to all parts of the clutch and to the universal joint. A wick communicates with the ball thrust bearing from the oil well beyond the end of the crankshaft.

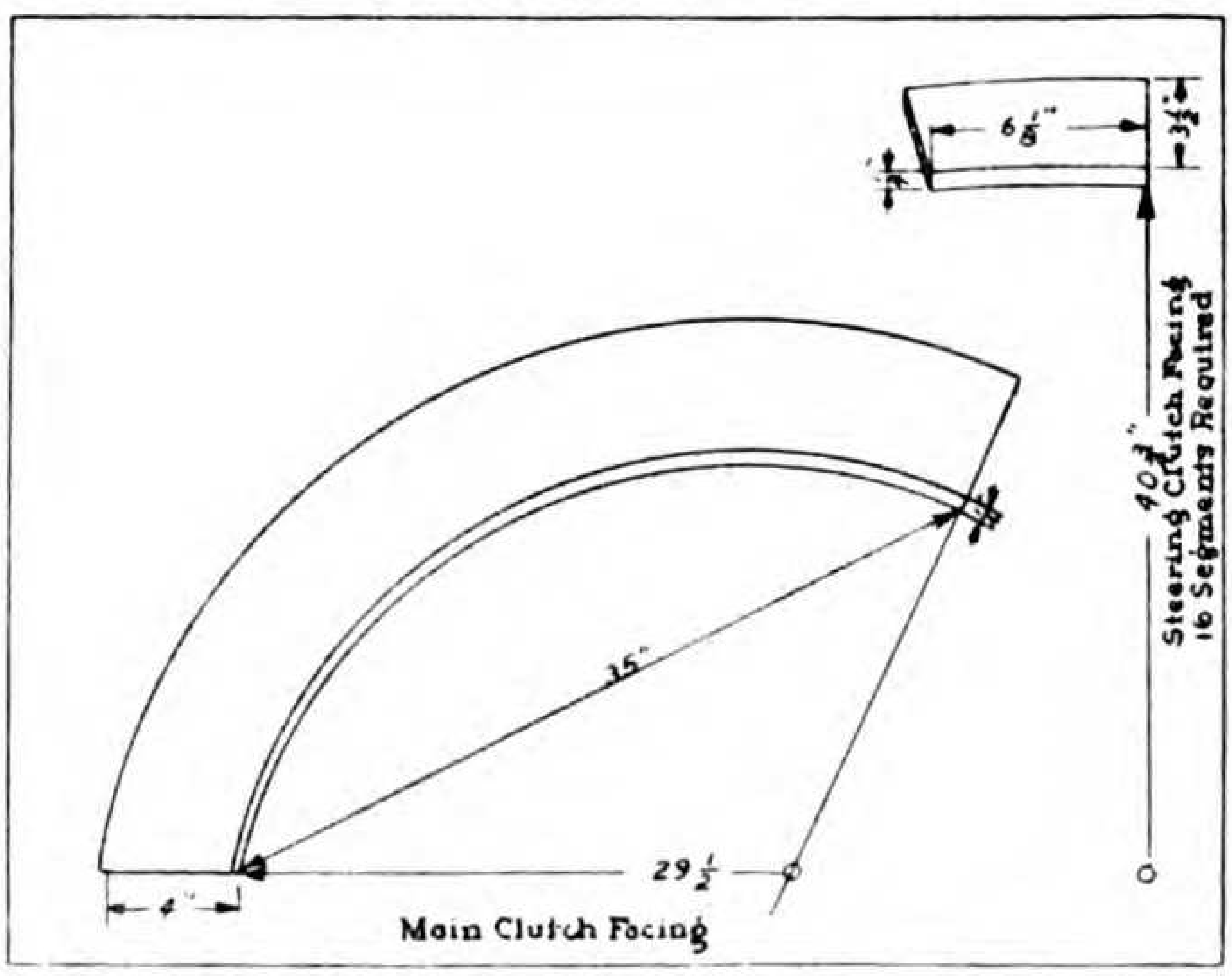
TO CLEAN THE CLUTCH FACING SURFACE

To clean the surface of the clutch facing, the clutch pedal should be locked in a depressed position throwing the cone out of communication and securely held. The fan belt should then be removed and the bell housing stud nuts removed, and the bell housing slipped back the necessary distance to provide access to the clutch facing. It will be necessary to remove the top armor plate, tank and radiator to secure the desired accessibility in working on any of the engine clutch or transmission parts. Care should be taken in removing the clutch, universal, or any of the parts which would allow freedom of the main clutch spring, to use two 3/8 inch studs in the holes provided for them, thereby releasing the spring tension gradually. If these bolts are removed without gradually releasing the tension of the spring, injury may result to the operator. Kerosene can be used as a cleaning agent.

TO REMOVE CLUTCH

Remove the top armor plate, gasoline tank, radiator and transmission, and place two 3/8 inch x 8 inch studs in the holes provided for them in the clutch housing. The purpose of these studs is to take the

Plate No. 32



PATTERN OF CLUTCH MATERIAL USED TO LINE CONE FACING stress of the spring in removing the clutch. Remove the nuts holding the clutch housing to the flywheel then let out the clutch spring, by means of the stud nuts and the clutch can be taken out.

TO RE-LINE CLUTCH

Remove the old lining and chip off the rivets. New lining is provided cut to proper size. If this is not available, a lining can be cut, using page 81 as a pattern. New rivets should be put in in such a way that they are countersunk below the surface of the lining, so that the metal of the rivet will not bear against the metal clutch driven face. Or split rivets driven from inside are used.

CLUTCH ADJUSTMENT

There is no adjustment for tension of the clutch spring, but an adjustment for throwout is provided in the shape of a turnbuckle on the throwout pull rod. In case the clutch continues to drag when it is depressed to its fullest extent, increased throwout can be secured by taking up on the turnbuckle.

CHAPTER IV

TRANSMISSION GROUP

GENERAL SPECIFICATIONS

Gear box type	Sliding selective.
Number of speeds	Four and reverse.
Shaft mounting	Ball bearing.
Shaft material	Chrome nickel steel.
Transmission gears	Chrome nickel steel.
Gear face, width	7/8 inch.
Gear pitch	6.
Number of Splines	6.
Gear case	Cast aluminum.

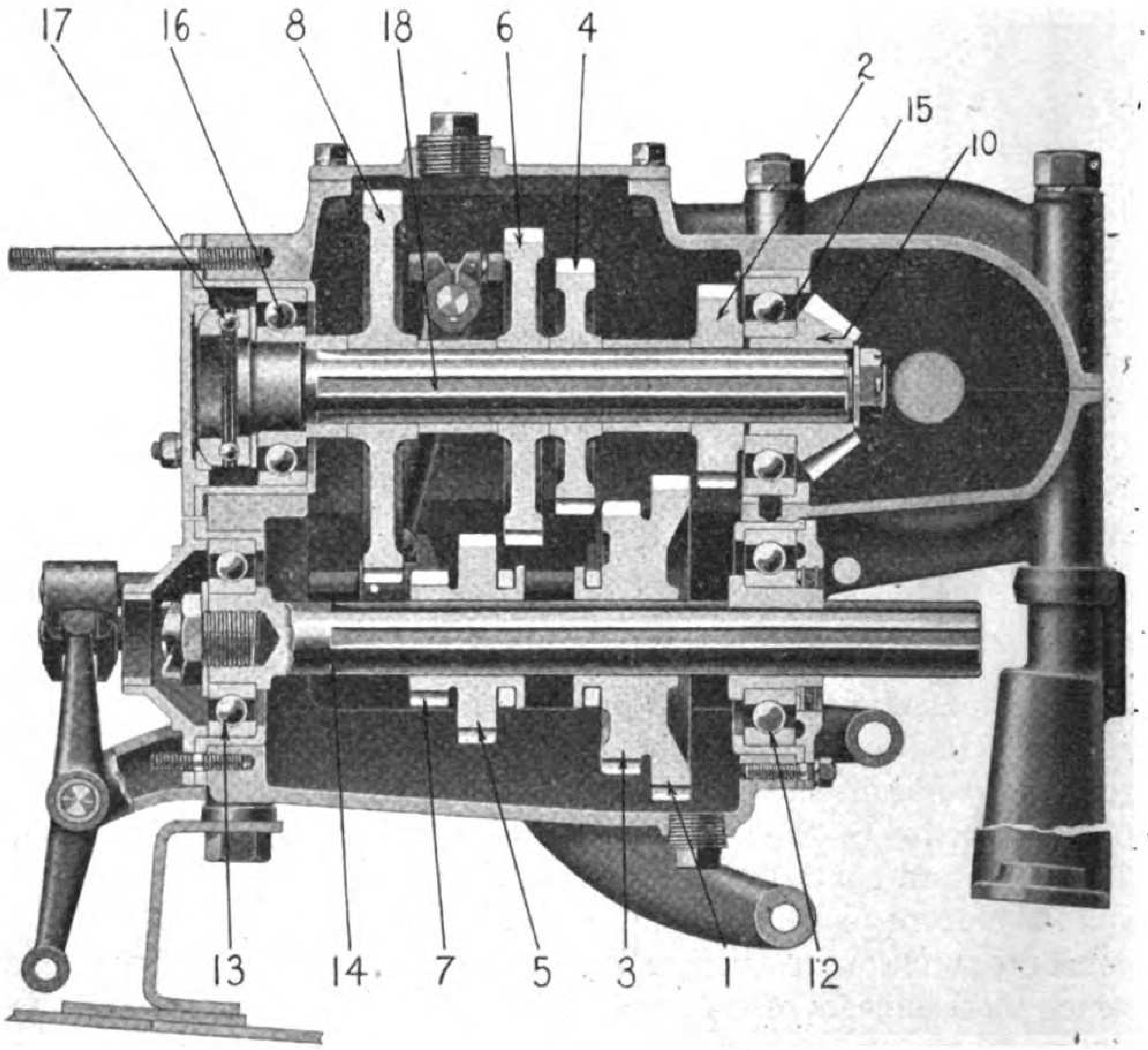
GENERAL DESCRIPTION

The transmission gear set has four forward reductions, and one reverse. It also contains a set of bevel gears for converting the drive to a transverse direction, necessary to carry it outward from the center of the tractor to the reduction gearing, which operates the track. The gears are contained in an aluminum cast housing, in which the splined chrome nickel steel shafts rotate on annular ball bearings. The gears are shifted in relation to one another by a shifter fork mechanism, which meshes gears of different diameters to secure the proper reductions. The main shaft of the gear set is in direct communication with the clutch shaft, through the medium of the universal or alignment joint described in Chapter III. The reductions in the box are 3.15, 4.54, .94 and .61 to 1. The fixed reduction through the track driving train is 30.58 to 1, giving total reductions between the engine and track sprocket of 95.5; 47; 28.78; and 18.6 to 1. The reduction on low speed and reverse are the same.

The transmission is a selective mesh type; the only gears being in mesh being those actually performing the function of reduction at the time. The main or engine transmission shaft is in the lower part of the gear box, and the countershaft is above it. The drive progresses from the rear or engine side forward along the main shaft, then upward to the countershaft, and back to the constant mesh bevel gears in the rear end of the box. These transmit the drive to the transverse shaft, which in turn carries the transmission to the spur gear reduction, through the steering clutch, and thence to a sprocket which actuates the driving track.

In high gear or fourth speed the drive progresses from the engine or main transmission shaft to the bevel gears through the gear 1 which meshes with gear 2. On third speed the drive passes from the main

Plate No. 33



TRANSMISSION SECTIONAL ASSEMBLY

1. Fourth speed main shaft gear.
2. Fourth speed countershaft gear.
3. Third speed main shaft gear.
4. Third speed countershaft gear.
5. Second speed mainshaft gear.
6. Second speed countershaft gear.
7. First speed main shaft gear.
8. First speed countershaft gear.
9. Reverse idler not shown.
10. Bevel pinion.
11. Bevel gear not shown.
12. Annular ball bearing for main shaft (rear).
13. Annular ball bearing for main shaft (front).
14. Transmission main shaft.
15. Ball bearing countershaft (rear).
16. Ball bearing countershaft (front).
17. Countershaft ball thrust bearing.
18. Countershaft.

---

shaft to the upper or lay shaft by means of the gear 3 which meshes with gear 4. On second speed the drive is transmitted from gear 5 which meshes with gear 6. On first speed the gear 7 meshes with gear 8. To secure reverse there is an idler gear 9, which is a wide gear meshing with gears 7 and 8, so that the drive in reverse passes from the main shaft to the lay shaft, by means of gear 7, which meshes with gear 9, and then from gear 9 to gear 8.

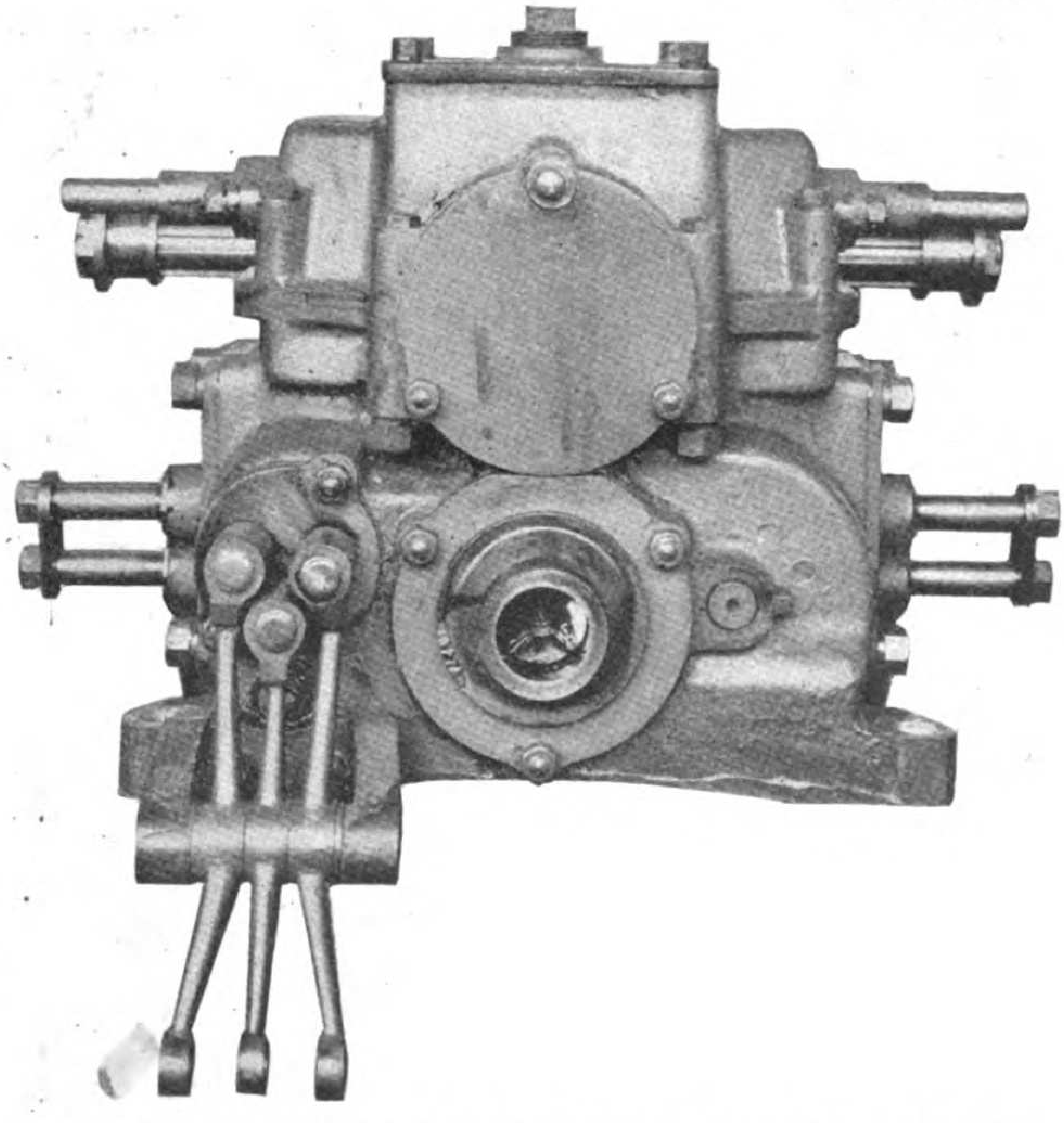
MAIN TRANSMISSION SHAFT

The main transmission shaft is a continuous splined shaft 16¾ inches long by 1.61 inches in diameter. It is of chrome nickel steel, mounted on annular ball bearings at each end. All the drive passes through this shaft, and is communicated from it to the countershaft above by means of the meshing of various gears, as previously explained.

COUNTERSHAFT

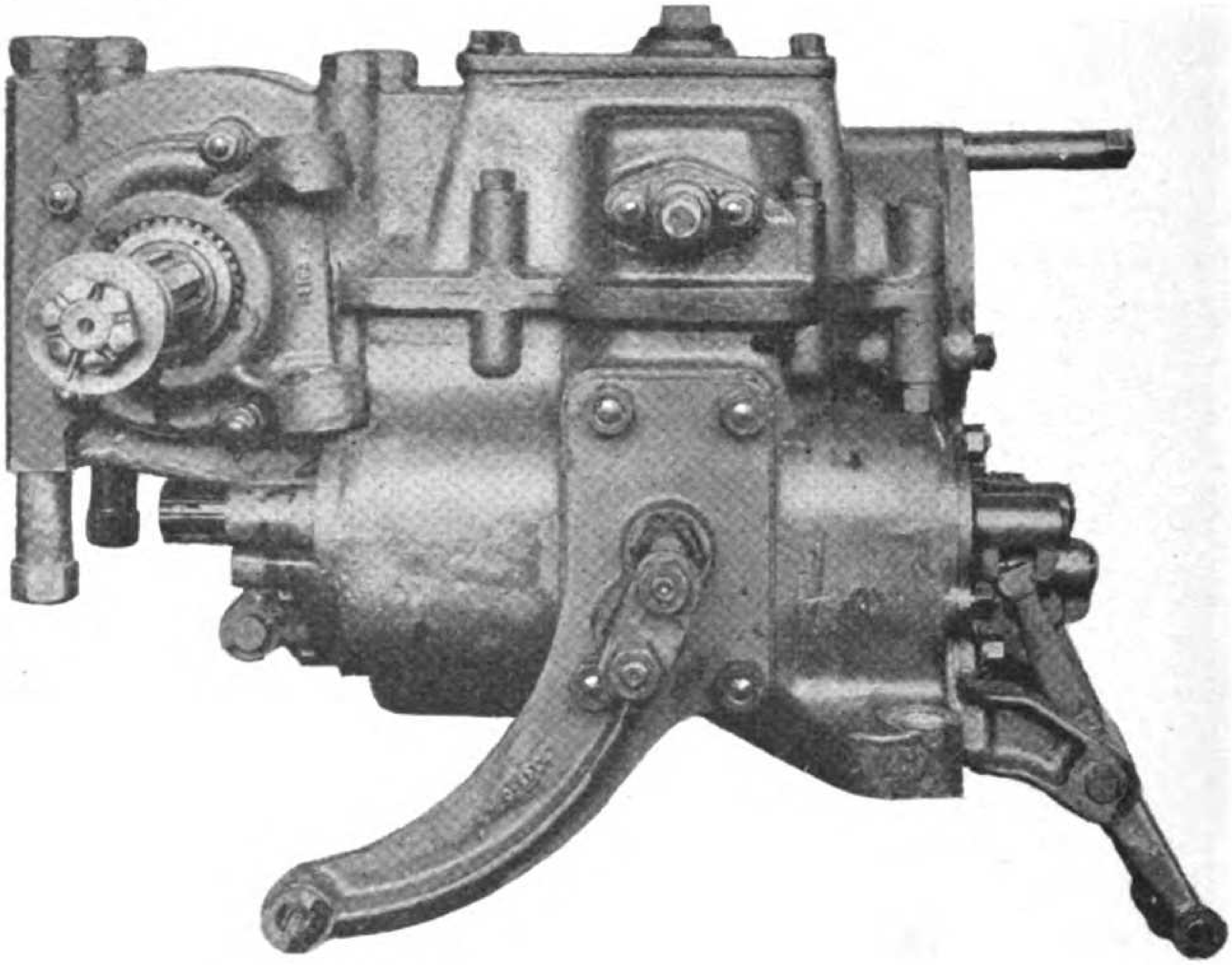
The transmission countershaft is a six splined chrome nickel steel shaft 23.30 inches long, 1.61 inches in outside diameter. It is mounted on annular ball bearings at each end. The rear end of the shaft carries the bevel pinion for the bevel gear drive, and, at the forward end, in addition to the annular bearing, there is a ball thrust mounted in a cage. This shaft receives the drive from the main shaft by means of the inter-meshing gears. The bevel pinion is carried on the splines and is held in place by a castellated nut.

Plate No 34



TRANSMISSION END VIEW SHOWING GEAR SHIFTER LEVERS

Plate No. 35



SIDE VIEW OF TRANSMISSION SHOWING HOUSING AND TRANSVERSE SHAFT

TRANSMISSION GEARS

There are nine gears in the transmission case, four of them being on the main shaft and four on the countershaft, while the reverse idler gear is mounted on a stud mounted in the transmission.

FOURTH SPEED GEAR

The fourth speed gear, which is that nearest the engine end of the main shaft, is chrome nickel steel, has 41 teeth, is 6 pitch and has a diameter of 7.166 inches. This gear is integral with the third speed gear 3, and slides on the splines of the transmission main shaft.

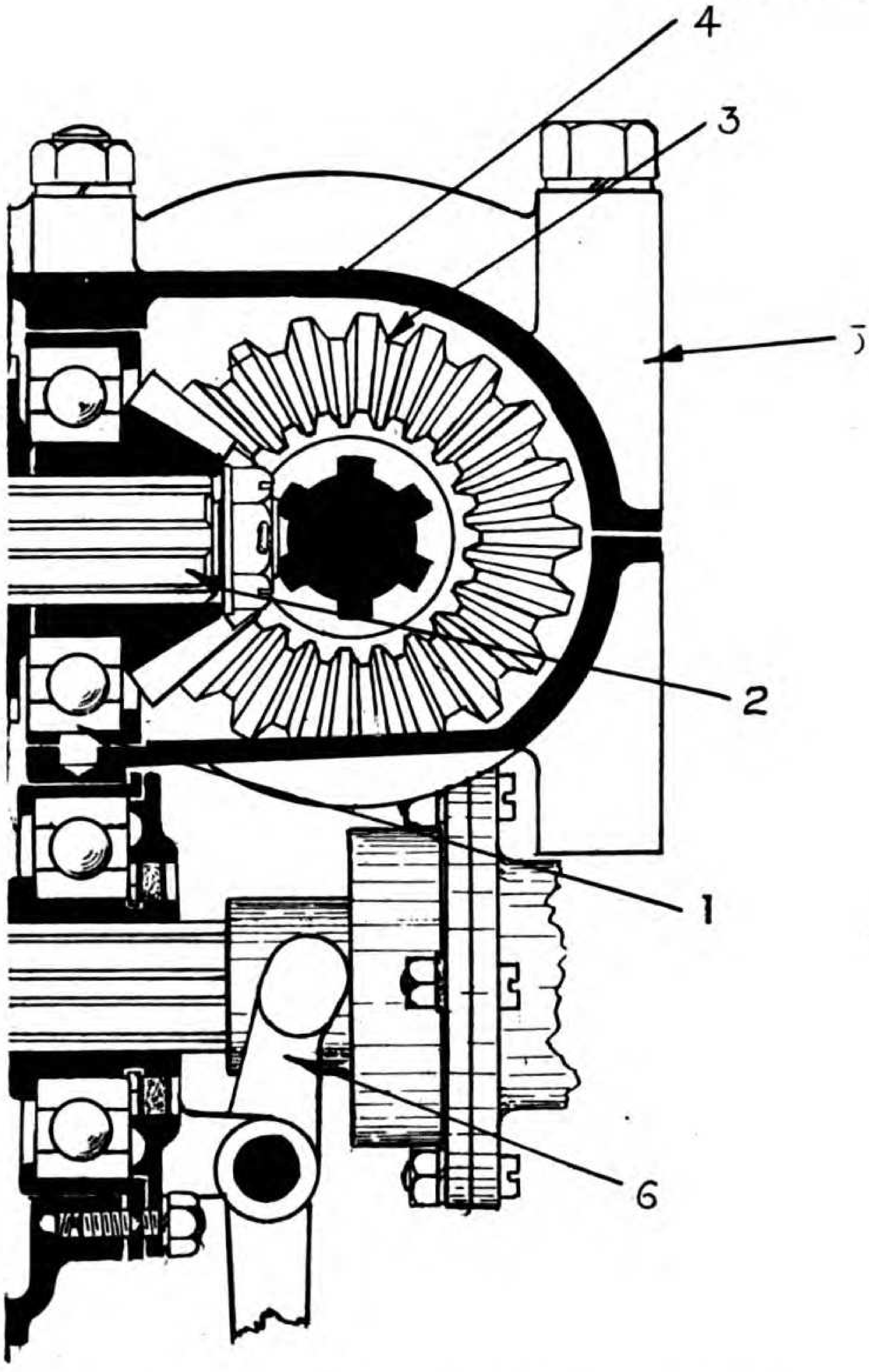
FOURTH SPEED COUNTERSHAFT GEAR

The fourth speed, or high gear countershaft gear, is on the engine end of the lay shaft, and meshes with the high speed main shaft gear. This gear 2 has 25 teeth, is 6 pitch and has a diameter of 4½ inches. It is fixed in position, as are all the countershaft gears, by means of a spacer between it and the adjacent gear. The gear is chrome nickel steel, cut from a forged blank.

OTHER DRIVING GEARS

The other reduction gears, as indicated on page 84, secure their relative mesh by sliding on the splines of the main shaft. Third speed gear 3 has 34 teeth and is 5⅞ inches in diameter, 6 pitch. It meshes with the second speed countershaft gear 4, which has 32 teeth, and is 5.66 inches in diameter. Second speed main shaft gear 5 has 26 teeth and is 4.66 inches in diameter, and meshes with second speed counter-

Plate No. 36



TRANSVERSE DRIVE FROM TRANSMISSION

1. Ball bearing supporting rear of countershaft.
2. Countershaft and pinion.
3. Bevel gear.
4. Bevel gear housing.
5. Upper half of transmission case.
6. Clutch throw-out lever.

shaft gear 6, which has 40 teeth and is 7 inches in diameter—all being of 6 pitch. The first speed main shaft gear 7 has 16 teeth, is 3 1/8 inches in diameter, and meshes with the first speed countershaft gear, which has 50 teeth and is 8.66 inches in diameter. The reverse idler 9 has 28 teeth, is 5 inches in diameter, and has a face width of 1 7/8 inches in diameter, which allows it to mesh with both 7 and 8, thereby reversing the drive. All these gears are chrome nickel steel, having 6 pitch.

TO REMOVE MAIN TRANSMISSION SHAFT

Remove the inside starter bolts which also hold the main shaft ball bearing retainer, and take off the front retainer cover. Remove the transmission cover studs and bolts, after which the top half of the gear case can be lifted off. When this is done the lay shaft and gears can be lifted out as a unit. The cross shaft also lifts out, and the main shaft can be pulled out through the end of the box, after having removed the front and rear bearing retainers. Care should be taken in removing this shaft not to burr the splines. If the shaft is driven out it should be done with a soft hammer, or a block of wood should be inserted between the hammer and the shaft. The gears are shifted by two forks of malleable iron. As stated, the shifting is all done on the upper or countershaft.

GEAR SHIFT INTERLOCK

To prevent the gears from slipping at the mesh, there is a spring plunger arrangement held in a cap on the gear case. The plunger fits into the notch of the rod, preventing the gears from sliding out of mesh. There are three of these rods actuating the gears on the countershaft, and each is held by a spring plunger or case hardened pin 3/4 inch in diameter. As these plungers are wedge shaped or beveled at the bottom they ride up on the shifter rod when it is moved through the lever, but exert sufficient force to retain the rod in place under the stresses of driving mesh.

TRANSMISSION TROUBLES

Owing to the nature of the service of the 6-ton special tractor, little or no transmission trouble is anticipated. However, it should be made a point, when draining the transmission case, as explained on page 22, to examine the old lubricant for metal chips which would indicate broken gears. By replacing worn parts indicated in this way, and by keeping the lubricant up to the standard of requirements mentioned on page 19, no mechanical trouble should be found. Drive is imparted to the steering clutch through the splined transverse shaft which receives in turn its drive from the bevel gears on the transmission. The entire steering clutch is concentric about this shaft, which is 23 3/10 inches long and $1\frac{5}{8}$ inches in diameter. It is of nickel steel and is mounted on a bearing of large annular ball bearings at its inner end on either side of the bevel gears, and on four ball thrust bearings to take care of the transverse stresses imparted by the drive and by the clutch spring.

TO REMOVE TRANSMISSION

Take off top armor plate, remove gasoline tank and radiator, and take out the two large bolts on top of the transmission. Remove the two bolts from the front of the transmission base, and take out the spacer on one side. Disconnect the control lines and the transmission then lift transmission with steering clutches straight out. See that steering clutches are turned to give a slight forward pull to disconnect the Oldham couplings.

CHAPTER V

STEERING CLUTCH AND BRAKE

GENERAL SPECIFICATIONS

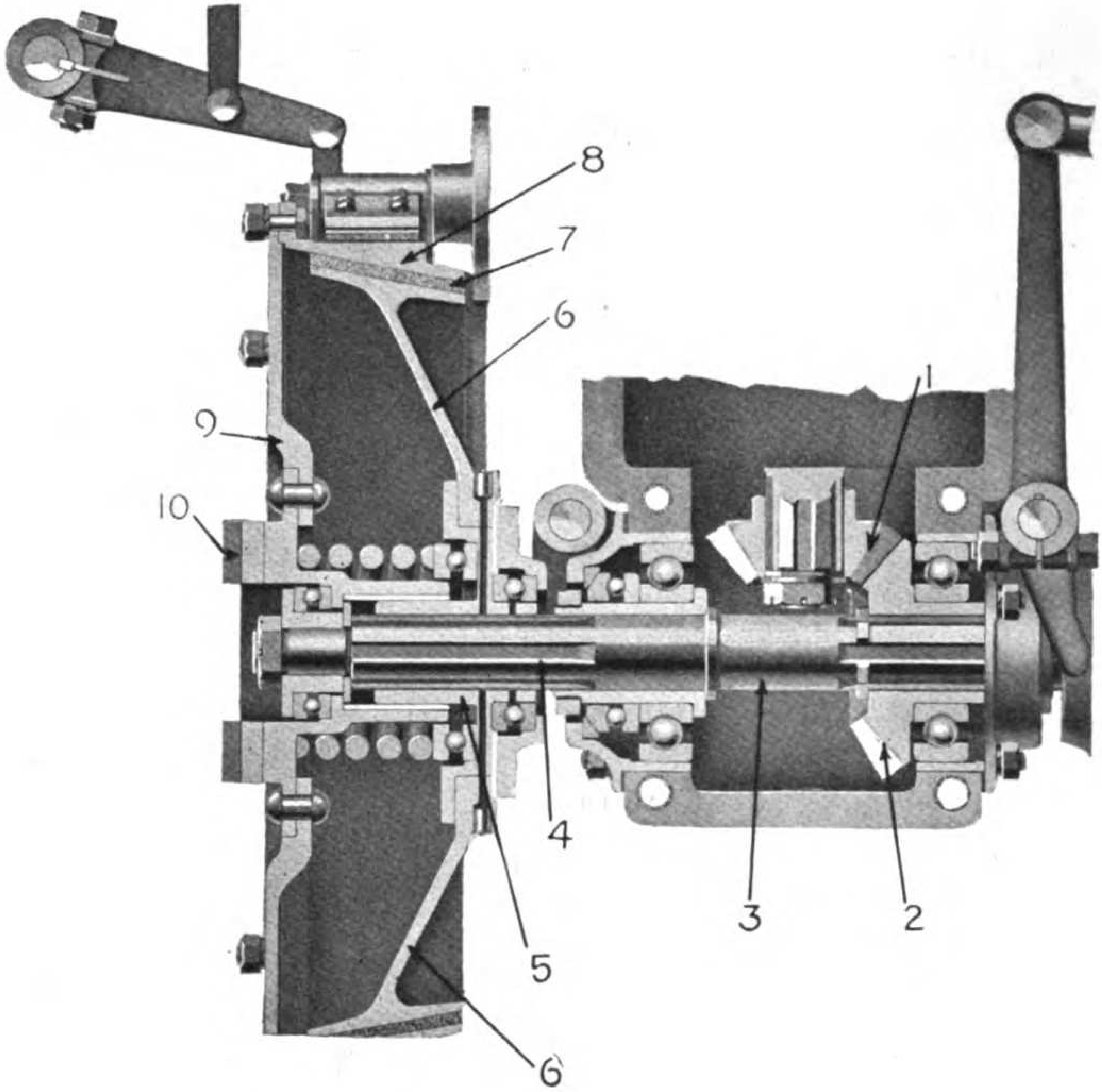
Clutch type	Inverted cone
Location	On transverse transmission shaft
Cone diameter, large	$17\frac{5}{8}$ inches
Cone diameter, small	16 inches
Projected face, width	$3\frac{11}{16}$ inches
Clutch facing	Woven asbestos fabric
Clutch spring, length	$2\frac{7}{8}$ inches under load of 1400 pounds
Clutch mounting	On splined transverse shaft
Brake type	Contracting
Brake diameter	$17\frac{7}{8}$ inches
Brake face, width	$2\frac{3}{8}$ inches
Brake material	Asbestos fabric
Brake control	Through steering clutch lever or pedal
Brake location	Drum surrounding steering clutch

GENERAL DESCRIPTION

The steering clutch unit comprises the inverted cone clutch, which connects the transmission with the reduction gear that drives the track, and also includes a brake mounted on the exterior of the driven clutch unit. The steering clutch and the brake are controlled by the steering lever, which first disengages the clutch, and, then upon further application, engages the brake. The entire unit, comprising both the steering clutch and brake, is mounted on the splined transverse shaft which takes the drive from the transmission and carries it outward from the center line of the tractor to the spur gear reduction and the track. The clutch spring is a single coil, mounted concentrically around the spline shaft. There is a ball thrust at each end of the clutch to take the spring which is loaded to 1400 pounds.

The steering clutch is oiled by means of oil cups in the inner clutch housing face. The oil channels lead directly to the splined shaft, and from this point pass to the bearing surfaces of the steering clutch. The clutch is faced with asbestos fabric, and the facing is mounted on a cast iron cone, which engages with a cast iron driven face. The brake is mounted on a drum placed on the outside of the driven clutch member, and has a diameter of $17\frac{7}{8}$ inches. It is actuated by linkage which contracts the asbestos band about the drum, bringing to rest one of the tracks, while the other may be free to move, thus enabling the tractor to turn about in a radius but a little over the width of the tractor.

Plate No. 37



STEERING CLUTCH AND BRAKE ASSEMBLY

1. Bevel pinion on transmission countershaft.
2. Bevel gear on transverse shaft.
3. Transverse shaft.
4. Splined end of transverse shaft.
5. Clutch driving collar.
6. Inverted cone clutch drive member.
7. Asbestos fabric material.
8. Clutch driven member and brake drum.
9. Clutch cover plate taking drive to Oldham coupling.
10. Oldham coupling.

TO RE-LINE CLUTCH

Remove the old lining and chip off the rivets. New lining is cut to proper size. If this is not available, a lining can be cut, using page 81 as a pattern. New rivets should be put in in such a way that they are countersunk below the surface of the lining, so that the metal of the rivet will not bear against the metal clutch driven face, or split rivets driven in from the inner side. The lining is in 16 segments. See page 81.

TO REMOVE STEERING CLUTCH

Remove the top armor plate, gasoline tank, radiator and transmission, take off nut from end of splined shaft and slide entire clutch unit off the spline shaft. As the spring tension is not excessive on the steering clutches, disassembling can be done without using spring relief studs, if handled carefully.

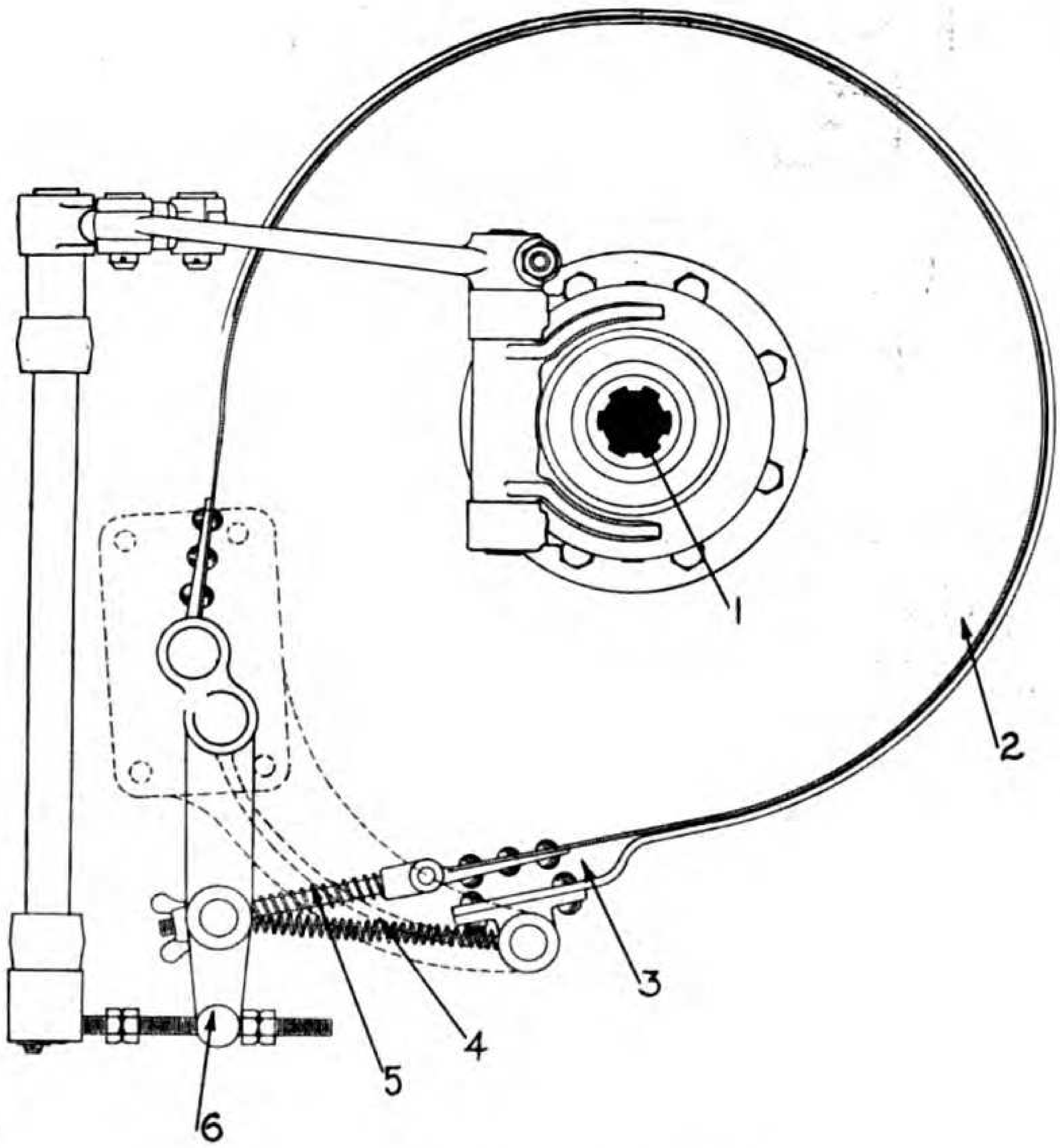
STEERING CLUTCH ADJUSTMENT

No adjustment is provided on the steering clutch for spring tension. There is an adjustment, however, on the steering clutch pull rod, to take care of the engagement and disengagement of the clutch. This turn buckle regulates the amount of throwout when the starting clutch lever is pulled, and will seldom require attention.

STICKING STEERING CLUTCH

To prevent the steering clutch from sticking, the driver, after stopping the tractor, should release the steering clutch with the hand reverse a few times to keep from sticking.

Plate No. 38



BRAKE ADJUSTMENT PROVISION

1. Transverse spline shaft.
2. Brake band.
3. Brake band and clamp.
4. Brake release spring.
5. Brake adjustment tension spring. (Adjustment made on wing nut at end of this rod.)
6. Brake actuating lever.

CHAPTER VI

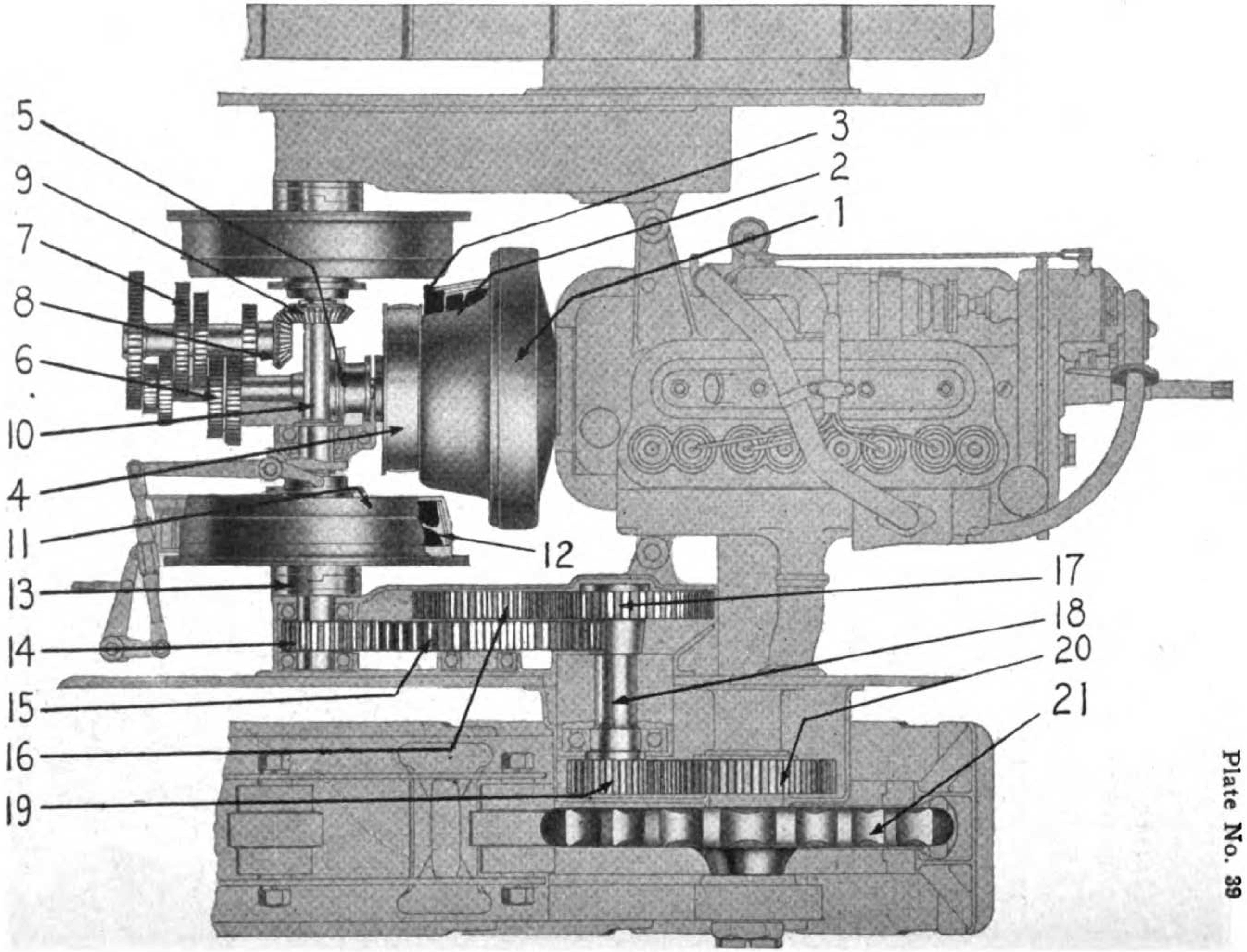
SPUR GEAR REDUCTION

GENERAL SPECIFICATIONS

Total reduction	22.8
Type of gears	Spur
Drive	Through Oldham coupling
Tooth form	Generated, involute
Pitch	4
Gear material	3½% nickel steel
Oldham coupling diameter	5⅝ inches
Number of teeth first pinion	15
Number of teeth first gear	63
Number of teeth second pinion	23
Number of teeth second gear	42
Number of teeth third pinion	13
Number of teeth third gear	37
Gear face width	1¾ inches
Back lash	.012—.025
Reduction gear housing	Aluminum casting

GENERAL DESCRIPTION

A spur gear reduction is mounted on each side of the tractor, giving a fixed reduction of 22.8-1. These gears are driven from the transverse shaft of the transmission through the steering clutch, by means of an Oldham coupling. They are contained within aluminum cast casings, and are the intermediate transmission members between the steering clutches and the sprocket which operates the track. The first pinion which receives the drive from the Oldham coupling is mounted on a 6 spline shaft, and has 15 teeth of 4 pitch, and meshes with a 63 toothed gear, which carries a 23 toothed pinion. This in turn meshes with a 42 toothed gear, carrying a 13 toothed pinion, which transmits the drive to the final reduction, which has a 37 toothed pinion. The face width of the spur gear reduction teeth is 1¾ inches, with the exception of the final reduction gear, which has a face width of 2⅛ inches, as has also the pinion which drives it. The first and second reduction gears, and the second and third pinions, which are mounted upon them are idlers, and are carried on annular ball bearings. The final reduction gear is directly connected to the track sprocket, being mounted on the rear axle and keyed to the track driving sprocket. The pressed cover plate for the spur gear case passes between the final reduction gear and the sprocket, and is held oil tight by a packing ring on the hub of the final reduction gear. The shaft which carries the



PROGRESSION OF DRIVE THROUGH REDUCTION GEARING

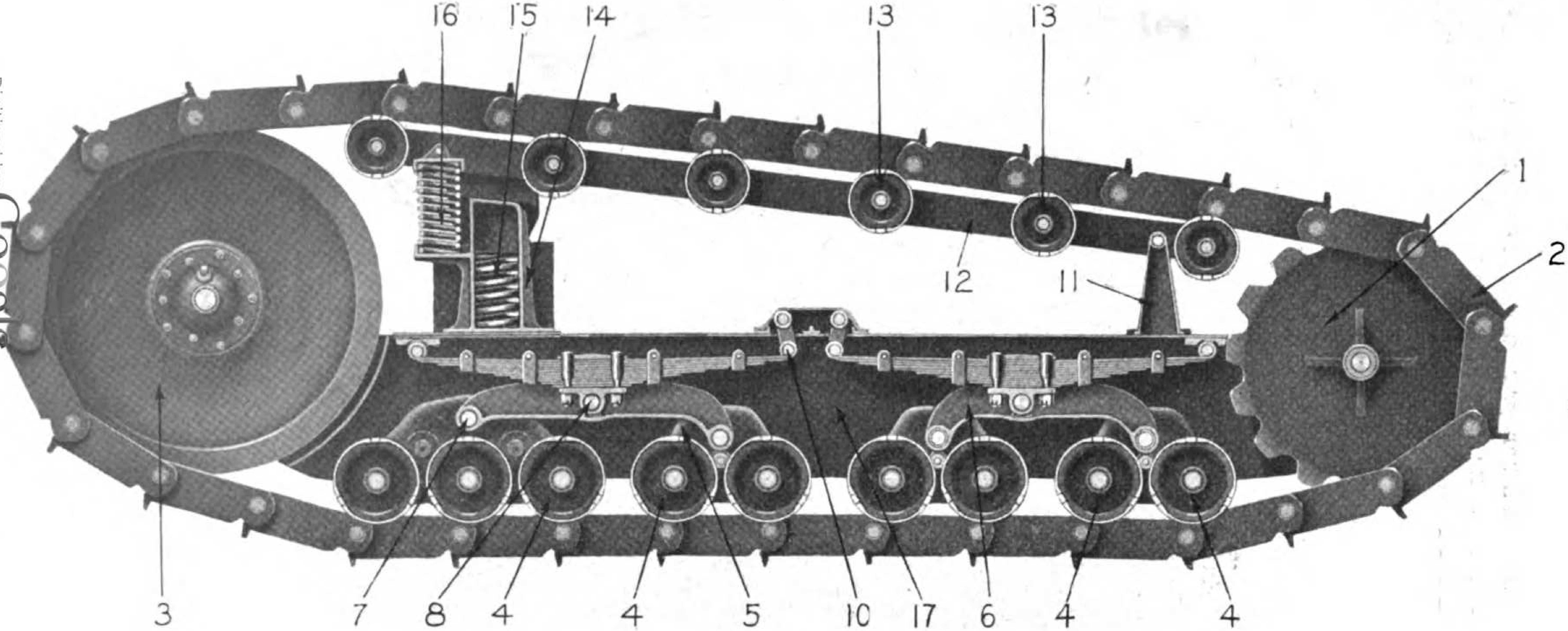
1. Main clutch driving member.
2. Main clutch driven member
3. Main clutch housing.
4. Fan belt pulley.
5. Alignment joint.
6. Transmission main shaft.
7. Transmission countershaft.
8. Bevel pinion.
9. Bevel gear.
10. Transverse shaft.
11. Steering clutch driving member.
12. Steering clutch driven member.
13. Oldham coupling.
14. Spur reduction gear.
15. Spur reduction gear.
16. Spur reduction gear.
17. Spur reduction gear.
18. Sprocket drive shaft.
19. Spur reduction gear.
20. Final spur reduction gear.
21. Track drive sprocket.

drive from the second reduction gear to the third or final reduction pinion is splined, and, as in the case of the reduction gears, except the final one, runs on annular ball bearings. The teeth on the reduction gear are 4 pitch.

TO REMOVE SPUR GEAR REDUCTION

The spur gear reduction is the last part to disassemble in taking down the tractor. To remove it, take off top armor plate, remove gasoline tank, radiator, and engine; take out the two large bolts on the top of the transmission. Remove the two bolts from the front of the transmission base, and take out the spacer on one side. Disconnect the control lines and Oldham couplings and pull out transmission. Remove track sprocket assembly and then take out all bolts through the spur gear reduction case, after which reduction case can be removed.

Plate No. 40



TRACK ASSEMBLY

1. Track drive sprocket.
2. Track link.
3. Track idler.
4. Track roller.
5. Track roller frame.
6. Roller truck.
7. Roller truck equalizer pivot.
8. Roller truck supporting pivot pin.
10. Spring shackle,
11. Upper roller frame pivot bracket.
12. Upper roller frame.
13. Upper roller.
14. Track frame supporting bracket.
15. Track supporting bracket spring.
16. Track tension spring.
17. Track frame.

CHAPTER VII

TRACK GROUP

GENERAL SPECIFICATIONS

Type of track	Link chain
Number of links	32 per track
Number of tracks	2
Tract drive	By sprocket
Track rollers, bottom	9 per track
Track rollers, top	6 per track
Track tension	By coil spring and idler location
Track guide	Roller idler
Track tread	Growser type
Roller diameter, bottom	7 inches
Roller diameter, top or supporting	4¾ inches
Track suspension	Coil spring
Roller truck suspension	Leaf spring
Track link length, center to center	9.842 inches
Link width	12¾ inches
Track pin diameter, growser end	1⅜ inches
Track pin diameter, plain end	1 inch
Link material	Cast steel
Roller material	Cast steel
Front idler material	Pressed steel
Truck leaf spring	11 leaf
Main leaf material	Vanadium steel
Supporting leaves	Carbon steel
Track tightener spring	Coil carbon steel
Growser depth	1 3/16 inches
Track roller bushing	Bronze

GENERAL DESCRIPTION

The tractor rolls upon a track which is laid by itself in the form of a continuous chain. The chain linkage places the track down in front of the rollers, upon which the tractor moves, and picks it up behind the rollers, carrying it over the top of the track frame and back again to the forward end where the operation is continuously repeated. There are 32 links in the track chain, and the track is driven by a sprocket at its rear end, and carried over an idler sprocket at its front end. To hold the track rigidly in its correct pathway, there is a set of track-carrying rollers mounted upon a bar underneath the top of the chain. This bar is pivoted at its rear end, and is forced vertically upward by a coil spring at its front end.

Plate No. 42

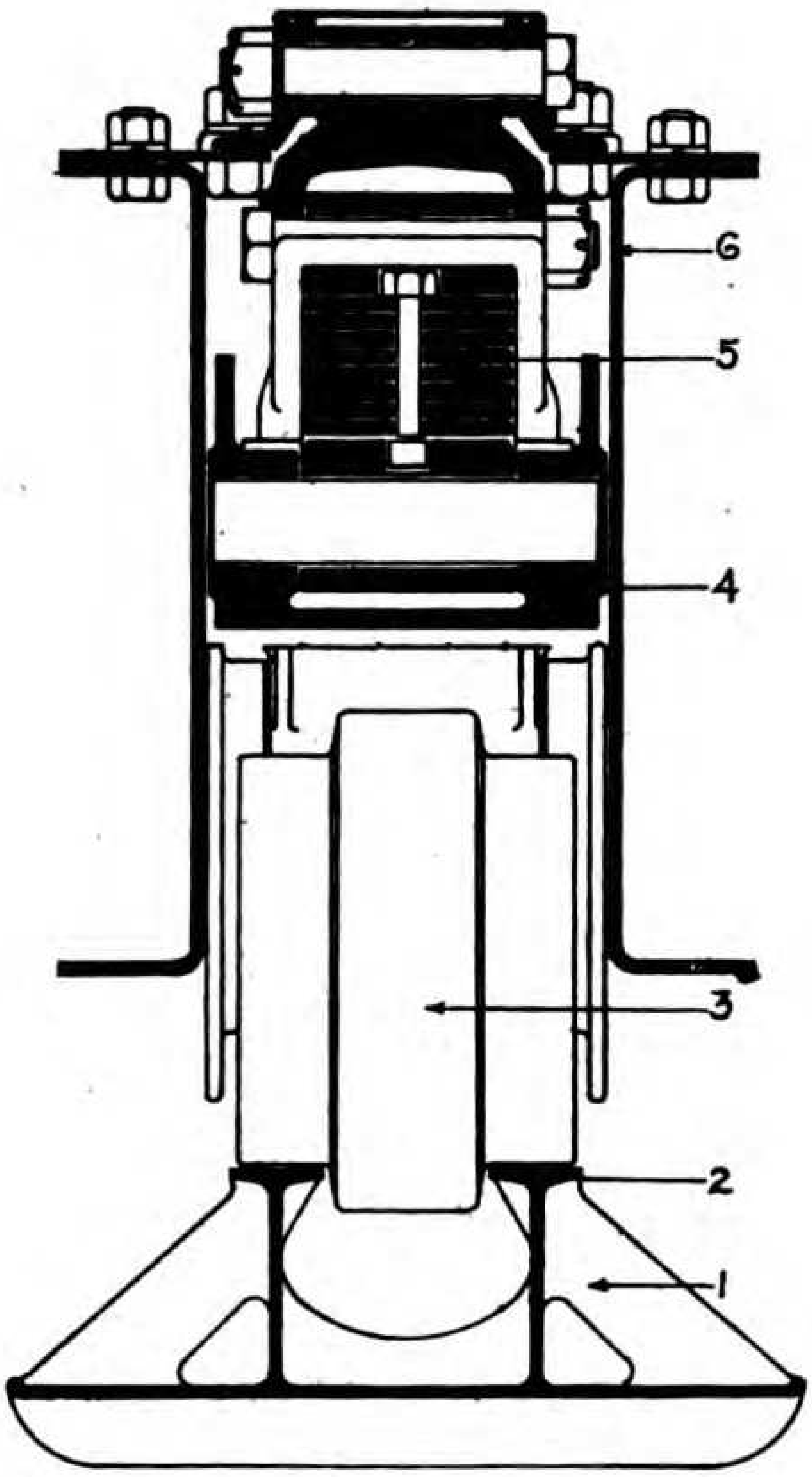
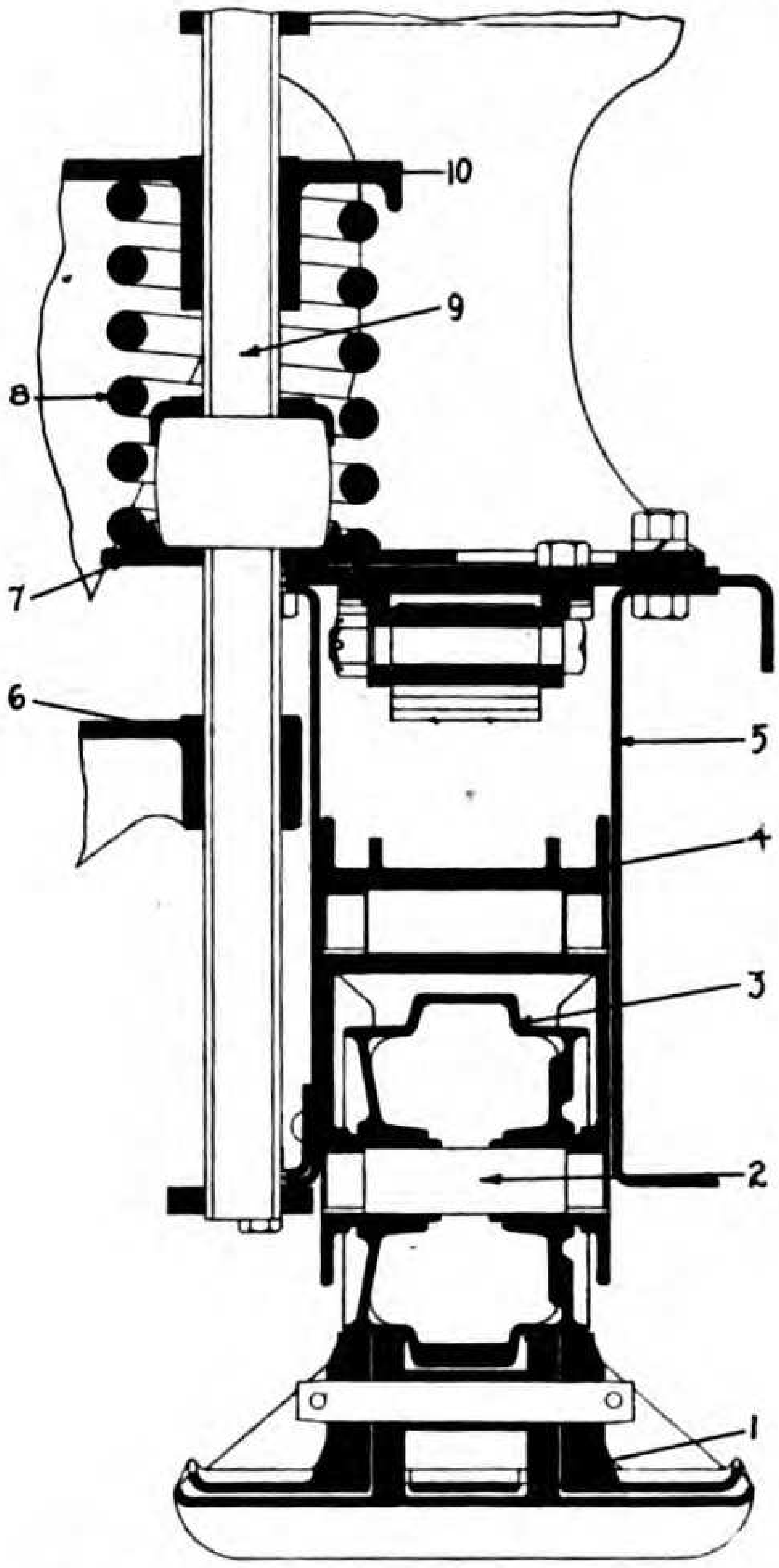


Plate No. 43



TRACK FRAME ASSEMBLY

1. Track shoe.
2. Track roller pin.
3. Track roller.
4. Track roller frame.
5. Track frame.
6. Tractor body supporting lug.
7. Track frame bracket.
8. Track supporting bracket spring.
9. Track supporting bracket guide.
10. Track supporting bracket.

TRACK SUPPORTING BRACKET

1. Track shoe.
2. Track rail.
3. Track roller.
4. Track frame pivot pin.
5. Track suspension spring.
6. Track frame.

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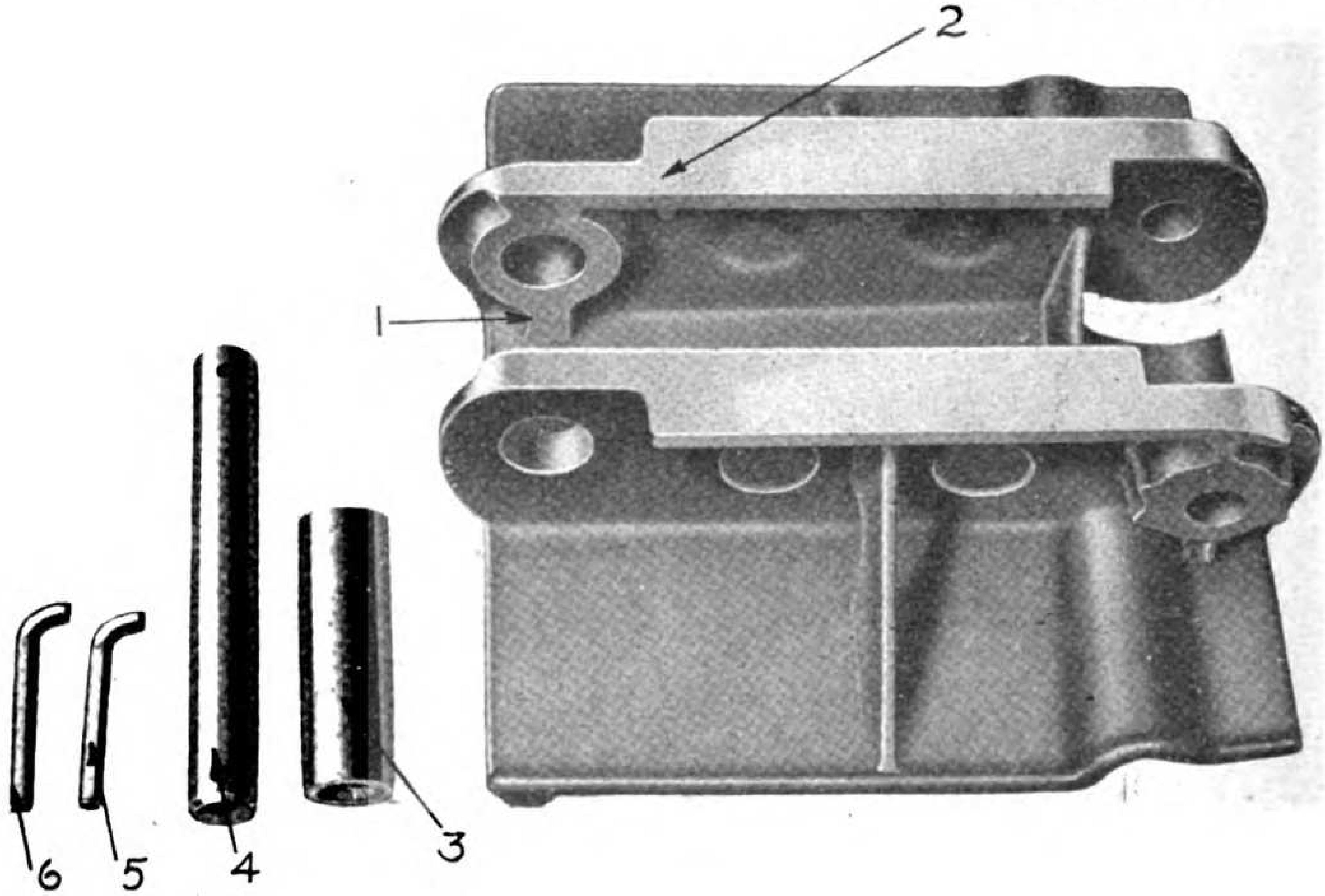
links has an integrally cast steel hook or growser, with which it is capable of obtaining a grip on the ground, greatly increasing the climbing ability of the tractor.

Structurally, the entire track mechanism is supported in an inverted "U" beam, which is bracketed to the bar on the tractor by means of spring mounted bracket previously mentioned. The drive is transmitted directly from the spur gear reduction through the driving sprocket of the track. The final reduction gear is keyed to the sprocket, which, in turn, transmits its drive by the meshing of the track link bushings between the sprocket teeth. As the track is moved around the track mechanism by the sprocket, the growsers obtain a grip on the

Plate No 44



TRACK PARTS

1. Track link.
2. Track rail surface.
3. Track pin (short).
4. Track pin (long).
5. Track pin retainer.
6. Track pin retainer.

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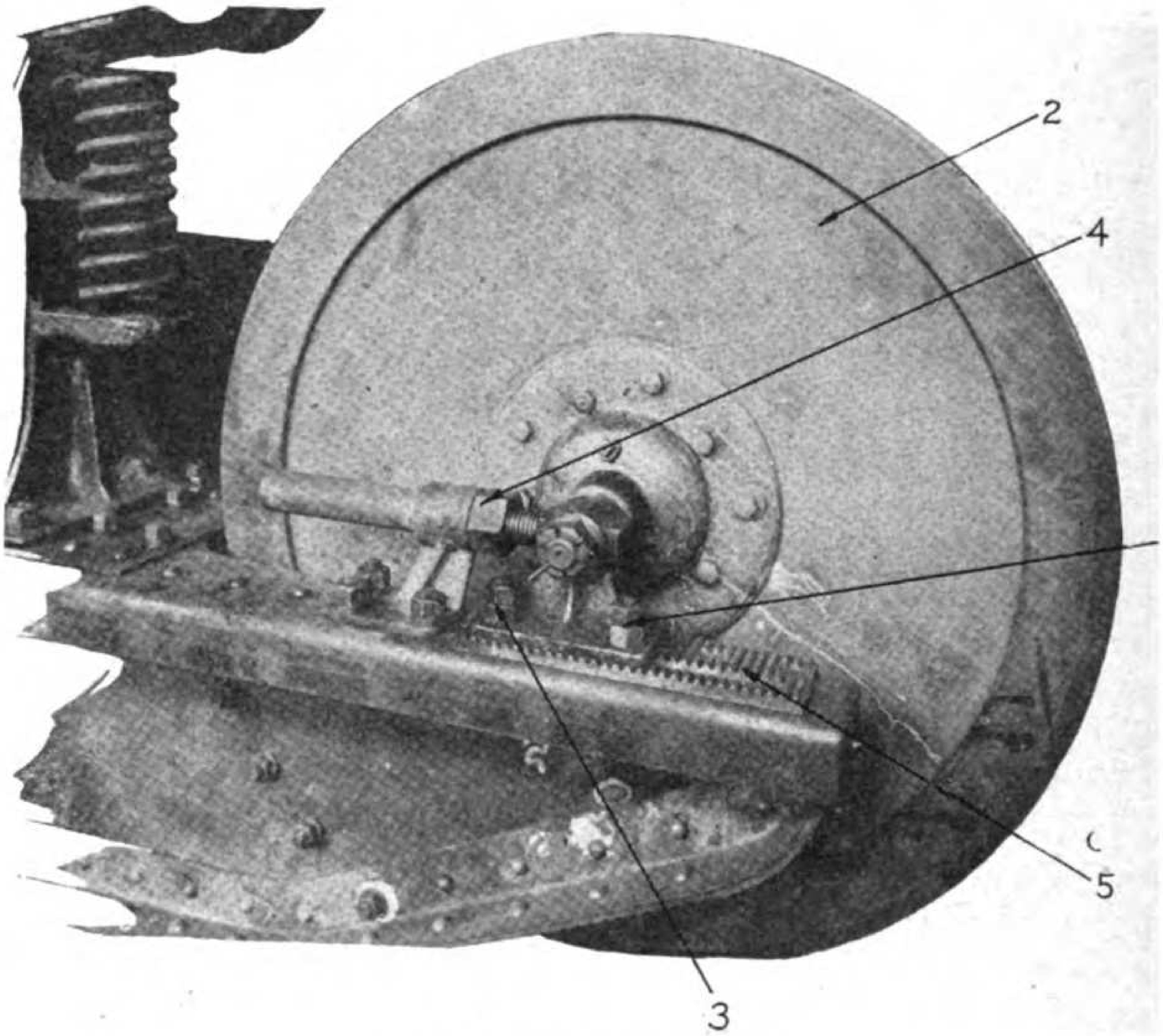
ground, hold the chain stationary, allowing the sprocket to obtain a grip on the bushings thus propelling the tractor forward. The propulsion is secured by the tendency of the sprocket to roll forward on the chain, thus communicating its drive to the sprocket axle, the axle pushes the tractor ahead and causes the rollers to travel over the rail which is carried by the chain. The trucks supporting the track rollers are pivoted at their centers, giving flexibility to the entire truck, and are also pivoted at the forward and rear ends of the roller frame. The linear speed of the track is the same as the linear speed of the drive sprocket, and since the growsers prevent slippage of the track on the ground, the linear speed on the tractor is the same as that on the chain. For the reductions of the various speeds see page 83. The quality of the track to accommodate itself to inequalities of the ground is given by the complete pivoting system, and also by the shackle arrangement of the semi-elliptic springs which support the trucks. These being pivoted at one end and shackled at the other are free to rise and fall to a small angle, while the rollers themselves can swing about on the equalizers at the pivot points.

Plate No. 41



TRACK ADJUSTMENT

1. Track idler bracket bolts (front).
2. Track idler.
3. Track idler bracket bolts (rear)
4. Track adjusting nut.
5. Track idler support bracket locating rack

The bottom rollers are the wheels upon which the tractor rolls. There are nine of these on each track, and these nine are carried on two independent equalizers or trucks. The forward truck has a group of three at its forward end, and two at its rear end, and the rear truck has two groups of two. The roller trucks are suspended by flat leaf springs of semi-elliptic type, pivoted at the outer end, and shackled at the ends toward the center of the tractor. These leaf springs form the connection between the roller trucks and the track frame. The entire track group with its appendages consisting of the drive sprockets, trucks, roller frames, rollers, etc., is bracketed to the main body of the tractor by a spring supporting bracket in which a heavy coil spring supplements the shock absorbing qualities of the leaf springs. The use of two independent trucks, each carrying independent roller groups, gives a wide degree of flexibility to the track apparatus, and allows it to accommodate itself to the inequalities of the ground over which it is traveling.

The track links themselves are pinned at each end. Each of the