HANDBOOK OF THE

TWO-TON TRUCK CHASSIS NASH MODEL 4017-A AND 4017-L

(SEVENTY-FOUR - PLATES)

JULY 3, 1918

No. 1999

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WAR DEPARTMENT,
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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,
Brig. Gen., Ordnance, N. A., Acting Chief of Ordnance.

TABLE OF CONTENTS.

CHAPTER I.

SPECIFICATIONS, OPERATION AND CARE.

CHAPTER II.

ENGINE AND ENGINE ATTACHMENTS.

CHAPTER III.

CONTROL DEVICES, LEVERS AND STEERING SYSTEM.

CHAPTER IV.

CLUTCH.

CHAPTER V.

TRANSMISSION, UNIVERSAL JOINTS AND PROPELLER SHAFTS.

CHAPTER VI.

AXLES.

CHAPTER VII.

WHEELS AND TIRES.

CHAPTER VIII.

FRAME AND SPRINGS.

CHAPTER IX.

EQUIPMENT.

CHAPTER X.

NOMENCLATURE.

INDEX.

LIST OF PLATES.

CHAPTER I.

CHAPTER II.

CHAPTER III.

CHAPTER IV.

CHAPTER V.

CHAPTER VI.

CHAPTER VIII.

CHAPTER IX.

CHAPTER X.

NOMENCLATURE.

SPECIFICATIONS, TECHNICAL DATA, DIMENSIONAL INFORMATION, PARTS NUMBERS AND DESIGNATIONS, CARE AND REPAIR OF

TWO-TON CHASSIS NASH MODELS 4017-A AND 4017-L.

These chassis models are alike except as follows:

Model 4017-A has electric generator and storage battery lighting.

Electric searchlight and electric side and tail lamps.

Magneto without impulse starter.

Model 4017-L has acetylene generator and searchlight. Oil side and tail lamps.

Speedometer.

Magneto fitted with an impulse starter.

Other than changes mentioned, the specifications for both models are identical. Where information or data applies only to one model it is so stated in the proper place.

HANDBOOK OF THE TWO-TON TRUCK CHASSIS NASH MODEL 4017-A AND 4017-L

CHAPTER I.

WEIGHTS AND OUTLINE SPECIFICATIONS.

Rated load capacity	pounds	4,000.00
Body weight allowance	do	1,200.00
Weight of chassis only	do	6,700.00
Maximum gross weight (including chassis, body and pay load)	pounds	11,900.00
Percentage of chassis weight on front tires (without load)		66.66
Percentage of chassis on rear tires (without load)		33.33
Percentage of load weight on front tires		30.00
Percentage of load weight on rear tires		70.00
Percentage of gross weight on front tires		45.00
Percentage of gross weight on rear tires		55.00
Overall length of chassis (without body)	inches	202.50
Overall width of chassis (at widest part)	do	78.50
Chassis wheelbase	do	124.00
Length of frame back of driver's seat	do	117.13
Width of frame (outside dimensions)	do	38.13
Height of rear end of frame from ground loaded	do	35.50
Height of rear end of frame from ground unloaded	do	38.50
Diameter of turning circle	feet	50.00
Tread of front wheels	inches	60.50
Tread of rear wheels	do	60.50
Road clearance under front axle (lowest point)	do	14.75
Road clearance under rear axle (lowest point)	do	14.75

ENGINE.—Four-cylinder, 4-cycle; L-head type, cylinders cast en bloc, with integral head. Bore 4.25 inches, stroke 5.5 inches. Horsepower 28.9, N. A. C. C. rating.

COOLING.—Water, centrifugal pump circulation.

LUBRICATION.—Force feed, using drilled crankshaft; spray to cylinders.

RADIATOR.—Tubular type with fins, removable cast iron headers.

IGNITION.—Eisemann high-tension variable spark magneto, type G4-II Edition. Model 4017-L fitted with an impulse starter.

CARBURETOR.—Type M-2, 1.25-inch Stromberg, plain-tube type, with hot-air connection.

FUEL FEED.—From main tank of 27 gallons capacity to auxiliary tank, holding two quarts, from latter to carburetor by gravity.

GOVERNOR.—Fly ball type, drives through flexible shaft from camshaft and is mounted between carburetor and short external inlet manifold.

CLUTCH.—Single-plate, dry-disc, fitted with clutch brake.

TRANSMISSION.—Selective, sliding-jaw clutch type, combined with silent chain reduction. Four speeds forward—one reverse.

DRIVE.—Drive from transmission through two propeller shafts fitted with Spicer universal joints, then to bevel ring gear in axles and through axles to internal gearing in four wheels. Torque absorbed through springs. Full Hotchkiss drive.

FRAME.—Channel section pressed steel. Six cross members. Five standard Ordnance transoms. Ordnance pintle at rear, towing hooks in front.

SPRINGS.—Front and rear semi-elliptic with auxiliary coil springs.

AXLES.—Front and rear identical. Bevel pinion and gear with M. & S. locking type differential at propeller shaft and internal gear at wheels.

BRAKES.—Two sets of brakes. Pedal-operated service brake of internal expanding type in wheel brake drums. Hand-lever operated emergency brake of external contracting type on transmission; hand-brake applies foot brakes also.

WHEELS.—Cast-steel disc wheels, all four identical. Wheels have brake drums cast integral. Wheels fitted with taper roller bearings.

TIRES.—36 inches x 6 inches, solid tires, pressed-on type.

STEERING.—All four wheels used for steering. Vertical steering column. Steering gear of screw and split nut type. Hardwood steering wheel.

CONTROLS.—Left hand steer. Change gear and emergency brake levers in front of driver's seat to right of steering column. Spark and throttle lever operated on sector clamped below steering wheel on front of steering column. Ignition ground wire switch on left side dash. Carburetor choke control on steering column. Clutch and service brake pedals left and right respectively. Accelerator pedal to left of change gear lever.

MAIN GASOLINE TANK.—Galvanized steel tank, 27-gallon capacity.

AUXILIARY GASOLINE TANK.—Steel tank, two quarts capacity.

EQUIPMENT.—Pyrene fire extinguisher; non-skid chains, complete in chain box; eyes for non-skid chains; hand-operated horn; odometer; hand flashlight; *Model 4017-A, fitted with speedometer;* electric searchlight, electric side lamps, electric taillamp, Bijur generator, storage battery. Model 4017-L, acetylene searchlight, acetylene generator, oil side lamps, oil tail lamp and speedometer.

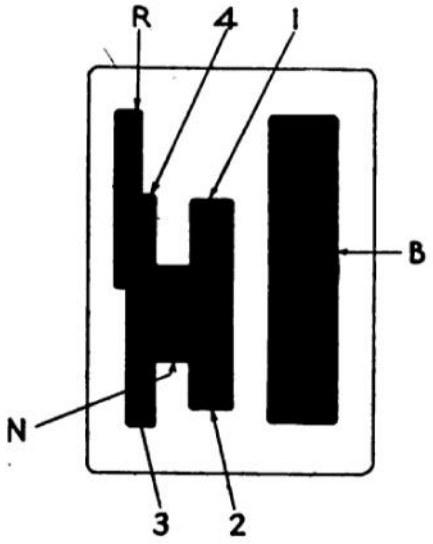
BRIEF DESCRIPTION NASH MODELS 4017-A AND 4017-L.

With the exception of a few details of equipment these models are identical. The Model 4017-L uses an impulse starting device on the

magneto shaft, while the 4017-A model has none; it uses acetylene lighting while the 4017-A model employs an electric generator and storage battery system; it is fitted with a speedometer in addition to an odometer, while the Model 4017-A has only an odometer.

The chassis is one of 124 inches wheelbase and is fitted with a four-cylinder engine, dry-disc clutch, four-speed transmission, and a drive

Plate No. 1



CHANGE-GEAR AND HAND BRAKE QUADRANT SHOWING POSITION LEVER SHOULD TAKE FOR DIFFERENT SPEEDS.

1—First speed.
2—Second speed.
3—Third speed.
4—Fourth or direct speed.
B—Emergency brake lever slots.
N—Neutral position.
R—Reverse.

to all four wheels, through shafts and internal gear-drive axles which are identical front and rear.

The engine is a standard design L-head, of Buda make, using force-feed lubrication, pump cooling, and fitted with a Stromberg carburetor feeding through cored manifold cast integral with cylinder block, an Eisemann magneto, and on the Model 4017-A only, with a Bijur generator.

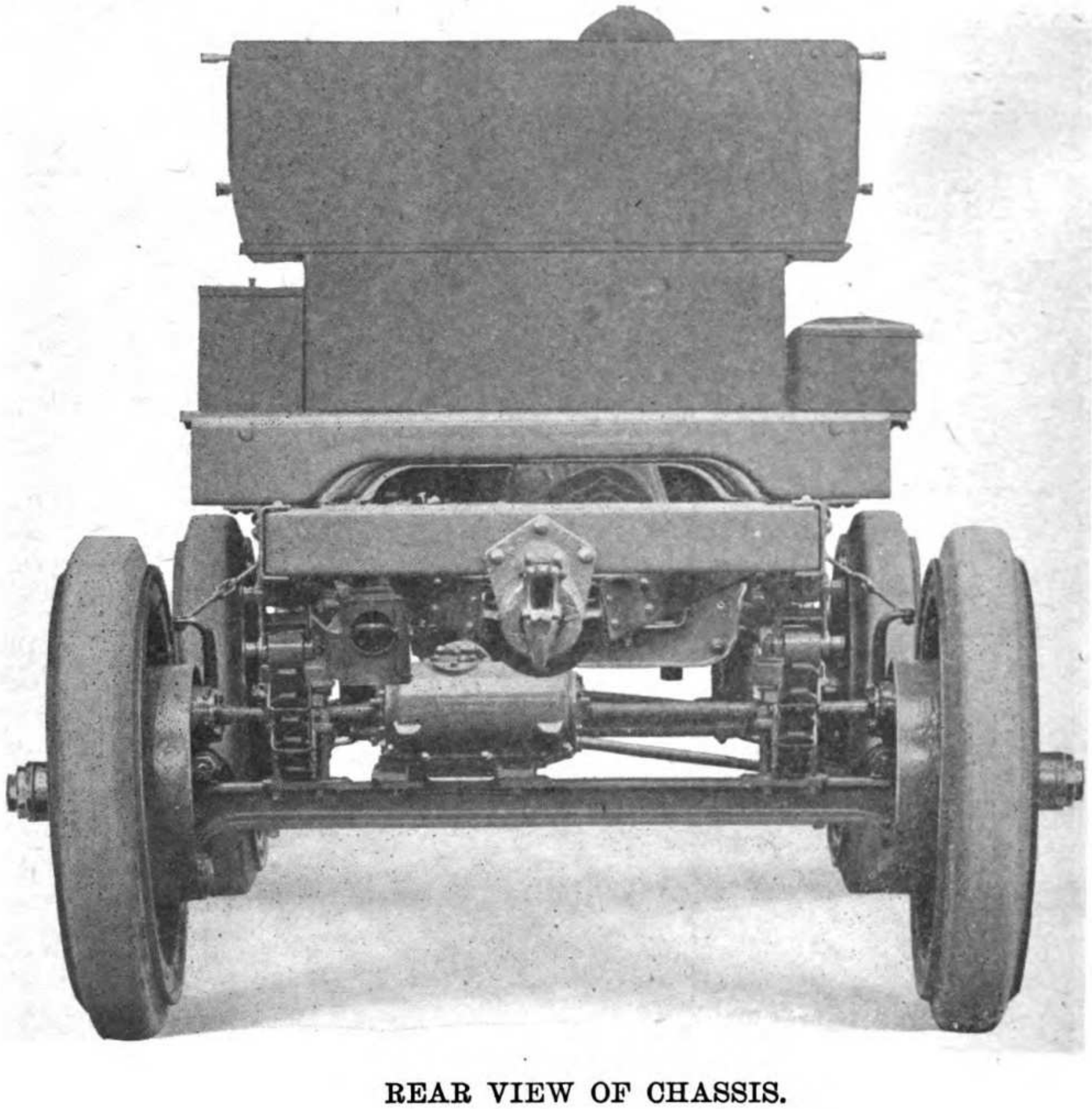
The clutch is of the dry-plate type and the drive from it is through an open two-joint propeller shaft to a four-speed, sliding jaw clutch type transmission. From the latter extend two two-joint propeller shafts, one forward and one rearward, to identical internal gear-drive axles. The live member has exposed axle shafts extending from it, and the ends of these shafts are each fitted with a universal joint and a spur pinion, the latter meshing with an internal gear bolted to a disc steel wheel. All the wheels are interchangeable and are all driving and steering wheels.

BRIEF OPERATING INSTRUCTIONS.

PRELIMINARY TO STARTING ENGINE.

See that gear shift lever is in neutral.
Set emergency brake.
Advance gas lever one-third travel.
Advance spark lever one-fourth.
Turn ignition switch to "MAGNETO" position.
Crank engine by spinning rapidly.
Pull up air choke lever for rich mixture, if necessary.

Plate No. 2



REAR VIEW OF CHASSIS.

AFTER ENGINE STARTS.

Advance spark.
Regulate auxiliary air control lever to secure smooth engine operation.
Close throttle lever until engine runs slowly.

TO START TRUCK.

Release hand brake.
Disengage clutch.
Engage low speed gear.
Increase engine speed slightly.
Slowly engage clutch.

GEAR CHANGES.

As truck gains momentum, disengage clutch, close throttle, shift to intermediate speed, open throttle slightly and engage clutch. When momentum is gained again disengage clutch, close throttle and engage next higher gear. Repeat operation until fourth speed is reached, after which truck speed can be controlled by accelerator (or hand lever).

GEAR CHANGES TO LOWER SPEEDS.

In changing to lower speed, necessitated by heavy loads or steep grades, disengage clutch, accelerate engine slightly, instantly shift to lower gear, engage clutch and open throttle to gain speed.

TO REVERSE TRUCK.

Reduce engine speed, disengage clutch, apply foot brake. When truck has stopped, engage reverse gear, release brake and engage clutch. Never engage reverse gear when truck is moving forward.

TO STOP TRUCK.

Reduce engine speed, disengage clutch, apply brake, place gear shift lever in neutral, engage clutch, set emergency brake.

TO STOP ENGINE.

Turn ignition switch to "OFF" position. Advance gas lever slightly to supply initial charge to assist for next start. In winter, pull up air choke when stopping.

DETAIL OPERATING INSTRUCTIONS.

PREPARATION OF TRUCK FOR SERVICE.

UNLOADING FROM SHIP OR CAR.

Great care should be exercised in unloading the truck, as carelessness may cause serious loss later. A thorough inspection should be made of the equipment sheet, comparing it with the equipment received. The box of tools and parts should be opened and checked over before being receipted for, and any movable parts that might be stolen or lost from the truck should be checked up. All seals on governor, transmission, differential and other places should be intact and if any have been tampered with make a careful inspection of the place where the seal belonged and note whether any damage might have been done to important parts. A

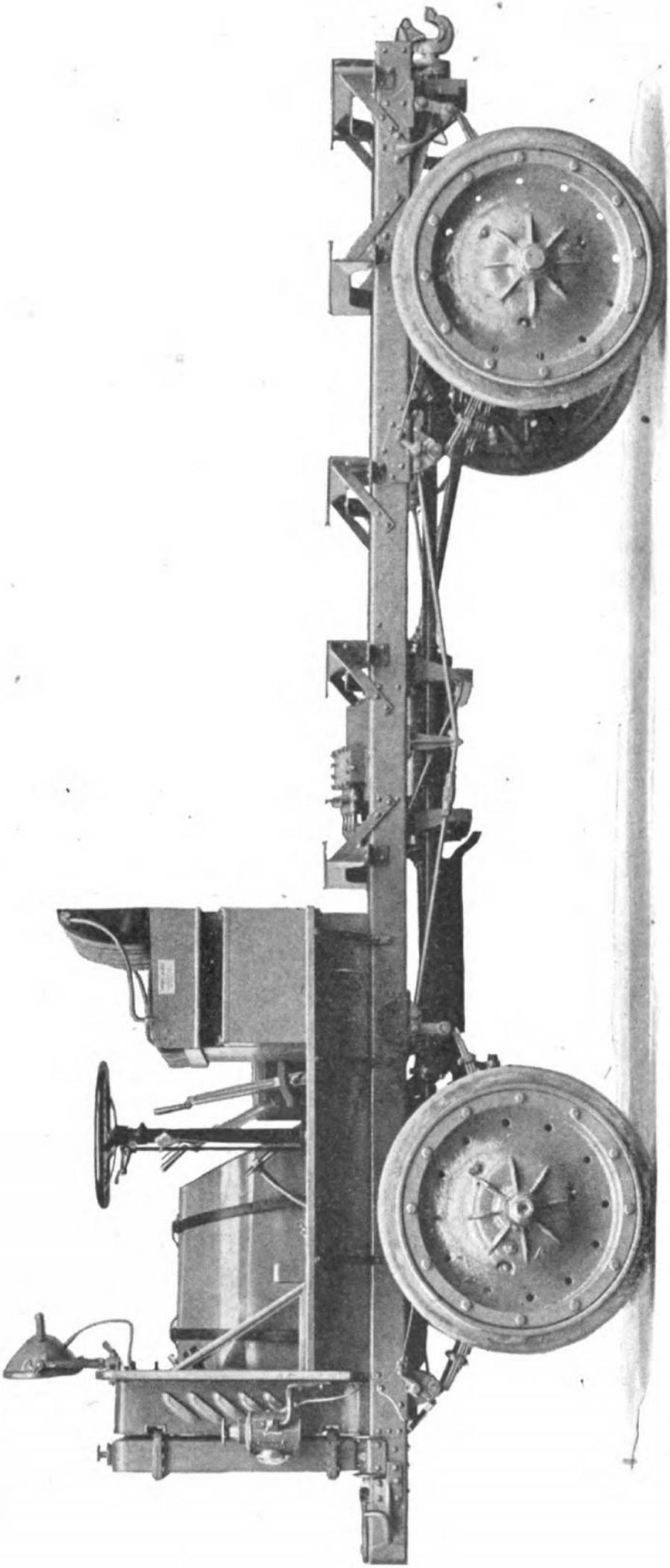
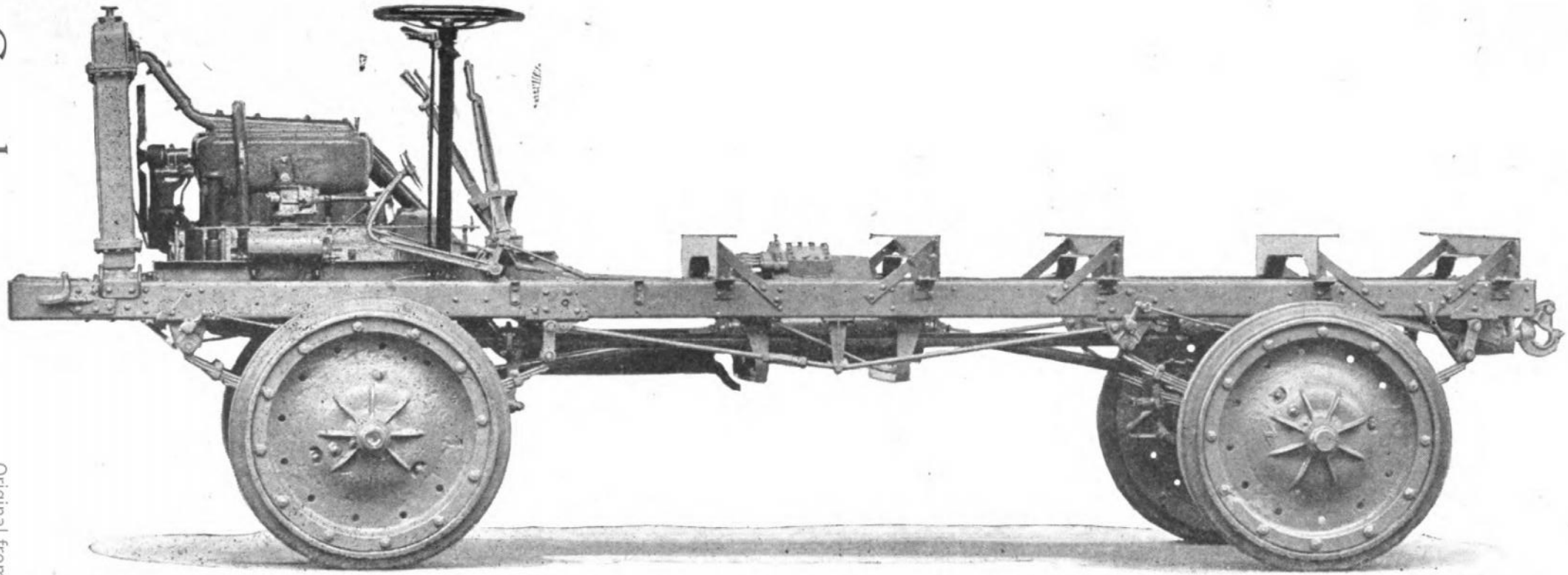


Plate No. 3

LEFT SIDE OF CHASSIS WITH DRIVER'S SEAT AND ENGINE HOOD IN PLACE

Plate No. 4



LEFT SIDE OF CHASSIS, ENGINE UNCOVERED AND MINUS DRIVER'S SEAT, SHOWING FIVE STANDARD ORDNANCE TRANSOMS MOUNTED ON FRAME.

nut or broken bolt slipped into the transmission may completely ruin a truck or cause loss of life, and these things should be watched carefully.

After the inspection of the shipment, so far as completeness goes, see that the drain cocks under radiator and water pump and the plug in cylinder water jacket are closed, and that all hose connections are tight. The radiator should then be filled with clean water to within two inches of the bottom of filler neck on radiator and all connections and joints tested. Care should be exercised in selecting water, get soft water, if it is procurable. The radiator and cooling system holds about seven gallons of water.

The crankcase of the engine should be examined and the specified grade of heavy oil put in so that the gauge on the left side of the engine indicates the proper level. The grease cups on the water pump glands should be turned down. Note if there is a water leak at that point. The spark plugs should be removed, and with a squirt can, about a tablespoonful of motor oil should be squirted on to the top of each piston, and the engine revolved by hand a number of times after replacing plugs, so that the oil will lubricate the cylinder walls. While turning the engine over notice whether there are any compression leaks around the cylinder head pet cocks, and have them closed.

Dampness and moisture may get to the working parts, and on arrival they may be rusted badly, grease may be lost out of important places, and equipment stolen or lost. In the former case the engine should be handled very carefully, because the pistons might have rusted fast or valves seized in the guides. Kerosene applied with an oil can to the tight parts will loosen them. A little kerosene in the clutch will make it function better, and prevent grabbing in case it has rusted on the plate. After the engine has been cranked freely by hand the gasoline tank lever should be turned to main supply with the long end of the lever down inclined at an angle of about forty-five degrees to the left. Fill gasoline tank with clean gasoline, being sure funnel and receptacle gasoline is carried in is thoroughly grounded on tank or explosion may occur, and after a sufficient quantity has been put in, unscrew the end of the gasoline pipe near carburetor and drain out a quart or so to clear line and tank of dirt before it reaches the carburetor.

Open the plug on the side of the transmission case and note oil level. If oil does not flow, fill to proper height with grade specified in lubricating instructions. Note oil level of differential housings and fill, if necessary, with specified grade.

A careful inspection should be made of the amount of grease in the wheels and on spindle bearings.

The pinion shaft roller bearings should be looked at in case they may have rusted or broken. If one of these bearings fail, serious damage might result.

After all spring bolts are oiled and grease cups have been turned down

to the limit and refilled with fresh grease, every universal joint on the truck should be opened and, if necessary, packed with grease. The propeller shaft joints should be given the greatest attention.

PRELIMINARY TO STARTING.

Before attempting to start be certain you have enough fuel, oil and water for the run. See that the crankcase level is correct, and that all lubricating instructions (see under lubrication, page 34) have been carried out. Make a superficial examination to see that nothing about the truck is broken or out of place; look underneath and notice if there is dripping which indicates a leak, except in the case of water coming out through the radiator overflow. You can tell by the feel and odor whether it is water, oil or gasoline. See that any danger is removed from driving, by an excessively loose part of the running gear or controls, such as steering knuckles, tie rod, drag link, wheels, etc.

The engine should then be started and let run idle without any load for from one-half to one hour before starting the truck. After standing on freight cars or on board ship for a long time piston rings may gum fast, valves rust in or the gasoline line clog up, and this preliminary running in will repay for the trouble in the time saved on adjustment later on.

After going into service the truck should be driven very carefully for the first week in order that the various parts may work into place and the rough edges wear off. The first five hundred miles are the most important in the life of the truck, and abuse early will surely result in poor efficiency probably later on, when the best will be required of the truck.

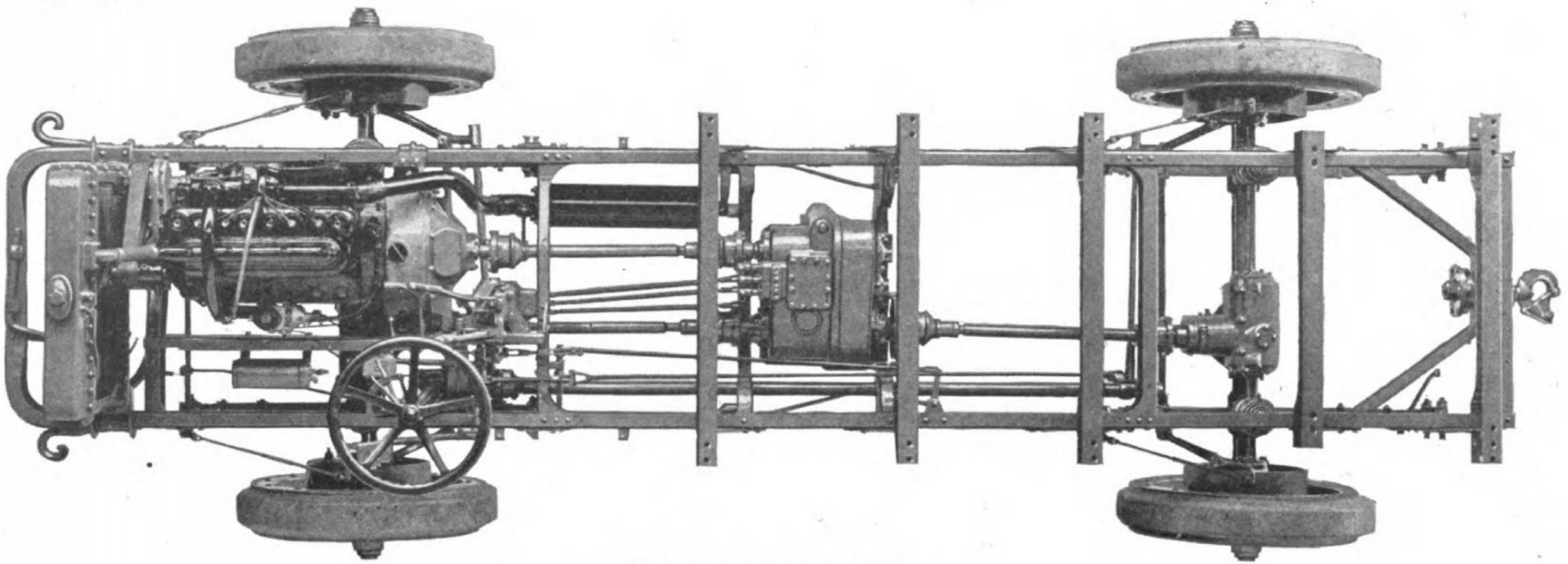
STARTING.

Before cranking the engine always see that the gearshift lever is in neutral position and the hand brake set. If you make a practice of setting the hand brake every time you shift into neutral when stopping you will be on the safe side. When stopping set the spark one-quarter advance and set the hand throttle lever one-quarter open. This sets these for the next start. Get into the habit of doing these things automatically.

Turn ignition switch to "mag" and then crank engine.

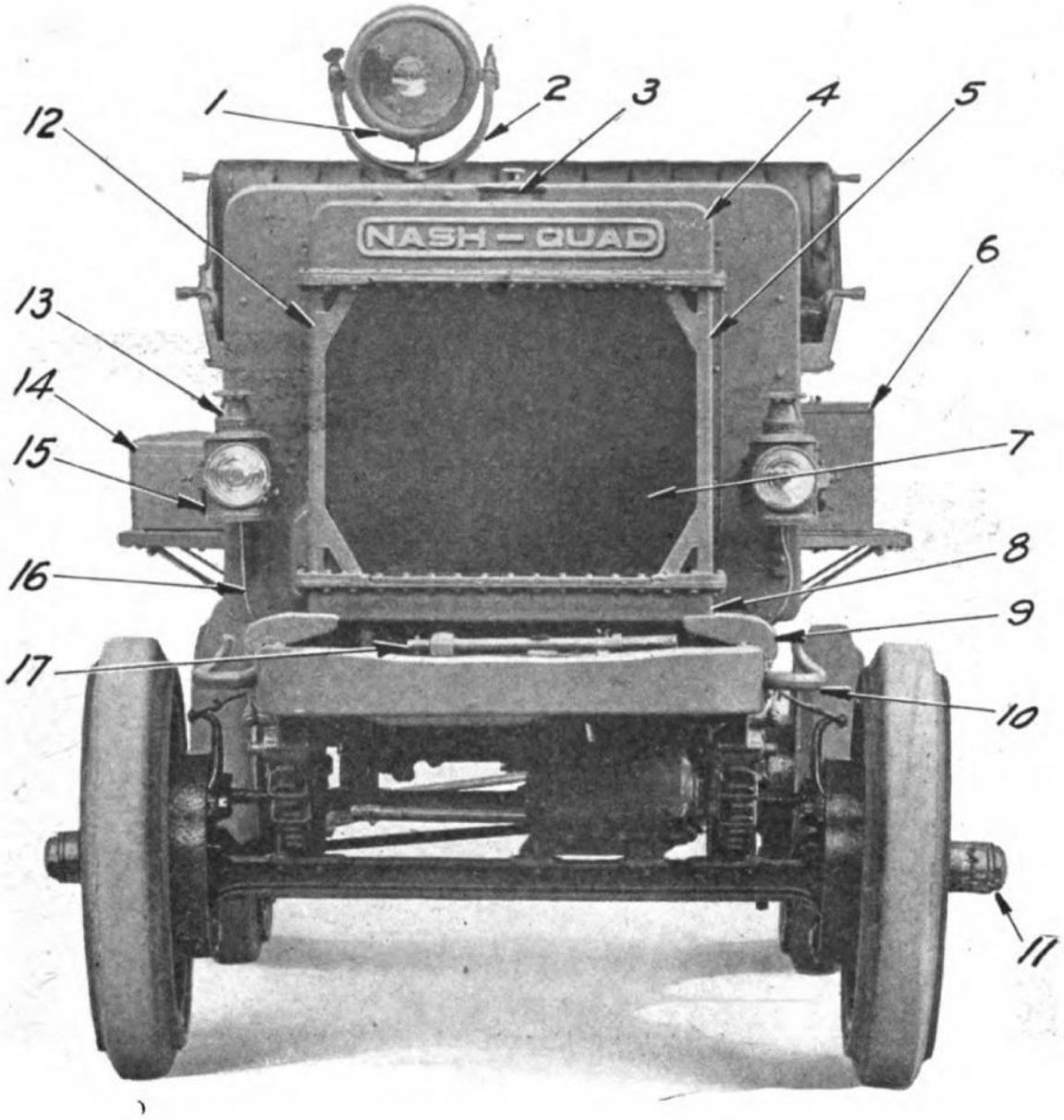
After the engine has started firing advance the spark as far as it will go and get a good idling position for the throttle lever. In the winter time it will be necessary to pull up the carbureter air choke before cranking so that a rich mixture is drawn into the cylinders. Do not keep the air choke pulled up longer than necessary. That means as soon as the engine starts firing push the choke down gradually until the engine runs and pulls smoothly. If it starts to backfire and spit keep the choke on full or part way as needed. It will require only a minute in the cold weather to get smooth running with the choke closed, that is, up.

Plate No. 5



PLAN VIEW OF CHASSIS.

Plate No. 6

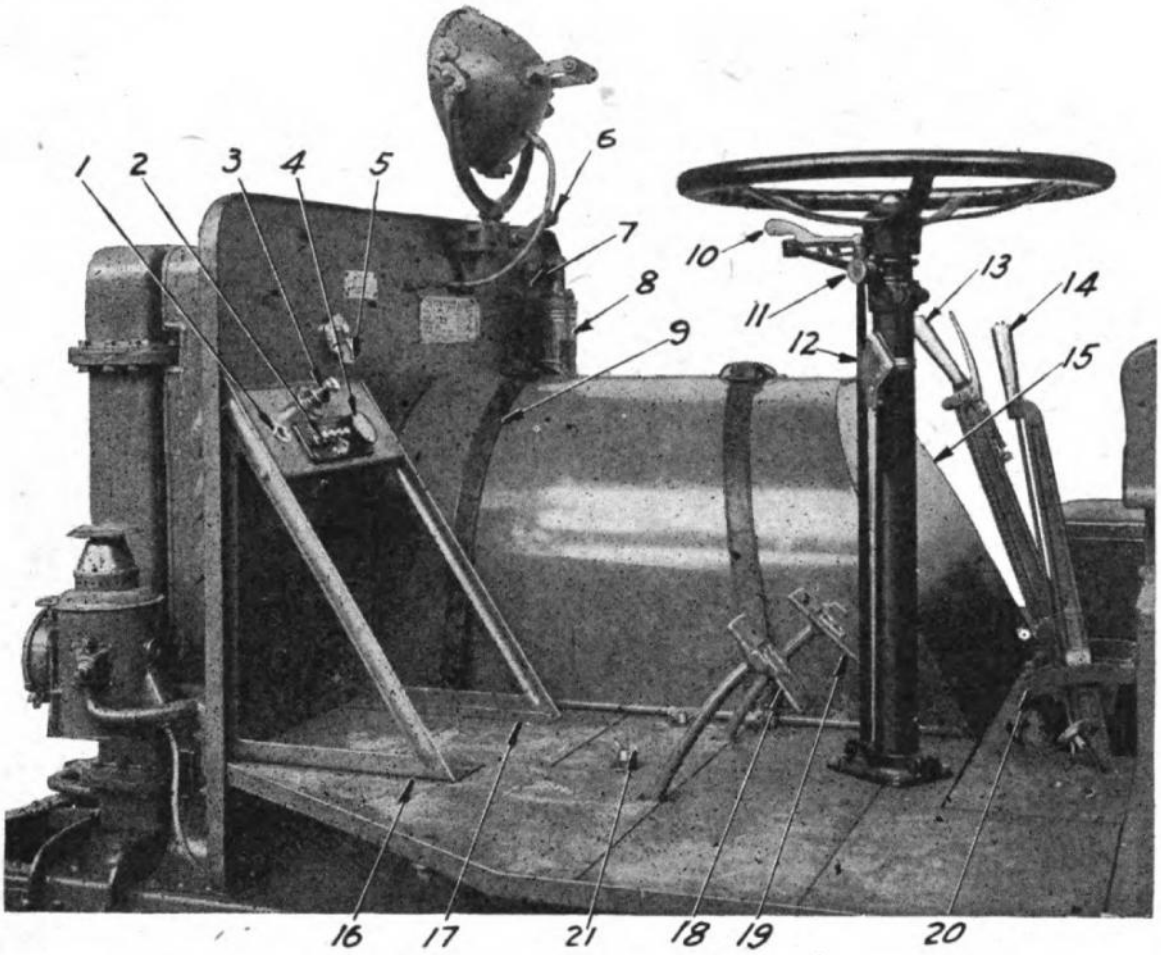


FRONT VIEW OF CHASSIS. MODEL 4017-A ONLY.

Ref. No.	Part No.	Name of Part.
1	37057-A	Searchlight.
2	35259-A	Searchlight bracket, complete.
3	32183-A	Radiator filler cap.
4	32186-A	Radiator top tank.
5	32178	Radiator side member.
6	35836-A	Battery cover.
7	32171	Radiator core, complete.
8	32185	Radiator bottom tank.
9	31087	Radiator bracket.
10	32530	Tow hook (left).
11	32713	Wheel odometer and hub cap.
12	32178	Radiator side member.
13	35327-A	Head lamp complete (Adlake).
14	32620-A	Tool box.
15	35339	Head lamp bracket.
16	35723	Side lamp wire.
17	32674	Starting crank.

Note.—Special instructions for Model 4017-L. This engine should be easier to start than in the 4017-A, because of the use of an impulse starting device fitted to the magneto. This impulse starter gives a very quick turn

Plate No. 7



DRIVER'S COMPARTMENT. MODEL 4017-A ONLY.

Ref. No.	Part No.	Name of Part.
1	35871	Trouble lamp socket.
2	35287-A	Lighting switch, complete.
3	35284-A	Instrument board lamp, complete.
4	36839	Ammeter (Weston).
5	35902	Magneto switch (Kick type).
6	36636	Searchlight bracket lever.
7	35281	Fire extinguisher bracket.
8	35249	Fire extinguisher.
9	35305-A	Hood strap (left).
10	33778	Spark lever.
11	CU-113	Steering column grease cup.
12	33662	Carburetor control.
13	32206-A	Hand brake lever.
14	35404-A	Change gear lever assembly.
15	32880-A	Hood, complete.
16	33042	Dash brace (upper left).
17	33043	Dash brace (upper center).
18	32651	Clutch pedal pad.
19	32650	Brake pedal pad.
20	32317	Gear shifted lever quadrant (outer).
21	NU-1006	Floor board clamp nut.

to the magneto armature, causing a good, hot spark to occur with only a single turn of the crank. It is not necessary to spin the engine to get the needed good spark, but it may be to get a good mixture.

If in cranking the engine it does not respond in a reasonable time, investigate instead of wasting energy cranking further. Go at the work systematically, keeping in mind all the time that there are three important systems, the failure of which will cause engine failure. These systems are: The fuel system, the ignition system and the valve system. If there is fuel and spark and the valves are working properly the engine should start, other things being equal. See page 104 for further information about failure to start.

If on cranking, the engine turns over only part way, stopping suddenly at one point and not going beyond, make an investigation to find an obstruction. In the winter a frozen water pump might cause this. Breakage of a timing gear or interference with free movement of any moving part of the engine will cause stoppage of this kind. Use your judgment, based on the previous run of the truck, recalling whether it was run with proper amount of oil, or if any unusual noises were heard.

In the winter time cranking may be more difficult than in warm weather, because of the thickening of the oil around the interior moving parts. Once the engine is started in cold weather let the engine idle for a while, until the oil has become sufficiently thin to circulate properly. Cold oil is like cold molasses, it will not flow readily.

RUNNING.

PRELIMINARY ADVICE.

Remember that in the first few hundred yards of running you should keep your eyes, ears and sensory system at work. Test the brakes to make sure they are working, instead of finding out in an emergency. Be satisfied that everything is running right.

THE CONTROL SYSTEM.

The control system consists of those parts necessary to start the engine, shift the gears, accelerate and keep the truck moving forward, and those needed to stop the truck. Thus the complete system consists of clutch and brake pedals, hand or emergency brake lever, spark and throttle levers, accelerator pedal, ignition switch, and carburetor air control.

THE CONTROLS AND THEIR USE.

STEERING WHEEL.

The steering wheel controls the direction of the truck. Turning the wheel to the right turns the truck to right and vice versa. Do not at-

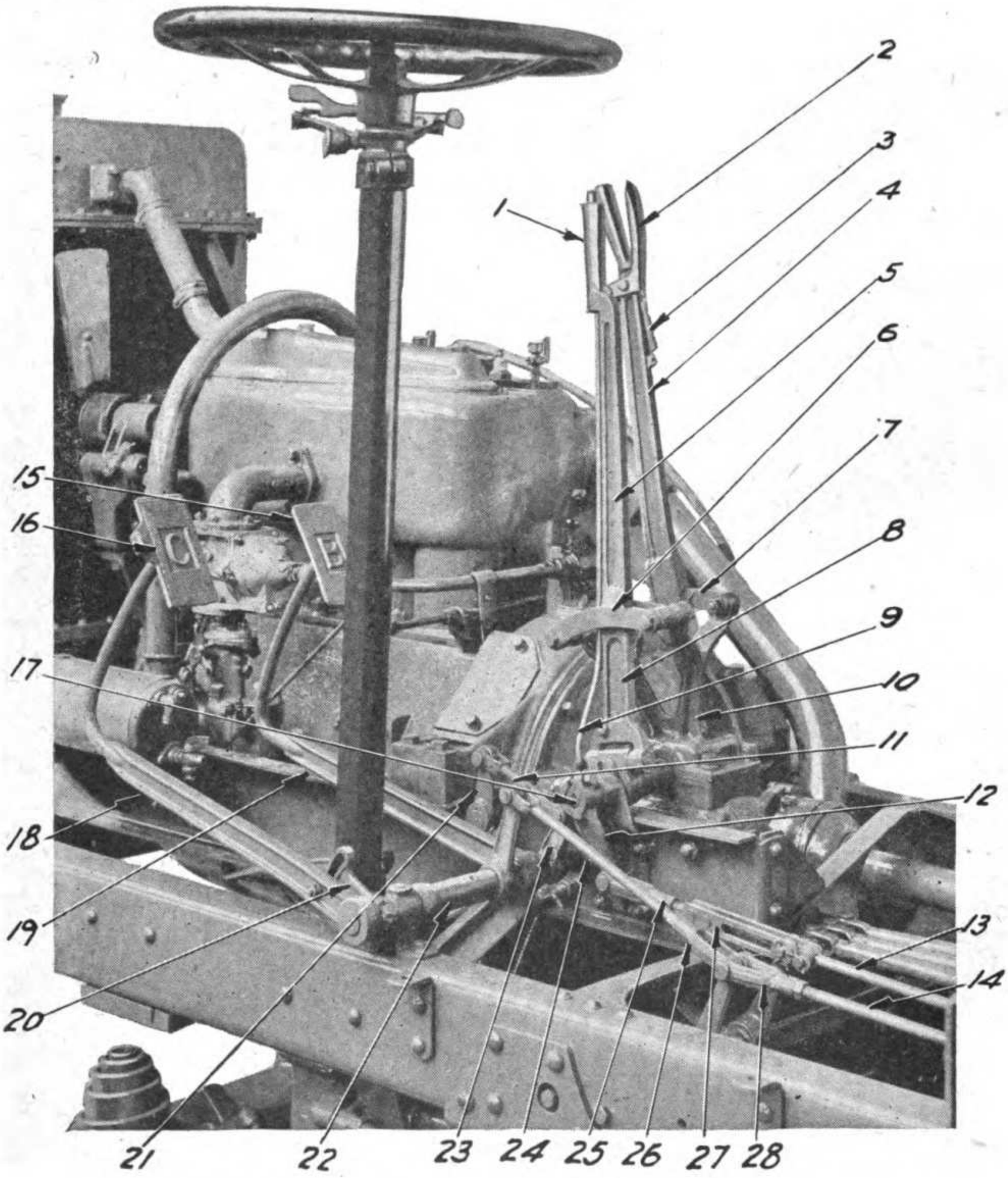
tempt, however, to turn the wheel forcibly when the truck is at rest. This throws needless strain on the steering connections. If you wish to observe the movement of the wheels, jack up the truck.

PEDALS.

CLUTCH PEDAL.

In front of the driver are two pedals. The one on the left is the clutch pedal. The one on the right is the wheel brake pedal. It is ordinarily used and without much pressure will lock all wheels. The clutch pedal, untouched, is in normal position, and in that position the clutch is engaged. When depressed the clutch is disengaged, i. e., independent of flywheel movement.

Plate No. 8



FRONT END OF CHASSIS, DASH REMOVED.

BRAKES.

The foot brake pedal, untouched, is in normal position, and in that position the brakes are not applied. When the pedal is depressed the foot brakes (one acting on each wheel) are applied. The hand brake, or emergency brake lever, when forward all the way releases the brake on the transmission countershaft. This hand brake, when pulled back all the way, sets all the brakes, the four-wheel brakes and the brake on the transmission countershaft as well.

ACCELERATOR PEDAL.

At your heel is the foot accelerator plunger which controls the throttle and speed of the engine.

GEARSHIFT AND HAND BRAKE LEVERS.

In the center of the foot-board are mounted two hand levers. The one at the left is the change-gear lever. The one at the right is the brake lever. Pulling it toward you the brake lever applies brakes on all wheels and transmission (five brakes). To release, compress the handle and return the lever to the front end of the quadrant, being sure that it is in the most forward position before starting the truck. It is well to occasionally use your emergency brake lever in order to determine that it is in proper operating condition, applying brakes on all four wheels and transmission. Grasp the handle of the change-gear lever lightly and

FRONT END OF CHASSIS.

Ref. No.	Part No.	Name of Part.
1	35404-A	Change gear lever assembly.
2	32329	Brake lever trigger.
3	32330	Brake lever trigger spring.
4	32325	Brake lever.
5	35385	Gear shifter lever.
6	32317	Gear shifter lever quadrant (outer).
7	32323	Hand brake lever quadrant.
8	35385	Gear shifter lever.
9	34750	Gear shifter lever reverse lock rod.
10	32324	Quadrant bracket.
11	32580	Clutch pedal shaft and throwout shift connecting rod.
12	32664	Hand brake shaft lever.
13	32412	Brake rod.
14	32409	Brake rod (rear).
15	32650	Brake pedal pad.
16	32651	Clutch pedal pad.
17	32331	Brake lever shaft.
18	31265	Clutch pedal.
19	32542-A	Brake pedal and tube, complete.
20	31674	Clutch pedal adjusting hub.
21	32770	Clutch throwout shaft lever (outer).
22	31263-A	Clutch pedal shaft, complete.
23	32572-A	Clutch throwout shaft lever (right).
24	36324-A	Brake rod inter-connecting (complete).
25	32390	Brake rod adjusting yoke.
26	32390	Brake rod adjusting yoke.
27	32391	Hand Brake and rocker shaft connecting link.
28	32411	Brake rod adjusting yoke.

move it backward and forward until you have become thoroughly familiar with its movements (engine not running). If you grip the lever hard, the muscles of the wrist become rigid and you lose the flexibility necessary for proper shifting of gears. Never move the gear shift lever unless the clutch is fully disengaged.

GEARSHIFT LEVER.

The gearshift lever is moved into the following positions in order to make the necessary gear engagements in the transmission. The illustration on page 15 of the quadrant shows where the lever ought to be for the different speeds.

First speed, push lever away from you to first notch ahead. Second—lever away from you to the extreme rear. Third—center to the extreme rear. Fourth—center to the front. Reverse—toward you to the extreme inner front. Button on top of lever must be depressed before reverse is engaged. Neutral—in center where lever may be moved easily to left or right.

IGNITION SWITCH.

The ignition switch has two positions—"Magneto" and "Off."

CARBURETOR AIR CHOKE.

The carburetor air control is located on the steering post. To enrich mixture for easy starting in cold weather, or after car has been idle for some hours, pull up. As engine fires properly, gradually work to the lowest point of adjustment. Do not keep this choke applied any longer than necessary. See page 21 concerning use of choke in winter.

SPARK AND THROTTLE LEVERS.

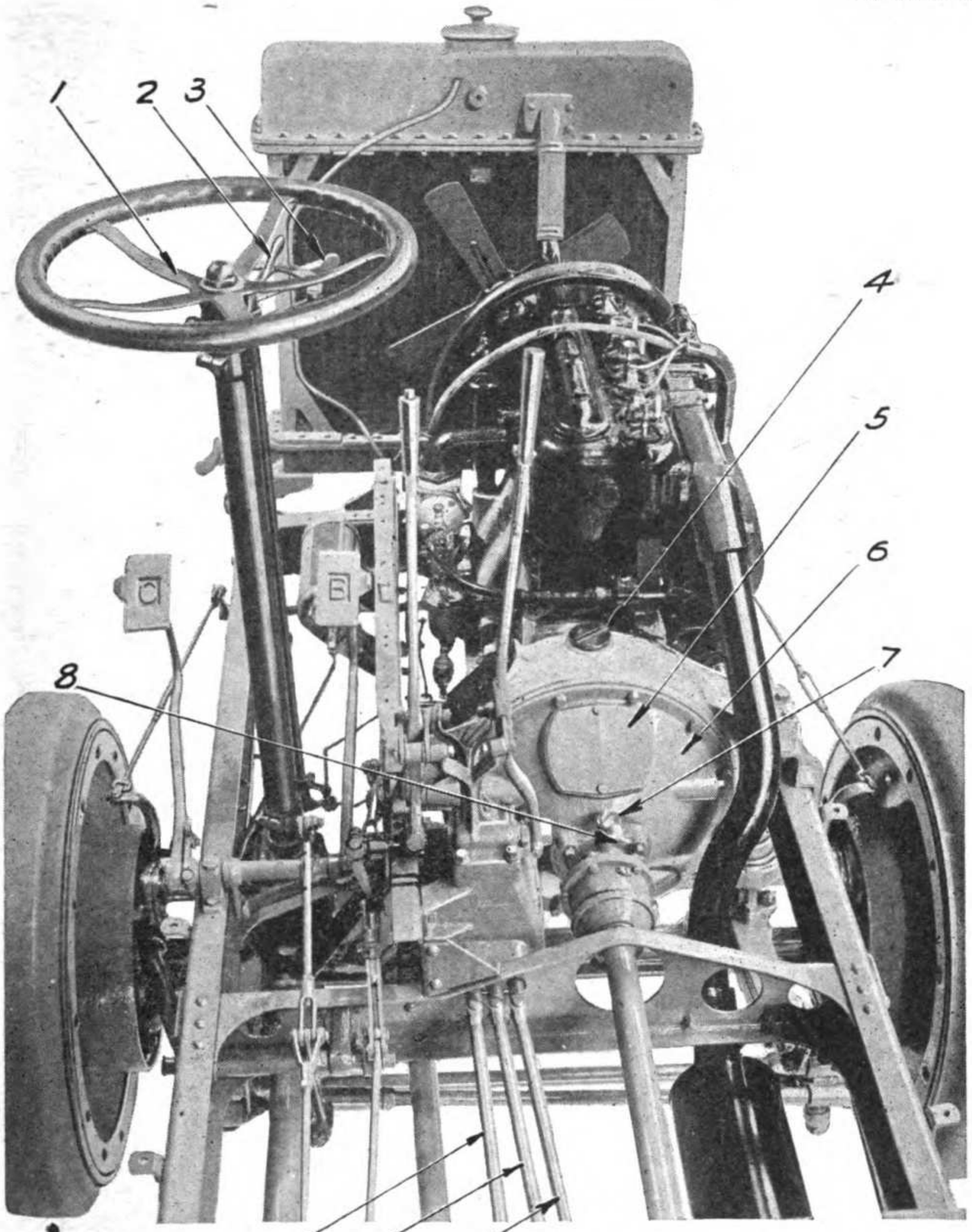
The spark lever on the steering post is the shorter of the two. For starting, usual position is one-quarter way up on quadrant. When the engine is running the spark lever must be advanced as far as possible without causing a spark knock (which must be avoided).

The throttle lever on the steering post is the longer of the two. For starting advance about two inches. When engine starts, return to normal position. Best results will be obtained by using accelerator pedal entirely, thus giving the use of both hands for the control of the truck.

GASOLINE SHUTOFF OR CONTROL VALVE.

The gasoline shutoff valve is located at the bottom of the gasoline tank. Looking at this valve from the front, the lever should stand at about a 45-degree angle to the right for reserve, and the same angle to the left for supply, and should be in an up-and-down position with the long end of the lever toward the top at about 45 degrees from center for "off" position.

Plate No. 9



VIEW FROM CENTER OF CHASSIS FORWARD, DASH REMOVED

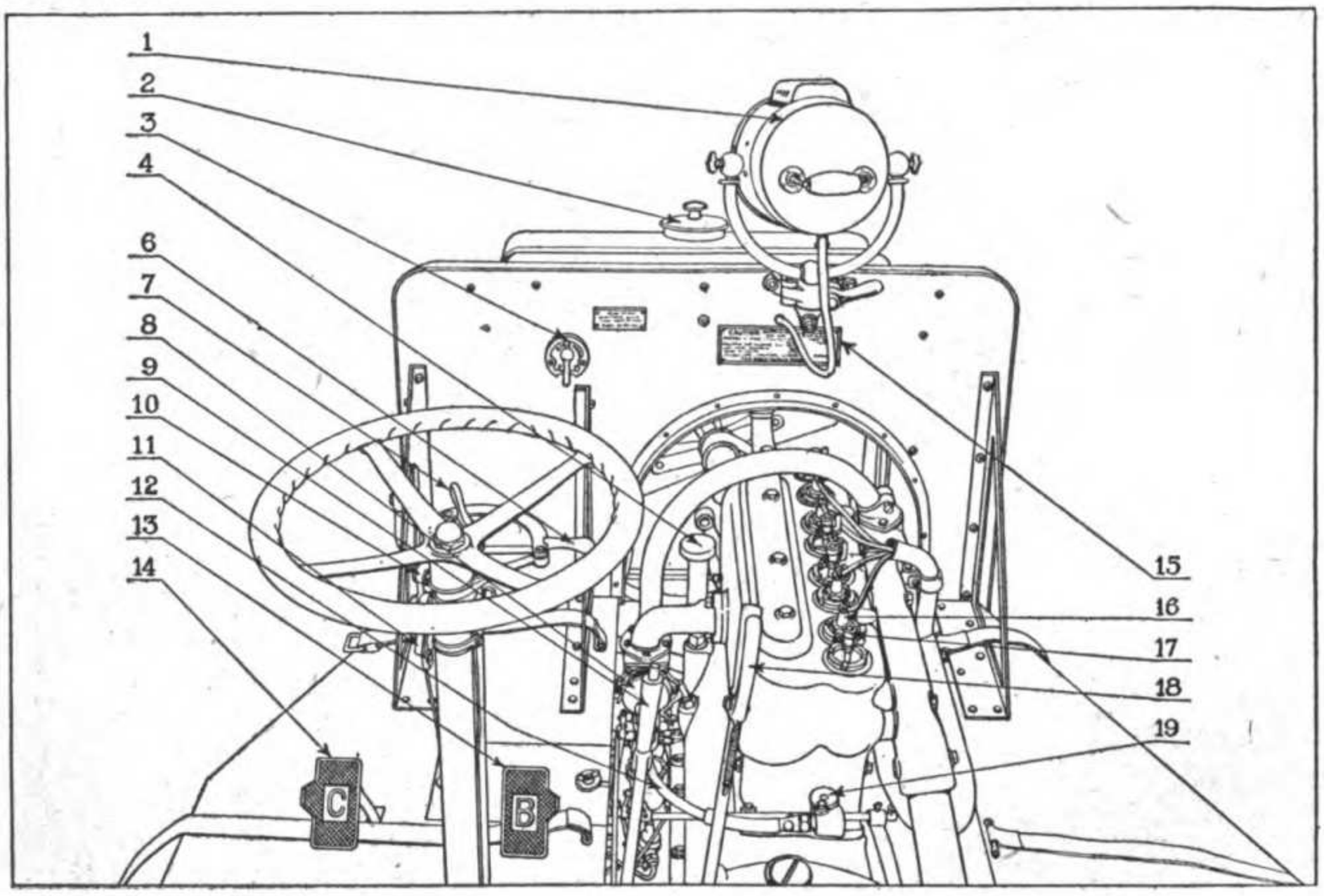
Ref. No.	Part No.	Name of Part.
1	36372	Steering wheel.
2	33779	Spark control lever.
3	33783	Throttle control lever.
4	34413	Flywheel housing cap.
5	30370	Clutch housing hand hole cover.
6	32583-A	Clutch housing assembly.
7	CU-209	Clutch shaft bearing retainer grease cup.
8	32472	Clutch shaft rear bearing retainer.
9	32166-A	Transmission operating tube assembly.
10	32166-A	Transmission operating tube assembly.
11	32166-A	Transmission operating tube assembly.

The gasoline tank is so constructed that before the gasoline will flow from the tank with this valve on reserve position, there must have been more than five gallons of gasoline in tank.

DRIVING.

In ordinary running keep the spark advanced as far as possible without causing the engine to knock. When knocking occurs retard the

Plate No. 10

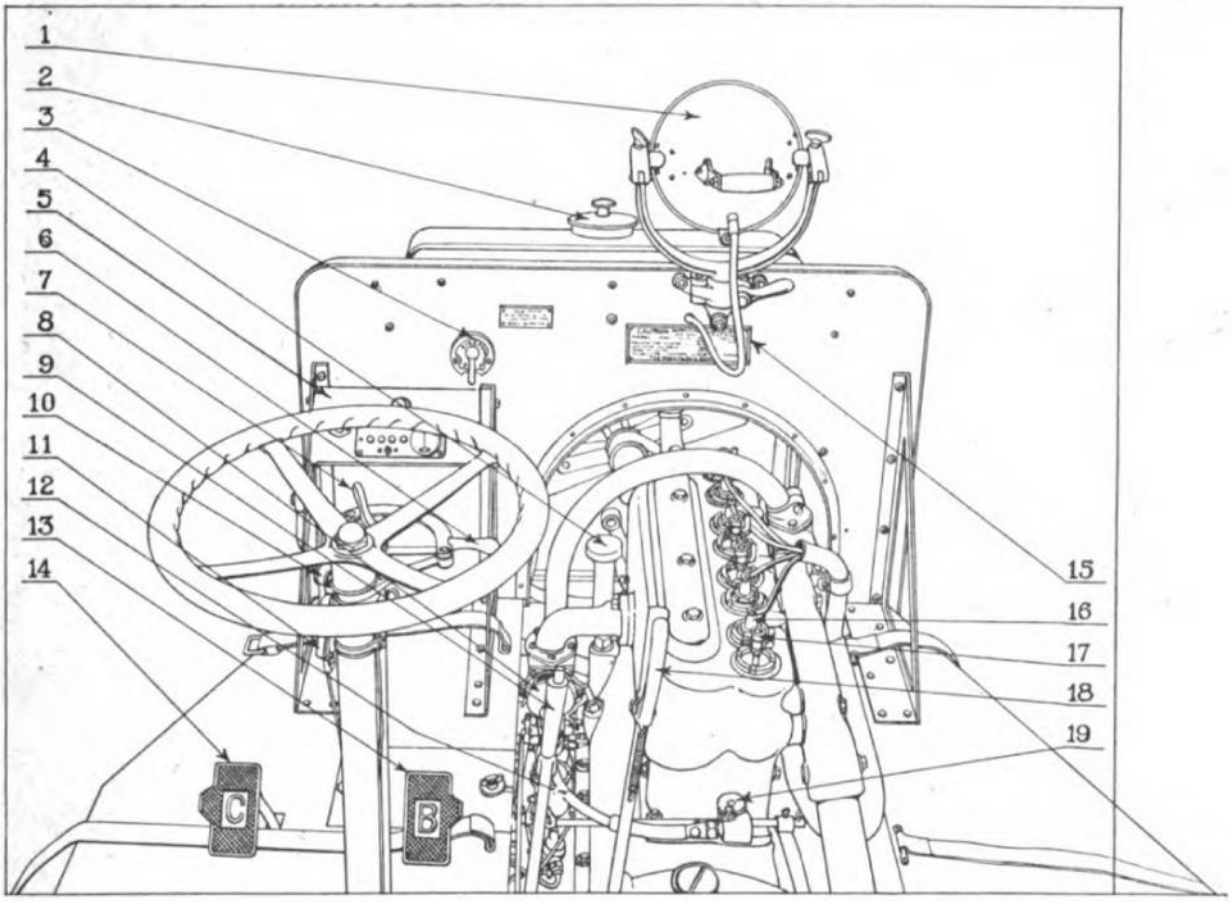


DRIVER'S COMPARTMENT. MODEL 4017-L ONLY.

Ref. No.	Part No.	Name of Part.
1	37058-A	Search lamp.
2	32183-A	Radiator filler cap.
3	35902	Ignition switch.
4	34395	Motor oil filler cap.
6	33784	Throttle lever.
7	33778	Spark lever.
8	31801-A	Governor.
9	35404-A	Change-gear lever.
10	CU-113	Steering column grease cup.
11	33662	Carburetor control.
12	32991	Governor drive casing.
13	32650	Brake pedal pad.
14	32651	Clutch pedal pad.
15	37105	Caution plate.
16	31946	Spark plug.
17	34359	Relief cock.
18	32206-A	Hand-brake lever.
19	35705-A	Governor drive gear housing.

spark. The engine speed may be controlled either by the accelerator pedal or the hand lever, the long one, under the steering wheel. In using either of these bear in mind the sensitiveness of the throttle, and do not

Plate No. 11



DRIVER'S COMPARTMENT. MODEL 4017-A ONLY.

Ref. No.	Part No.	Name of Part.
1	35270-A	Search lamp and bracket assembly.
2	32183-A	Radiator filler cap.
3	35902	Ignition switch.
4	34395	Motor oil filler cap.
5	35764-A	Instrument board.
6	33784	Throttle lever.
7	33778	Spark lever.
8	31801-A	Governor.
9	35404-A	Change-gear lever.
10	CU113	Steering column grease cup.
11	33662	Carburetor control.
12	32991	Governor drive casing.
13	32650	Brake pedal pad.
14	32651	Clutch pedal pad.
15	37105	Caution plate.
16	31946	Spark plug.
17	34359	Relief cock.
18	32206-A	Hand-brake lever assembly.
19	35705-A	Governor drive gear housing.

open the throttle wide suddenly, but gradually. Get accustomed to using the accelerator pedal, using the hand lever only for an idling point and also for traveling at a fixed speed.

SHIFTING GEARS.

Remember that the clutch should be engaged gradually, that is, allow the pedal to return to normal position slowly instead of quickly. Gradual engagement means less shock to the whole power transmitting mechanism.

You may find in starting up that after the clutch has been released the shift into first cannot be made. If this is the case engage and disengage the clutch again and try to shift. In other words, let the clutch in and out once or twice until the clutch jaws are in proper position. After meshing, engage clutch slowly to avoid starting the truck with a jerk.

To shift to any gear (or speed), the rotative speed of the two parts of the gear clutch which are to be engaged must be as near uniform as possible. When starting the truck (from a fixed position) the speed of the driving member is reduced to zero (otherwise the teeth of the clutch would clash), as the speed of the driven member is zero. This is attained by disengaging the clutch fully, at which position the clutch brake is effective. The function of the clutch brake is to overcome the inertia and internal friction of the clutch, which, otherwise, would "spin" for some time. The speed of the driving member in the transmission is therefore dependent upon the relative position of clutch disengagement, time, of course, being considered in all cases.

SHIFTING INTO FIRST SPEED.

From neutral to low, press clutch pedal down fully. Place change-gear lever in first-speed position, letting clutch in gradual, at the same time slightly speeding up engine. The change from first to second is made best at a speed of from three to six miles an hour by disengaging clutch, but not so far as to apply clutch brake, and pulling back gearshift lever quickly into second speed position, increasing engine speed (by opening throttle) to secure additional power, and engage clutch slowly. The entire operation must be completed before the truck speed has decreased materially. The change from second to third can be made best at truck speed of from six to eight miles per hour. The change from third to fourth can be made best at a speed of about ten miles per hour.

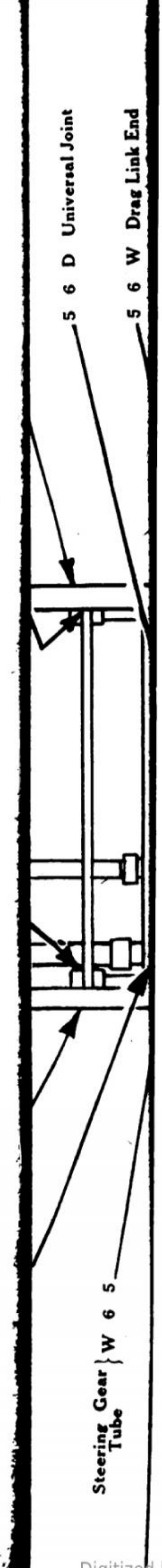
CHANGING FROM FOURTH TO THIRD.

In changing from fourth to third, disengage clutch sufficiently to shift into neutral, then engage clutch (meanwhile speeding up engine) to increase speed to that of the third speed gear, then quickly disengage clutch, engage third gear and engage clutch slowly.

In making changes from any gear to a lower one the motor should be speeded up with clutch engaged during the changing operation in order that the clutch speed may pick up to the transmission speed, thus rendering engagement easy.

WHEN TO CHANGE TO LOWER GEAR.

Fourth speed is direct drive in the transmission, no gears delivering power. It is the speed usually used on level roads. Do not attempt to change from a higher to a lower speed until the truck has slowed down to that speed. Do not try to climb steep grades or pass over heavy sandy roads



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on high gear. When the engine labors, change to a lower speed. This will save the moving parts and prolong the life of the engine.

DRIVING UP AND DOWN GRADES.

In driving down grade there are three forms of resistance that can be used to control the speed of the truck. Its momentum can be arrested by means of the brakes, the gears may be shifted into a lower speed, or the engine may be used as a brake by shutting off the ignition. The lower the gear used the greater resistance, so that the greatest possible resistance in the transmission is had with the gears in the first speed. Added resistance may be had by shutting off the ignition, and, of course, still more by using the brakes. All three forms (the gears in first, the ignition off and brakes applied) hardly need be used. The object is to refrain from using the brakes because keeping them applied wears the linings.

In ascending a grade use judgment about the ability of the truck. If it is very steep, shift to a lower gear before you get on the grade. If you think it can be done in high without the engine knocking do not shift. Make as quick a shift as possible, if it is necessary to do shifting on an upgrade. If you happen to stall the engine on the grade, shift immediately into neutral and apply the hand brake, at the same time cramping the wheels.

"RIDING" THE CLUTCH.

In driving along do not "ride" the clutch, that is, do not keep your foot on the clutch pedal. Even slight pressure on the clutch pedal causes excessive wear of the clutch bearings and may cause slight slippage.

STOPPING.

In slowing the truck down always slow down the engine first and anticipate your stop, so as to avoid excessive use of the brakes.

After the truck has been brought to a standstill, the gears shifted into neutral and the hand brake applied, turn the ignition switch to "Off" postion, retard the spark lever to one-quarter position and the throttle lever to one-quarter open, placing these controls ready for the next start.

LUBRICATING INSTRUCTIONS.

PRELIMINARY ADVICE.

Study the lubricating chart inserted after page 32 for parts that require attention. Perfect and continuous lubrication means less wear of parts, less trouble and a better running truck. Lubricant is of little value mixed with dirt, so before you oil or grease a part make sure there is no dirt on the surfaces, that not even the smallest speck of dirt gets to a moving part. Cleanliness of moving surfaces is absolutely essential. Use clean cloths to wipe these surfaces after they have been cleaned by means

of gasoline or kerosene. Make periodic lubrication a habit. Attend to certain parts daily, as indicated on the chart, to others weekly and others monthly. These are maximum periods.

SPECIFICATIONS OF LUBRICANTS.

After each part mentioned in lubricating instructions, and indicated on the lubricating chart (see chart after page 32), will be found a figure which indicates the kind of oil or grease best suited to the lubricating needs of that part. The meaning of the various figures is explained below:

2A. Motor oil, medium, specification No. 3502.
2B. Motor oil, heavy, specification No. 3502.
4. Heavy, straight mineral gear compound, specification No. 3504.
5. Light cup grease, specification No. 3505.
6. Medium cup grease, specification No. 3506.
8. Heavy, straight mineral oil, specification No. 3508.
9. Steam cylinder oil, specification No. 3509.

ENGINE.

2A. Winter.
2B. Summer, capacity 9 quarts, to be brought to level daily.

CRANKCASE CAPACITY.

Nine quarts of reserve oil are carried in the bottom of the crankcase. The amount of oil is indicated by the position of the indicator rod located on the left hand side of the engine. By unscrewing this indicator rod a few turns it may be lifted out, and the depth of the oil in the crankcase noted on the lower end of rod.

WHEN AND HOW TO DRAIN CRANKCASE.

The drain cocks and drain plugs should be inspected from time to time, as they become loose, and consequently cause loss of oil.

The crankcase is of course brought to level daily, but after about 1,000 miles of running the crankcase oil has lost some of its lubricating qualities due to the breaking down of the oil and also to contamination by water, a product of combustion, working its way past the rings. The poor oil will have a black color and will be much thinner (of lower viscosity) than fresh oil. The more frequently crankcase oil is changed, the better, but there is no need to make a useless change. The object is not to permit running for any length of time on poor oil and changes at 1,000-mile intervals usually suffice.

When the engine is cleaned and drained of its old oil, a gallon of kerosene should be introduced through the combined filler and breather cap, located at the front of the left hand side of the engine, after which the engine should be run slowly for a few seconds. Drain same thoroughly and refill with nine quarts of fresh oil as specified.

CLEANING OIL PUMP SCREEN OR STRAINER.

To clean the oil pump screen or strainer, the oil pump must be removed. Make sure that the joints and pump packings are tight, and that the oil pump is running properly after replacement. Should be cleaned each 1,000 miles.

GOVERNOR.

No. 2A weekly.

To lubricate, remove the oil filler screw, and fill chamber with lubricant. This should be done weekly. Every month remove the drain screw. Be sure the two screws below the governor shaft are kept tight to prevent oil leaking. (See page 88, Care and Adjustment of Governor.)

MAGNETO.

No. 2 every other week.

Twenty drops off the end of a toothpick of light clean mineral oil, every two weeks, distributed as follows:

One drop of oil in the oil hole on side of breaker box most convenient, lubricating surface between magneto frame end and movable breaker box, five drops of oil in the small hole at the driving end of magneto, lubricating the distributer wheel bearing, and fourteen drops in the large hole at driving end, lubricating the shaft bearing which takes all the driving load.

For small engine parts see chart inserted after page 32.

For operation of engine lubricating system see page 63.

CLUTCH.

No. 6 daily.

The clutch itself, being of the dry-plate type, needs no plate lubrication, but on the rear of the clutch housing there is a large grease cup, which lubricates the rear bearing of the clutch. This should be kept filled with fresh cup grease. A second grease cup is located on the universal joint to the rear of the clutch housing. It lubricates the clutch shaft bearings.

PROPELLER SHAFT UNIVERSAL JOINTS.

No. 6 daily.

Since all the propeller universal joints are of the same construction, they are lubricated in the same manner. To lubricate them, remove the plug at the top of each. Clean monthly with kerosene and repack with cup grease.

TRANSMISSION.

Summer, 33% of No. 2B and 67% of No. 4
Winter, 50% of No. 2B and 50% of No. 4 } every other week.

To renew the lubricant in the transmission, remove the top cover. The level of oil should reach to half the depth of the transmission.

FRONT AND REAR AXLES.

Internal drive gears { 50% of No. 6 / 50% of No. 8 } every two weeks.

To lubricate the internal gear pinion bearings of both axles, remove the outer plugs on the webs of the front and rear wheels, and fill with lubricant as above specified.

WHEEL SPINDLE BEARINGS.

{ No. 6 in summer / No. 5 in winter } weekly.

To lubricate the wheel spindle bearings, remove the inner of the two plugs, and fill with grease.

STEERING KNUCKLES.

{ No. 9 in summer / No. 2A in winter } daily.

To lubricate the lower steering pins, turn down the cups. At the top of the steering knuckle pins there are oil cups for lubricating the upper bushings.

AXLE UNIVERSAL JOINTS.

{ No. 6 in summer / No. 5 in winter } weekly.

To lubricate the axle universal joints remove the plug on the axle just inside the universal joint flanges. It is necessary to completely dissemble the axle to clean these joints.

DIFFERENTIALS.

{ 60% of No. 4 and 40% of No. 5 in summer / 25% of No. 4 and 75% of No. 5 in winter } every two weeks.

Remove the cap on top of the differential housings on the front and rear axles to inspect, and insert new lubricant. In order to clean, remove the top half of the differential housings. Remove all old lubricant, thoroughly clean with kerosene, and fill to level with new lubricant.

STEERING GEAR.

{ No. 6 in summer / No. 5 in winter } weekly.

To lubricate, remove a plug which is near the lower end of the steering column housing, and inject lubricant freely.

CONTROL SET.

No. 2A weekly.

A few drops of oil should be placed in the foot lever bearings. They should be oiled through the oil holes provided for the purpose.

SPRINGS.

Once every two months jack up the frame, and by removing the spring clips the spring leaves may be pried apart. Lubricate between the leaves with graphite. Should leaves be excessively rusted, it is well to dismantle the spring, remove the rust, and paint the leaves with graphite paint.

MAINTENANCE ROUTINE.

DAILY MAINTENANCE ROUTINE.

ENGINE.

Tighten all wiring terminals.
Tighten any loose nuts.
Clean exterior of spark plug porcelains.
Clean magneto externally.
Note tension of fan belt.
Inspect oil pump for performing its function.
Fill radiator (twice).
Fill gasoline tank.
Inspect all gasoline, oil and water lines and connections for leaks.

BRAKES.

Examine, and adjust brakes (if necessary).

GENERAL.

Clean, trim and fill all lamps and generator.
Inspect springs for breakage.
Report any breakage.
Check tool equipment.
Inspect wheel alignment and all steering connections.

LUBRICATION.

See chart after page 32.
Fill oil squirt can.

WEEKLY MAINTENANCE ROUTINE.

ENGINE.

Inspect all wires for proper support and freedom from damage.
Thoroughly clean engine externally.
Inspect for oil leaks.
Inspect control connections.
Inspect all water connections for leaks.
Remove, clean and adjust all spark plugs.

Remove magneto distributor cover and clean with gasoline and clean cloth.

Drain water and dirt from water trap in gasoline line.

Inspect carburetor control connections and connections with governor.

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

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

BRAKES.

Inspect and thoroughly clean all brake connections.

SPRINGS.

Inspect center bolt of spring and spring clips for apparent tightness.

WHEELS.

Inspect tires for undue damage.

TRANSMISSION.

Clean and inspect all control connections.

WHEEL UNIVERSALS AND DRIVING PINION BEARINGS.

Inspect wheel universal joints and drive pinion bearings for excessive looseness, by inserting a screwdriver between the spring clip bolts and the axle shafts. If considerable vertical movement is possible universal joints should be examined and the proper adjustment of pinion bearings made by removal of shims from between the bearings cage and the knuckle body.

BODY AND EQUIPMENT.

Inspect body bolts, hood fasteners and all similar bolts for apparent tightness.

Inspect tool equipment for completeness.

LUBRICATION.

(See chart after page 32 for parts needing weekly attention.)

MONTHLY MAINTENANCE ROUTINE.

ENGINE.

See page 103, under Carbon Removal, for method of doing the work, and how to determine if carbon is present in quantity in the engine.

Examine and inspect engine for loose parts, leaks, noises.

Clean oil strainer.

Grind valves if necessary. See page 55 for instructions on doing the work.

IGNITION.

Clean magneto collector ring, file and adjust breaker points.

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 around shafts.

STEERING.

Put two jacks under front and rear axles, near wheels, and lift wheels slightly off from the ground, then inspect all connections for wear or undue looseness.

SPRINGS.

Thoroughly clean and inspect spring shackle connections.
Inspect springs, replacing any defective parts.

DIFFERENTIALS.

Clean and inspect all differential housing for oil leaks.
Inspect all bolts for tightness.

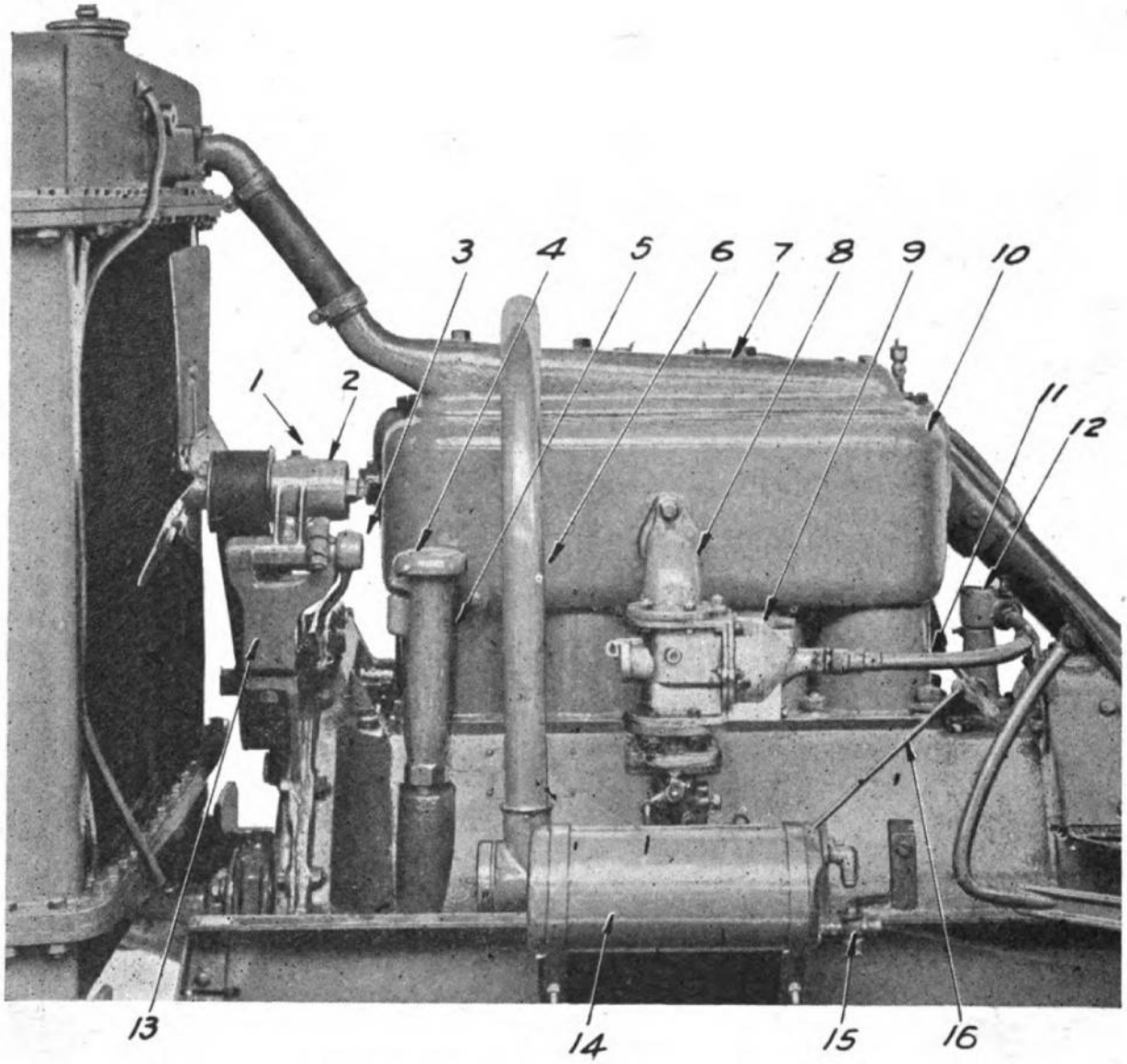
WHEELS.

Remove hub cap and inspect for supply of lubricant.
Inspect all wheels for proper relative alignment.

GENERAL.

Inspect drip pan for security.
Inspect speedometer drive for reliability.

Plate No. 13



LEFT SIDE OF ENGINE.

Ref. No.	Part No.	Name of Part.
1	PL-102	Fan shaft bearing grease plug.
2	32721	Fan shaft bearing.
3	32724	Fan belt tightening spring lever.
4	34395	Breather body cap.
5	34394	Breather body.
6	33051	Carburetor hot air tube.
7	32456	Water jacket top cover.
8	33297	Intake pipe.
9	31801-A	Governor (duplex).
10	34555-A	Cylinder.
11	32291	Governor drive cable casing.
12	35705-A	Governor spiral drive gear housing.
13	32720	Fan shaft bearing bracket.
14	33500-A	Auxiliary gasoline tank.
15	35839	Auxiliary gasoline tank shut-off cock.
16	32830	Spark rod.

CHAPTER II

ENGINE AND ENGINE ATTACHMENTS.

DESIGN, CONSTRUCTION AND OPERATION IN BRIEF.

The engine is a standard design of Buda make, having four block-cast, L-head cylinders with heads integral. The block is mounted on a cast-iron crankcase, which is in two halves, horizontally split. The cylinders are 4.25 inches dia. bore by 5.25 inches stroke, cooled by centrifugal pump circulation; lubrication is by force-feed and splash; ignition is by Eisemann magneto, and carburetion by a vertical outlet Stromberg carburetor fed by gravity. The engine is equipped with a governor. The valves and valve operating mechanism are on the right, together with the water pump, driven from the timing gears; the magneto driven by an extension of the pump shaft, and the lighting generator with a drive taken between the pump and magneto. On the Model 4017-L there is no electric lighting generator.

ENGINE OPERATION.

The engine operates on the four-stroke cycle which is the same as that of all truck and passenger car engines made in the United States. There are four distinct strokes of the pistons necessary for the completion of a cycle, these four strokes being called: Intake, compression, power and exhaust.

Upon being cranked by hand, a piston descends while its intake valve is open, and draws into the cylinder through the carburetor and the intake pipe, a charge of gas. When piston is just past the bottom of its stroke, and again returning upwards the intake valve closes, and as the exhaust valve is at this time also closed, the gas is trapped within the cylinder and compressed by the piston's upward motion.

When piston reaches top of its stroke, the spark occurs and explodes the mixture which, due to its increase in pressure, drives down the piston with considerable force, thus storing up energy in the flywheel for the succeeding strokes.

When the piston nears the bottom of its stroke the exhaust valve opens, allowing the expanded, and now useless gases to escape, and stays open during the following upward movement of the piston, allowing the ejection of the remaining burned gases.

DESIGN, CONSTRUCTION AND OPERATION IN DETAIL.

CYLINDERS.

MATERIAL AND CONSTRUCTION.

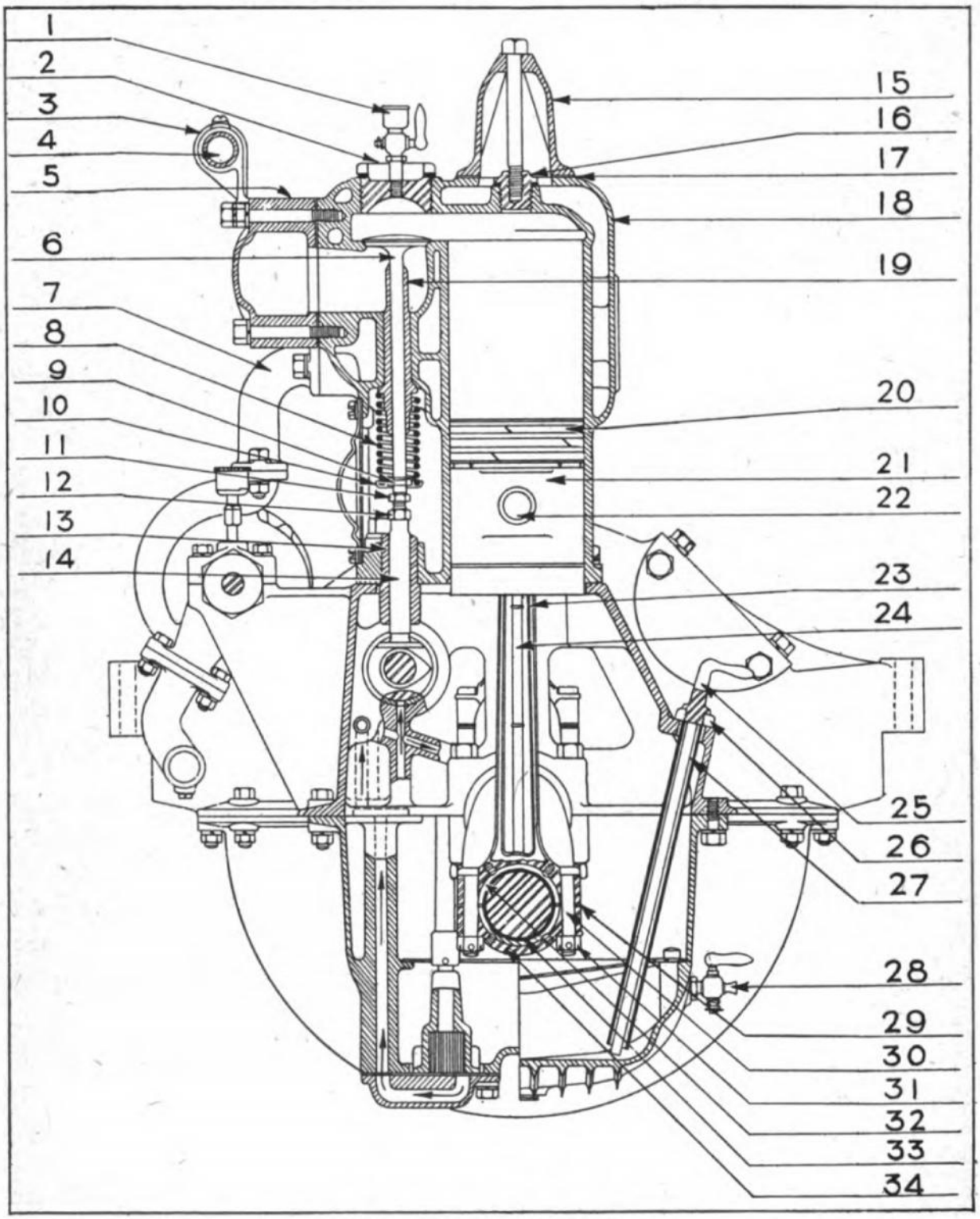
The cylinders are of gray iron, cast in block, and bolted to a cast-iron crankcase. The cylinder casting has the inlet passages cored out so that

the carburetor attached to a short external elbow, or manifold, on the left, feeds across the block through the cored passages. The block has an integral head, but uses valve plugs, so that removal of the valves is possible when the plugs are removed. The water jacket top cover with a portion of the water outlet pipe is a unit bolted to the top of the casting.

PRIMING CUPS.

There are four priming cups screwed into the valve plugs. These cups may be used for priming in winter or for testing the firing and compression.

Plate No. 14



END SECTION OF ENGINE.

IF JACKET IS CRACKED.

If a cylinder water jacket is cracked, emergency repair can be made by calking or by shellac saturated cloth strips pasted over crack, and permitted to dry before filling cooling system with water.

CYLINDER SCORED.

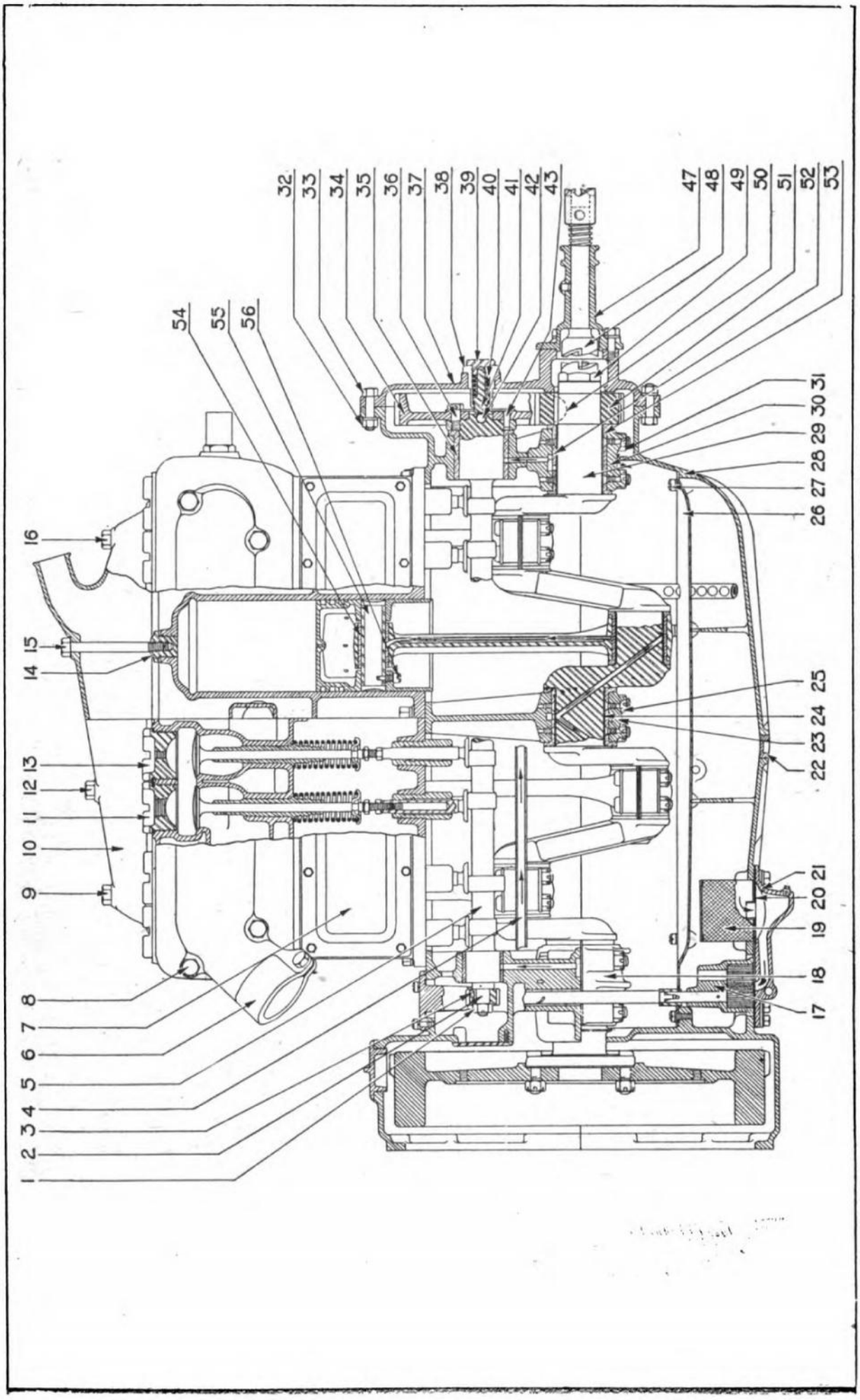
Cylinders may become scored because of engine operation for long periods when overheated, lack of lubrication, tight pistons, loose or broken wrist pin, piston out of round, connecting rod out of alignment, broken piston rings, connecting rod bearing tight (frozen), water or dirt in lubricating oil, burr on piston.

PISTONS.

The pistons are of cast iron of the usual design, with flat top, and using three diagonally-split rings. The ring grooves are 0.250 inch wide. The piston diameter at the top is 4.23 and 4.246 inches at the bottom with a top clearance of 0.020 and at the bottom 0.004 inch. The piston is 5.375 inches long. The difference in clearance between the top and bottom of the piston is due to the difference in expansion at top and bottom, the top

END SECTION OF ENGINE.

Ref. No.	Part No.	Name of Part.
1	34359	Priming cup.
2	34368	Valve chamber plug (exhaust).
3	32982	Wiring manifold bracket.
4	32981	Wiring manifold.
5	34370	Exhaust manifold.
6	35564	Valve.
7	34407	Water pipe from pump to cylinder.
8	34387	Valve spring.
9	34389	Valve spring retainer lock
10	34388	Valve spring retainer.
11	34381	Valve tappet adjusting screw.
12	34382	Valve tappet adjusting screw nut.
13	34391	Valve tappet guide.
14	34380	Valve tappet.
15	32456	Water jacket top cover.
16	34377	Water jacket plug.
17	34366	Water jacket top cover gasket.
18	34555-A	Cylinder.
19	34390	Valve stem guide.
20	34476	Piston ring.
21	34474	Piston.
22	34485	Piston pin.
23	34490-A	Connecting rod.
24	34481	Oil duct.
25	34402	Oil level gauge handle.
26	34401	Oil level gauge tube and nut.
27	34402	Oil level gauge blade.
28	CO-116	Oil level pet cock.
29	34482	Connecting rod bearing shims.
30	34484	Connecting rod bolt.
31	NU-352	Connecting rod bolt nut.
32	34479	Connecting rod bearing (upper).
33	34480	Connecting rod bearing (lower).
34		Connecting rod bearing cap.



SECTIONAL VIEW RIGHT SIDE OF ENGINE.

Plate No. 15

SECTIONAL VIEW RIGHT SIDE OF ENGINE.

Ref. No.	Part No.	Name of Part.
1	NU-354	Oil pump drive gear lock nut.
2		Shoulder for oil pump drive gear.
3	34457	Oil pump drive gear.
4		Oil distributing tube.
5	34560-A	Camshaft.
6	34370	Exhaust manifold.
7	34383	Cylinder side plate.
8	34362	Exhaust manifold screw.
9	34360	Water jacket top cover screw (rear).
10	32456	Water jacket top cover.
11	34367	Valve chamber plug (intake).
12	34362	Water jacket top cover screw (center rear).
13	34368	Valve chamber plug (exhaust).
14	34377	Cylinder water jacket plug.
15	34363	Water jacket top cover screw (front center).
16	34361	Water jacket top cover screw (front).
17	34529	Oil pump body.
18	34493	Crankshaft rear bearing cap.
19	34539	Oil pump screen.
20	34540	Oil pump screen cover gasket.
21	34528	Oil pan sediment filter.
22	PL-125	Oil pan drain plug.
23	34497	Crankshaft center bearing cap.
24	34498	Crankshaft center bearing (lower).
25	NU-354	Crankshaft center bearing cap lock nut.
26	34527	Oil pan trough.
27	SC-603	Oil pan trough screw.
28	34542	Oil pan.
29	34492	Crankshaft.
30	34495	Crankshaft front bearing cap.
31	NU-354	Crankshaft front bearing cap lock nut.
32	NU-124	Gear case cover bolt nut.
33	SC-3404	Gear case cover bolt.
34	34463	Camshaft gear.
35	34521	Camshaft front bearing.
36	SC-245	Camshaft gear screw.
37	34557-A	Gear case cover.
38	34451	Camshaft thrust spring housing.
39	34453	Camshaft thrust spring nut.
40	34452	Camshaft thrust spring.
41	34454	Camshaft thrust spring plunger.
42	BA-105	Camshaft thrust ball.
47	34550	Starting crankshaft bracket.
48	34551	Starting crank clutch.
49	34507	Crankshaft jaw.
50	KE-114	Crankshaft pinion key.
51	34505	Crankshaft pinion.
52	34509	Crankshaft front bearing (upper).
53	34496	Crankshaft front bearing (lower).
54	34478	Connecting rod bushing.
55	34485	Piston pin.
56	34486	Piston pin set screw.

getting much hotter, hence expanding more. Below the bottom ring groove are six holes, 0.156 inch diameter, equally spaced around the circumference. These holes are for draining excess oil, scraped off cylinder wall by bottom ring, back into the crankcase.

The piston bosses are reamed 1.125 inches diameter and the outer circumference of the piston at the piston pin is relieved a depth of 0.0156 inch.

PISTON TROUBLES.

The piston moving up and down in the cylinder must constantly be lubricated by a film of oil otherwise both it and the cylinder wall will be scored. If run without oil the piston will seize in the cylinder. The usual piston trouble encountered is due to excessive piston ring wear which permits oil leakage into the combustion chamber and gas leakage downward into the crankcase. Piston pin wear is not unusual. This latter causes knocking. Both are brought about by lack of or insufficient lubrication. Piston and rod may be removed through the crankcase.

PISTON PIN (OR WRIST PIN)

The piston pin is the means of fastening the upper end of the connecting rod to piston. The piston pin is held in place by a set screw, screwed into a piston boss, through which the piston pin passes. The set screw is 0.312 inch in diameter. The piston pins are of case-hardened steel 3.75 inches long and 1.125 inch in diameter, drilled hollow, inside diameter 0.8125 inch long. A hole 0.234 inch in diameter is drilled at one end of the piston pin to receive the end of the set screw previously referred to.

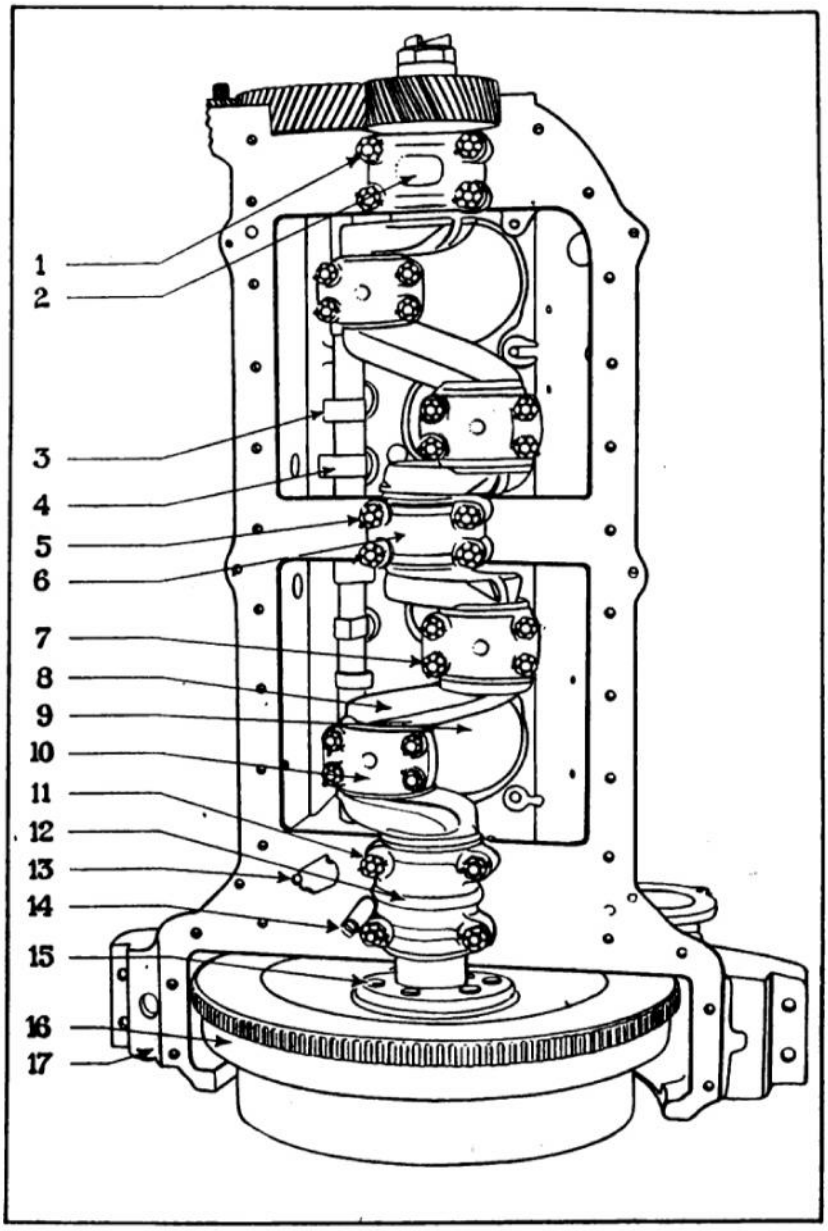
TO LOCATE WEAR OF THE PISTON PIN BEARING.

If the piston is in place in the engine and the lower half of the crankcase 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.

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 line of the crankshaft. Or a pair of calipers may be used to determine uniformity of distance between the top of the crankcase and the underside of a piston ring on all sides of the piston. Or with a straightedge laid across the top of the piston lengthwise of the engine, the distance to the crankcase under straightedge may be measured at its ends.

Plate No. 16



VIEW OF ENGINE FROM BOTTOM WITH LOWER HALF OF CRANKCASE REMOVED.

Ref. No.	Part No.	Name of Part.
1	NU-354	Front bearing lock nut.
2	34495	Front bearing cap.
3		Cams.
4		Cams.
5	NU-354	Center bearing lock nut.
6	34497	Center bearing cap.
7	NU-352	Connecting rod bearing lock nut.
8	34508-A	Crankshaft.
9		Cylinder opening.
10		Connecting rod bearing cap.
11	NU-354	Rear bearing lock nut.
12	34493	Rear bearing cap.
13		Oil lead to distributing tube.
14	34467	Oil pump shaft.
15	34473	Flywheel bolts.
16	34561-A	Flywheel.
17	34556-A	Crankcase (upper).

PISTON RINGS.

The piston rings are of cast iron, and being flexible, press against the cylinder wall and form a gastight joint, preventing the leakage of gas downward and oil upward. There are three diagonally-split, eccentric rings per piston. When compressed in the cylinder the ring has 0.016 inch clearance between the ends. Wear, resulting from service or abuse, increases this clearance. The ring dimensions are as follows: Width, 0.249 inch; thickness, 0.1875 inch; eccentricity, 0.031 inch.

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 grooves 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 very thin, light gauge sheet metal, about 2 inches long by .375 inch wide, the rings being pushed down evenly all around to prevent any twisting of the ring, which might result in distortion and uneven bearing on the cylinder wall.

In fitting piston rings be sure that each ring moves freely in its groove and still has .001 inch clearance up and down. Also make certain that all dirt is removed from the groove and ring and that before the piston with rings is inserted in the cylinder, that all the ring ends are not in alignment, thus preventing a free downward path for the gas.

LAPPING RINGS.

In order to get a good piston ring fit in the ring groove it may be necessary to lap the ring on a level plate lightly sprinkled with fine emery moistened with oil. After lapping for a few seconds, clean the ring in gasoline and try for fit. Lap more, if necessary, rather than grind it too small at one operation.

PISTON RING TROUBLES.

After fitting the piston rings 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, the 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 past. In case it is 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 a piston comes down.

REMOVING PISTON RINGS.

In removing piston rings they may be slid off over skids, see page 48, or a ring spreader may be used to spread the ring after which it may be lifted over the piston top.

CONNECTING ROD.

MATERIAL AND CONSTRUCTION.

The connecting rod is used to connect the piston with the crankshaft.

The connecting rod is an I-beam forging attached at its lower end to crank pin of the crankshaft, and at its upper end to the piston pin. The upper end of the connecting rod is bored 1.375 inch to admit a bushing of phosphor bronze, which is bored 1.125 inch in diameter to admit the piston pin. The bushing is 2.125 inches long.

CONNECTING ROD BEARING.

The lower end of the connecting rod is bored 2.5 inches to receive a bearing. This bearing is of phosphor bronze, lined with white metal. Its bore is 2.125 inches. The connecting rod is 12.25 inches long center to center of bearings.

The lower end of the connecting rod is split horizontally, the bottom piece being called a cap, which holds half of the rod bearing; the other half is in the upper portion of the rod. The cap is bolted to the rod proper by means of four alloy-steel bolts and castellated nuts.

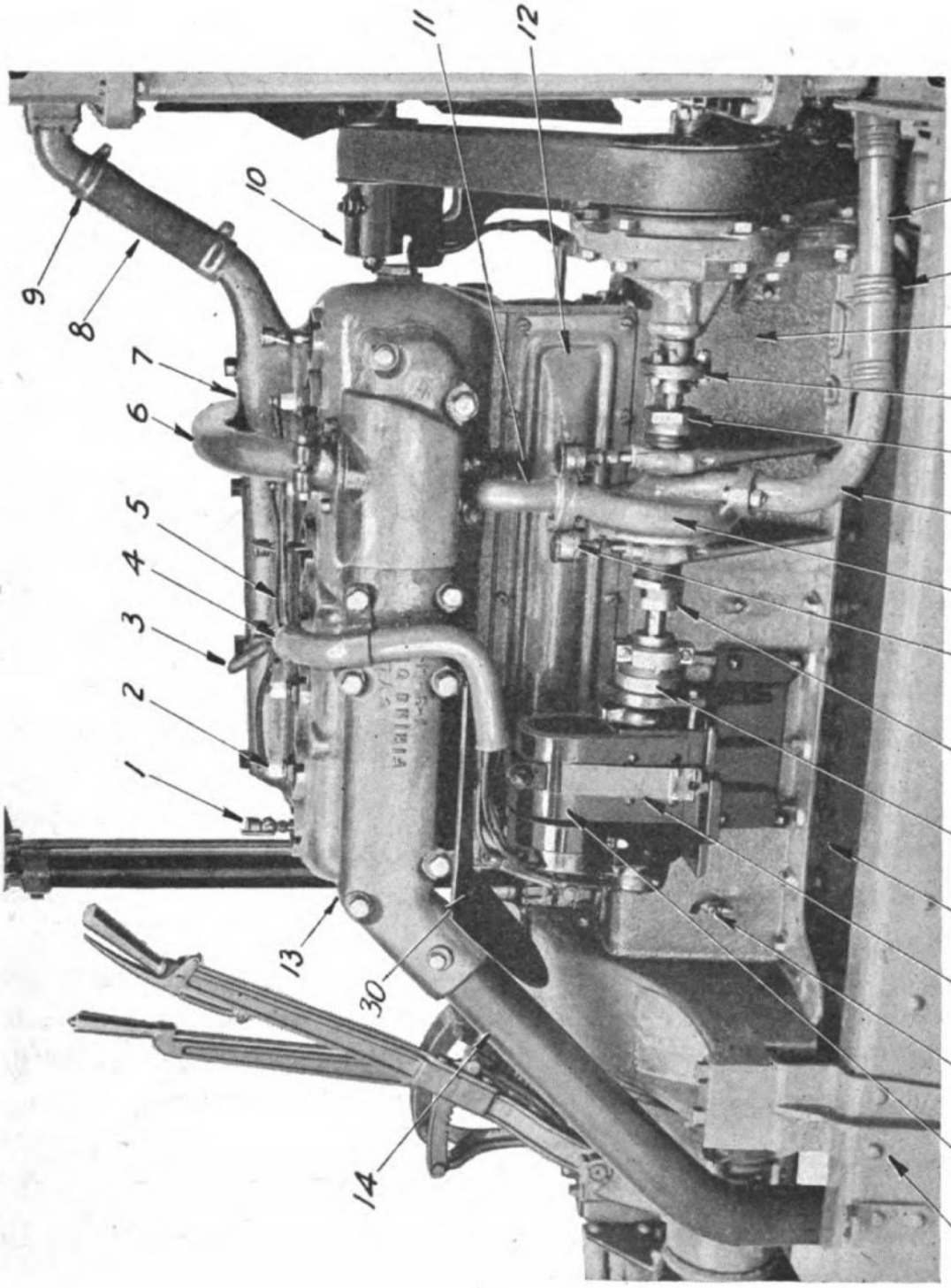
CONNECTING ROD OIL TUBE.

Along the side of the connecting rod is banded an oil tube which carries oil from the connecting rod bearing to piston pin bearing.

TO REMOVE CONNECTING ROD.

To remove connecting rod and piston, drain off oil, and remove oil pan, turn engine over by hand until lower end of connecting rod to be removed is down; remove connecting rod bearing nuts, turn engine over until rod end is under camshaft with cranks about horizontal, open pet cock, take off cap and lower rod and piston down carefully to prevent piston ring breakage.

Plate No. 17



RIGHT SIDE OF ENGINE, EXTERIOR VIEW, MODEL 4017-L ONLY.

RIGHT SIDE OF ENGINE, EXTERIOR VIEW, MODEL 4017-L ONLY

Ref. No.	Part No.	Name of Part.
1	34359	Priming cup.
2	31946	Spark plug.
3	34180-A	Magneto to switch wire.
4	32981	Ignition wiring tube.
5	33809	Ignition wire (Cyl. No. 2).
6	33051	Carburetor hot air tube.
7	32456	Water jacket top cover.
8	32454	Radiator inlet hose.
9	33022	Radiator inlet hose clamp.
10	32721	Fan shaft bearing.
11	34407	Water pump connection to cylinder.
12	34383	Cylinder side plate.
13	34370	Exhaust manifold.
14	33653	Exhaust pipe.
15	32444	Motor rear support bracket (right).
16	36773-A	Magneto.
17	CO-118	Oil distributing pipe pet cock.
18	35334-A	Magneto fastening strap (brkt. half).
19	34542	Oil pan.
20	36930	Impulse starter.
21	30521	Water pump packing nut (rear).
22	34415	Water pump grease cup.
23	35477-A	Water pump assembly.
24	32463	Water pump inlet connection.
25	34420	Water pump packing nut (front).
26	34444	Water pump drive coupling flange.
27	34556-A	Crankcase, complete.
28	33023	Radiator outlet hose clamp.
29	33086	Radiator outlet tube.
30	35273-A	Magneto shield.

TO REPLACE CONNECTING ROD BEARING.

To replace a connecting rod bearing, remove oil pan, disconnect connecting rod bearing and pull out piston; take out bearing by removing countersunk screw which holds bearing in place in connecting rod and cap; replace new bearing and fit to shaft, leaving enough end play, but no looseness up and down.

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 bearings may be sized before they are placed in the rod or cap. In case an end flange 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 or bronze back) next to shaft should be filed or scraped down about .25 inch to prevent contact with crankshaft and prevent side pressure, also to aid lubrication.

After the connecting rod has been so 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 (rotate).

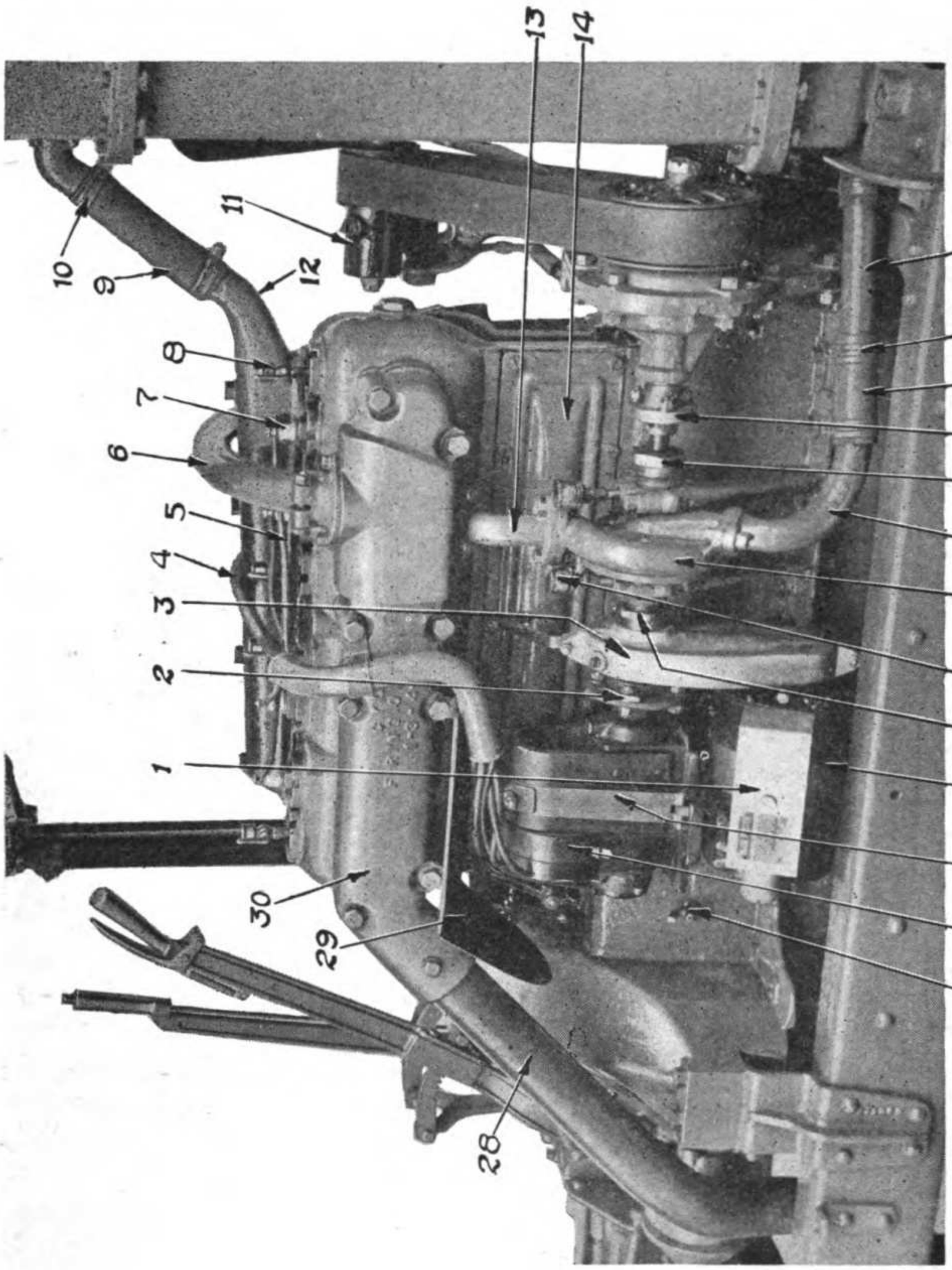


Plate No. 18 RIGHT SIDE OF ENGINE, EXTERIOR VIEW, MODEL 4017-A ONLY.

RIGHT SIDE OF ENGINE, EXTERIOR VIEW, MODEL 4017-A ONLY.

Ref. No.	Part No.	Name of Part.
1	36028	Voltage regulator.
2	34106	Magneto coupling disc.
3	33122 } 33123 }	Generator drive chain housing.
4	34180-A	Magneto to switch wire.
5	33809	Ignition wire.
6	33051	Carburetor hot air tube.
7	31946	Spark plug.
8	34359	Priming cup.
9	32454	Radiator inlet hose.
10	33022	Radiator inlet hose clamp.
11	32721	Fan shaft bearing.
12	32456	Water jacket top cover.
13	34407	Water pump connection to cylinder.
14	34383	Cylinder side plate.
15	33086	Radiator outlet tube.
16	33023	Radiator outlet hose clamp.
17	32462	Radiator outlet hose.
18	34444	Water pump drive coupling flange.
19	34420	Water pump packing nut (front).
20	32463	Water pump inlet connection.
21	35477-A	Water pump assembly.
22	34415	Water pump grease cup.
23	30521	Water pump packing nut (rear).
24	35117-A	Generator.
25	35334-A	Magneto fastening strap (brkt. half).
26	36252-A	Magneto.
27	CO-118	Oil distributing pipe pet cock.
28	33653	Exhaust pipe.
29	35273-A	Magneto shield.
30	34370	Exhaust manifold.

CONNECTING ROD BEARING SHIMS.

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 up (drawing the caps against the shims solidly) but never strained. If a castellated nut is tight when in such a position that cotter pin hole does not line up, the nut should be removed 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.

TO ADJUST CONNECTING ROD BEARINGS.

The work of properly adjusting a connecting rod bearing simply by dropping the lower half of the crankcase should be done carefully. Remove the bearing cap and an equal thickness of shims from each side, and replace caps, tighten all nuts securely and crank engine to determine tightness of bearing. Adjust but one at a time, then loosen cap before adjusting another, to insure uniform tightness.

VALVE GEAR.

The valve gear or valve system includes every part from the camshaft to the valve head, thus the system consists of camshaft, push rods, valves with spring, etc.

CAMSHAFT.

MATERIAL AND CONSTRUCTION.

Since the valves are all on one side they are opened by the action of a single camshaft having eight cams.

The camshaft is of case hardened steel. Its length is 28.125 inches. There are three camshaft bearings: The front bearing is 2.06 inches in diameter by 2.25 inches long; the center bearing is 2.03 inches in diameter by 1.50 inches long, and the rear is 1.623 inches in diameter by 1.50 inches long.

The valve tappets have mushroom followers which rest upon eight cams forged integral with the camshaft, and are actuated when the camshaft rotates. The camshaft is driven by means of a large helical gear on its forward end, meshing with a helical gear on the crankshaft. (See page 62 for description of gear.)

The forward end of the camshaft is flanged to permit the attachment of the camshaft driving gear. Its rear end is threaded to receive a nut, which clamps the oil pump driving gear in place.

ADJUSTMENT FOR CAMSHAFT END PLAY.

Since the teeth of the driving gear of the camshaft are helically cut, the whole shaft has a tendency to thrust forward when in motion. To offset the thrust the front end of the shaft is bored to receive a .5 inch steel ball, which rests against the flanged end of a steel plunger, which is held against the ball by a spring. The latter is fastened to the front end of the crankcase, and is adjustable from the outside.

TO REMOVE CAMSHAFT.

To remove camshaft the motor should be taken out of chassis, then take off timing gear housing cover, and cylinder block. Drive the camshaft out through the front, as the rear bearings are made smaller than the front.

VALVES.

There are two valves of the poppet type to each cylinder—one intake valve and an exhaust valve. Their names are indicative of their functions. The valves, including their stems, are of tungsten steel, with heads 2.125 inches in diameter. The valve stems are .435 inch in diameter and 7.5625 inches long from underneath the valve heads to the bottom of the stem. The head is .281 inch thick. One quarter inch from its lower end each valve stem is groove cut, .265 inch wide and .309 inch bottom diameter. Into the grooved space there is slipped a split washer, over which the bottom end of the valve spring rests on valve spring retainer. The stems move in cast iron guides, not bushed.

VALVE SPRINGS.

The valve springs are 5 inches long when free, and have an outside diameter of 1.375 inch. They are made of twelve coils of No. 9 gauge wire (0.148 inch diameter).

VALVE TAPPETS (OR PUSH RODS).

Each valve is actuated by a case-hardened steel valve tappet (adjustable as to affective length) with a mushroom follower on bottom end, which bears on the cam. The overall length of the tappet is 3.9375 inches. The diameter of the mushroom head is 1.46875 inches, and of the stem .625 inch.

The end of the tappet is drilled and tapped for a .375 inch adjusting screw, by means of which the tappet-to-valve clearance may be varied.

VALVE TAPPET GUIDE.

The tappet functions in a cast iron guide, which is forced into place in the cylinder block from the bottom. The guide is 2.75 inches long. The guide is formed of two diameters, the lower 1.25 inches in diameter by 1.25 inches long, and an upper section which is 1.127 inch in diameter and 1.5 inch long.

VALVE CLEARANCE.

The proper clearance between valve stems and the tappet is .006 inch for the intake valves, and .008 inch for the exhaust.

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

VALVE STICKING.

A valve may stick because of an overheated stem or guide caused by tightness, carbon, lack of lubricant or a bent stem.

GRINDING VALVES.

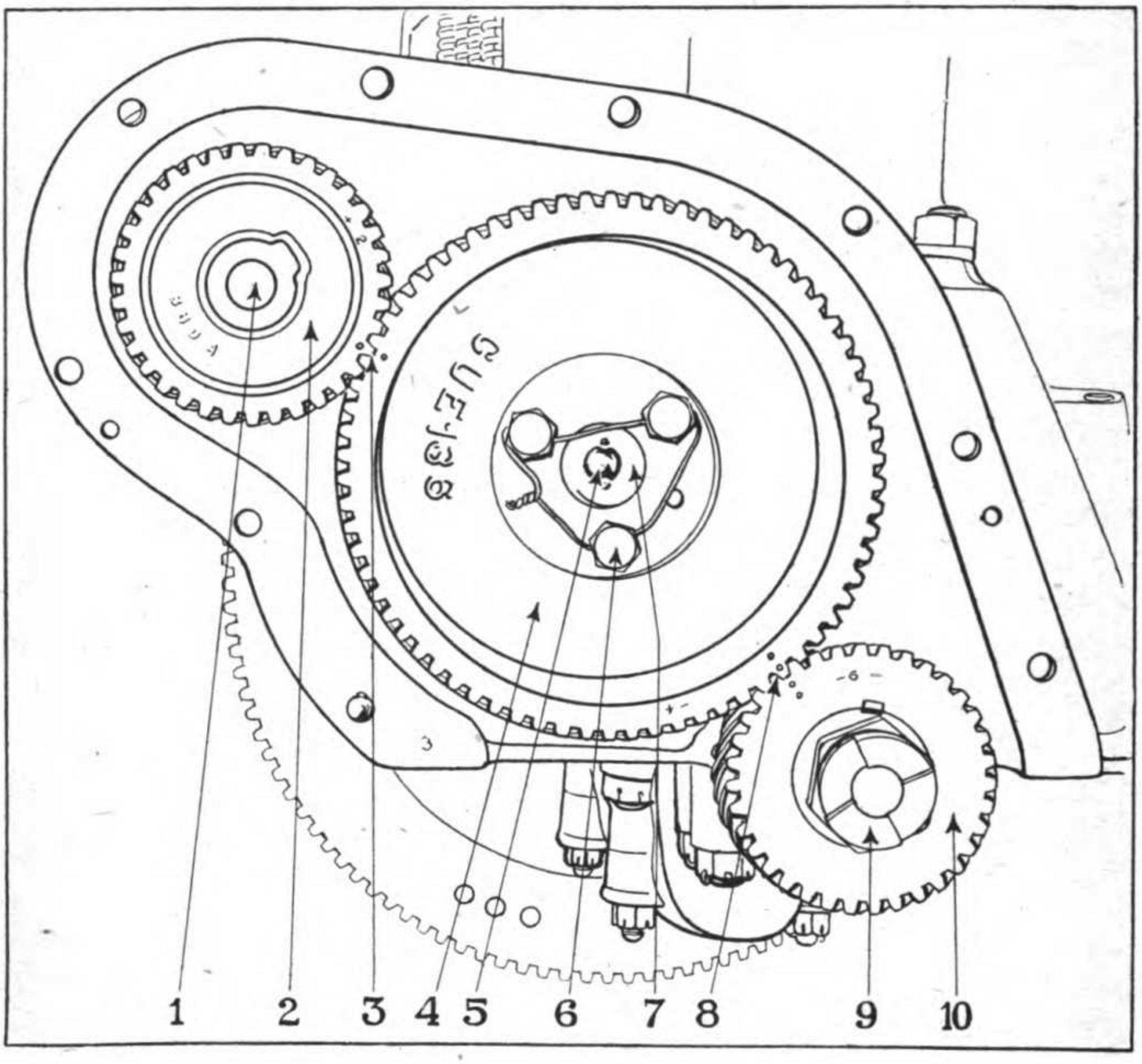
In order to maintain gas-tight joints the valve faces must fit their seats perfectly. If they do not, there will be a loss of compression resulting in a loss of power.

When valves or seats become dirty or pitted, they should be ground. To remove them take out all spark plugs. Take out all priming cups and with special wrench, which accompanies every tool kit, take out the eight valve chamber plugs. Lift up springs with spring compressor, and take out split washers at end of valve stems. Take out valves and remove springs and washers. Turn down push rod, adjusting screw to allow clearance between the stem and the push rod. Close the valve ports with a clean cloth. Mix a little oil with emery or powdered carborundum. Place a little of this grinding compound on the valve face. Place the valve in its own position. Mark the valves, if necessary, so you can tell where each belongs. Insert a screwdriver into the slot in the valve head; then turn with a semi-circular movement of the screwdriver, exerting no pressure. This can be done easily by holding the handle between the palms of the hands. Occasionally lift the valve from the seat,

turn half way round and continue. When done correctly a light silvery color will be given to both seat and face.

In case the valves are very badly pitted, and grinding until the pits

Plate No. 19



FRONT END OF ENGINE WITH GEAR CASE COVER REMOVED.

Ref. No.	Part No.	Name of Part.
1	34447	Pump shaft.
2	34446	Pump gear.
3		Marks for timing.
4	34463	Camshaft gear.
5	BA-105	Ball for adjusting end play.
6	SC-245	Camshaft gear cap screw.
7		Camshaft gear flange.
8		Markings for timing camshaft.
9	34507	Crankshaft extension.
10	34505	Crankshaft gear.

were removed would grind the valve seat down too deeply, the valve should be faced off. It should also be faced in case a ridge has been worn on valve face by the constant operation. In facing valves in lathe, a drill

chuck should be used in which to chuck the valve stem as it is self-centering, the center hole in valve head being cleaned free of carbon and a tail center run into the hole, holding valve securely. In case valves are so hard that facing with a tool is impossible, they may be ground on an emery wheel, but should not be ground down beyond the ridge, it serving as a guide.

After the valves have been ground the surface of the valve and seat is a series of high and low points. After the engine has been run for several hours this surface will have hammered smooth and the valve tappet clearance will have decreased, therefore excessive clearance should be allowed immediately after grinding the valves, and finally adjusted after the engine has run several hours.

Then readjust tappets to .008 inch on exhaust and .006 inch on intake.

Do not grind valves more frequently than necessary. An occasional application of kerosene on the valves and stems is beneficial and often saves grinding.

Intake valves seldom need grinding. Exhaust valves are subjected to greater heat and require attention more frequently.

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 connect the two.

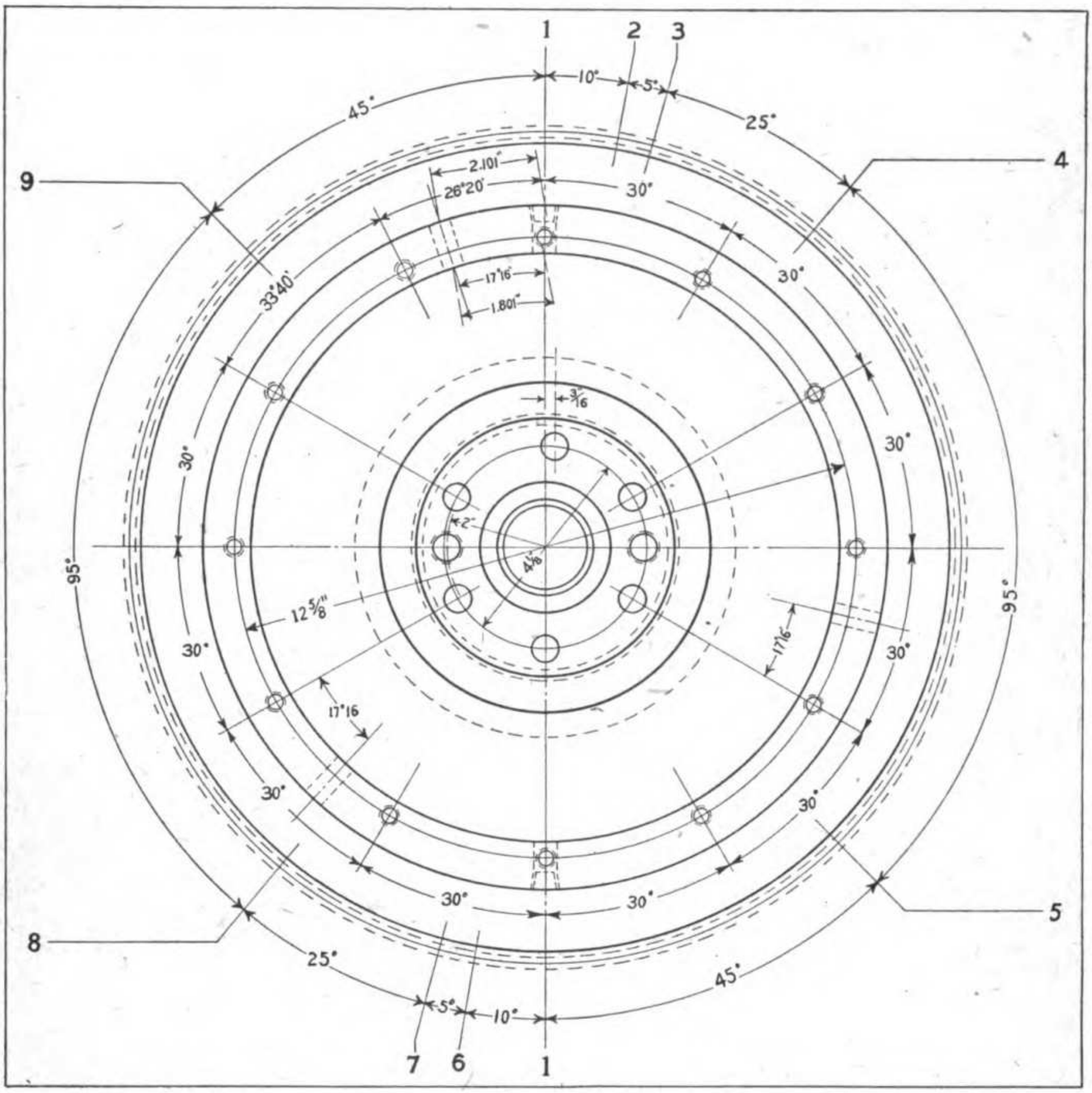
If it is desired to check the valve timing it is necessary to make use of the marks on the rim of the flywheel. These flywheel marks may be observed through an opening in the top of flywheel housing. A threaded plug is removed from the opening and the flywheel rim may be seen underneath. The flywheel is marked as follows (each mark having a vertical line next to it):

DC 1 and 4—meaning dead center for pistons 1 and 4, that is, pistons 1 and 4 are at the top.
DC 2 and 3—meaning dead center for pistons 2 and 3, that is, they are at the top of the stroke.
N-Op —Inlet valve opens.
N-Cl —Inlet valve closes.
X-Op —Exhaust valve opens.
X-Cl —Exhaust valve closes.

When the line across the flywheel face at the mark DC 1 and 4 is directly in the middle of the hole in the flywheel case, pistons 1 and 4 are at the very top of the stroke — dead center. The engine fires cylinder No. 3 firing after No. 1, and No. 4 after No. 3, and No. 2 after No. 4, and then No. 1 again and so on.

Starting with cylinder No. 1, have someone crank the engine while you observe through the hole. When inlet valve of No. 1 cylinder starts to open the line next to mark N-Op should be right in the middle of the hole. Similarly when the engine is cranked further until the line N-Cl

Plate No. 20

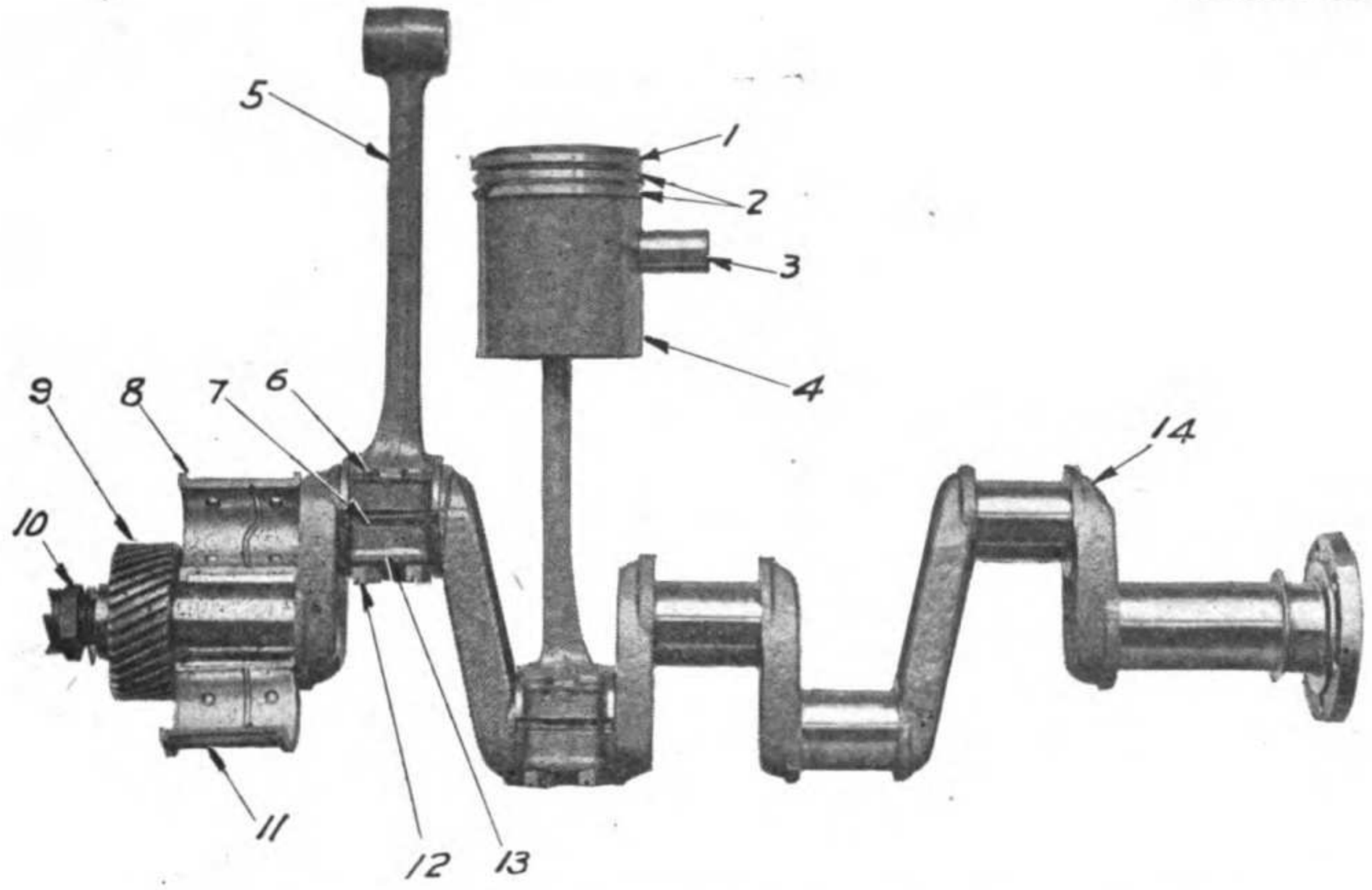


VALVE TIMING DIAGRAM.

1—Dead center.
2—Exhaust closes 1 and 4
3—Intake opens 1 and 4
4—Intake closes 2 and 3
5—Exhaust opens 1 and 4
6—Exhaust closes 2 and 3
7—Intake opens 2 and 3
8—Intake closes 1 and 4
9—Exhaust opens 2 and 3

appears in the middle of the hole the inlet valve should just close. If the valves do not open and close at the right time, a tappet adjustment may be made so they will open and close just as the opening and closing lines pass the center of the observation hole.

Plate No. 21



CRANKSHAFT WITH CONNECTING ROD AND PISTON.

Ref. No.	Part No.	Name of Part.
1	34476	Top piston ring.
2	34475	Second and bottom piston rings.
3	34485	Piston pin.
4	34474	Piston.
5	34489-A	Connecting rod.
6	34484	Connecting rod bearing bolt.
7	34483	Connecting bearing shim laminated.
8	34509	Crankshaft front bearing (upper).
9	34505	Crankshaft pinion.
10	34507	Crankshaft starting crank jaw.
11	34496	Crankshaft front bearing (lower).
12	NU-352	Connecting rod bearing bolt nut.
13		Connecting rod cap.
14	34492	Crankshaft.

The valve timing figures, that is, the time of valve opening and closing with relation to the position of the piston, are as follows:

Inlet valve opens 15 degrees or 2.159 inches on the flywheel rim after top dead center.
Inlet valve closes 40 degrees or 5.759 inches on the flywheel rim after bottom dead center.
Exhaust valve opens 45 degrees or 6.473 inches on flywheel rim before bottom dead center.
Exhaust valve closes 10 degrees or 1.439 inches on flywheel rim after top dead center.

These points or distances before and after top dead center are not stamped in figures on the flywheel, but instead, the thing that happens at the point is marked. Thus, at 15 degrees after top center the mark N-Op appears.

TIMING GEAR MARKS.

If, for any reason, the camshaft is removed, it must be returned to exactly the same position it occupied before. This is done easily since both camshaft and crankshaft gears are stamped, as shown in the illustration on page 56, and when these stamps or punch marks coincide the gears are in proper mesh.

CRANKSHAFT.

The crankshaft is the means of converting the reciprocating motion of the piston into rotary motion. The crankshaft rests in bearings in the upper half of the crankcase. To the shaft are attached connecting rods which have pistons at their upper end.

The straight-cheek crankshaft is of manganese steel, and is 32.0625 inches long, while its overall height is 8 inches. The crankshaft is mounted in three bronze-back babbitt bearings. The front bearing is 2.124 inches in diameter by 3.156 inches long. The center is 2.249 inches in diameter by 2.75 inches long, and the rear bearing is 2.374 inches in diameter by 4.2187 inches long. The rear end of the crankshaft is flanged to receive the flywheel, which is bolted to the flange. The front end is drilled, and tapped to receive half the starting crank clutch. This end is also key seated for a No. B Woodruff key, which keys the crankshaft gear in place.

CRANKSHAFT BEARING CAPS.

The crankshaft is held up in the main bearings by means of caps. These are of malleable iron, and are held in place by .5 inch studs.

The bearings are held in place by shoulders in the bearings themselves, and by flat head brass machine screws, which screw through the bearings, and into the malleable iron caps.

The connecting rod bearings are lubricated by oil carried from the main bearings by centrifugal force through holes drilled through the crankshaft cheeks, as shown in the illustration on page 44.

KNOCKS IN BEARINGS.

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

TIGHTENING CRANKSHAFT BEARINGS.

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

If one or more layers are removed and that is found to be too much, substitute a thin shim of paper for one of the metal layers removed.

The water pump and magneto helical gear meshes with the camshaft gear, and so actuates both the water pump and the magneto. The gear is keyed to the front end of the pump shaft, and is identical in all respects save bore and key seat with the crankshaft gear. It is bored .9375 inch and key seat .1875 inch wide.

OIL PUMP GEAR.

The oil pump helical gear is keyed to the rear end of the camshaft, and meshes with a similar small gear near the top of the vertical shaft which drives the oil pump. It has 12 teeth cut right angle helical at an angle of 45 degrees. The gear has a face .75 inch, and is bored .625 inches, and made of case hardened steel.

LUBRICATING SYSTEM.

OPERATION OF SYSTEM.

The lubricating system is the pressure type (operating at a maximum of 35 pounds) operated by a gear oil pump drawing oil from reservoir through wire screen to pump through a vertical tube to horizontal distributing tube inside of crankcase. This tube feeds oil to ducts running to crankshaft bearings and camshaft bearings. The crankshaft is drilled through the crankshaft cheeks, oil being forced through the holes to the connecting rod bearing, and from there through a copper tube on the outside of connecting rod to the wrist pin bearing. The oil forced out from the bearings by pressure lubricates cylinder walls, pistons and valve push rods and falls down into the base and back to the oil reservoir. The overflow through the check valve at the front of engine goes to the timing gear housing, and from there by gravity back to the oil reservoir and so through oil screen to pump.

ACTION, FUNCTION AND CONSTRUCTION OF OIL PUMP.

The oil is drawn from the crankcase bottom into the pump at one end, and is carried around between the teeth of both gears, next to the sides of the pump body to the other end of the pump body.

The oil is prevented from returning by the teeth of the two gears meshing together (as one gear drives the other). It escapes through the pump outlet passage into a pipe connection with a main oil passage in the crankcase.

The oil pump is of the gear type, and is bolted to the bottom of the left side of the crankcase oil base. It is driven from the camshaft by a pair of spirals, through a vertical shaft made of cold-rolled steel. The shaft is .625 inch in diameter and 13.5625 inches long. It revolves in a cast iron guide lined with a die-cast white metal bushing. The bottom of the shaft is flattened and fits into the upper end of the oil pump gear

shaft. The upper end of the shaft extends through the top of the crankcase and is notched to receive the driving end of the governor flexible shaft.

The two spur gears in the pump are of hardened steel—one is forged integral with the pump gear shaft, the other with a small shaft on which it runs in the body of the pump. These gears have each 12 teeth (12 pitch)—a pitch diameter of 1 inch, outside diameter 1.166 inch and a face of 1.25 inch.

OIL FILTER.

Below the level of the oil pump and bolted to the crankcase there is a cast-iron oil pan sediment filter, over the top of which is placed an inverted cylindrical screen. The oil flows into the pump from the filter, thus allowing sediment to settle at the bottom. A .5-inch plug is provided to allow the sediment to be drained off periodically.

WORN BEARINGS AFFECT PRESSURE.

In a pressure system of lubrication it is important to keep bearings tight so that oil pump passages will not leak at this point, and so prevent full quantity of oil reaching all parts of system—not only to prevent other bearings from being starved, but to prevent cylinders and over loose bearings receiving an excess of oil (middle main bearing especially).

REGULATING OIL PRESSURE.

The oil supply and pressure are regulated by adding or taking away washers under oil pressure valve screws, which increases or decreases spring tension on ball check. To ascertain if oil pump is working, open pet cock, on right side of engine, near flywheel.

WATER COOLING SYSTEM.

OPERATION OF SYSTEM.

The cooling system is necessary primarily to prevent the oil in the engine from burning up completely and thus causing the moving parts to seize. By passing water around the hot parts and keeping that water always below the boiling point the heat is carried off by the water.

The cooling system consists of water jackets around the cylinders, a centrifugal pump for forcing the water around the system, a radiator for receiving the water for cooling and a fan for causing an air draft through the radiator so that the water in the radiator tubes can impart its heat to the passing air. There are, of course, the necessary connections between the radiator and the pump and engine, so that pump can force the water around so the hot water enters the top of the radiator, and leaving, after being cooled, through a hose connection at the bottom.

CENTRIFUGAL PUMP.

The pump is located on the front right side of the engine, and is mounted on brackets cast integral with the crankcase. It is of the centrifugal type, inclosed in a cast-iron housing, and has a bronze rotor.

The rotor is 3.994 inches in diameter and is .875 inch wide. It is keyed to its shaft which is .75 inch in diameter and 10.312 inches long.

The pump is provided with two glands each projecting .875 inch. These are integral with the bronze bushings. These bushings support the pump shaft, which is driven by a coupling from the pump gear shaft.

There is keyed to the rear end of the shaft, half of the flexible coupling which drives the magneto. About 5 inches from its end the shaft is drilled to receive a No. 3 taper pin and key seated to permit the attachment of the pump rotor.

WATER PUMP GEAR SHAFT.

The water pump gear shaft is made of carbon steel. It is 9.531 inches long, and its largest diameter is 1.375 inches. The extreme front end of the shaft is key seated to permit the keying to it of the lower fan pulley. This end is also threaded to receive a nut, which clamps the pulley in place.

The rear end of the shaft is drilled and key seated for the attachment of one-half of coupling. The other half of this coupling is keyed to the water pump shaft.

The shaft is supported in bearings cast in the upper half of the crankcase and the gear case cover. These bearings are lined with a die cast babbitt bushings.

TO PACK WATER PUMP GLANDS.

The water pump glands (packing boxes 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 a 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 tin snips or heavy scissors. The gland nuts should not be tightened any more than necessary to prevent leakage of water.

TO TEMPORARILY REMEDY DEFECTIVE WATER PUMP.

In case of a damaged or inoperative pump, the water pump rotor should be removed from the pump to prevent its obstructing the passage. The cooling system must be full to insure circulation (by thermo-syphon)

water, or cloths soaked with gasoline may be applied to the pump and lighted to thaw the ice.

To avoid freezing in winter use an anti-freeze solution, or cover the lower portion of the radiator with cardboard to obstruct air flow. The lower portion is always colder than the top because water settles to a lower level as it cools. The water, as it enters the top of the radiator, is hot, having just come from around the cylinders.

RADIATOR.

The cylinder walls are cooled by water (pumped into the water jacket) absorbing the heat. This heat is then radiated away from the water while in the radiator by the radiating fins on the vertical tubes through which the water passes on its return to the water pump, the fins being cooled by the air drawn past them by the fan behind the radiator. The tubes and radiating fins are made of copper, because of its conductivity.

The radiator consists of a core, the largest unit, which is composed of finned copper tubes running vertically, on top of this core is the upper tank, a cast iron member having the filler neck and water inlet attached. Between the tank and the core is a rubber gasket. At the bottom of the core is the lower tank, a cast iron member from which the water passes into the water inlet pipe. This bottom tank has the drain attached and also studs which run through the frame to hold the radiator in place. There is a similar gasket between core and bottom tank. The sides of the core are fitted with cast iron pieces bolted in place. A steel clamping strip, 0.375 by 1 inch, extending between the radiator side members, is bolted to back (opposite gasket) of core header plate, to stiffen same and prevent leakage.

COOLING FAN.

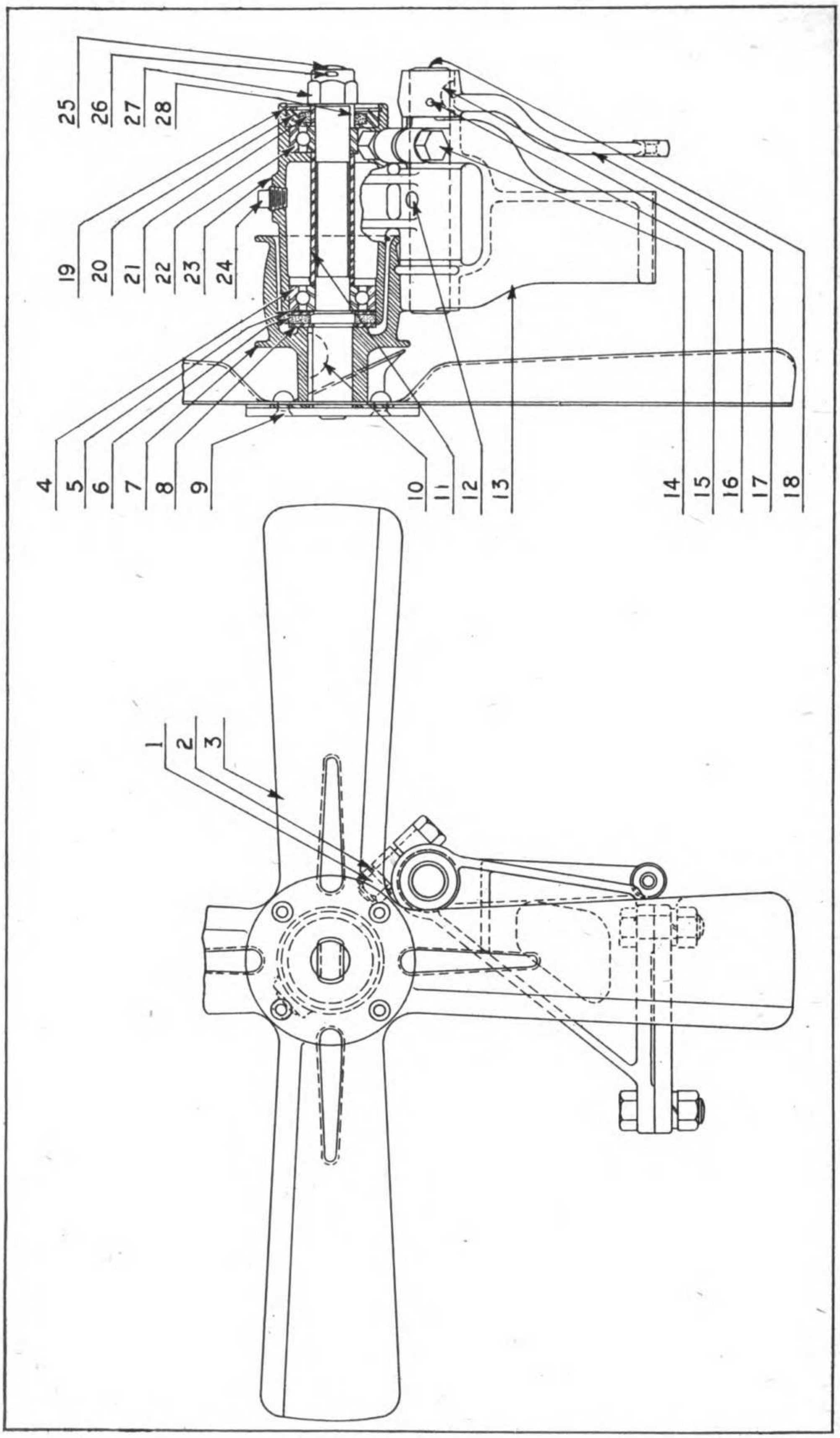
The fan is bracketed in front of the engine and driven by a flat belt from a pulley on the right-hand side. The fan shaft is carried on ball bearings. Tension of the fan belt is secured by a spring on the fan adjusting arm. The fan bearings are lubricated by removing pipe plug on top of the fan shaft bearing and injecting lubricant.

The fan assembly is bolted by two .5 inch bolts to a shelf or bracket that is an integral part of the engine gearcase cover (the covering over the timing gears). The fan is of the conventional built-up type; four sheet-steel blades being riveted to a stamped-steel spider with a riveted-in steel hub. To the hub is riveted a machine steel shaft, 7.6875 inches long, and 2.125 inches wide between its two flanges.

FAN PULLEYS.

Behind the fan there is keyed on the shaft a cast-iron belt pulley, 3 inches outside diameter and 2.1875 inches wide between flanges. It is bored 0.875 inch.

Plate No. 24



FAN AND FAN BRACKET ASSEMBLY.

of oil into the crankcase to make sure that the moving parts will not stick, due to rapid burning of the oil.

IF RADIATOR TUBE BREAKS.

If outside tubes are broken in radiator in field, for quick repair pinch together or roll each end of break with pliers. To take tube out and plug holes it is necessary to remove upper and lower tanks.

SOLDERING.

TO PREPARE RADIATOR PARTS FOR SOLDERING.

If a tube becomes broken it may be soldered. Before soldering copper, 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 gasing ceases. If extra strength muriatic acid is used in making cut acid, it should be diluted with about 25% its volume of water before adding the zinc. If the gasing 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 will throw acid.

SOLDERING TIN.

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

SOLDERING IRONS AND STEELS.

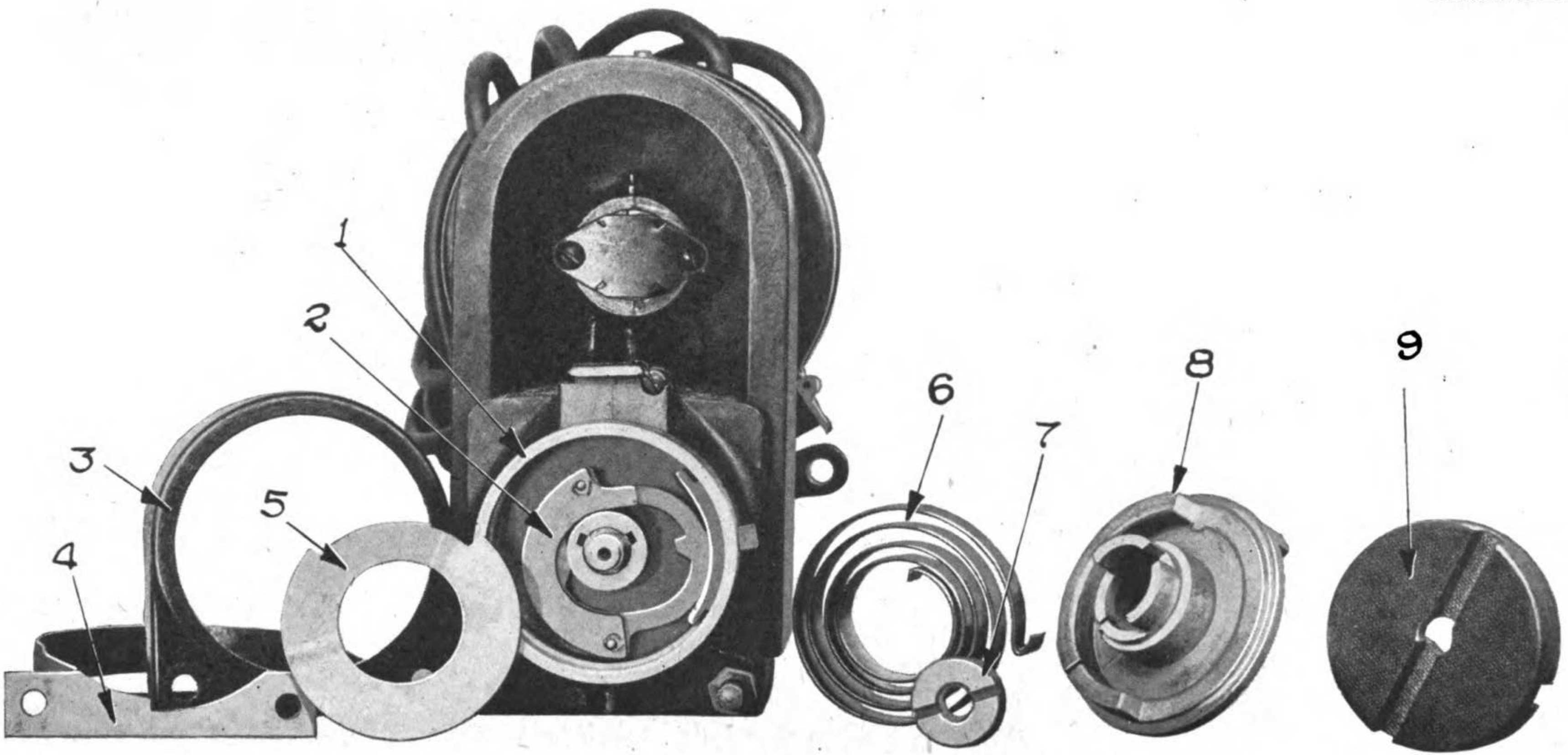
Cast iron, malleable iron, steel and black iron, or sheet iron, should be scraped bright, then cleaned with sulphuric acid before applying the cut acid. This being done, solder as for copper. In the case of cast iron the parts being soldered must be heated.

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."

The soldering iron should be filed bright, then tinned with solder, after being cleaned with salamoniac. If salamoniac is unavailable rosin 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 clean.

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



MAGNETO WITH IMPULSE STARTER ASSEMBLY, MODEL 4017-L ONLY.

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 in their respective order.

MAGNETO MAINTENANCE.

Aside from lubrication, as mentioned in the following, there is little attention required. Eisemann Type G-4-II Edition should receive 20 drops of light mineral oil every two weeks, distributed as follows: One drop in the oil hole (one most convenient) on side of breaker box, 5 drops in the small hole and 14 drops in the large hole at the driving end of the magneto.

TO CLEAN BREAKER POINTS.

The platinum contacts of the breaker mechanism should be occasionally cleaned with gasolene, and for obvious reasons, thoroughly dried before starting the motor. The distributor disc and collector ring should likewise be cleaned once or twice each month with a cloth moistened with gasoline.

WHEN TO REPLACE IGNITION CABLES.

In order to obtain the best results, the cables should be at once replaced if they show signs of cracking or wearing. After a year of normal service, it is advisable to carry in reserve a few carbons for the distributor plate, as well as a contact spring and an adjustable contact screw.

IMPULSE STARTER.

Used on Model 4017-L Only.

This device mounted on the armature shaft outside of the magneto proper is simply a means of giving the armature a quick, fast turn. The impulse starter contains a spring whose stored up energy is released by tripping (by means of a dog) a ratchet to which the spring is attached. The Eisemann impulse starter eliminates the necessity of an auxiliary ignition system for starting, as this device causes the magneto to produce a hot, fat spark, regardless of how slow the engine is cranked.

The device does not have to be set by hand and above 180 R. P. M. is automatically drawn out of action.

IGNITION TROUBLES AND HOW TO REMEDY THEM.

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.

If the engine misses, the corresponding spark plug should be examined to see that the gap is not too large. This gap between the electrodes

To charge the magnet, the free end of the wire should be touched to the (negative) battery terminal for about 2 seconds (not longer), then withdrawn, this operation being repeated about a dozen times. Striking the magnet when the current is on with a piece of hardwood, or a small piece of lead or soft brass, will materially assist in increasing the degree of magnetization that will be attained.

A keeper with cross section about equal to cross section of the magnet should be put across the ends of the magnet immediately after charging. 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 the 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 lightly, as mentioned above.

THE CONDENSER.

The condenser, which is connected across the platinum breaker points, absorbs the current of the primary coil away from the breaker points when they separate, thereby minimizing the tendency for the current to continue flowing across the gap between the separated points, greatly diminishing the arcing, and consequently burning and pitting of the platinum breaker points. This charging of the condenser contributes to a very quick interruption of flow of the primary current, which sudden change (in potential) is necessary for the induction of the desired high voltage in the secondary circuit. When the points come together again, the condenser discharges the voltage that has been impressed on it (as the points separated), this discharge assisting in quickly establishing the flow of current in the then closed primary circuit. The Secondary voltage produced without a condenser is only about 5 per cent normal.

WHEN CONDENSER IS PUNCTURED.

When a condenser becomes punctured, a temporary adjustment frequently overcomes the difficulty. Close the spark plug gaps as closely together as possible without actually permitting them to touch each other and the engine will frequently run.

It may be necessary, however, to improvise a condenser, which may be done by using two ten to twenty-foot lengths of insulated wire (of from 25 to 35 B. & S. gauge), doubling each wire and bringing its two ends

in contact with each other), being filed, if necessary, to secure square contact.

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.

IGNITION TROUBLE DUE TO OVERPRIMING.

Over-priming or choking with gasolene usually results in the excess gasolene condensing on the insulated terminal of the spark plug and draining down and forming a drop across the air gap, or mixing with the carbon deposited thereon and forming a path for the current from the center electrode up along the insulation to the ground. This path, offering far less resistance to the flow of the current than the air gap between the points of the plug, the current naturally flows over this path, no spark resulting.

EXCESS OIL IN MAGNETO.

In the primary circuit of the magneto oil acts as an insulator. For instance, if oil works on to the platinum points it will prevent a flow of current from one point to the other, except in a very restricted area where the oil may have been squeezed out as the points snapped together. The resistance will raise as the area decreases to a point where the oil will be burned, leaving a carbon deposit on the points further increasing the resistance and burning until no current flows through.

It will be noticed from the above that oil is an insulator, especially in the primary circuit, where the voltage is insufficient to overcome the insulating properties of the oil. In the secondary circuit the voltage is sufficiently high to overcome the resistance of the oil, and as dust (either road, metallic, or carbon) is always in the surrounding atmosphere, it settles on the oil and the whole acts as a conductor for the high tension current (resulting in a short circuit).

CARBURETION SYSTEM.

The carburetion system is the means of supplying the engine with an explosive mixture of gasoline and air. The system consists of a carburetor which receives gasoline from a supply tank and mixes it with air in proper proportions, and a system of passages from the carburetor to the inlet valves or the ones which control the passage of the mixture into the cylinders.

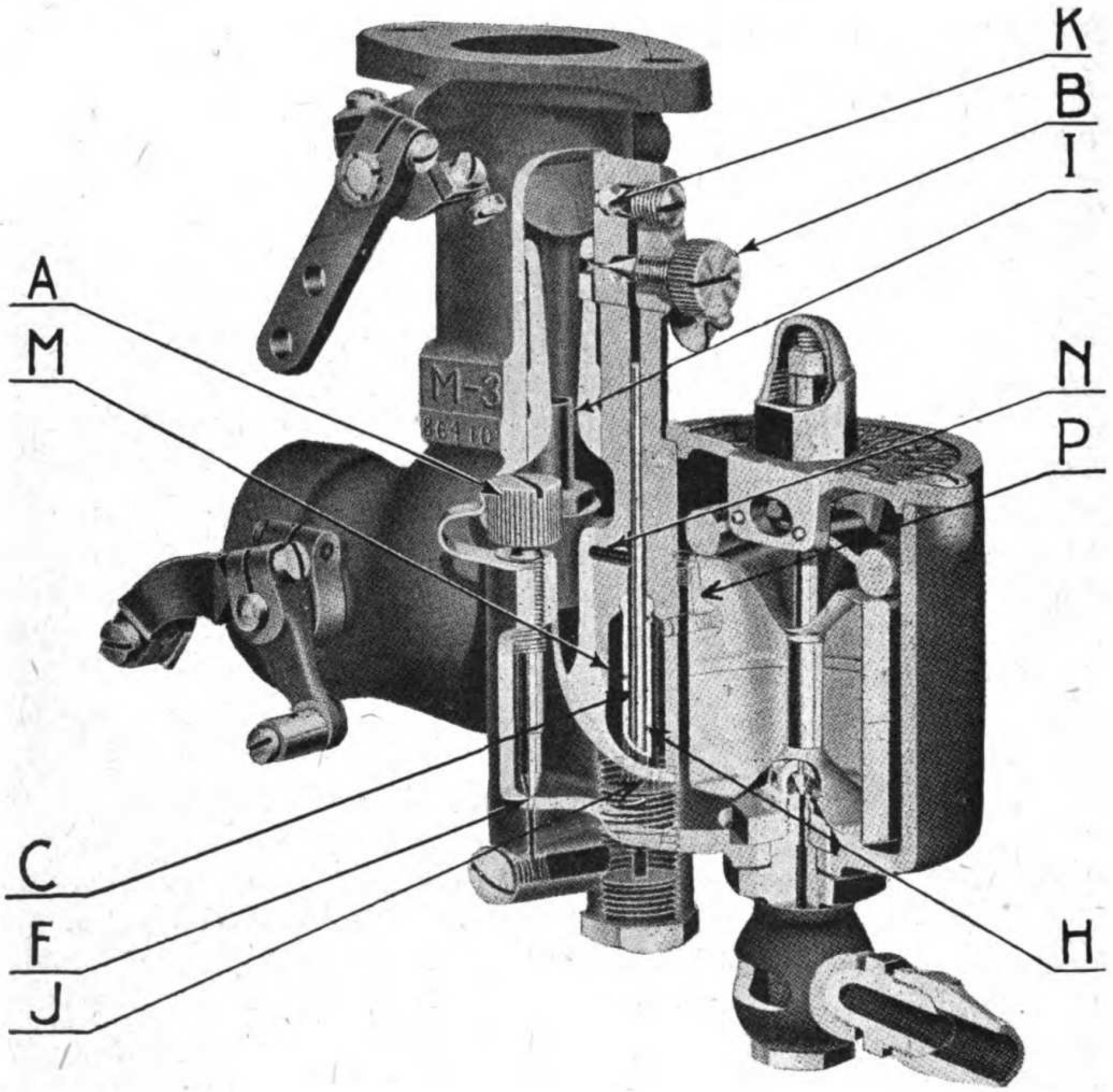
CARBURETOR.

The engine is equipped with a type M, size 2 (1.25 inch) plain tube Stromberg carburetor, which is bolted to the underside of a flanged cast iron connection to the governor.

CARBURETOR ADJUSTMENT.

There are two adjustments on this new Stromberg, shown in the illustration below: A, the main adjustment, controls the gasoline supply from the float chamber and regulates the mixture through the whole driving range. Turning nut A anti-clockwise, or to the left, raises the needle and gives more gas; clockwise, less. If an entirely new adjustment is necessary, turn nut A clockwise (to the right) until needle just seats, then open A three complete turns (to the left), which should give a mix-

Plate No. 28



CUT-AWAY VIEW OF STROMBERG MODEL M-3 CARBURETOR

A—High speed adjusting needle.
B—Low speed adjusting screw.
C—Main supply channel.
F—Needle valve seat.
H—Air bleeder holes (for high speed only).
I—Small venturi.
J—Opening through which gasoline passes into idling tube.
K—Idling jet.
M—Accelerating well.
N—Passage to discharge holes in small venturi.
P—Air bleeder.

ture considerably rich. After starting and warming up the engine this adjustment may be regulated, as necessary, for the best driving mixture.

The gasoline for idle is taken in above the throttle and diluted with air from the inside of the carburetor, as regulated by screw B, which should be between .5 and 1.5 turn to the left, or anti-clockwise, from the seating position. After the engine is warm this may be regulated, as necessary, turning to the right, or clockwise, for more gas and to the left, or anti-clockwise, when less gas is required. Note that idle adjustment is effective only when throttle is nearly closed.

For starting and warming up with the present-day fuel, it is absolutely necessary to use the air choke until proper operating temperature is attained. Ordinarily, the engine will start readily with the control closed one-half to three-fourths of the way. In very cold weather it may be necessary to pull the control up all the way, but this should be done only for an instant, as this cuts off all the air and delivers raw gasoline only. For hand cranking in cold weather the control should be almost completely closed, while the throttle should be one-fourth to one-third open.

After starting the control should be adjusted, as necessary, and, allowing the motor a moment to steady itself, should be set at a point where the engine will have full power and yet not too rich a mixture for smooth running. As the engine warms up the control may be lowered. Instead of setting the mixture permanently rich, it is much better to use a moderate setting and then to give intelligent attention to the operation of this control. For winter use it is advisable to partly cover the radiator, as a water temperature of 130 degrees F., or above, is absolutely necessary if an engine is to show its normal flexibility and power.

Under such conditions the full supply of hot air should, of course, be used. In the warm months the season adjustment shutter on the air horn may be opened to admit cold air, if necessary.

TO DETECT AND REMEDY A LEAKY FLOAT.

A leaky float will be detected by gasoline overflowing when engine is stopped. To remedy this, either a new float should be installed or the old float repaired. To repair, heat the float slightly until the gasolene therein is expanded to a point where the pressure will force the vapor out of the very small hole, through which the gasolene has leaked into the float, thus identifying its location. As soon as this hole is found, enlarge same slightly, so the gasolene 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, or dirt on the seat preventing the float valve making contact over the entire surface of seat, or a ridge on the float valve.

HOW A 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, lack of power and a strong odor of the exhaust.

TO DETECT AND REMEDY INTAKE MANIFOLD LEAKS.

If gasolene is applied to the leak while the engine is running, with a squirt can or thoroughly saturated piece of waste, enough gasolene will be sucked in to stop the missing. Oil put on the leak will be sucked in and disappear. Intake joint gaskets should be shellacked on both sides.

DETECTION OF AND RESULTS FROM INSUFFICIENTLY HEATED AIR.

The incoming air which enters the carburetor through the air horn at the bottom should always be heated, as the hot air passing around the gasolene well, below the primary nozzle, will increase the temperature of the well, the primary nozzle, and the gasolene contained herein, thereby assisting the vaporization of the gasolene. This warm mixture passing through the intake manifold naturally warms the manifold and prevents condensation of the vapor on the inner walls. Insufficient heat, permitting condensation can be detected by the engine "loading" after same has been idling and the throttle is opened quickly, as the vapor which has condensed and adheres to the manifold in drops, is picked up by the incoming air as the throttle is opened, enriching the mixture sufficiently to cause engine to miss fire until manifold has been cleaned of condensed vapor. The incoming air is heated by passing around the outside of the exhaust pipe. Exhaust gas cannot be used as it contains a large percentage of carbon monoxide, preventing combustion of the fresh charge.

HOT AIR BOX OR STOVE.

The incoming air is heated by the hot air box, or stove, which receives hot air from around the outside of the exhaust pipe.

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.

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

TO PREVENT WATER IN CARBURETOR.

The strainer body drain plug in the bottom of the carburetor should be removed occasionally, and any accumulated water and dirt drained out, preventing any possibility of trouble.

TO PREVENT WASTE OF GASOLINE BY CARBURETOR FLOODING.

Shut off the gasoline at the tank when the truck is left standing on a steep grade, because the carburetor float may bind against the stud, due

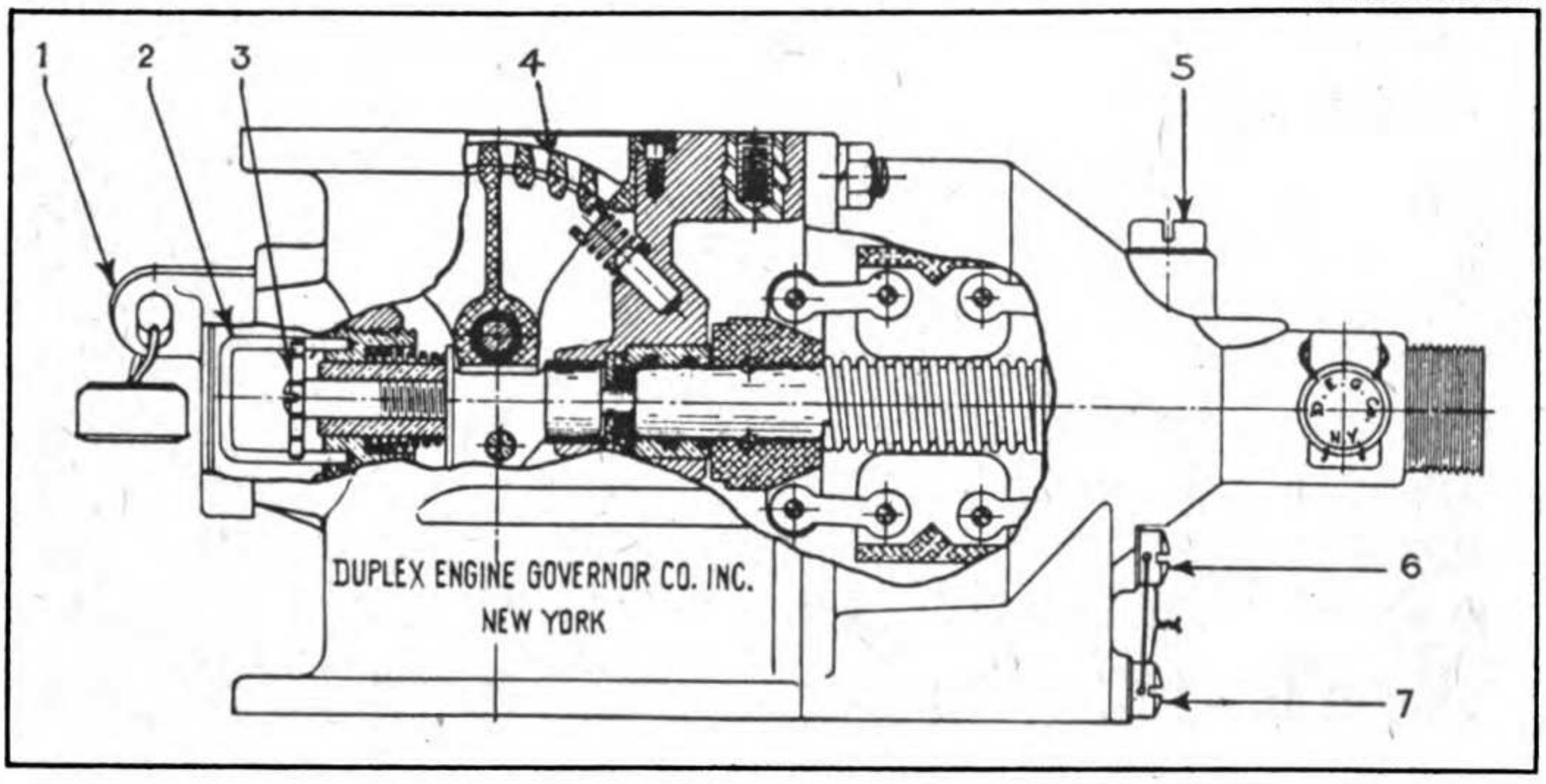
to the angle of the truck, and hold the needle valve open when the gasoline will leak out through the nozzle, and, if a truck stands with the front end downhill the nozzle openings may be below the level of the gasoline in the carburetor float chamber, then the gasoline would leak out.

GASOLINE TANK AND LINE (FUEL FEED SYSTEM).

The gasoline system or fuel feed system consists of a main tank (27 gallons) mounted under the driver's seat, feeding to an auxiliary tank (2 quarts) mounted on the left front side of engine from whence the flow is by gravity to the carburetor.

The main tank is of tern plate and is divided by means of a wall extending part way up the middle. This wall is high enough so that the volume on either side is five gallons. Each side has a .375-inch brass pipe

Plate No. 29

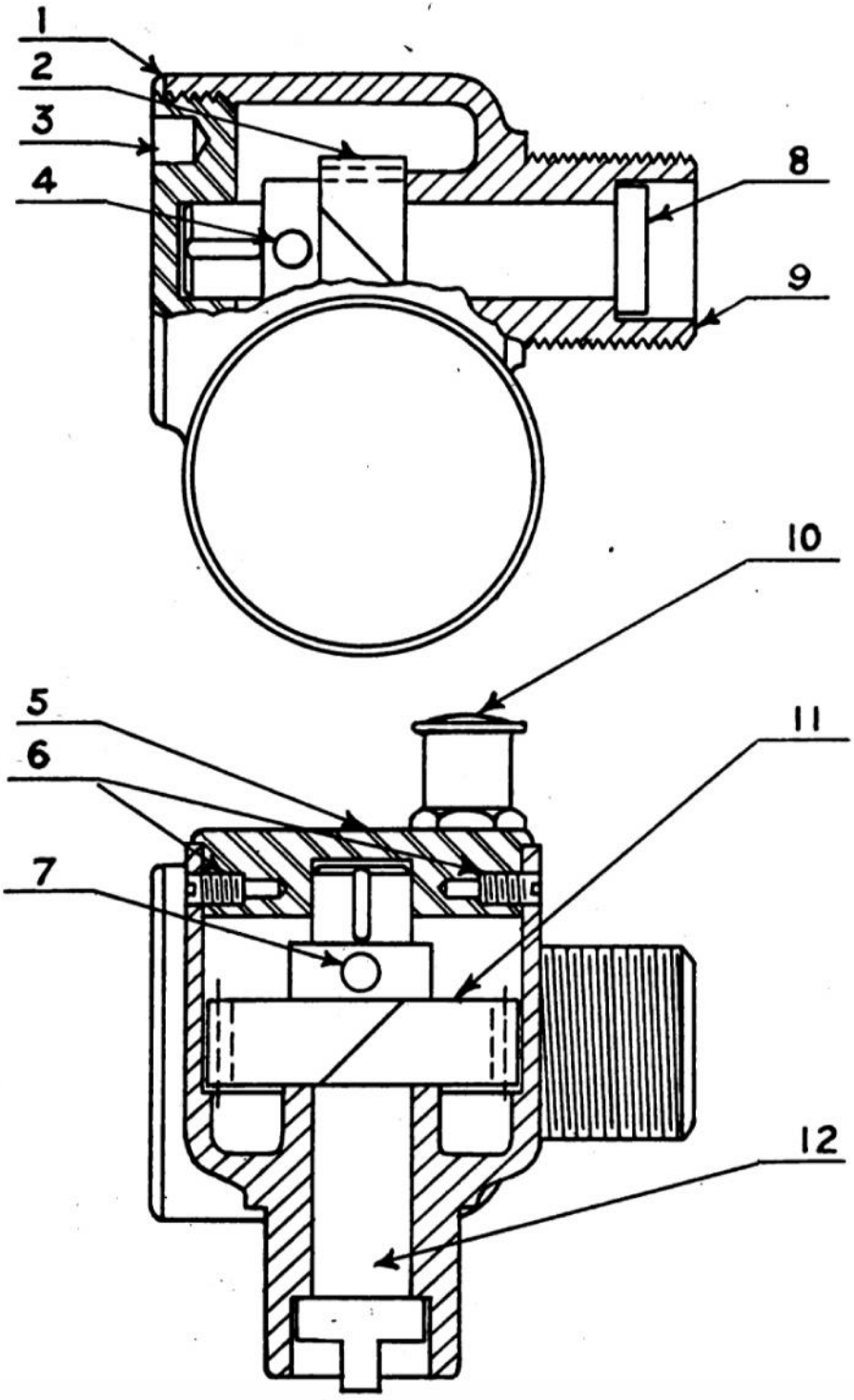


CUT-AWAY VIEW OF SIMPLEX GOVERNOR.

Ref. No.	Part No.	Name of Part.
1	34073	Locking pin.
2		Yoke.
3		Hand wheel.
4	34044	Valve seat.
5	34330	Oil filler screw.
6		Oil discharge.
7		Oil level.

running to a three-way control valve. When the control valve arrow points toward the line running from the control to the auxiliary tank the fuel from the main tank is shut off. The line from main tank to auxiliary also is of .375-inch brass tubing. This pipe enters near the top of the auxiliary tank and extends across the tank. The auxiliary tank is fitted with a vent which runs up the steering column. From the auxiliary tank there is a .375-inch tube with a shut-off valve and strainer in the line. This strainer consists of an iron bowl and a brass cap with fine mesh screen between them.

Plate No. 31



GOVERNOR DRIVE HOUSING ASSEMBLY.

No. Ref.	Part No.	Name of Part.
1	35709	Housing cap gasket.
2	35711	Spiral drive gear.
3	35710	Housing plug.
4	PI-507	Spiral drive gear pin.
5	35707	Housing cap.
6	35708	Housing cap screw.
7	PI-507	Spiral drive gear pin.
8	34652	Spiral drive gear shaft driven.
9	35706	Housing.
10	OI-101	Housing oiler.
11	35712	Spiral drive gear.
12	35713	Spiral drive gear shaft drive.

the tension spring attached to the cutout pulls its armature away from the core and opens the circuit.

OPERATION OF THE VOLTAGE REGULATING UNIT.

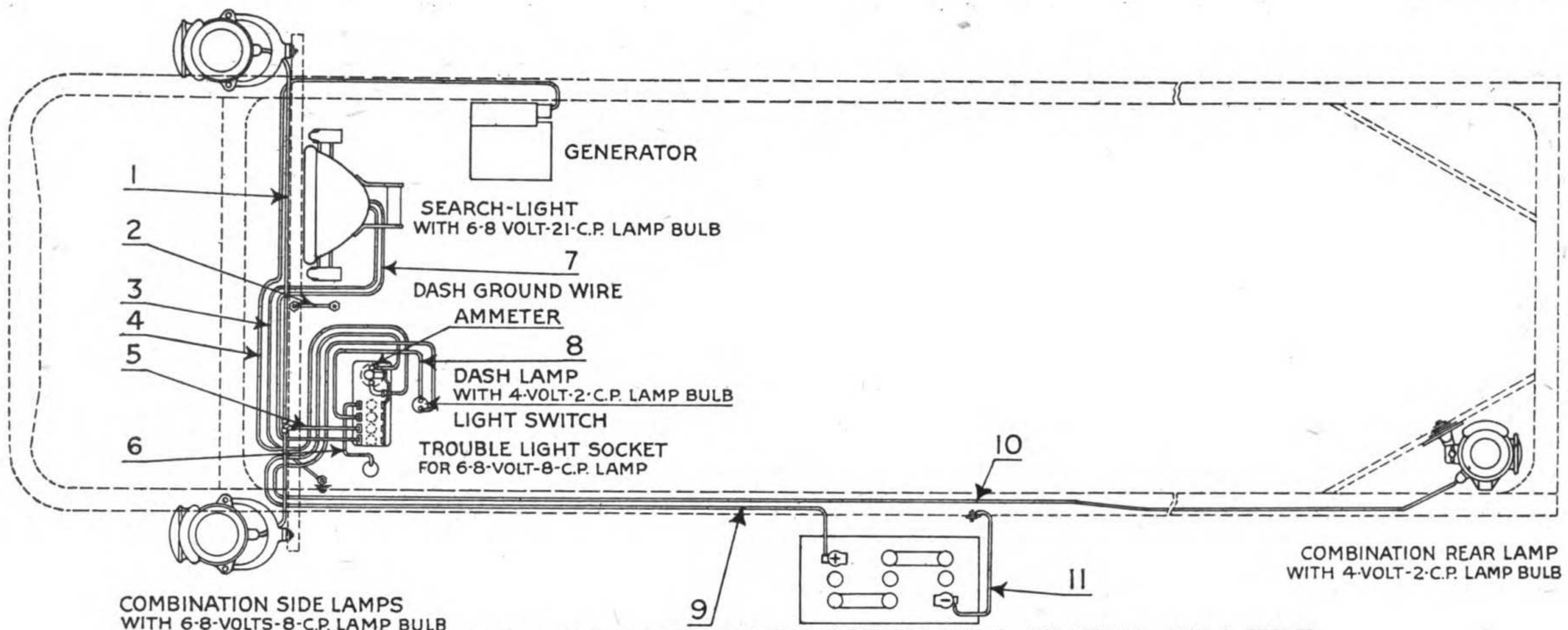
The voltage regulating unit, as shown on page 93, at B, consists of a core having a single winding, this winding being connected across the generator. The current in the winding and the resulting magnetic pull of the core will depend upon the pressure developed by the generator. Opposite one end of the core is a vibrating armature which is spring retracted away from the core. When the armature is spring retracted away from the core it makes contact so that there is a by-pass around the resistance (D), which is in series with the field winding of the generator. With the vibrating armature in this position the shunt field winding receives the full pressure developed by the generator. With increasing generator speed the voltage increases until the armature develops 7.75 volts, and at this electrical pressure the regulator begins to function and will maintain 7.75 volts across the generator brushes at all higher speeds.

With increasing generator speed the voltage will tend to rise above 7.75. If, however, this value is exceeded by a very small amount, the increased pull on the armature of the regulating unit will overcome the spring pull and the armature will be drawn towards the core, thus opening the contacts and inserting the resistance in the generator field circuit. The added resistance in the field circuit decreases the exciting current in the field winding and the voltage developed by the armature tends to drop below the normal value of 7.75 volts. If the voltage drops slightly below the normal the pull of the spring on the regulator armature predominates, and the armature moves away from the core and closes the cutout, which short circuits the resistance and permits the exciting field current to increase. This cycle of operations is repeated at rapid intervals and maintains the generator voltage constant at all speeds above the critical value at which it develops 7.75 volts with the resistance cutout of the field circuit.

There is nothing slow or haphazard in the way the above operations take place, nor is there any marked change in voltage necessary to make the regulator operate.

The rapidity of vibration depends, to a large extent, upon speed, but in general the regulator armature vibrates in the order of one hundred to one hundred and fifty times per second. The actual voltage developed by the generator is made up of a series of very fine ripples above and below a straight line, the mean value of these ripples being 7.75 volts, the constant value for which the regulator is adjusted.

It is obvious that increasing the tension of the regulator spring will increase the constant voltage which the generator will maintain. Under no circumstances should the regulator spring tension be increased in an attempt to have a generator charge at a higher rate at low speed.



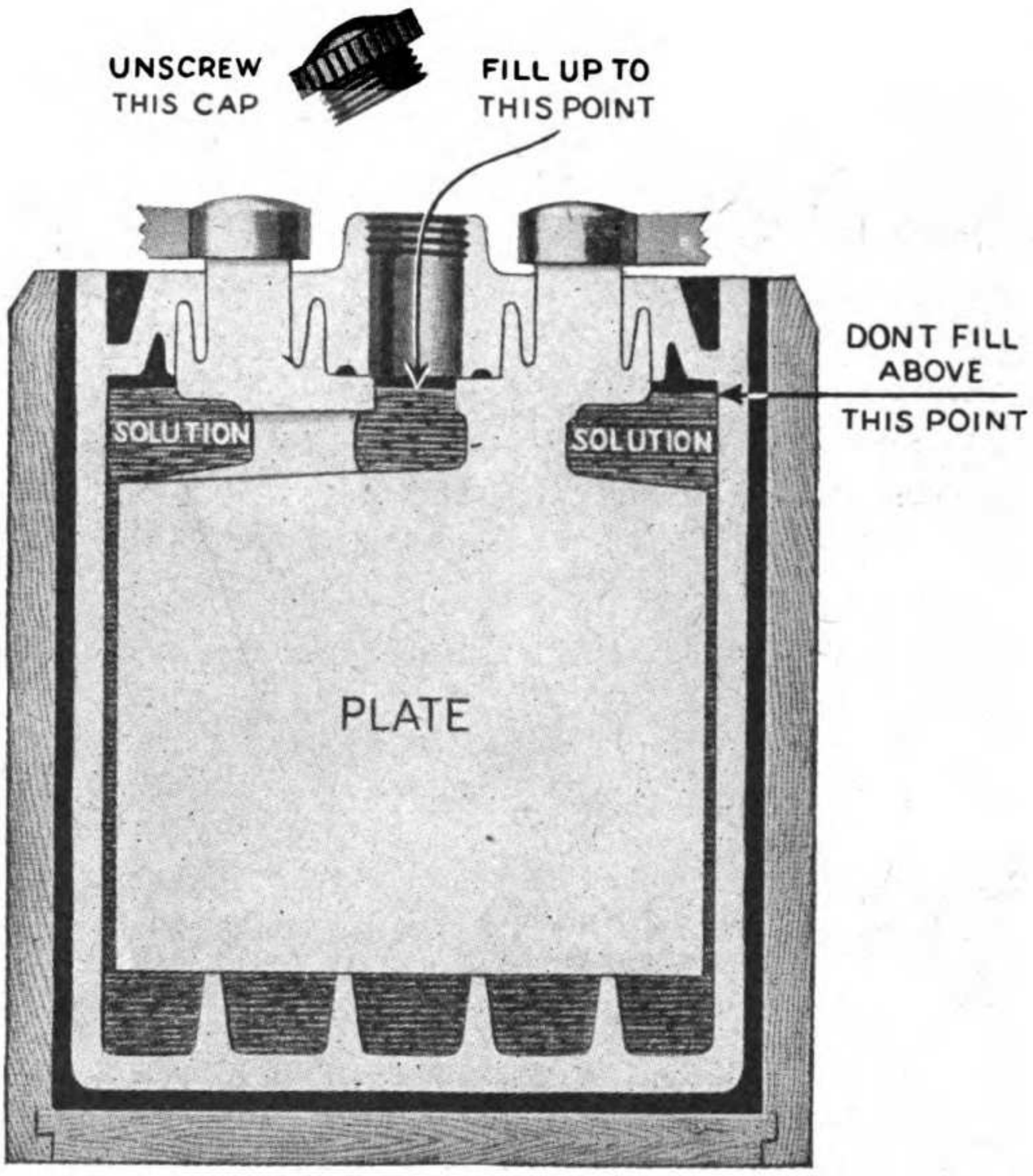
WIRING DIAGRAM ELECTRIC LIGHTING SYSTEM USED ON MODEL 4017-A ONLY.

Ref. No.	Part No.	Name of Part.
1	35723	Side lamp wire.
2	35751-A	Dash ground wire complete.
3	35755-A	Searchlight ground wire complete.
4	35719-A	Generator to switch wire complete.
5	35722-A	Sidelight wire to switch wire.
6	35748-A	Trouble lamp to switch wire.
7	35744-A	Searchlight to switch wire.
8	35848-A	Dash lamp to switch wire.
9	35715-A	Battery to ammeter wire.
10	35741	Tail lamp wire.
11	35753-A	Battery ground wire.

known as electrolyte or battery solution. This does not actually store up electricity, but produces a chemical change in the plates. When a circuit is established between the elements, the active material of the plates changes back to its original condition and an electrical current is generated.

Immediately upon receipt of the truck, the vent plugs in the cover of

Plate No. 35



SECTION THROUGH STORAGE BATTERY SHOWING CORRECT LEVEL OF ELECTROLYTE.

each cell should be removed to see that the solution fully covers the tops of the plates. If it does not, add distilled water. Do not fill the cells so full that the solution bubbles out of the vent plugs. Wipe off any excess which may appear.

Use only clean non-metallic vessels for handling and storing water to be used for battery purposes.

Never add acid of any kind to the battery to replace evaporation, because only water and not acid evaporates.

Water for battery purposes should be distilled. The water must be free from alkali, iron or other impurities.

The battery should be kept clean and free from dirt.

5. Magneto breaker points sticking.
5. Magneto breaker points dirty.
6. Low test gasoline.
7. Gasoline too cold.
8. Air leak in manifold.
9. Air leak in manifold gaskets.
10. Valve stem guides worn.
11. Ignition wire connections off.

The exhaust may be smoky for the following reasons:

1. Oil feed too great.
2. Oil too thin.
3. Pistons, piston rings or cylinders worn.
4. Mixture too rich (black smoke).

The engine compression may be poor for the following reasons:

1. Valves leak compression.
2. Valve plugs, priming cocks or spark plugs leak compression.
3. Piston rings or cylinder walls worn or scored.
4. Valve warped.
5. Valve not seating.
6. Valve stem bent.

Explosions will occur in the muffler for the following reasons:

1. Rare mixture.
2. Exhaust valve sticking.
3. Exhaust valve riding.
4. Dirty or sooty muffler.
5. Magneto improperly wired to plugs.
6. Accumulated unburned gases in muffler.

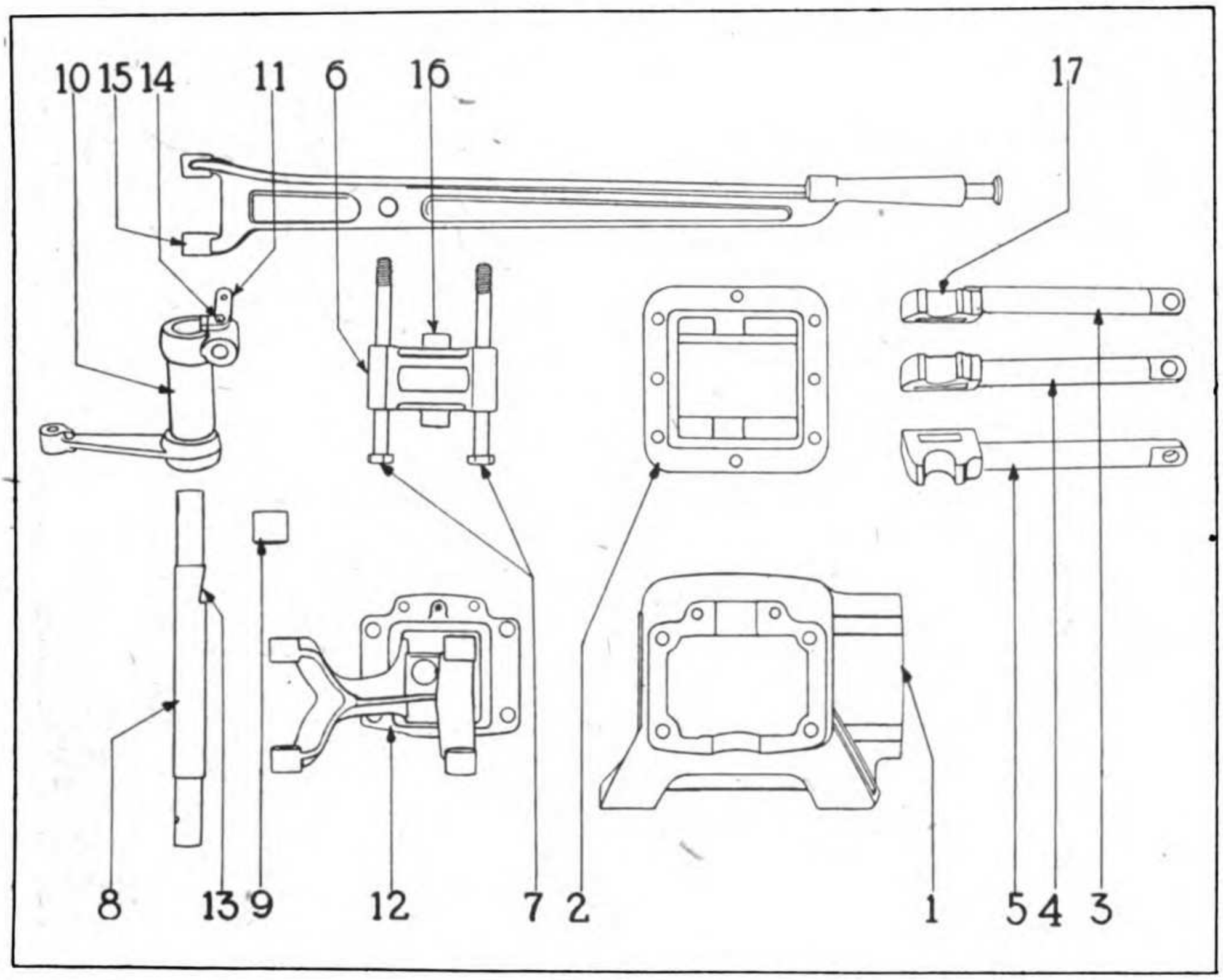
An engine will overheat for the following reasons:

1. Lack of water.
2. Fan belt broken or slipping.
3. Pump not working.
4. Air pocket in water line.
5. Rusty or scaly radiator.
6. Clogged water jacket.
7. Defective water hose.
8. Valves out of time.
9. Magneto timed late.
10. Poor lubrication.
11. Faulty carburetor adjustment.
12. Driving with retarded spark.
13. Excessive carbon.

An engine will knock for the following reasons:

1. Loose main bearings.
2. Loose connecting rod bearings.
3. Loose wrist pin.
4. Piston slap.

Plate No. 37



HAND CONTROL GEARSHIFTING MECHANISM DISMANTLED.

Ref. No.	Part No.	Name of Part.
1	34133-A	Shifter case.
2	32354	Shifter yoke guide.
3	32352	Reverse speed shifting yoke.
4	32351	Third and fourth speed shifting yoke.
5	32350	First and second speed shifting yoke.
6	32355	Shifter yoke interlock.
7	32597	Shifter yoke interlock bolt.
8	32331	Hand-brake shaft.
9	32322	Hand-brake shaft bushing.
10	35405-A	Control shifter lever tube.
11	34748	Operating lever reverse lock.
12	32324	Quadrant bracket.
13		Reverse notch.
14	34747	Operating reverse lock screw.
15	35385	Operating lever.
16		Lugs on interlock.
17		Notch in shifting yoke.

device. Its function is to permit the shifting of and to retain in engagement such gears as are selected by the hand-control lever. Operating rods with adjustable yokes from rigid connection between the control levers and shifter case.

GEAR SHIFTER CASE.

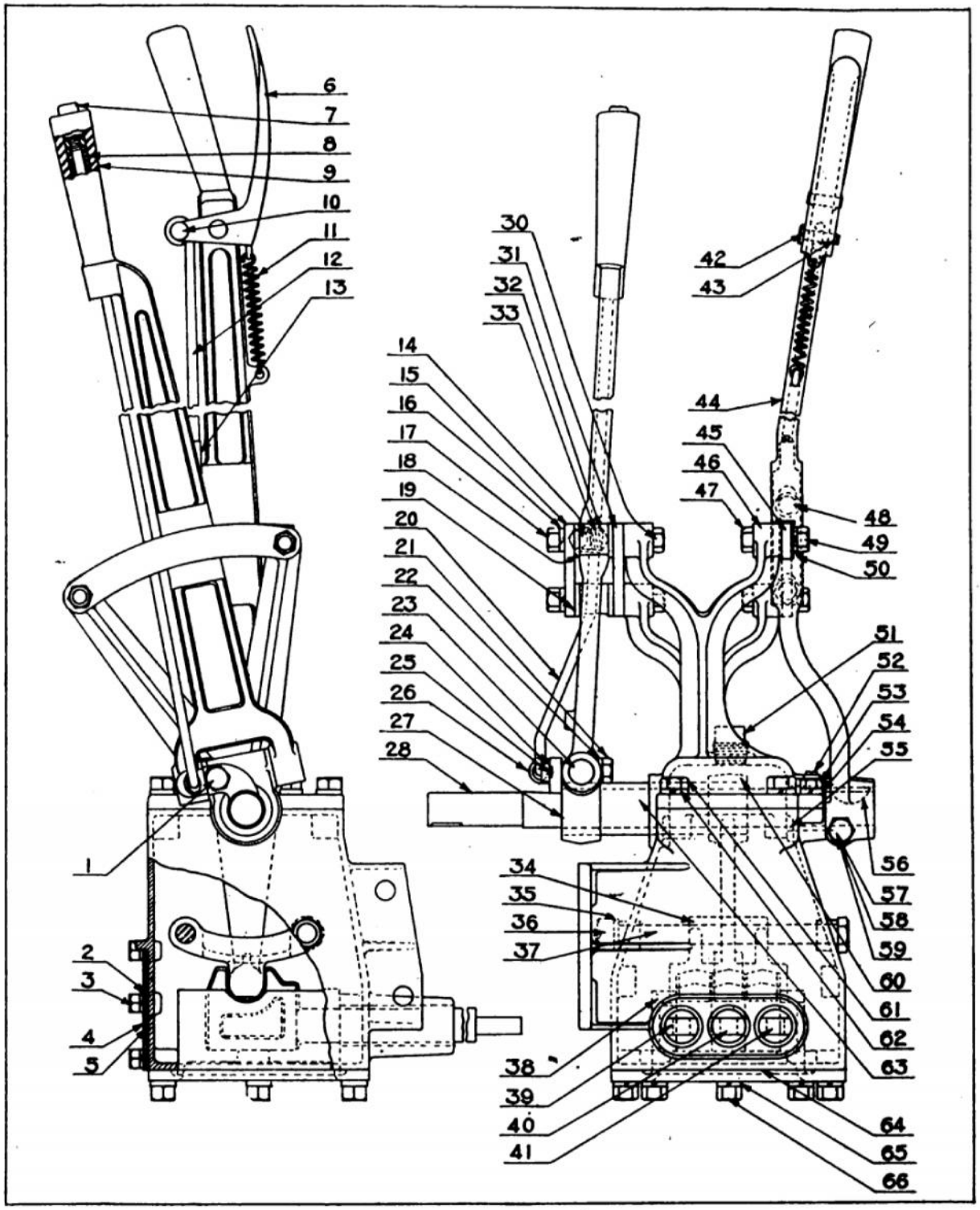
Beneath the gearshift lever is a cast iron case which contains three shifter yoke guides and the interlocker which prevents any two of the

yoke guides from moving when the third is being shifted. From the gearshifter box three rods afford a connection with the transmission dog clutches. One rod controls the first and second speed, the center one the third and fourth speed, and the other rod controls the reverse.

CONSTRUCTION OF SHIFTER CASE.

By means of the illustration on page 113 the operation of the component parts of the shifter case can be readily understood. Shifter tube

Plate No. 38



CONTROL LEVERS ASSEMBLY.

should be taken that the tube moves freely after the guide is inserted. The guide may be removed by the insertion of a small screw in the threaded hole on its upper end. Next the shifter box packing gland (19), together with packing, should be inserted, followed by the key and shifter tube lever (20), lockwasher (21), and nut (22). Shifter fork locknut (13) may now be firmly secured against shifter tube arm (29), care being taken to place a large wrench over the shifter tube lever (20) while making this adjustment, to prevent the possibility of breaking the projecting portion of shifter tube guide (15). The reverse gear shifting mechanism is now properly adjusted. See page 114.

Third and fourth speed gear (10) should next be placed at a point exactly equal distant from the engaging clutches of gears (7) and (11). See page 136. Then referring to the illustration on page 113, the shifter rod (32) should then be so turned in or out of shifter fork (30) that the shifter lock ball (6) is located in the central of the three notches or depressions. The insertion of shifter tube guide (15) can be followed by the placing of parts (19), (20), (21) and (22). Locknut (13) can then be promptly secured, as previously described, thus completing the adjustment of the third and fourth speed shifting device.

First and second speed gears (30) and (32), in the illustration on page 136, should next be disposed with their jaws equal distance from those of gears (29) and (34), respectively. Shifter tube (18) (page 113) so turned in or out of shifter fork (11) that lock ball (6) is located in the central of the three notches or depressions. The assembly of shifter tube guide (15) operates (19), (20), (21) and (22), together with the securing of locknut (13),.followed as on the previous tube. The entire shifting mechanism is now properly adjusted. Lock springs (8) may be given further attention and the adjusting screws (10) firmly locked.

Adjusting yokes (24), which are placed on the end of the operating rods, should be so tightened or loosened as to permit the easy insertion of clevis pins (23), assuming, however, that the shifter lever control mechanism has been properly adjusted.

GEAR SHIFTING FORKS.

Directly in front of the transmission the gear shift rods connect with three tubes which enter the transmission case at the top. Inside the case these tubes are connected with three shifting forks, two of which are provided with two fingers each, while the third has but one. The fingers of one fork fit in slots at the side of the first and second speed gears. These gears are always held close together, although they rotate independently. Third and fourth gears are on the splineshaft and are further apart. The fork with but one finger connects with a rocker shaft tube in the bottom of the transmission case, and operates the reverse gear.