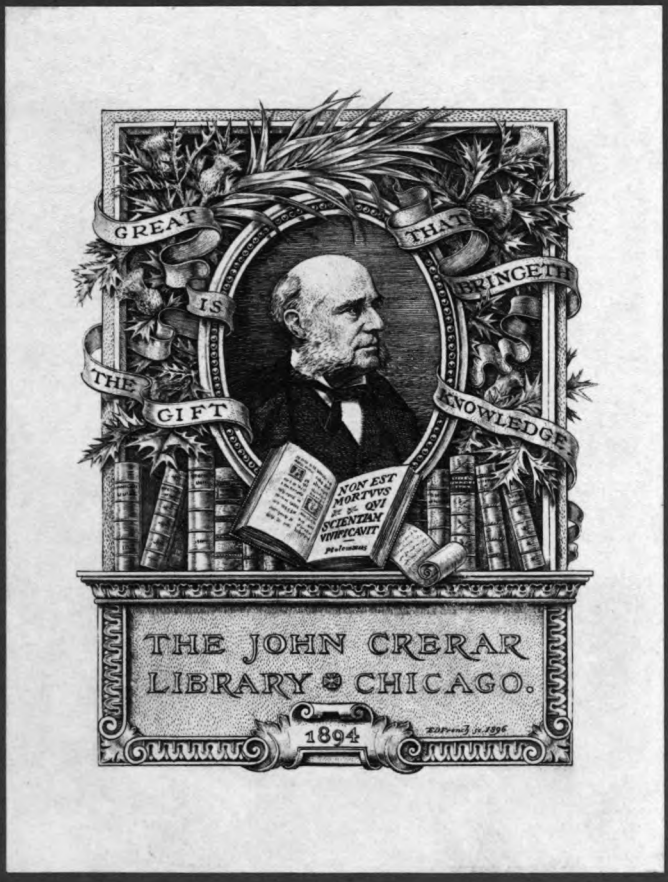

No. 1977

PRELIMINARY HANDBOOK

OF THE

MARK VIII TANK

143 PLATES, ONE INSERT

NOVEMBER 15, 1918
REPRINTED MARCH 6, 1925

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

This manual is published for the information and government of the United States Army.

BY ORDER OF THE SECRETARY OF WAR:

C. C. WILLIAMS,
Major General, Chief of Ordnance,
United States Army.

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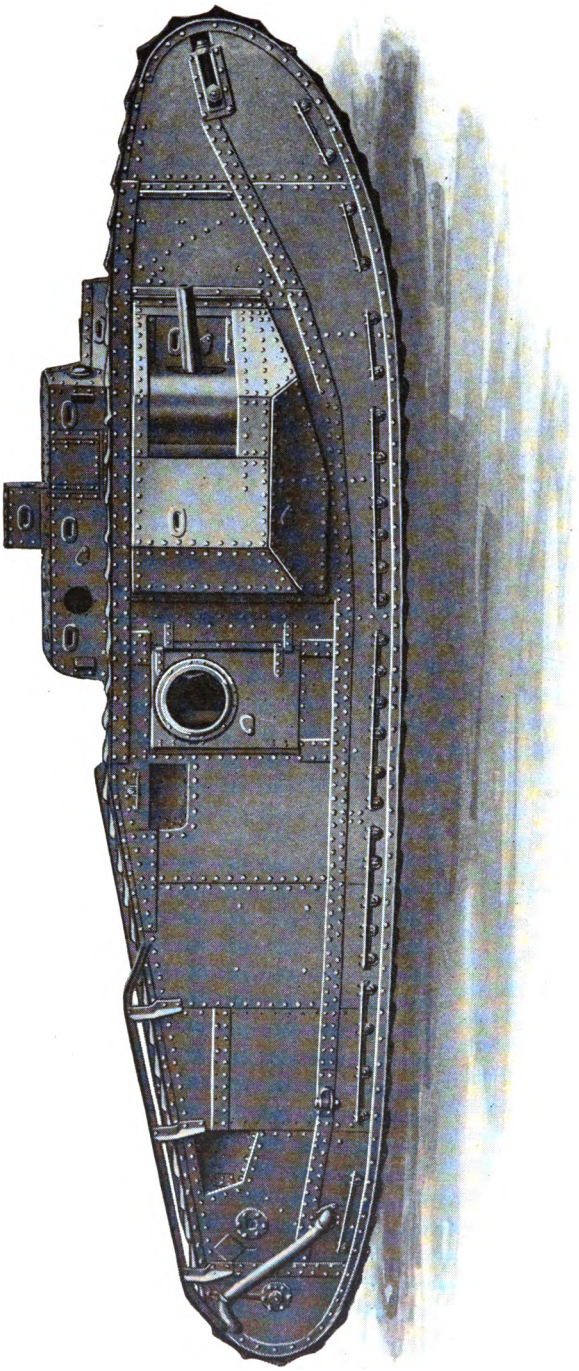
PLATE NO. 1



RIGHT SIDE VIEW OF 35-TON TANK, MARK VIII

HANDBOOK OF THE MARK VIII TANK

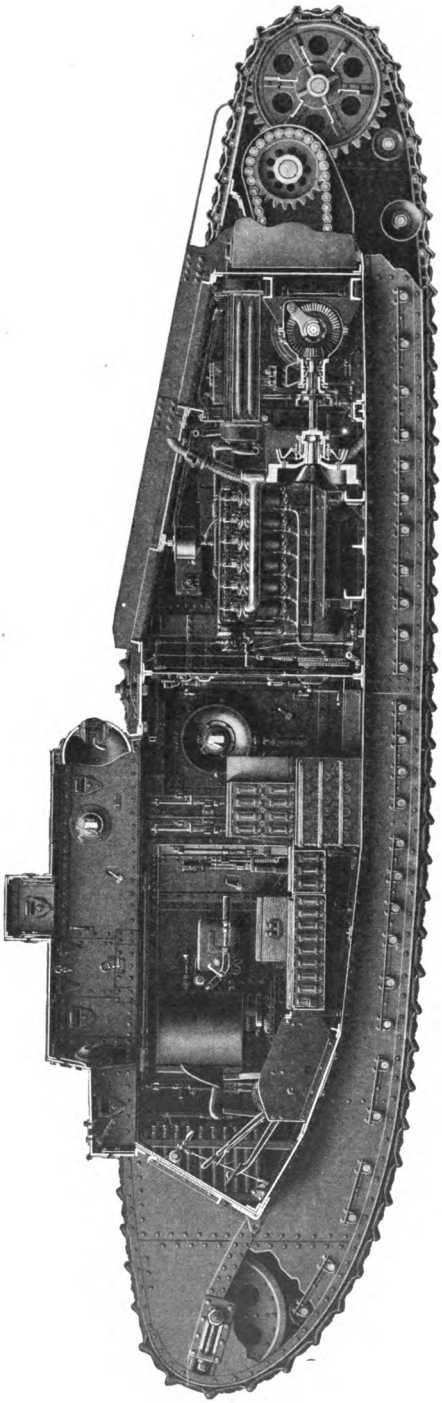
CHAPTER I

GENERAL DESCRIPTION AND INSTRUCTIONS

Table of weights and outline specifications

Length, over all	34 feet 2½ inches.
Width, over all	12 feet.
Width, sponsons withdrawn	9 feet.
Height, over all	10 feet 3 inches.
Ground clearance under hull	1 foot 8¾ inches.
Weight, loaded	40 tons.
Area of ground contact	41.052 square feet.
Unit ground pressure at 1″ submersion	975 tons per square foot.
Tread, center to center of tracks	5 feet 9½ inches.
Width of track shoe	2 feet 2½ inches.
Forward speed at 1,400 r. p. m.:	
High gear	5.2 m. p. h.
Low gear	1.4 m. p. h.
Diameter of turning circle	40.5 feet.
Length of ground contact	9 feet 3½ inches.
Number of track links	78.
Length of track, expanded	72 feet 6 inches.
Engine, B. H. P. at 1,400	338.
Number of forward speeds	2.
Number of reverse speeds	2.
Total high-speed ratio	32.545 to 1.
Total low-speed ratio	126.64 to 1.
Number of gasoline (petrol) tanks	3.
Total gasoline (petrol) capacity	240 gallons.
Number of 6-pounder guns	2.
Number of machine guns	7.
Number of spare machine-gun barrels	7.
Number of round 6-pound common shell	182.
Number of round 6-pound case shell	26.
Number of doors	3.
Weight of engine	850 pounds.
Weight of gasoline (petrol) carried	1,440 pounds.
Type of radiator	Tubular.
Total cooling area	89.5 square feet.

PLATE No. 2



SECTIONAL VIEW THROUGH THE 35-TON TANK, MARK VIII

Ground pressures

Sub-mersion	Length of contact	Area of ground contact in square feet	Pressure in tons per square foot	Pressure, pounds per square inch
Inches	*Inches*			
1	109	40.118	0.997	13.85
2	190	70	.5714	7.944
3	221	81.34	.4918	6.83
5	277	101.95	.3923	5.45
10	324	119.25	.335	4.66
15	350	130.49	.307	4.26

BRIEF DESCRIPTION 35-TON TANK, MARK VIII

The Mark VIII machine is an armored track-laying type of fighting tank in which the hull or body acts as the structural frame of the tractor, as well as the housing for the propelling and fighting units and crews. It differs from previous and other types of tractors and self-propelling land units in that it has no chassis or supporting frame structure, but more closely resembles marine structure, in that the hull carries with it the entire mechanism and all of the running gear except the track links which pass around the hull in the form of a continuous belt on each side of the machine.

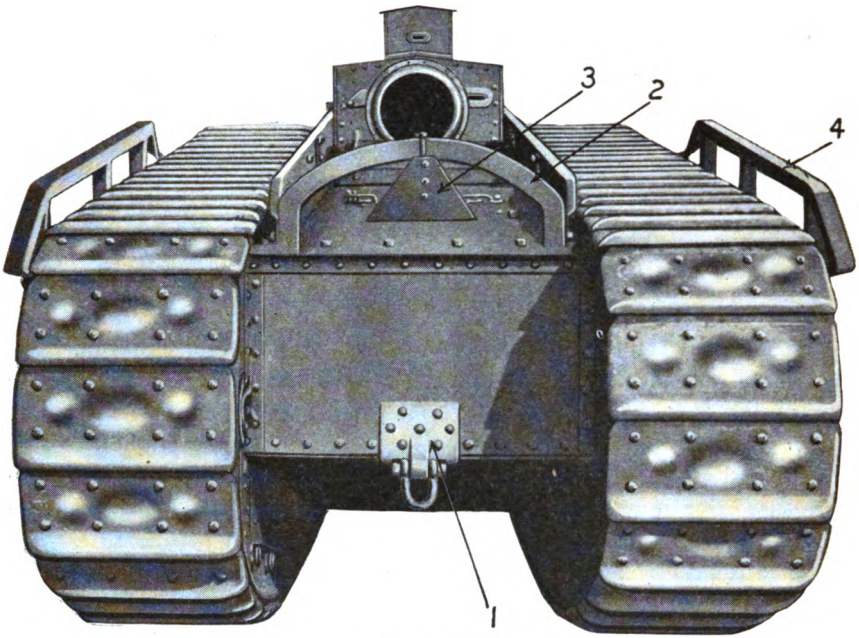
Propulsion on the Mark VIII machine is secured by taking the drive from a 12-cylinder Liberty engine through a planetary gear box, thence through a chain drive, which in turn actuates the driving sprocket of the track. As the track is propelled continuously around the machine, it carries with it sections of the rail over which the rollers, upon which the machine runs, travel. The length of the track belt allows the machine to accommodate itself to inequalities of the ground, while at the same time providing a rail surface for the supporting rollers.

The machine is 34 feet 2½ inches in length, 12 feet in width, and the over-all height is 10 feet 3 inches. The engine and driving members, including the clutch, the epicyclic transmission and chain drive, are located in the rear of the hull. The engine together with the clutch and epicyclic gearing and other necessary engine parts occupy the engine room, which is 9 feet 9 inches in length.

HULL LAYOUT

From the rear of the engine room back to the center of the track-driving wheel is 4 feet 8⅛ inches. In front of the engine room is the fighting and operating room, at the forward end of which is the driver's seat with the control levers. On either side of the fighting compartment there is a sponson or projecting swinging structure carrying a 6-pounder gun. The sponsons contain gun mountings capable of giving a wide radius of fire with the 6-pound guns. In addition, the sponsons themselves may be swung back into the

PLATE No. 3



TOWING GEAR

Ref. No.	Name	Ref. No.	Name
1	Towing bracket.	3	Deflector plate.
2	Stern guide for haulage rope.	4	Rear strut unditching gear.

interior of the fighting compartment to reduce the width of the machine to permit it to be loaded on a standard railway car.

Surmounted above the fighting compartment is the main turret which carries five machine guns. Above the main turret is the directing officer's coning tower from which it is possible to obtain vision on all sides of the machine and from which its movements may be directed. Located in the fighting compartment are sufficient ammunition storage provisions for both 6-pounder and machine guns. Entrance to the fighting compartment is secured through a door on either side and in the doors there are also mounted machine guns. This gives a total of seven machine guns, five being in the main turret and two in the doors; and two 6-pounders, one located in each sponson.

The fighting compartment is separated from the engine room by a bulkhead in which there are sliding doors.

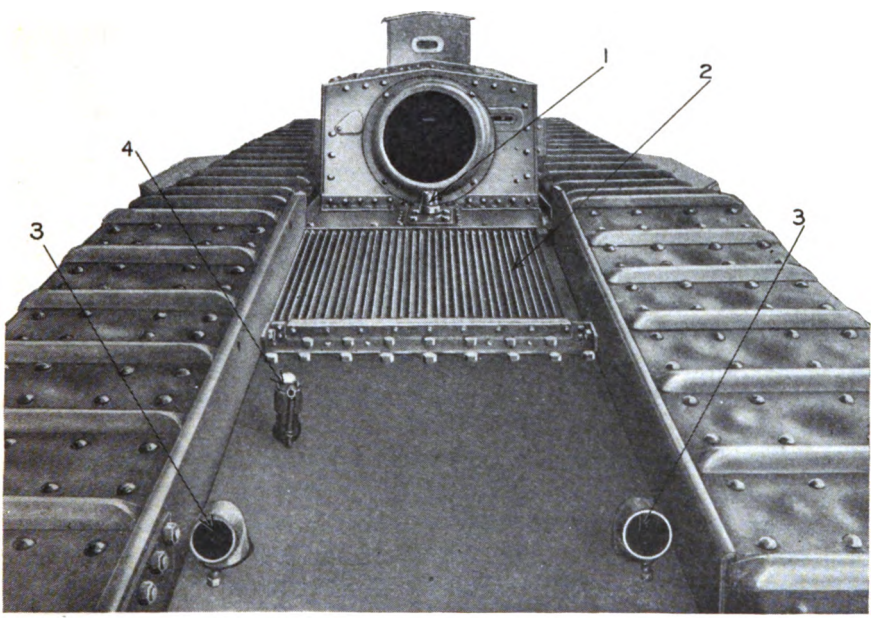
The exterior portion of the hull is elongated on each side to provide a guide for the track. The rear extremity contains the chain housing for the chain drive and the track driving sprocket and the forward extremity carries the track adjusting wheel which can be moved forward or backward to tighten or loosen the track chain.

Steering is accomplished by allowing the track on one side to move at a faster rate than the track on the other which tends to swing the machine in the direction of the slow-moving track. If one track is locked and the other track is moving ahead, the machine will be turned in the narrowest possible radius. The radius in which the machine can be turned depends to a large extent upon the nature of the ground, as owing to its weight, it will dig up the ground to the side as it is being turned, which will impede the rate at which it can be swung around and will sometimes necessitate a wider turning arc.

PROGRESS OF DRIVE

The units employed in propelling the Mark VIII machine are the engine, which is the source of power; the clutch which connects the source of power with the reduction gearing; an epicyclic or planetary gear box which contains the reduction gear; a chain drive

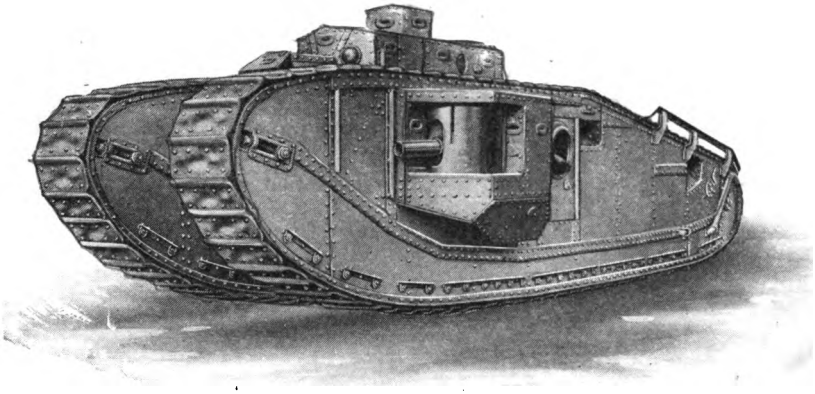
PLATE NO. 4.



TOP OF MACHINE

Ref. No.	Name
1	Roof towing bracket.
2	Inlet louver.
3	Exhaust pipes.
4	Filler pipe for water-cooling system.

PLATE NO. 5.



THREE-QUARTER FRONT VIEW OF MARK VIII MACHINE

which transmits the drive from the reduction gearing to the roller sprocket; the roller sprocket and finally the track driving sprocket which measures with the track links and propels the track. The epicyclic gear box provides two speeds which may be utilized either forward or reverse.

DRIVE AND CONTROL

Control of the engine, clutch, epicyclic gear, reduction, steering, etc., are all taken care of from the driver's seat, which is located in the forward end of the hull. The driver's seat is of such a height that the driver's head is within a boxlike structure at the front end of the main turret. There are slits cut in this compartment which allow the driver to look to either side or ahead. The slits can be closed by rotating protecting shields when under fire, and when not under fire, the driver can raise a hinged door at the front of the turret, allowing a clear and unobstructed view ahead of the machine.

Outside of the spark and throttle connections and other engine controls, the driver has four levers and a peddle. The two inside levers are for shifting gears and control the epicyclic transmission. The left outside lever controls the clutch and the right outside lever is for reversing the peddle which is in the center of the track brake. When either shifting lever is in neutral, the track brake on that aside can be applied so that shifting both levers to neutral permits applying track brake to both tracks.

BRIEF OPERATING INSTRUCTIONS

PRELIMINARY TO STARTING ENGINE

Before running, thoroughly clean all parts coated with grease or slush applied for protection in shipment.

Fill radiator and water tanks with clear water.

Fill engine-oil reservoir. (See page 51.)

Fill oil reservoir of epicyclic transmission.

Lubricate entire machine in accordance with instructions. (See pages 17 to 27.)

Unpack and place all tools and equipment in proper locations. (See Nomenclature List, pages 184 to 239, and other parts of book dealing with specific tools and equipment.)

IMPORTANT NOTE.—Before attempting to drive the Mark VIII machine, be certain that the brake on the cardan shift is adjusted, so that in shifting, the spinning of the shaft will be stopped or serious damage to the transmission will occur.

HOW TO DRIVE

To drive the machine, the following routine should be observed:

1. Follow instructions on pages 51 to 61 regarding putting the engine in condition to start.
2. Make sure that reversing lever is in neutral and clutch in full *in* position.
3. Start engine as per directions on page 51.
4. Allow engine to warm up so that the temperature of the cooling water in radiator is at least 160 degrees.
5. Make sure epicyclic levers are in neutral.
6. Pull back clutch lever *all the way.*
7. Put reverse lever into forward position carefully and slowly.
8. Let clutch in slowly.
9. Let epicyclic lever into low speed (outside slots) and machine will slowly start.
10. Shift either left or right lever to high speed, leaving clutch engaged. (See page 150.) This will cause machine to swing in a long arc due to difference in speed of tracks, but it is an easy way of taking up the increased load due to shifting into high gear.
11. Shift other lever to high gear.

SHIFTING TO LOW

To shift to low gear it is only necessary to move the levers into low gear position without touching clutch.

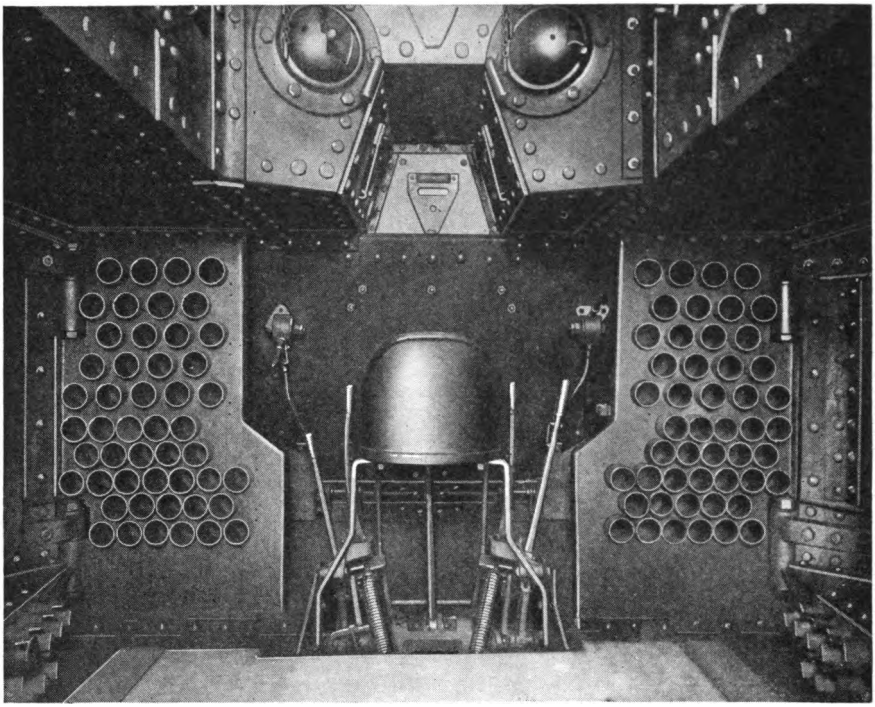
TO REVERSE MACHINE

1. Put both shifting levers in neutral.
2. Pull clutch lever back as far as it will go.
3. When sure that cardan shift has stopped running, shift to reverse by putting reverse lever in position (as shown on page 151).
4. Engage both low gears.
5. Let clutch in gradually.

TO STEER MACHINE

To turn, put track on side toward which it is desired to turn into neutral. If machine does not turn quickly, but moves ahead, depress foot pedal.

The pedal brake is interconnected with the transmission, so that the brake can only be applied on the side which is in neutral.



DRIVER'S SEAT AND CONTROLS, ALSO SHOWING AMMUNITION STORAGE

The pedal is a positive brake on the track which is in neutral; it does not effect a track when it is in low or high gear. Placing the lever in neutral allows the brake on that side to be applied when pressure is applied to the pedal.

TO MAKE A WIDE TURN

To make a wide turn, the track on the side toward which it is desired to turn should be in low gear, while the other track should be in high gear. This allows the track on one side to turn at a faster rate than that on the other and will give the wide turning arc desired.

PASSING OVER OBSTRUCTION

In going over all obstructions which are sufficiently high to lift the front end of the machine clear of the ground, the speed levers should be slipped to allow the machine to ease itself over the obstructions. It will be remembered that the weight of this machine is about 40 tons and it has to be allowed to gently absorb the shock due to its returning to normal position after having been lifted clear of the ground. By allowing the speed levers to slip the machine will gradually come back into contact with the ground and the jar and shock which would otherwise result can be avoided.

TRANSPORTING MARK VIII MACHINE

To accommodate the Mark VIII machine to the ordinary railway transportation methods, it is possible to swing the sponsons in front by the methods told on page 37. When the sponsons are swung in as thus described and the guns in the sponsons are drawn back, the standard railway flat car can be used.

MILEAGE PER GALLON OF GASOLINE

It is estimated that the machine will consume 30 gallons per hour of travel. At the speed of 5 miles per hour, this would mean one-sixth of a mile per gallon, or with a capacity of 240 gallons, this would mean a cruising time of eight hours or a cruising range of about 40 miles, estimating that the machine consumes 6 gallons per mile. This, however, is only an estimate, and will vary in practice.

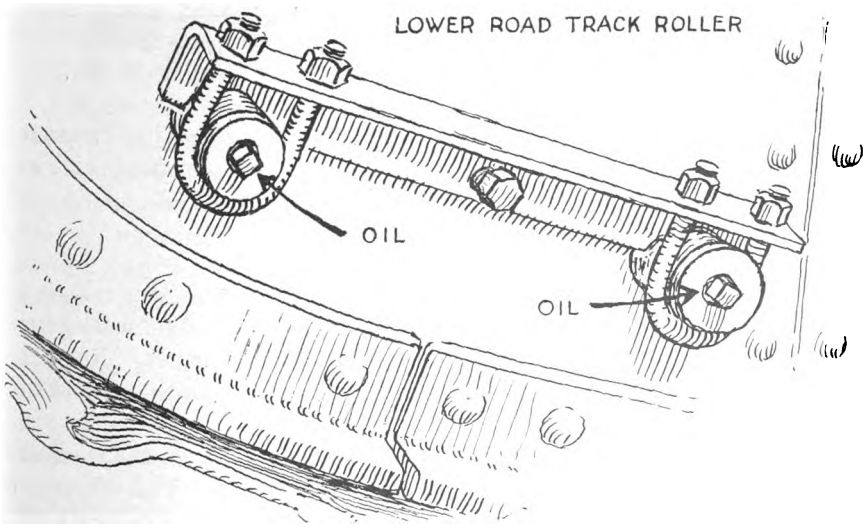
LUBRICATING INSTRUCTIONS

The lubrication of the Mark VIII machine is highly important, and the performance of the machine depends largely upon how well the following instructions are carried out. They should be made a matter of routine, and followed exactly as laid down herewith.

ENGINE LUBRICATION

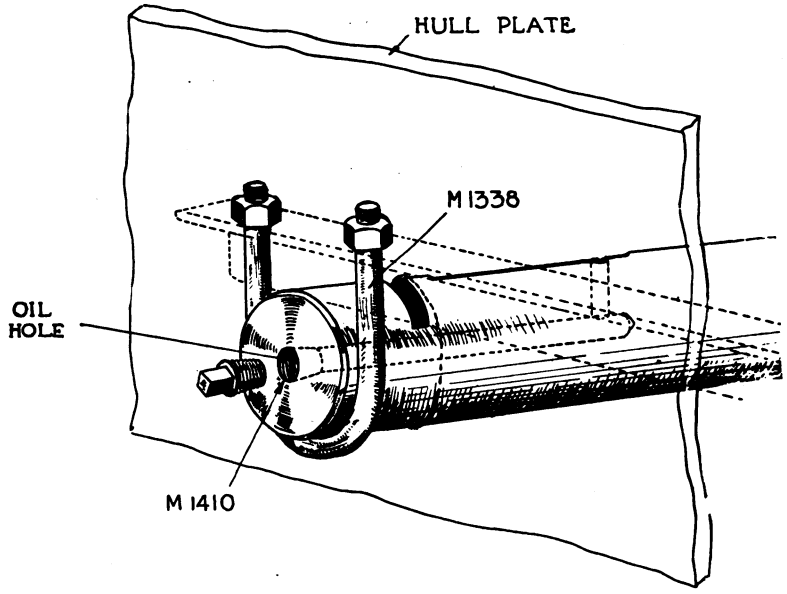
The engine is lubricated from a reservoir on the starboard side of the hull alongside the engine. Although the capacity of this tank fitted on the machine is 16 gallons, not more than 4 or 5 gallons of

PLATE NO. 7



Liberty engine oil (see page 54) should be put in. If more than that is put in, the tank is apt to flood the engine. This tank oils all parts of the engine except one oil cup at the thrust bearing. This cup should be filled daily.

PLATE No. 8



LOWER ROAD TRACK ROLLERS

The lower road track rollers are lubricated by removing the plugs on the ends of the roller shafts. These rollers should receive a squirt from the oil can once or twice a week, and the oil used should correspond to the well-known 600–W grade.

UPPER ROAD TRACK ROLLERS

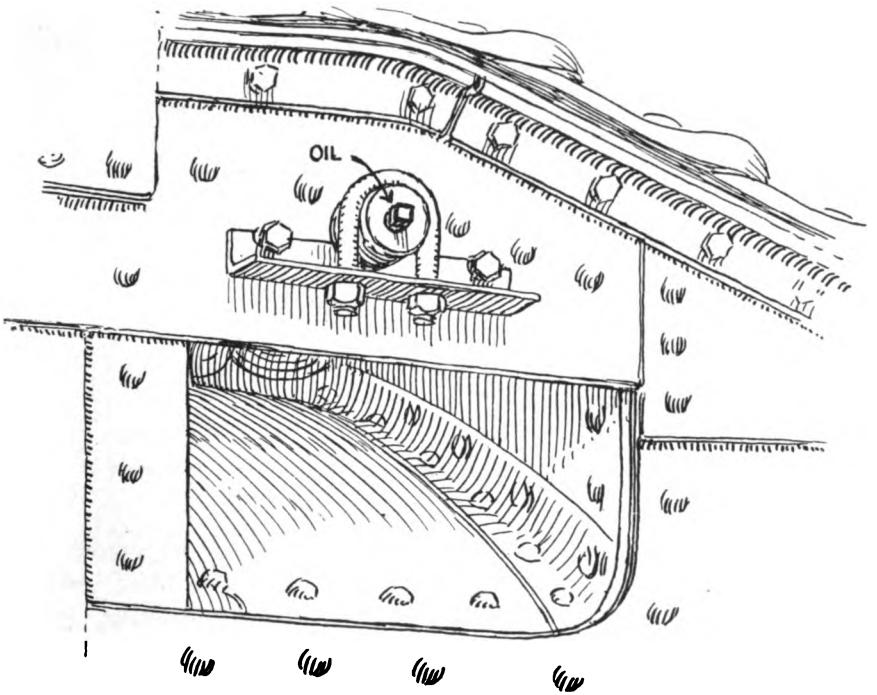
The upper road track rollers are lubricated by removing the plugs on the ends of the roller shafts, and filling as full as possible once or twice a week with oil corresponding to the 600–W grade.

EPICYCLIC GEAR

Be sure that the cups on each side of the epicyclic gear case, into which passes the lead for the main bearings, is kept full of wool waste. This allows of the gradual feed to the main bearings. No other packing material should be placed in these cups, as the results will not be satisfactory.

The epicyclic gear is lubricated from the oil tank on the starboard side of the hull, above the removable side plate. This oil tank is filled through the plugs in the top, and has a capacity of 2 gallons of 600–W oil. The tank should be inspected weekly, and filled to the

PLATE No. 9



UPPER ROAD TRACK ROLLER

top. The oil is carried from the tank by a mechanical lubricator, which oils the four main bearings, and the roller pinion shaft.

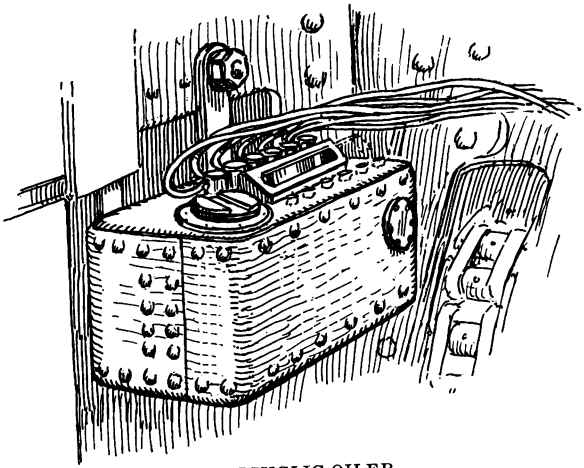
There is a cap on the top of the bevel gear case which should be filled once a week, having a capacity of 2 gallons. This takes care of the bevel gears and the shifter clutch, which governs the forward and reverse speeds.

The epicylic gear trains are taken care of by removing the two caps or plugs in the gear case, and filling once a week with 3 gallons of oil. To flush out the gear case, which revolves, the cap is first brought to the top, and the gear case filled with kerosene and then allowed to rotate to the bottom for draining. The case can then be brought back so that the cap is at the top, and can be refilled by putting 3 gallons of oil in each of the oil holes.

FRONT CONTROL RODS

The front control rods are lubricated through the oil holes in the lever shaft. Each of these holes should be given a squirt from the oil can at least once a month.

PLATE No. 10

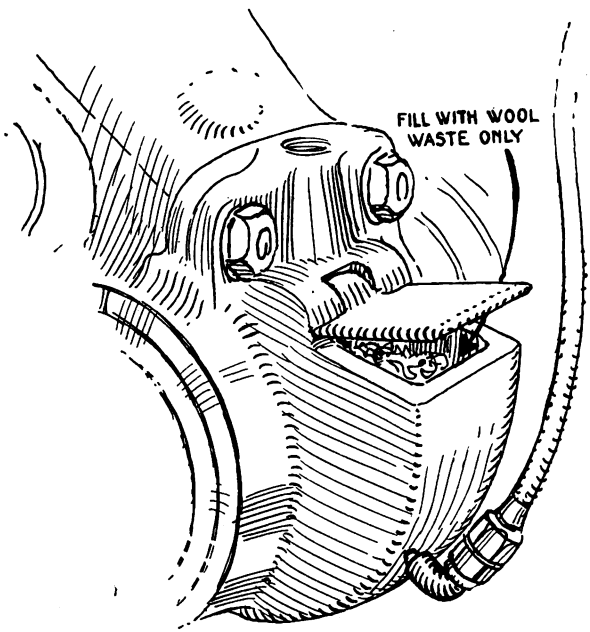


EPICYCLIC OILER

CENTER CONTROL RODS

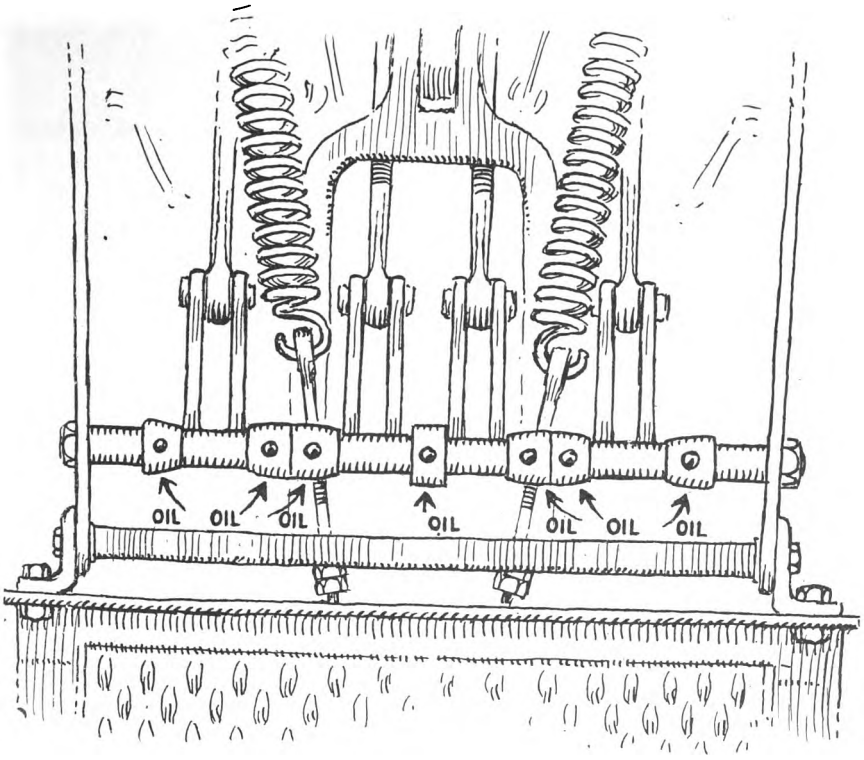
To lubricate the center control rods it is necessary to remove the center section of the ammunition rack. This can be lifted out, as it is separated from the rack itself. The lubrication of the center

PLATE No. 11



EPICUCLIC CUP

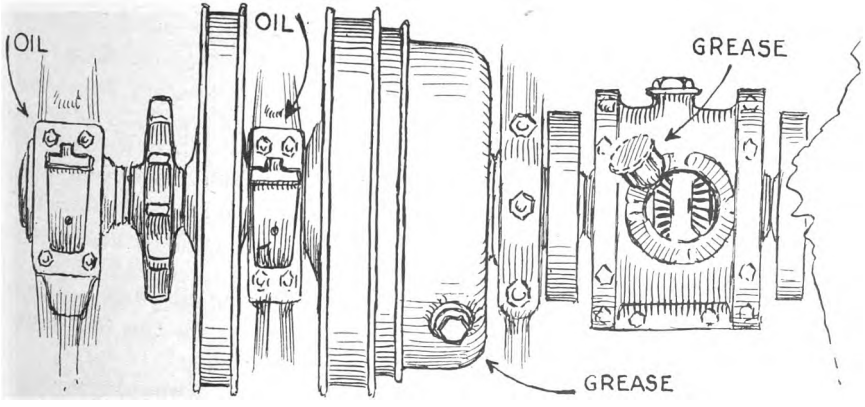
PLATE No. 12



CONTROL RODS

control rods is taken care of by oil holes on the top of each unit, and these should receive a squirt from the oil can monthly.

PLATE No. 13



EPICYCLIC CASE

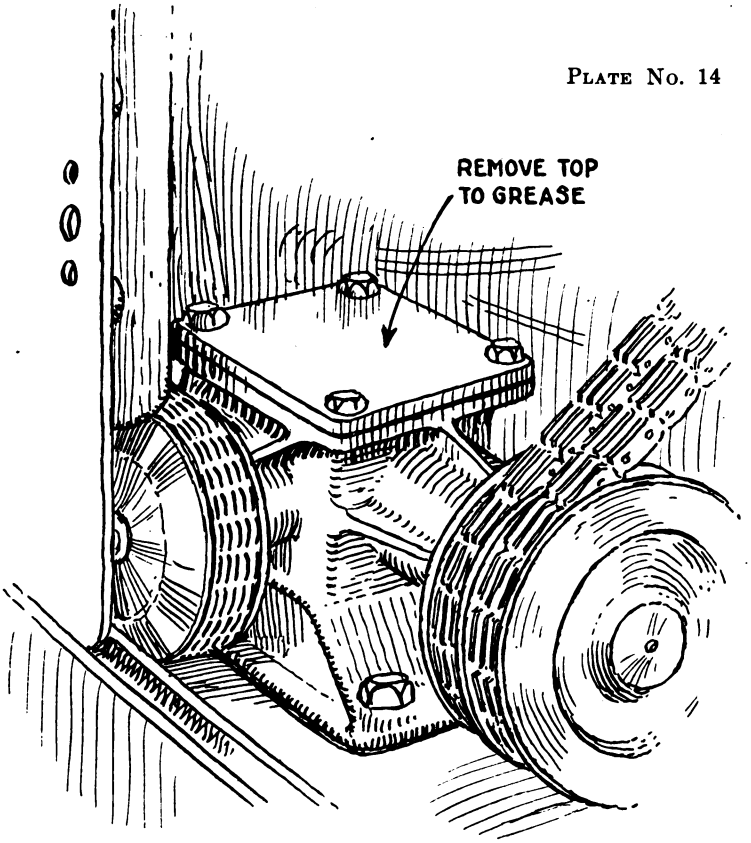
REAR CONTROL RODS

The rear control rods should receive a drop of oil weekly on the pins and on the wearing points.

TRACK LINK PINS

The pins which connect the track links should receive an oil bath

PLATE NO. 14



FAN BEVEL BOX

in assembly. The track should be run through an oil bath monthly by driving the machine through a prepared oil pool, or by swabbing at accessible points, such as the mudholes.

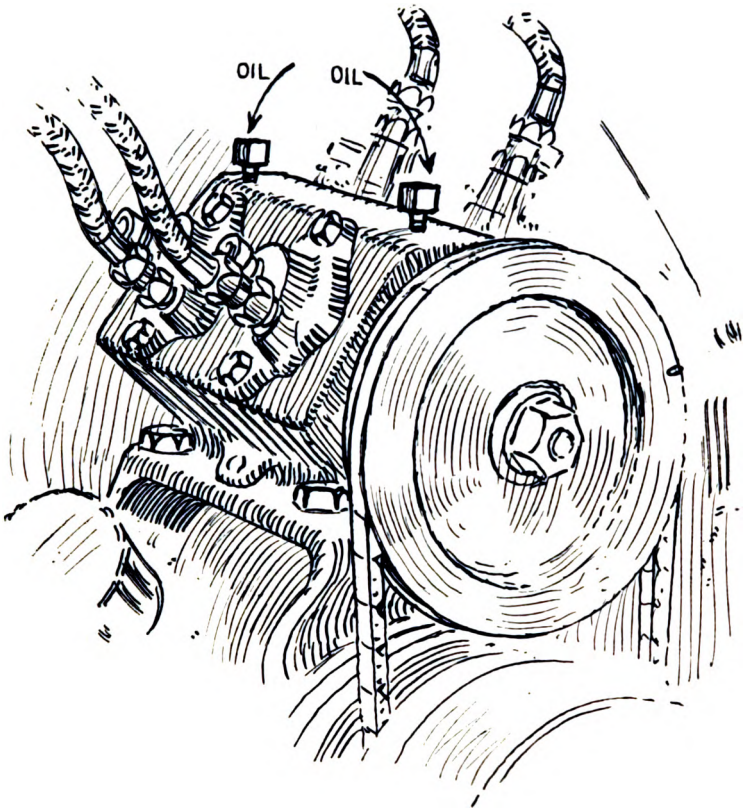
COOLING FAN

The Sirocco cooling fan is lubricated through the oil plugs. There is one plug on the fan casing and the other plug on the fan shaft. These should receive a squirt from the oil can weekly.

VENTILATING FANS

The ventilating fan is lubricated by removing the oil plugs on the ventilating-fan casing. Each of these holes should receive a squirt from the oil can weekly.

PLATE NO. 15



AIR PUMP

ROAD TRACK DRIVING WHEEL

The road track driving wheel is lubricated by removable plates on the ends of the ventilating-fan driving-wheel shafts. They are on the outside of the machine. The oil can should be applied to put as much oil of the equivalent of 600–W as possible into the boss. This should be done weekly.

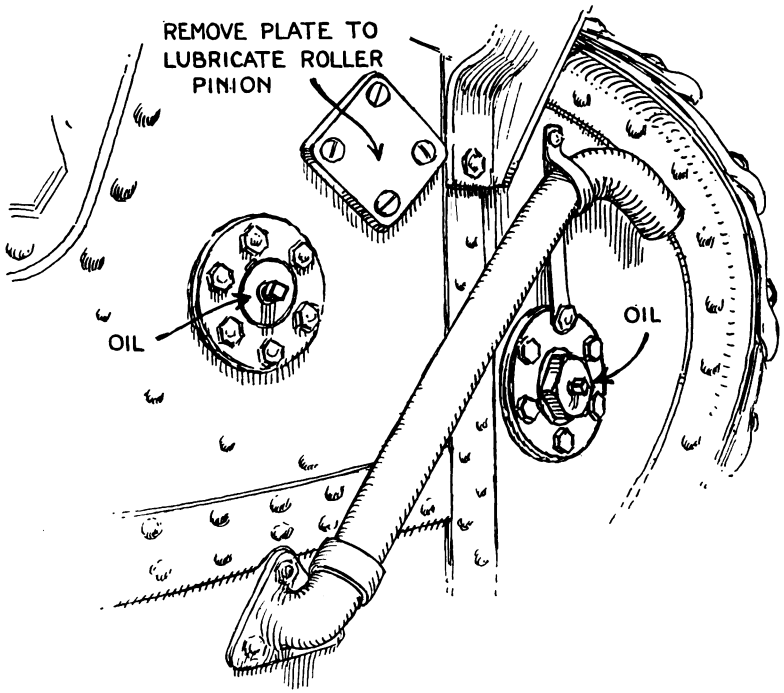
ROAD TRACK ADJUSTING WHEEL

The road track adjusting wheel is oiled through the plugs on the ends of the road track adjusting-wheel shafts. The plugs are removed, and by means of a squirt can as much 600–W oil as possible is introduced. This should be done weekly.

ROAD TRACK ADJUSTING SCREW

Before attempting to adjust the track the threads of the road track adjusting screw should be cleaned and thoroughly oiled. This should be done whenever the track is adjusted.

PLATE NO. 16



DRIVE CHAIN

The sprocket drive chain should be lubricated through the holes in the links. It should also be well lubricated before assembly. This should be taken care of daily if the machine is in service.

ROLLER PINIONS

The roller pinions are lubricated through the holes in their circumference. To reach this remove the end hull plate on the side. This should receive a squirt of oil monthly.

CLUTCH-CONTROL SHAFT

The clutch has a shaft which holds the clutch-control links. The oil holes in the links should receive a squirt from the oil can weekly.

AIR PUMP

The air pump should receive oil through the two plugs in the top of the pump. About a cup full of oil is required for each of these plugs, and they should be lubricated weekly.

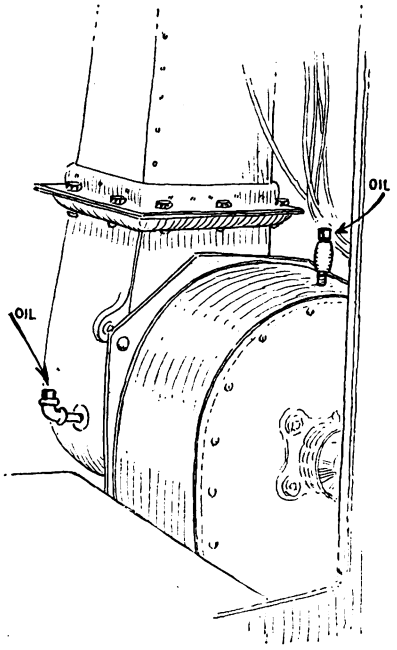
FAN BEVEL BOX

The fan bevel box should contain about a quart of 600–W oil, or equivalent, and should be filled monthly.

JOCKEY PULLEY

The jockey pulley is lubricated through the plug in the side of the pulley, opposite the ball-bearing center. This should receive a squirt from the oil can every week.

PLATE No. 17



VENTILATOR FAN

GENERATOR

The generator has two oil plugs on the side, into each of which two or three drops of light oil, such as Veedol light, should be placed, biweekly.

STARTING MOTOR

There are two oil plugs on each end of the starting motor, into which two or three drops of light Veedol oil should be placed, biweekly.

CLUTCH

All accessible bearing parts of the clutch, with the exception of the cone surface, should receive a squirt of oil from the can weekly.

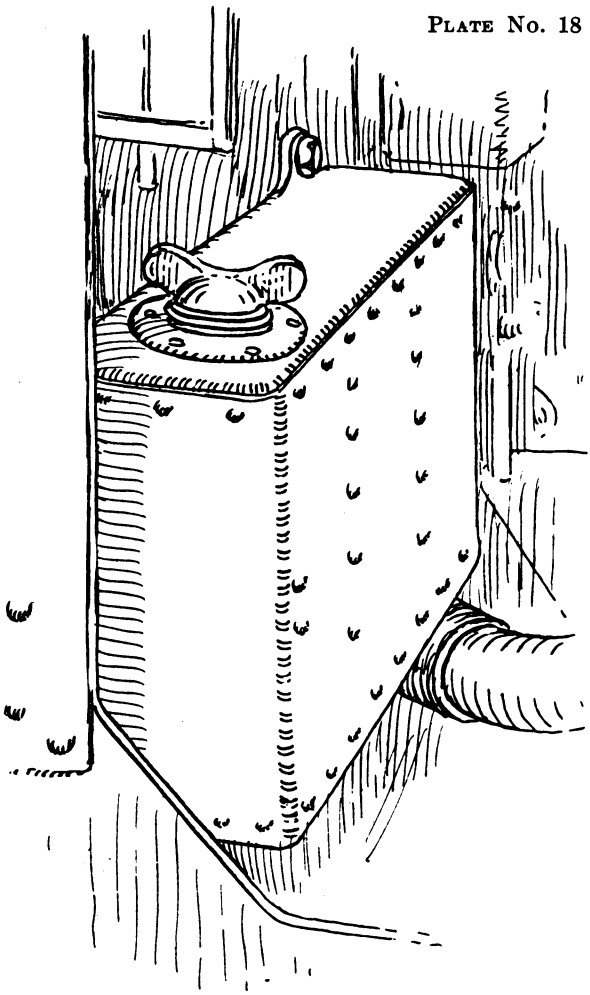
ROAD TRACK

Before placing the road track on the machine give the links a thick coating of heavy oil, and also the drive-wheel teeth, in order to reduce the wear on the links.

SPONSON HINGES

The sponson hinges and rollers should receive a few drops of oil monthly, and before drawing in the sponson.

PLATE NO. 18



ENGINE-OIL RESERVOIR

LUBRICATING ROUTINE

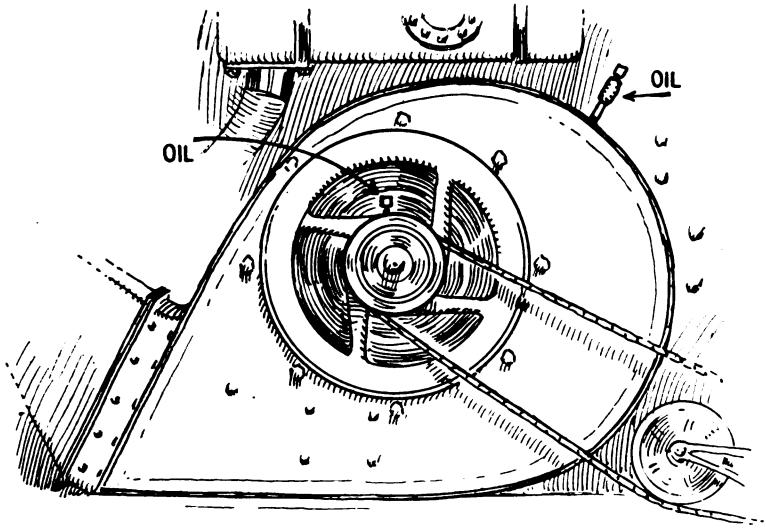
The following parts should be lubricated daily: Cup at engine thrust; drive chain.

The following parts should be lubricated biweekly: Lower road track rollers; generator; starting motor.

The following parts should be lubricated weekly: Epicyclic gear tank; epicyclic gear trains; rear control rods; cooling fan; ventilating fan; road track driving wheel; road track adjusting wheel; clutch shaft; air pump; jockey pulley; clutch.

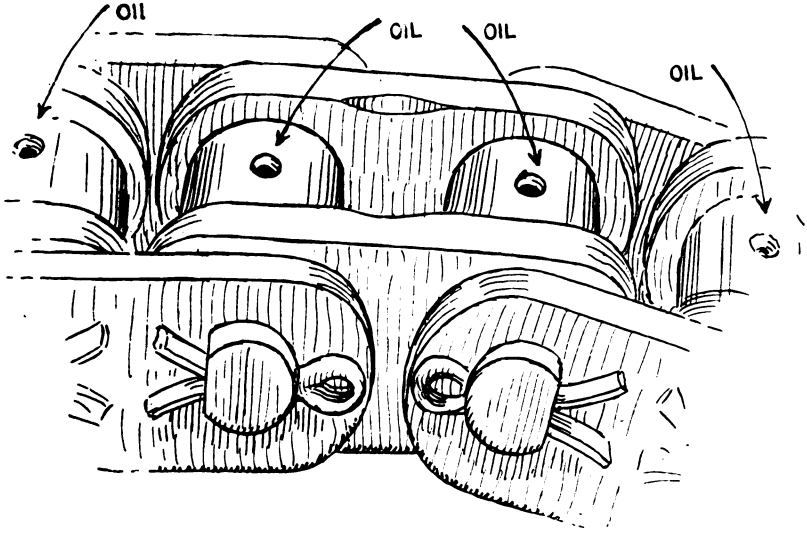
The following parts should be lubricated monthly: Cap on top of bevel gear case; front control rods; center control rods; road track pins; roller pinions; fan bevel box.

PLATE No. 19



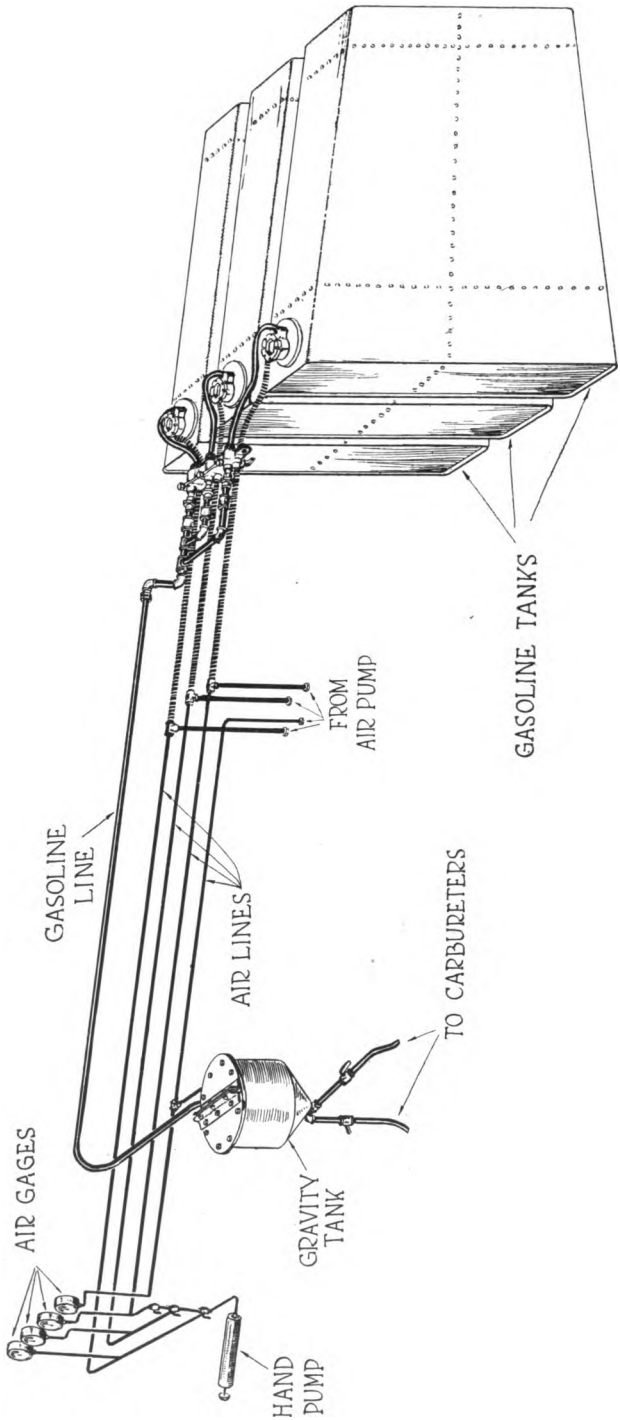
SIROCCO FAN

PLATE No. 20



CHAIN DRIVE

PLATE No. 21



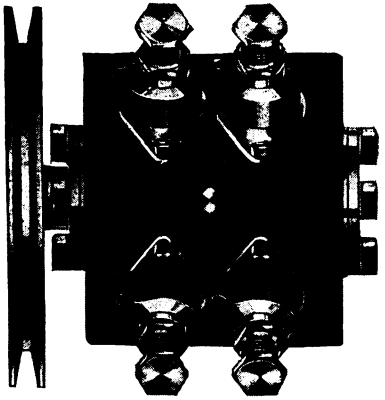
LAYOUT OF GASOLINE PRESSURE-FEED SYSTEM USED ON 35-TON TANK, MARK VIII

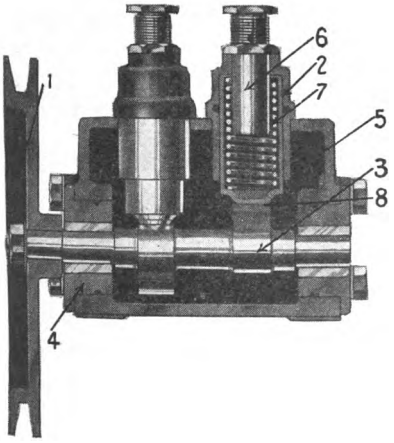
GASOLINE SYSTEM

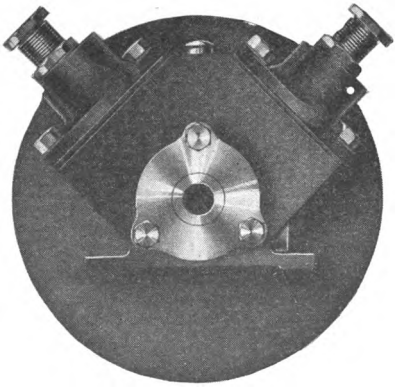
OUTLINE SPECIFICATIONS

Total gasoline capacity	240 gallons.
Number of tanks	3.
Capacity per tank	80 gallons.
Size of pipe to carburetor	¼-inch.
Other gasoline piping	½-inch.
Type of feed	Pressure.
Type of pump	Reciprocating.
Pressure on system	2 to 4 pounds.

PLATE NO. 22



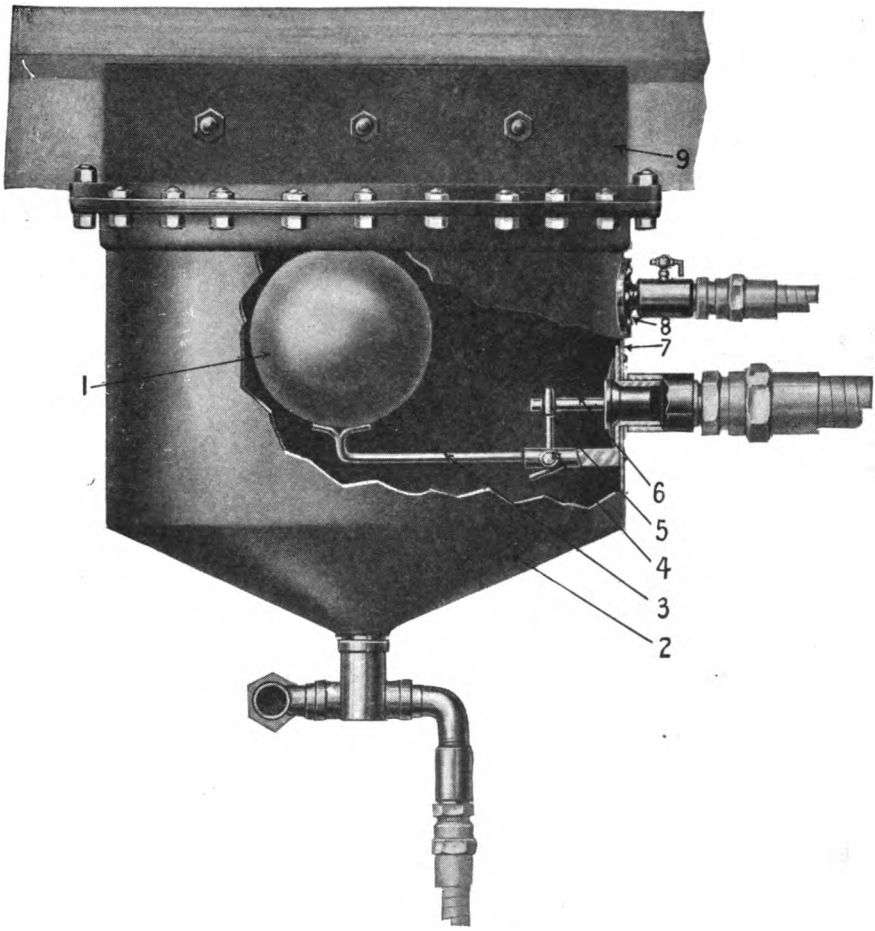




AIR-PRESSURE PUMP

Ref. No.	Part No.	Name
1	SH900B	Air-pressure pump pulley.
2	SH900A	Air-pressure pump bushing.
3	SH900C	Air-pressure pump cylinder.
4	SH900D	Air-pressure pump shaft.
5	SH903A	Air-pressure pump base.
6	SH901E	Air-pressure pump displacement plug.
7	SH901A	Air-pressure pump spring.
8	SH901D	Air-pressure pump piston.

PLATE NO. 23



PRESSURE REGULATING TANK

Ref. No.	Part No.	Name
1	SH950C	Float.
2	SH950A	Tank.
3	SH950F	Float rod.
4	SH950G	Pin for valve bracket.
5	SH950B	Valve bracket.
6	SH950E	Valve.
7	SH950H	Valve bracket holder and gas inlet
8	SH950D	Air-pipe connection.
9	SH972A	Regulating tank support.

GASOLINE (PETROL) SYSTEM

GENERAL DESCRIPTION

The gasoline or petrol supply is carried in three tanks, of 80 gallons capacity each, mounted near the rear of the machine, just below the top plating. The gasoline or petrol tanks are all similar, and are mounted side by side. The gasoline is forced by pressure from these three tanks to a gravity tank mounted directly above the engine, from which the flow is by gravity and pressure to the two carburetors. Pressure is supplied by the engine-driven air pump, the pump being

a four-cylinder design, operated by the cam shaft. The gasoline tanks are placed to the rear of the engine room and separated from it by means of the bulkhead.

THE AIR-PUMP DRIVE

The air pump is mounted just above the clutch, and is driven by a V belt on the pulley on the engine-shaft brake. The pulley on the air pump operates the cam shaft, which works directly against the pistons or plungers of the pump. Before the engine is in motion, a sufficient pressure can be secured to start the flow of fuel by means of a hand pump, located on the bulkhead between the engine room and fighting compartment. The flow is received from one of these three tanks, depending upon which one of the cocks is open to the gravity tank, located above the engine. The triple combination tap is a ground key cock type, with a T handle between the tank and carburetor, and controls the flow from the individual tanks. The type of connections used on the gasoline system are flexible metal hose soldered into T union connections.

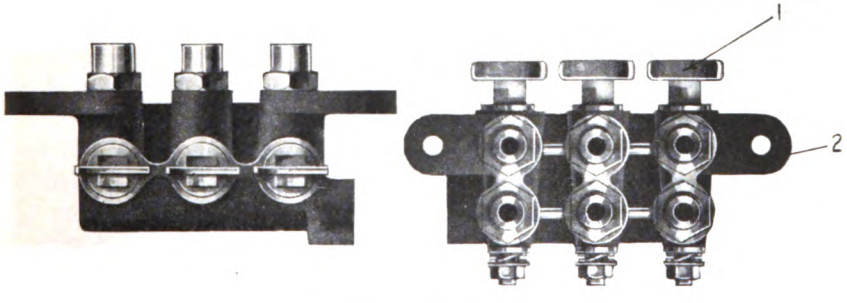
TO FILL GASOLINE SYSTEM

To fill the gasoline tank it is necessary to unlock the hinge plates over the caps by means of a socket wrench key. These two hinged plates are lifted up, and this exposes the three filler caps or inlets in the top of the tank. These caps are removed, and the gasoline tanks can be filled.

TO START GASOLINE FLOW

To start the gasoline flow it is necessary to use the hand pump.

PLATE NO. 24



COMBINATION TAP

Ref. No.	Part No.	Name
1	M-1764	Combination tap plug.
2	M-1763	Combination tap body.

AIR-PRESSURE SYSTEM

The gasoline system has a pressure feed (see p. 28) with three supply tanks in the rear end of the hull and a pressure regulating tank over the engine. The air pressure is furnished by a piston air pump, mounted on a frame over the cardan shaft, from which the pump is operated by means of a belt. Three air tubes of ¼-inch armored flexible brass tubing run from the pump to the roof of the machine, where they are connected to tees from one end of which tubing of the same type leads along the under side of the roof to ball check valves which are connected to the lower valves of the combination tap which passes through the bulkhead between the engine room and gasoline-tank compartment. From the rear end of the combination tap ½-inch tubes lead to the top of the three gasoline tanks.

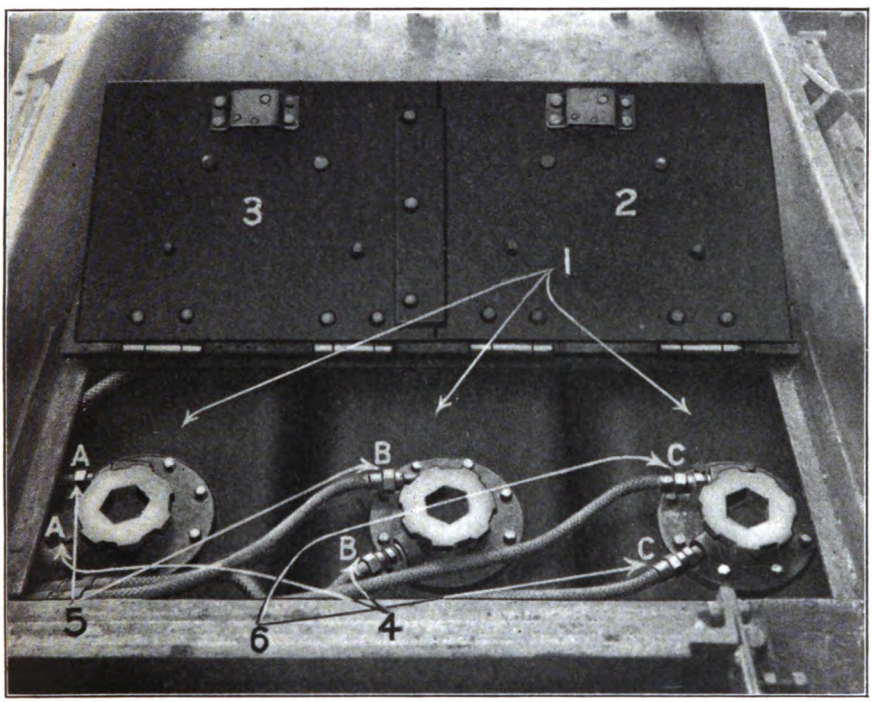
From the forward ends of the tees ¼-inch outside diameter seamless copper tubing runs along the upper right-hand corner of the tank to the bulkhead, where each is connected to a main tube of the same which leads to a pressure hand pump mounted on the engine-room bulkhead over the port engine-room door. On the engine-room bulkhead are mounted air-pressure gauges, tubes from which are connected with the tubes from the tanks to the hand pump. Between the gauges and the main line to the pump are fitted ground spindle valves with levers. From the remaining plug on the air-pressure pump a ¼-inch flexible brass tube leads to the pressure-regulating tank over the engine. Just before reaching the regulating tank it is connected to a cross. From one side leads a ¼-inch copper tubing which connects to a pressure gauge on the bulkhead showing the pressure in the regulation tank. A pet cock is connected with the other side of the tee.

GASOLINE-PIPE CONNECTIONS

From connections in the filling pipes of the gasoline tanks three 5-inch flexible brass tubes (Titeflex) lead to three connections in the rear end of the combination tap on the bulkhead. In the front end of the tap are fitted three valves with nut heads. Connected to these valves are ball check valves; from the ball check valves ¼-inch tubing runs to the three way connection, from which a ½-inch tube leads to the side of the regulating tank.

From underneath the regulating tank two ¼-inch tubes, with ground spindle lever valves at the tank, lead to the forward and rear carburetors.

PLATE No. 25



GASOLINE TANK

Ref. No.	Part No.	Name
1	M-1755	Petrol tank.
2	M-1785	Port cover for petrol tank.
3	M-1786	Starboard cover for petrol tank.
4	M-984 A B & C	Petrol tubes from tank to combination tap.
5	M-981 A B & C	Air-pressure tubes tank to combination tap.
6		Filling cap.

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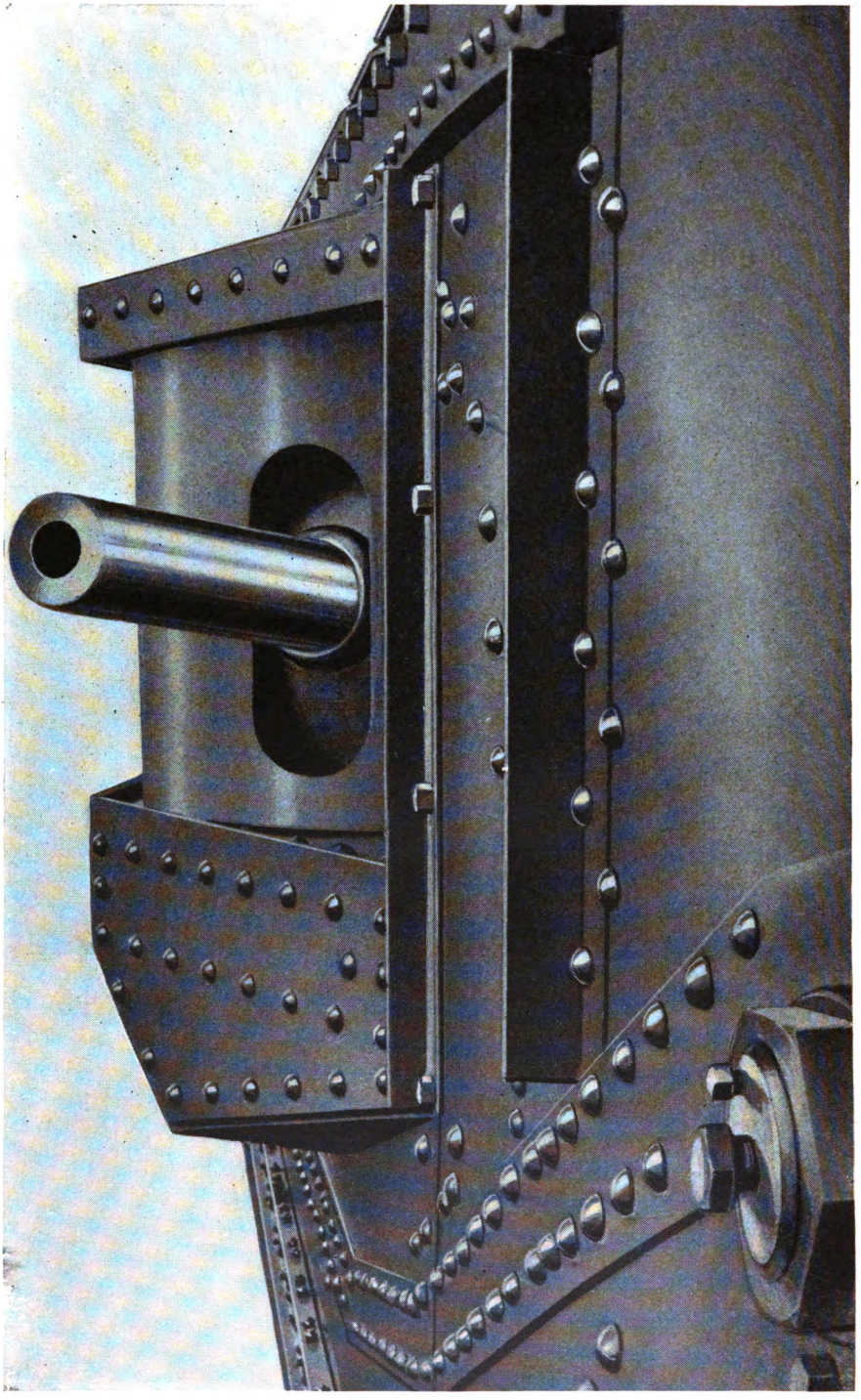
PLATE NO. 26



SIDE OF HULL WITH SPONSON AND GUN

CHAPTER II

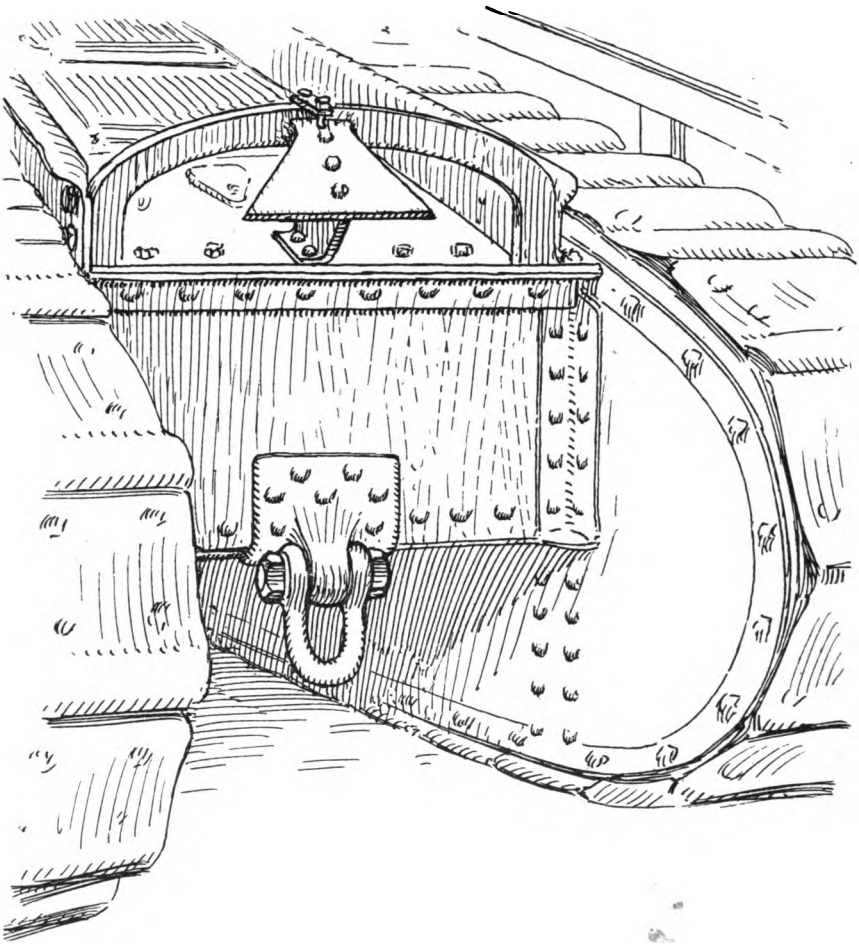
HULL STRUCTURE

Outline specifications

Length	34 feet 2½ inches.
Thickness of side plates	12 mm.
Thickness of backplates, rear of gasoline (petrol) tank	16 mm.
Thickness of front wing plates	10 mm.
Outside skirting plate	10 mm.
Thickness of front diaphragm plate	12 mm.
Thickness of main turret side plates	16 mm.
Thickness of main turret top plates	6 mm.
Thickness driver's turret plates	6 mm.
Thickness of hemispherical turrets in doors and main turret	14 mm.
Thickness of lookout turret plating, top	6 mm.
Thickness of lookout plating, side	16 mm.
Thickness of sponson floor plates	8 mm.
Thickness of sponson roof plates	6 mm.
Thickness of sponson top shield	8 mm.
Thickness of sponson bottom shield	8 mm.
Thickness of sponson side plates	12 mm.
Thickness of sponson floor plates, forward	12 mm.
Thickness of sponson floor plates, aft	6 mm.
Thickness of roof plate abaft turret	6 mm.
Thickness of roof plate over engine	6 mm.
Thickness of roof plate over petrol, gasoline tank	10 mm.
Thickness of roof plate over driver	6 mm.
Thickness of doors	12 mm.
Length of main turret, over all	10 feet 3½ inches.
Width of main turret, over all	3 feet 4½ inches.
Height of main turret, without outlook turret	1 foot 10½ inches.
Length of driver's turret	2 feet 3 inches.
Width of driver's turret	1 foot 7 inches.
Height of driver's turret	1 foot 1 inch.
Height of lookout turret above main turret	12½ inches.
Inside length of lookout turret	18 inches.
Inside width of observer's turret	18 inches.

DESCRIPTION OF HULL

The hull of the Mark VIII machine is composed of armor plate of various thickness, ranging from 6 to 16 mm. (0.236 to 0.630 inch). The side elevation of the hull is a modified ellipse, flattened along the



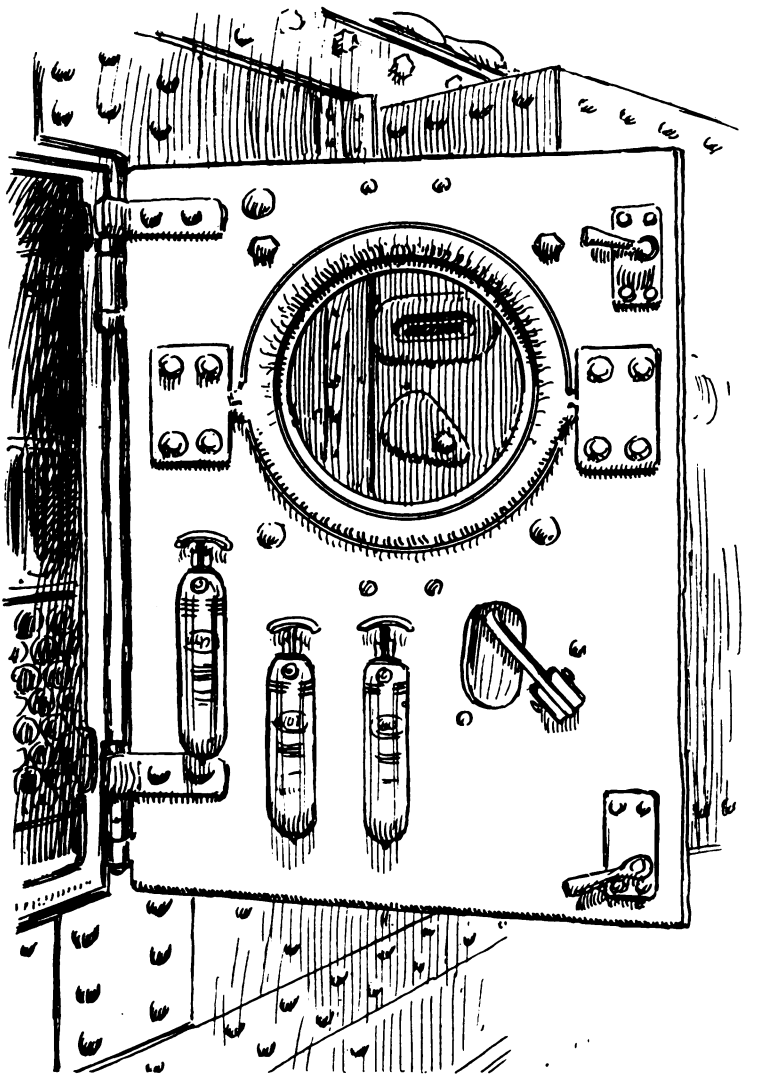
REAR END SHOWING TRIANGULAR SPLASH PLATE AND TOWING EYE

bottom for length of contact between the track and the ground and flattened along the top. From above, or in plan the hull appears in H form, the cross bar of the H being the hull or body proper, containing the engine and fighting compartments, while the uprights of the H represent the side plates of the hull which also act as guides for the track.

Not only does the hull act as the container or housing for the driving and fighting mechanism as well as the crew, but it is also the backbone structure of the entire machine. The plating of the hull, therefore, performs the three functions of acting as a housing, as a protection and also as a supporting structure.

Within the sides of the hull and projecting from it are two sponsons which carry 6-pounder guns. These sponsons are carried outboard to allow the guns to have a forward range as well as covering a wide arc on either side of the machine. They are located at the forward end

PLATE No. 28



DOOR OF HULL SHOWING FITTINGS

of the fighting compartment. The gun mounts are capable of rotating in the sponsons to give the necessary flexibility of fire.

In order to accomodate the Mark VIII machine to the limitations of railway transportation it is possible to draw the sponsons inboard.

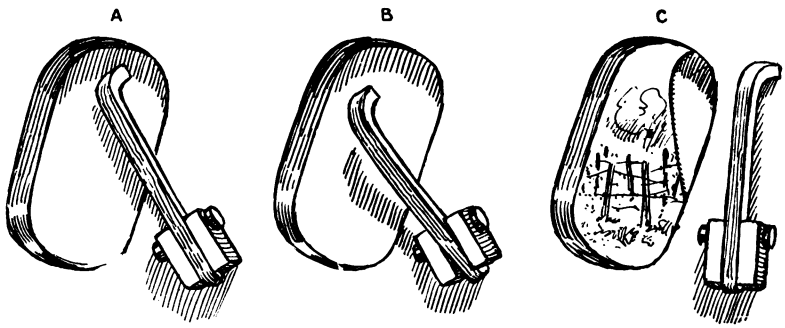
This is accomplished by removing the bolts connecting the angle bar flange with the hull shell plating at the rear end of the sponson. Removing these bolts frees the sponson and allows it to be swung back on a hinge bracketed to the forward extremity of the sponson and to the shell plating at this point.

To further narrow the machine so that no part will project in shipment by rail, beyond the 9-foot railway loading gauge, the guns in the sponsons are drawn back. The machine-gun mounts which project from the doors in the sides of the hull are also designed to just equal, but not to exceed the 9-foot loading width.

SPONSON ROLLER

Near the inner edge of the sponson in rear of the ammunition stowage is the sponson roller which carried the weight of the sponson when being moved in or out.

PLATE No. 29



PROGRESSIVE STEPS IN UNCOVERING REVOLVER HOLE

The sponson roller bracket is bolted to the floor of the sponson above the floor plate, and has a short bearing on each side for the roller shaft. The roller is 40 mm. bore, 110 mm. outside diameter and 27 mm. wide and runs on roller track for the sponson, which is on an arc of a circle with the sponson hinges as a center. The track is a steel bar ¾ inch wide by 4 inches high and is held by bolts to three brackets which are riveted to the floor.

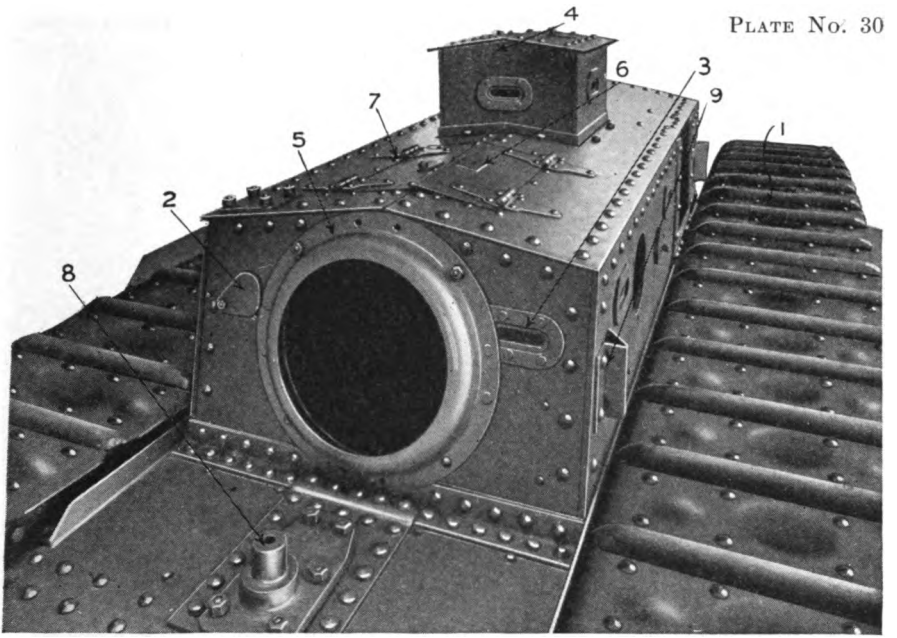
MAIN TURRET

On the top of the hull there is located the main turret. This is rectangular in form and carries surmounted upon it the lookout turret which is also rectangular in form. At the forward end of the main turret is located the driver's turret, also of rectangular form. The lookout turret is of such a height that when a man stands on the officers' kit box located on the ammunition storage compartment below it, his head will be at the proper height to look out through the peepholes on all sides of the machine.

HULL DOORS

There are three main doors in the hull; two are in the fighting compartment, located on each side at the rear, and the other is at the top of the machine entering into the main turret from above. The side doors are 28½ inches wide and 41⅞ inches high. The top door is 20 inches along the length of the machine and 15⅞ inches wide. In

PLATE NO. 30



TOP OF HULL

Ref. No.	Part No.	Name
1	M-1264	Road track.
2	M-2630	Revolver port cover.
3		Peephole.
4	M-2380	Outlook turret.
5	M-3120	Cover plate for hemispherical turret.
6	M-2355	Main turret roof doorplate, starboard
7	M-2356	Main turret roof doorplate, port.
8	M-3922	Roof towing bracket.
9	M-2440	Camouflage net support socket.

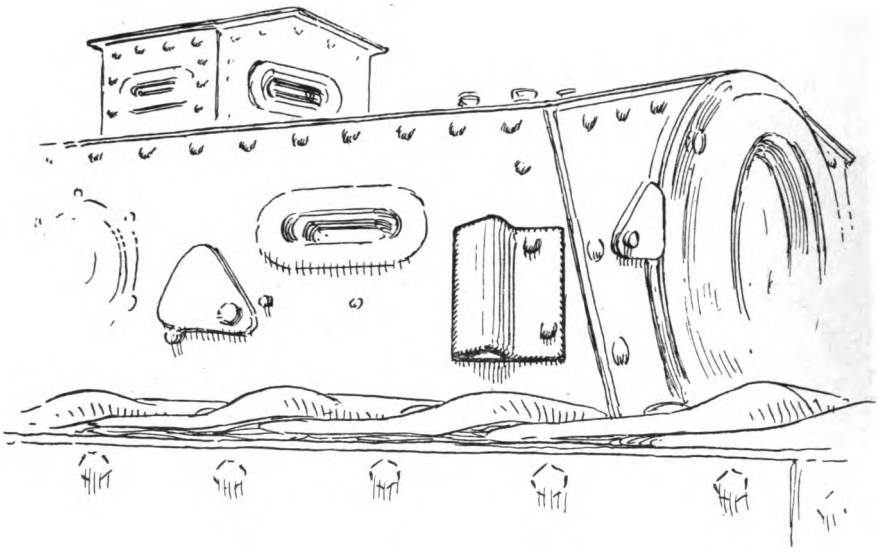
addition, there are other openings in the hull for observation or other purposes. In the front end of the driver's turret there is a plate which can be swung outward, allowing the driver a clear vision forward when not under heavy fire. Similarly there are openings on each side of the main turret just forward of the lookout turret which can be swung open to give a clear view on either side of the machine.

The side doors leading into the fighting compartment are pierced for machine-gun mounts and there are also five holes in the main turret to provide for five additional machine guns. The spherical mounts for these machine guns fit into these holes.

LOUVERS

The top of the hull is pierced at the rear end between the tracks by openings for the intake and exhaust air louvers. These louvers are above the engine-room compartment. The intake louver is above the forward end of the engine at the front end of the engine compartment and the exhaust louver is above the radiator at the rear end of the engine compartment. The openings in which the louvers are fitted are rectangular. The dimensions of the intake-louver opening are 3 feet 1¼ inches wide by 2 feet 1.825 inches long and the exhaust-louver opening is 3 feet 1¼ inches wide by 3 feet 1⅝ inches long.

PLATE NO. 31

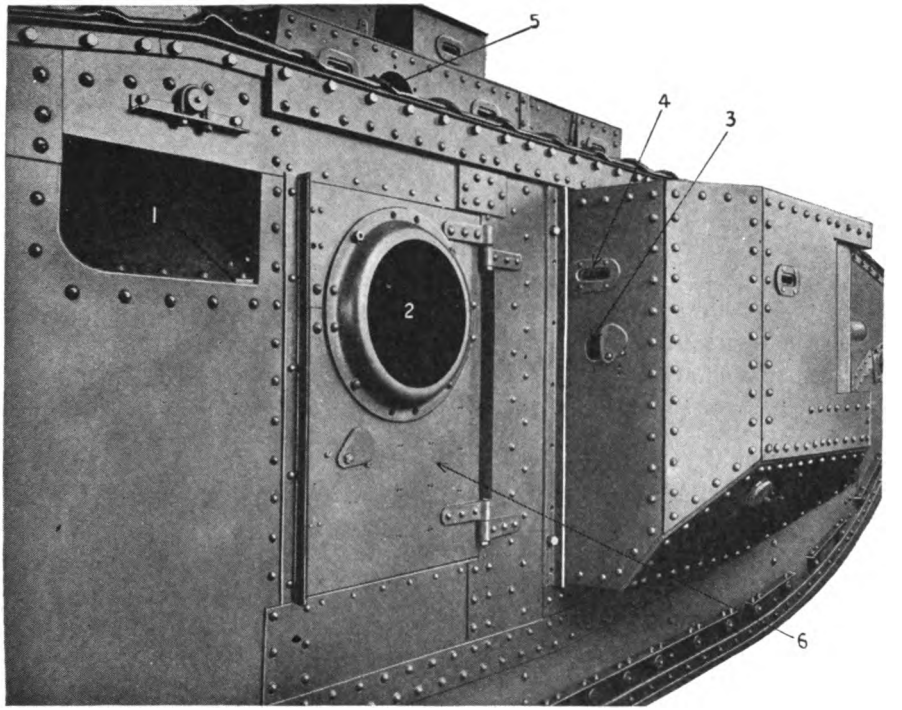


SIDE OF TURRET SHOWING CAMOUFLAGE BRACKET

The louvers are composed of bars of 6 mm. armor plate bent to an angle of 90 degrees and spaced face to face in herringbone style, so that while permitting the air to readily pass through they act as a baffle against projectiles or fragments, causing them to lose their energy before entering the engine compartment. The extreme width of each louver blade, outside to outside, is 2½ inches. The radius around which the blade is bent in turning to the 90-degree angle is one-half inch. There are 29 blades in the outlet louver and 34 blades in the inlet. The proper distance between the louvers is held by 122 carbon steel distance pieces, which take care of both the inlet and outlet louvers.

As a further protection the louvers are set between two 6 mm. flanged steel bars, projecting 8¾ inches above the top surface of the hull, on each side of the louver.

PLATE NO. 32



SIDE OF HULL

Ref. No.	Name	Ref. No.	Name
1	Mud shoot.	4	Peep hole.
2	Opening hemispherical turret.	5	Machine-gun mounting opening.
3	Revolver hole.	6	Side door.

TO REMOVE LOUVERS

To remove the louvers, pass a rope sling beneath the blades so as to sustain them, then release the set screws on the end which jam the assembly together. This will allow the entire unit to drop apart.

In shipping the Mark VIII tank the sponsons are swung inboard and the observation tower lowered flush with the top of the main turret.

38285—25†——4

TO REMOVE SPONSONS

To remove the sponsons, take out the pins from the hinges upon which the sponsons swing inboard; then remove the bolts from the rear of the sponsons which bolt them against the shell plating. The 6-pounder guns should be removed from the sponsons (see p. 174), as well as all other parts stored therein, before pulling the hinge pins or removing the bolts. This should not be attempted without a chain fall.

TO REPLACE SPONSONS

To assemble the sponson in place it should be lifted into its withdrawn position by means of a chain fall or some other means and the hinge pins then slipped into place. The nuts are placed on the hinge pins and the sponson then swung into the outboard position, when the bolts holding it to the shell plating can be fitted. If it is desired to fully assemble the sponson the guns can be placed inboard before the sponsons are fitted. If good lifting devices are handy the entire unit can be assembled before it is lifted into position.

TO OPEN BULKHEAD DOOR

The bulkhead center door slides upward and downward in grooves and can be held up by a hook on the bulkhead just over the opening, the hook engaging in the handle of the door. The two side doors are carried by two rollers, each running on a track over the doors, the lower end being guided by a groove in the lower bulkhead plate.

The door is locked in the closed position by a lock catch engaging against the bulkhead. The lock hand has a spring which keeps the catch clear of the bulkhead when the door is open. To lock, push the lock handle in, depressing the spring and turn the handle toward the center of the bulkhead until the handle is locked.

MOUNTED ON BULKHEAD

The following parts are mounted on the bulkhead, between the engine room and the fighting compartment:

The machine-gun ammunition racks at the top.

First-aid carrier at one end of the rack on the starboard side of the bulkhead.

Machine-gun repair kit at the front end of the bulkhead.

Instrument board directly under the machine-gun rack, which carries the oil gauge, three gasoline or petrol tank gauges, gasoline gauge for auxiliary tank, tachometer, and yardometer.

To the right of the instrument board there is a pressure and a hand pump, for supplying initial pressure to the gasoline or petrol tanks and at the center near the floor is the starting crank. There are two doors through the bulkhead, one on each side, leading into the engine compartment.

OPENINGS IN HULL

The following is a list of the openings in the hull assembly:

Main turret, rear.—Machine-gun post, with pistol hole on right, 3½ by 2½ inches, peephole on left, 1 by 4¼ inches.

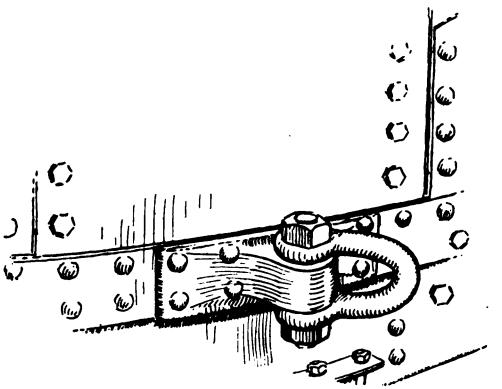
Main turret, port side.—Starting from rear and working forward. Peephole, machine-gun hole, pistol hole, peephole, 16.812 by 15.812 door, pistol hole.

Main turret, starboard.—Starting from rear and working forward. Peephole, pistol hole, machine-gun hole, peephole, 16.812 by 15.812 door, pistol hole.

Main turret, front.—Machine-gun hole on each wing, peephole in center.

Main turret, top.—Rear end double doors, opening upward, each 21½ by 8⅞ inches.

PLATE NO. 33



SIDE TOWING BRACKET

Observers' turret.—Peephole on each of the four sides, and two peepholes in the roof.

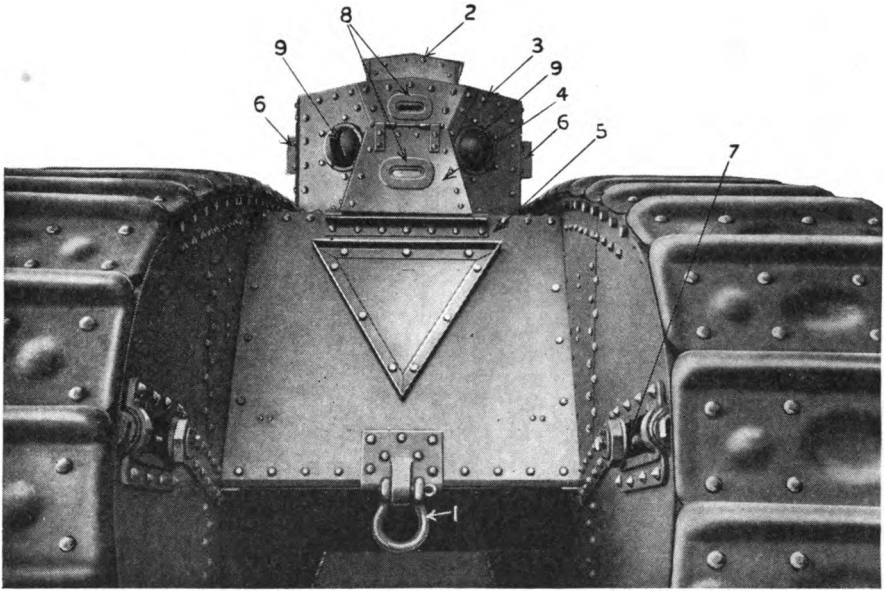
Drive turret.—Peephole in both port and starboard side, outward opening in flap in front, with peephole in center, periscope hole in top.

Main hull door openings.—Behind sponson, and to the center of hull, door on each side 29⅞ by 59⅞ inches, machine-gun hole in each door, and pistol hole in each door.

Sponsons.—Peephole in backplate on the starboard side, one pistol hole.

In front wing, starboard side	Peephole and pistol hole.
In front wing, port side	Peephole and pistol hole.
Back plate, port side	Peephole and pistol hole.
Back wing, port side	Peephole.
Side plate, starboard side	Peephole.
Side plate, port side	Peephole and pistol hole.
Shield plate, starboard	Telescope sight slot, 6-pounder post.

PLATE NO. 34



FRONT OF MACHINE

Ref. No.	Name
1	Towing bracket.
2	Outlook turret.
3	Main turret.
4	Driver's turret.
5	Splash angle.
6	Camouflage brackets.
7	Road track adjusting screw.
8	Peephole.
9	Machine-gun mounting.

CHAPTER III

ENGINE AND ENGINE SYSTEMS[1]

Outline specifications

Engine type	4-cycle.
Number of cylinders	12.
Cylinder arrangement	V form.
Cylinder shape	I head.
Bore	5 inches.
Stroke	7 inches.
Piston displacement	1,649.34 cubic inches.
Brake horsepower	At 1,400 r. p. m.
Cylinder cast	Singly.
Cylinder material	Iron.
Piston material	Aluminum.
Piston length	5 inches.
Piston clearance	0.02 inch.
Number of piston rings	3 per piston.
Type of ring	Eccentric.
Piston pin	Steel tube.
Piston-pin diameter	1.25 inches.
Piston-pin length	$4\frac{15}{16}$ inches.
Connecting rod	I-beam forging.
Connecting-rod length	12 inches between centers.
Crank shaft	Drop forgings
Crank-shaft diameter	2.625 inches.
Number of crank-shaft bearings	7.
Cam shaft	Drop forging.
Cam-shaft diameter	1 inch.
Number of cam-shaft bearings	7.
Valve location	Overhead.

ENGINE AND ENGINE SYSTEMS

GENERAL DESCRIPTION

The engine is mounted longitudinally within the hull of the machine at the rear end. It is contained within the engine compartment, inclosed by the two side walls of the hull, the floor, the upper plating of the hull and the transverse bulkhead which separates the engine compartment from the fighting compartment. It is a 12-cylinder Liberty type, with singly cast cylinders and an overhead valve action. The action is a V design, having six cylinders on each side, and an independent cam shaft for each set of six cylinders. The cam shaft is overhead, and each cam shaft operates directly on the overhead rockers by means of roller followers. The valves open downward into the cylinders. Each cam shaft has 24 cams, and each is driven by a set of bevel gears from the cam shaft.

[1] Much of this data deals with airplane type. Taken from Signal Corps book for preliminary handbook.

The engine group includes the engine itself, a governor, water pump, Delco ignition system, Ball carburetor, and the cooling system, which includes a radiator, Sirocco fan blower, and the necessary driving units.

PREPARING ENGINE FOR SERVICE

While every possible precaution is taken at the factory to insure Liberty engines being properly assembled, the human element, which is not infallible, must always be considered; therefore:

1. Inspect all visible bolts and nuts and see that they are properly drawn up and securely locked.

2. Inspect throttle and spark controls and see that throttles of both carburetor assemblies are synchronized. See that throttle control at driver's seat permits full throttle opening.

See that spark control at driver's seat permits the specified range of advance and retard at the distributor. (10 degrees after dead center retarded and 30 degrees before dead center advanced).

3. Check tappet gap. With the cylinder set on the firing point the gap between the inlet-valve tappets and the valve stems should be 0.014 to 0.16 and between the exhaust-valve tappets and valve stems should be 0.019 and 0.021.

4. Inspect all electrical connections. See that all wire terminals are properly soldered clean and firmly attached at the distributors, generator, battery, switch, and voltage regulator.

All wire terminal nuts should be cotter pinned or screwed down on lock washers.

See that all wires are properly insulated and supported at close intervals in such a manner that the insulation will not be abraded.

5. Inspect ignition system. Note whether or not the mark on the distributor assembly base coincides with the corresponding mark on the cam-shaft housing flange.

6. Check each breaker individually by turning engine over until breaker is wide open and testing "gap" (width of opening) by means of thickness gauge marked "distributor contacts" attached to distributor wrench. Gap should be 0.010 to 0.013 of an inch.

7. Check timing of one main breaker on each distributor assembly with an eight-volt lamp and battery or with an electric torch.

8. Check synchronization of two distributor assemblies.

Clean inside of distributor covers by wiping with soft cloth moistened with alcohol or gasoline; dry carefully.

9. Replace covers so that terminal marker 1 L is just to the left of the red mark on the assembly bases spark retarded. With the engine set on the firing point of No. 1 L cylinder—in other words, with the No. 1 crank set 10 degrees past the compression dead center—the carbon brush in the end of the distributor rotor should bear on the brass contact marked 1 L on the distributor head.

10. Remove spark plugs and inspect carefully for defective or broken porcelain. The electrode should be tight in the insulator and the insulator should be properly gasketed and drawn up tightly to prevent gas leakage. Hot gas blowing through a plug will overheat and render it inoperative. A spark plug which has been used and has given satisfactory service is always safer than a new plug; therefore do not discard spark plugs simply because they have been used, unless it is known positively that they are defective.

NOTE.—Defects in spark plugs will be most apparent when the plugs are hot.

11. Check spark-plug gap should be 0.015 to 0.018 of an inch. A gauge is provided marked "spark plug" on the distributor wrench.

12. Clean plugs; use a stiff brush and gasoline.

13. Replace plugs, being careful that gasket is in place and that plug is drawn down tightly on it.

14. Trace out high-tension wires from the distributors and be sure that each plug is connected to the correspondingly marked terminal on the distributor.

NOTE.—Plugs on the side of the cylinders toward the flywheel are connected to the left-hand distributor. Plugs on the opposite side of the cylinders are connected on the right-hand distributor.

Order of firing.—Standing at the distributor end of the engine and looking toward the flywheel, the groups of cylinders are designated as left and right, respectively, and are numbered 1, 2, 3, 4, 5, and 6, beginning at the distributor end. The order of firing is as follows:

1	2	3	4	5	6	7	8	9	10	11	12
1 L	6 R	5 L	2 R	3 L	4 R	6 L	1 R	2 L	5 R	4 L	3 R

THE GASOLINE SYSTEM

15. Connect pipes, and, with gasoline shut-off cock open, inspect all piping and connections carefully for leaks. Inspect gasoline strainer for leaks.

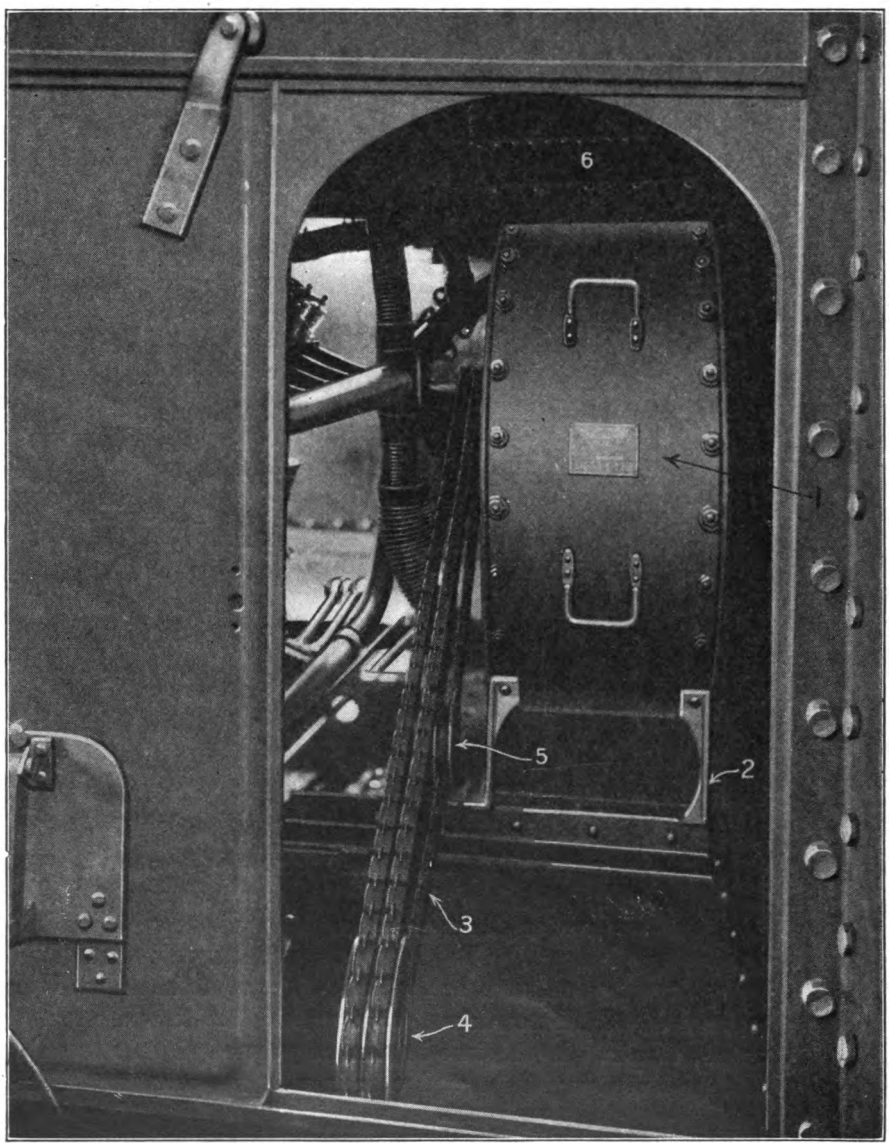
Be sure that carburetor float chambers fill properly and that carburetor does not "flood." To determine whether or not the carburetor float chamber is full, unscrew the cap over the needle valve. If the chamber is full the needle will be down on its seat and can not be depressed further. If this needle can be pressed down it would indicate either a stoppage in the pipe or insufficient pressure in the tank.

16. Close gasoline shut-off cock. Caution: If temperature is 40 degrees Fahr. above zero or lower, follow "cold weather suggestions" on page 55.

TO FILL COOLING SYSTEM

Use water which is as free from lime and other impurities as it is possible to obtain.

PLATE No. 35



SIROCCO COOLING FAN

Ref. No.	Part No.	Name
1		Large fan.
2		Fan support.
3	M-1135	Whittle belt.
4	B-113 21153	Driving pulley (fan bevel box).
5	M-1030	Jockey pulley.
6	M-1193	Water tank.

17. Examine the radiator, pump, water jackets, piping, and all connections carefully to be sure that there are no leaks in the cooling system. (See Cooling system, p. 97.)

18. Fill engine-oiling system. Lubricating oil of the following properties is recommended:

ENGINE-OIL SPECIFICATIONS

High specific gravity oils.—This class includes all oils having a specific gravity above 0.9100 (or below 24° Baumé conversion by the Tagliabue Manual, ninth edition, or below 23.85° Baumé conversion by the Bureau of Standards' conversion table, Circular No. 57) having a pour test below 15° F. (Tested by the method of the American Society for Testing Materials).

Low specific gravity oils.—This class includes all oils having a specific gravity below 0.9100 (or above 24° Baumé conversion by the Tagliabue Manual, ninth edition, or above 23.85° Baumé conversion by the Bureau of Standards' conversion table, Circular No. 57) and having a pour test above 15° F. (Tested by the method of the American Society for Testing Materials.)

Physical properties and tests.—The oil must be made from pure, highly refined petroleum products, and must be suitable in every way for the entire lubrication of stationary cylinder aircraft engines operating under all conditions.

Viscosity.—The viscosity of the oil when tested in a Saybolt Universal Viscosimeter at 212° F., shall be as follows:

High specific gravity oil, 70 seconds to 75 seconds.

Low specific gravity oil, 85 seconds to 90 seconds.

Pour test.—The oil must pass the following pour test:

High specific gravity oil, not over 15° F.

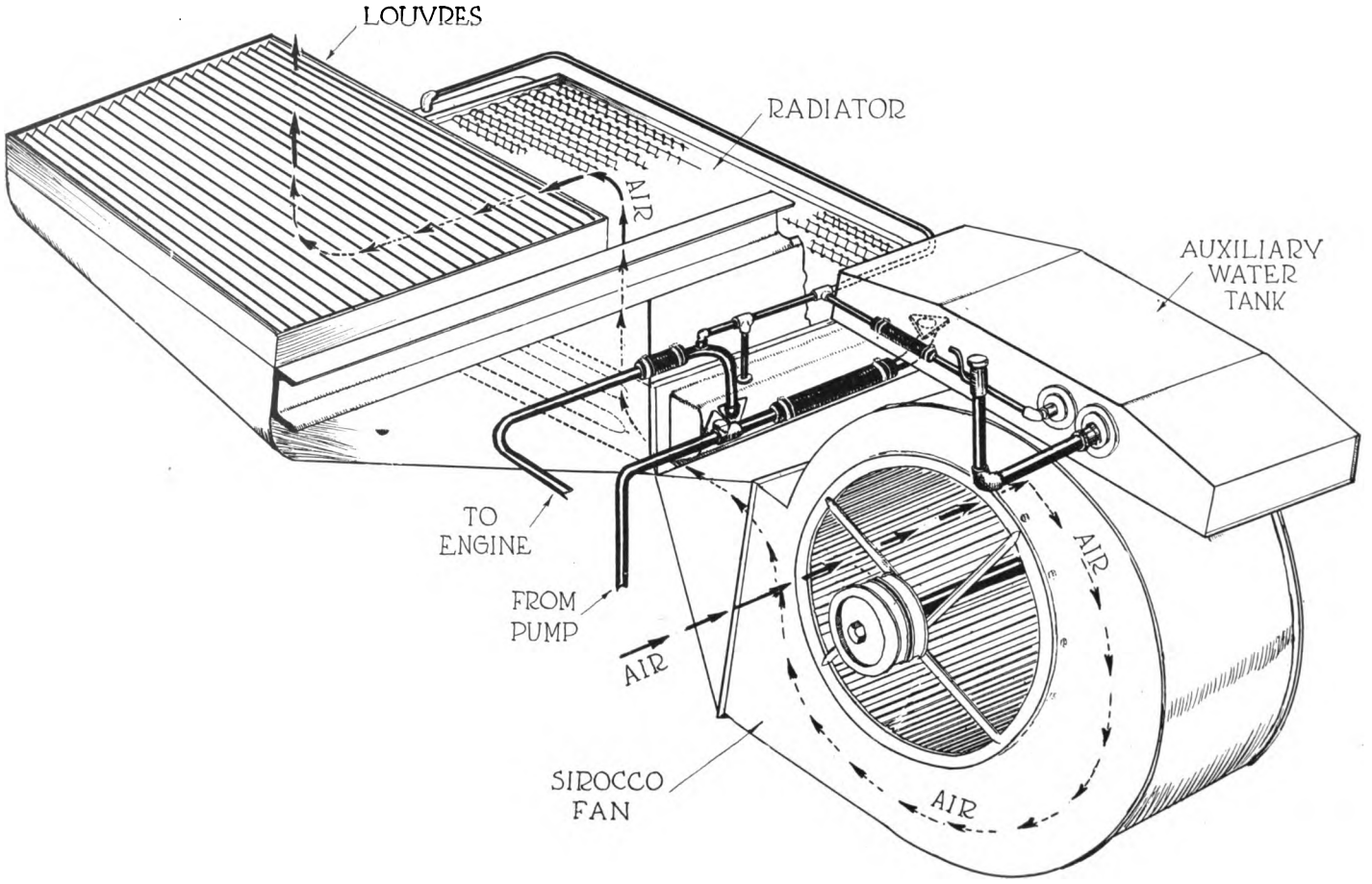
Low specific gravity oil, not over 40° F.

Flash point.—The oil must have a flash point over 350 degrees Fahr. in a Cleveland open cup.

Carbon.—The oil must not show a carbon residue of over 1.5 per cent by the Conradson method. The carbon shown must be loose and flaky and must break up easily in the crucible.

Emulsion test.—One ounce of oil shall be placed in a standard 4-ounce sample bottle with 1 ounce of distilled water. The mixture shall be heated to a temperature of 180° F. and then shaken vigorously for five minutes. After standing for one hour the oil must be clear and of the same color as before the test. All the water must have settled and appear only slightly cloudy.

All tests must be made in accordance with methods adopted by the American Society for Testing Materials. Detailed descriptions of the



COOLING SYSTEM

Conradson Carbon Test and the Pour Test have been reprinted in Signal Corps Specifications No. 3525, which will be furnished on application.

Physical properties and tests to be determined as follows:

Gravity: Baumé, at 60° F.

Flash: Cleveland open cup.

Fire: Cleveland open cup.

Viscosity: Saybolt Universal Viscosimeter, at 100°, 130°, and 212° F.

Pour test: American Society for Testing Materials' method.

Carbon: Conradson method.

Color: Lovibund.

FILLING ENGINE-OIL RESERVOIR

Remove plug on side of oil-pump housing during the process of filling the reservoir and allow it to remain out until oil flows from it.

Do not fill reservoir more than three-quarters full.

19. See that ignition switches are in "off" position and try compression of each cylinder separately by cranking the engine over slowly by means of the crank and "rocking" it up to each compression point. Any weak cylinders can readily be detected, either by the decreased resistance to cranking or by the hissing sound due to the leaking valve or spark plug.

Locate the weak cylinder in the following manner: Crank the engine over again, meanwhile watching the number 6–L exhaust valve. When this valve is wide open the piston in No. 1–L cylinder will be coming up on its compression stroke and just before the valve closes No. 1–L will have reached its point of highest compression or top dead center.

Now start from this point and crank the engine slowly past each compression period, at the same time calling off the numbers of the cylinders in their order of firing until the weak one is reached. For the causes of loss of compression see page 59. It sometimes happens that an engine will show uneven compression when cold, but will be all right at running temperature, so that it is not advisable to assume that anything is radically wrong with it until it has been warmed up and the compression tested again.

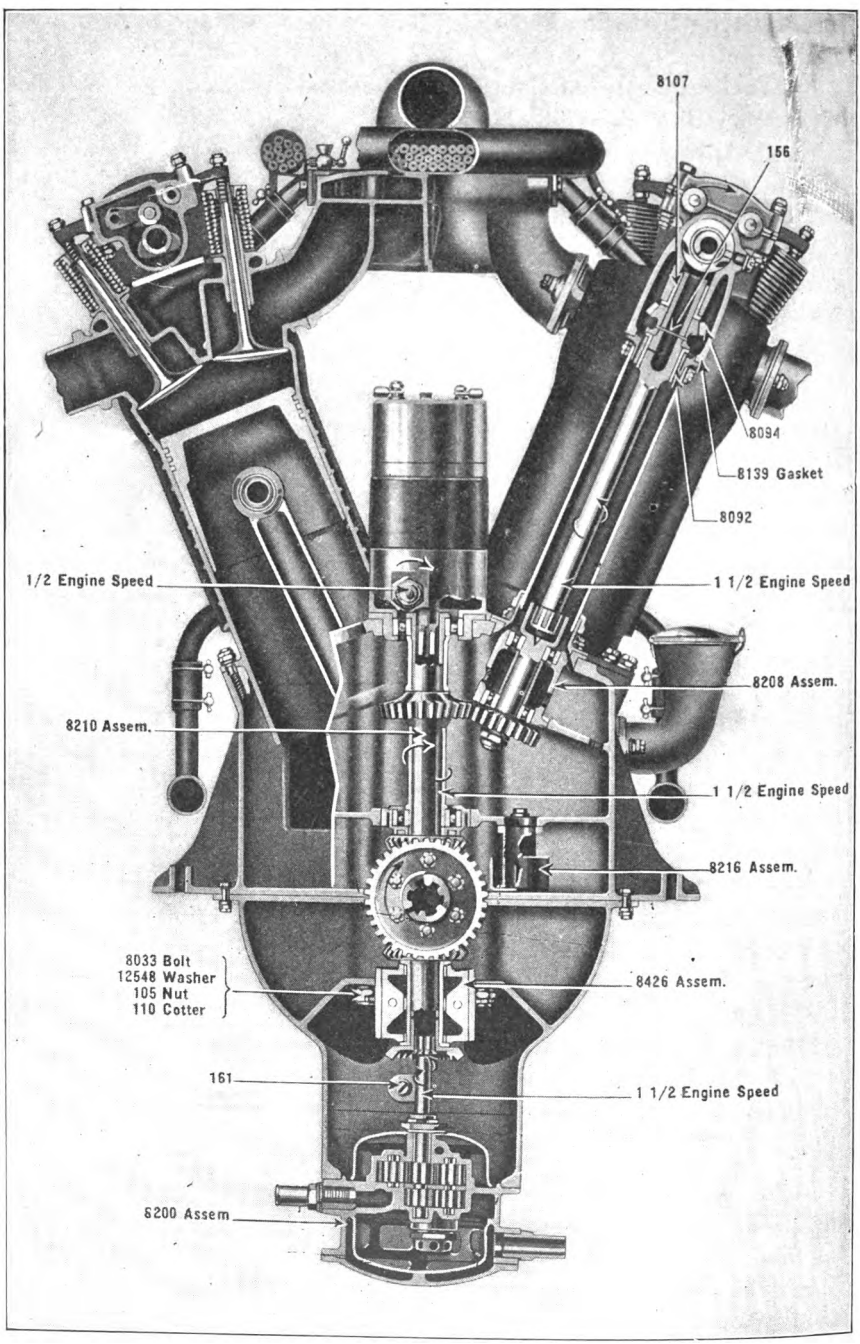
TO START ENGINE

Before starting a new engine, or one which has stood idle for some length of time, it is advisable to inject a small quantity of lubricating oil (about one-half ounce) through each priming cock. With the ignition switches "off," turn the engine over through five or six revolutions to distribute the oil over the cylinder walls.

Set throttle just slightly open; in other words, at a point which will run the engine at 600 to 800 r. p. m.

Set spark at fully retarded position.

PLATE NO. 37



VALVE AND PUMP DRIVE

The ignition system for Liberty engines is so designed as to absolutely prevent the production of a spark when turned backward, nor will the engine "kick back" if it should happen to "rock" after cranking. However, it is essential that the spark be retarded when cranking.

Prime engine by injecting a small quantity (fill priming cock twice) of gasoline through each priming cock. In cold weather it will be necessary to prime the engine a little more heavily than in warm weather. It is better, however, to insufficiently prime it than to prime it too heavily.

With the ignition switch still "off," turn engine forward two revolutions.

Turn one (either one) ignition switch "on," and start engine by means of the electric starter or hand crank.

The switch is so designed that with both switches turned "on" the generator is connected in, which will result in a rather high rate of discharge from the battery and possible difficulty in starting. Both switches should be turned "on," however, as soon as the engine is running.

As soon as the engine is started advance the spark about one-half way, leaving the throttle in approximately the starting position, and allow the engine to run at idling speed (about 800 r. p. m.) for five to ten minutes, or until it is thoroughly warmed up. At the same time test crank case temperature with your hand. The crank case should be warm by the time the temperature of the water has increased to 150° F.

Accelerate and slow down the engine occasionally to throw the oil up into the cylinders.

In extremely cold weather it is possible that the cooling water might warm up more rapidly than the lubrication oil. In this case it would be advisable to stop the engine for a few moments in order to allow the heat from the cylinders to travel down to the crank case.

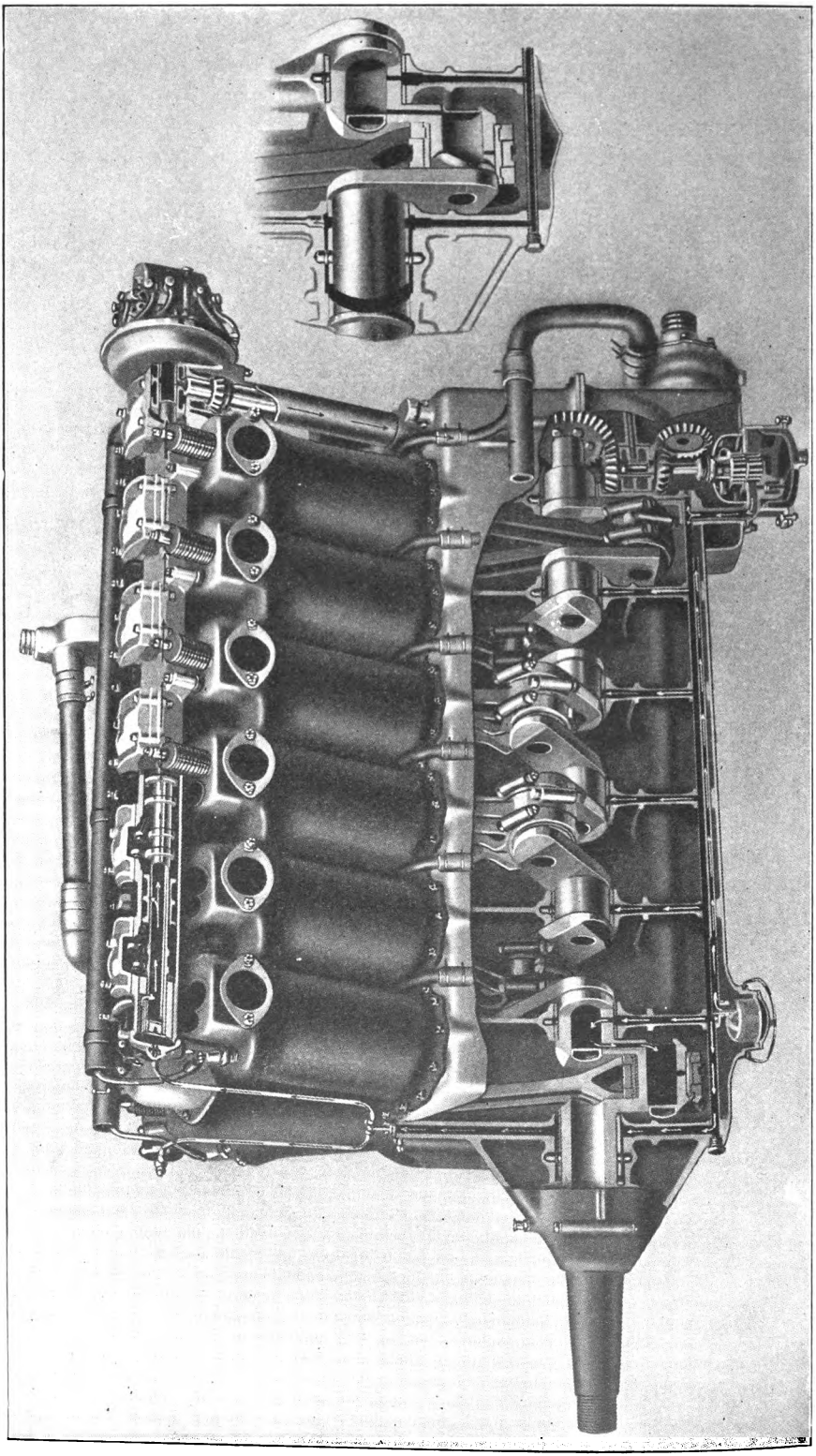
In the meantime—

Note the oil-gauge pressure. After about three minutes running at 600 to 800 r. p. m. this should show above 5 pounds pressure, and at 1,600 r. p. m. up to 30 pounds maximum. Failure to show these pressures may be due to dirt on the relief valve seat. The gauge will show higher pressures when the engine is first started, and is colder than after it has thoroughly warmed up.

Examine all oil piping for leaks.

AIR-PRESSURE GAUGE

Note air-pressure gauge.—The engine-driven air pump, with its regulator, is designed to hold the pressure on the gasoline tank at approximately 3 pounds. In order to determine whether or not the pump



ENGINE OIL SYSTEM

is functioning properly, screw down the pressure regulator adjusting screw. This should cause the pressure in the tank to rise if the pump is operating as it should. Now screw the regulator adjustment up until the pressure is held steadily at 3 to 4 pounds.

Note water circulation.—Temperature gauge should show a steady rise up to not to exceed 200° F. The most efficient temperature will vary with weather conditions, but will average 180° F.

Note ammeter reading.—At idling speeds the ammeter needle will stand on the "discharge" side of zero. At about 650 r. p. m., with both switches "on," the needle will stand at zero, and at high speeds it should stand on the "charge" side of zero.

When the engine is well warmed up the throttle may be opened partially (neutral gears) and the speed of the engine noted. Tachometer should show not over 1,350 to 1,400 r. p. m.

Operation of each ignition head should be tested separately by shutting off first one switch and then the other. The engine should show the same r. p. m. in each case. With the throttle wide open, whether the engine is running on one or both sets will make very little difference in the speed (possible 10 or 15 r. p. m.). At lower speeds (600 to 800 r. p. m.) the effect will be more apparent.

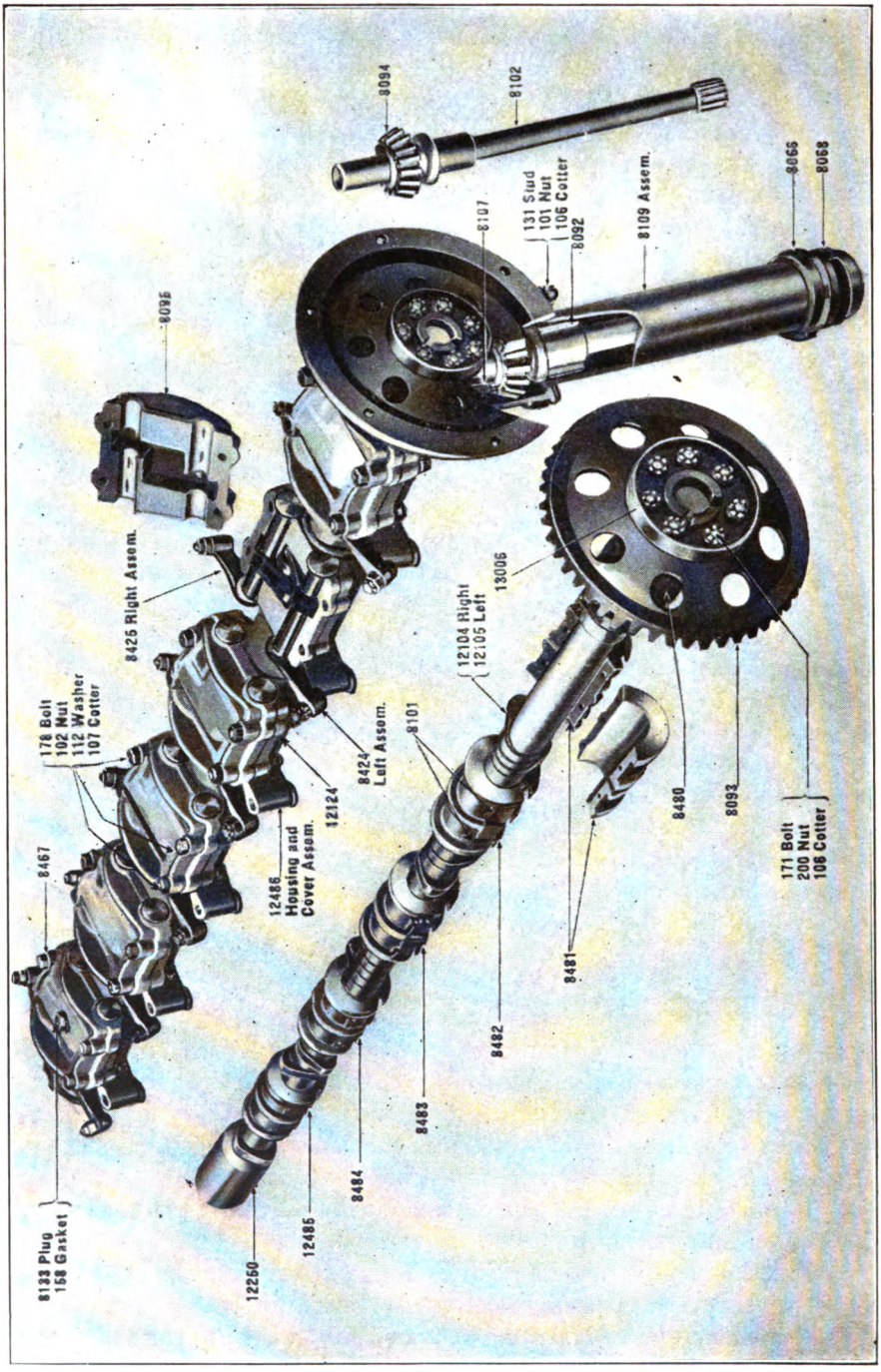
Before stopping the engine, throttle it down to idling speed for a minute ot two, then turn the ignition switches to "off," and at the same time open the throttle wide. Opening the throttle will "choke" the engine and cause it to stop immediately. Allowing the throttle to remain in the idling position may permit an overheated plug or particle of carbon to fire the engine spasmodically for some time after the ignition is cut off.

Caution.—Do not attempt to crank an engine immediately after it has been stopped. An overheated plug or incandescent particle of carbon might cause preignition and a disastrous back kick. Allow it to cool off for a few minutes.

COLD-WEATHER SUGGESTIONS

1. Inspect the engine carefully, as instructed on pages 57 to 65.
2. Put 3 gallons of hot lubricating oil into the engine crank case. Oil should be heated in an open-top container set into boiling water.
3. Put a sufficient quantity of hot oil into the oil reservoir, so that the reservoir will be about two-thirds full after the 3 gallons placed in the crank case have been pumped back into it.
4. Remove the vent plug in the side of the oil-pump body so that the hot oil may run in to prime the pump.
5. Fill the cooling system with boiling water. Soft water should be used wherever available. Do not use any antifreeze preparation.
6. Prime the engine and start at slow speed with the throttle partially closed.

PLATE NO. 39



CAMSHAFT ASSEMBLY

7. Accelerate and slow down the engine occasionally to throw the oil up into the cylinder. Run the engine until the oil has been thoroughly distributed as indicated by the action of the oil-pressure gauge and a uniform temperature of the engine. This period need not be continuous, and, if possible, engines should be alternately run for a few minutes, stopped for five minutes, and then restarted.

8. If the machine is not run at once the engine should not be allowed to remain stationary for more than 10 minutes at a time, as it will get cold again.

TO DRAIN ENGINE

9. After finishing a test or run, drain all oil and water before the engine has had an opportunity to cool off. Plug No. 250 and sump cover No. 8129 should be removed to drain the oil from the engine. A plug of the same number (No. 250) is provided in the bottom of the water pump for the purpose of draining the water.

10. Spark plugs should be removed from the engine and kept in a warm place if the engine is to stand idle overnight or for any considerable period.

ENGINE TROUBLES

The diagnosing of gasoline-engine troubles is largely a matter of experience on account of the fact that a symptom may be due to any one of a number of causes. A correct conclusion can only be arrived at by a process of elimination. The different causes, as set forth in the table which follows, have been arranged in the order in which they most frequently occur.

Try one thing at a time and in the order given in the table. Once the trouble is located the remedy should be obvious. It is essential that any troubles be remedied immediately when they are located; otherwise serious damage or the entire failure of the engine may result.

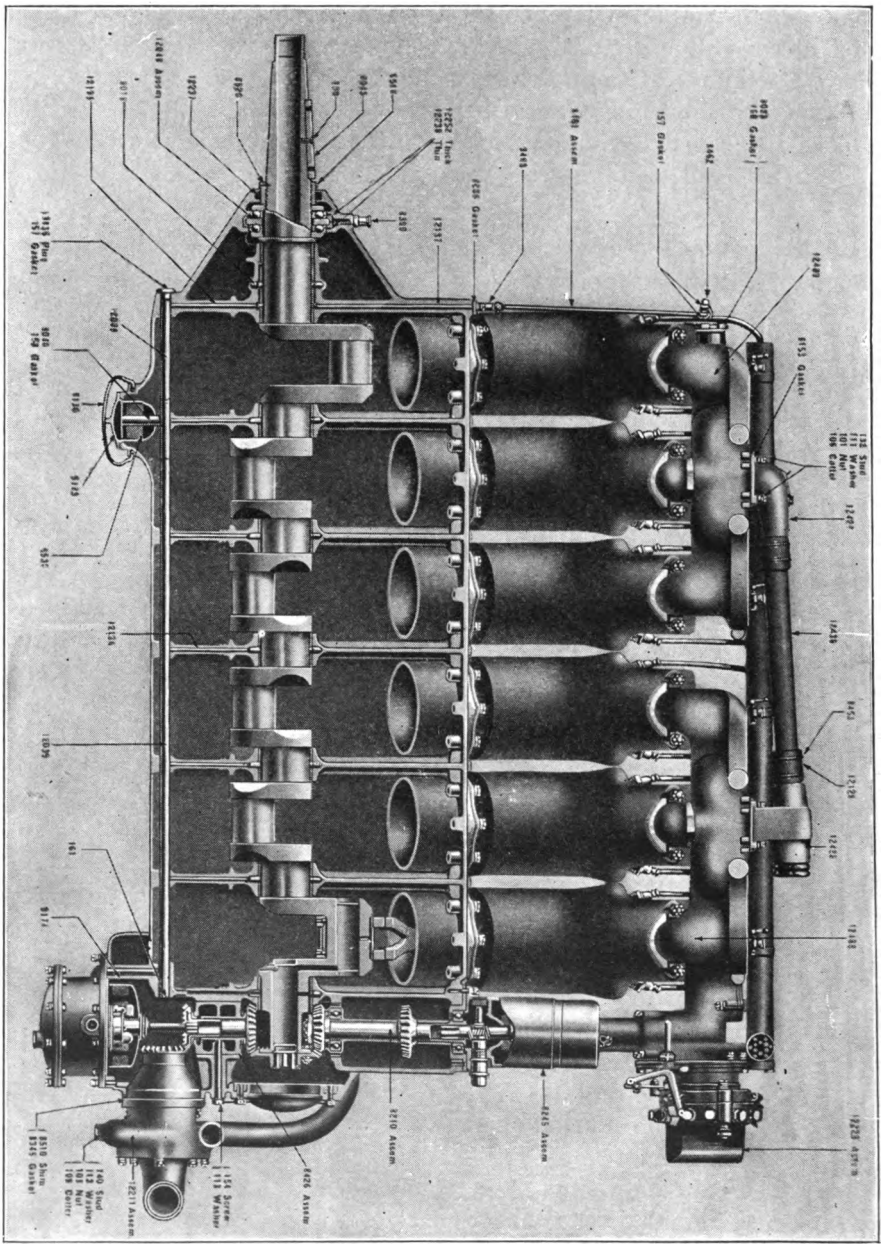
If the engine can not be turned over under reasonable pressure:

1. Examine water pump for ice.
2. Examine gears for obstruction.

If engine fails to start, it may be due to any one of the following causes:

1. Lack of gasoline.
   Examine tank.
   Examine shut-off cock.
   Examine trap.
   Examine piping.
   Examine hose connections.
   Examine carburetor float valve.
2. Primed too heavily.
3. Insufficiently primed.

PLATE NO. 40.



LONGITUDINAL ENGINE SECTION

4. Throttle too wide open.
5. Throttle not opened wide enough.
6. Water in carburetor.
7. Battery not up to full strength.
8. Loose connection at battery, switch, distributor.
9. Broken wire.
10. Dirt or moisture on outside or inside of distributor.
11. Wires improperly connected.
12. Ignition incorrectly timed.
13. Air leak in intake manifold.
14. Valves improperly timed.

If engine stops:

1, 6, 8, 9, 10 above.

1. Throttle control loosened up or disconnected.
2. Overheated.

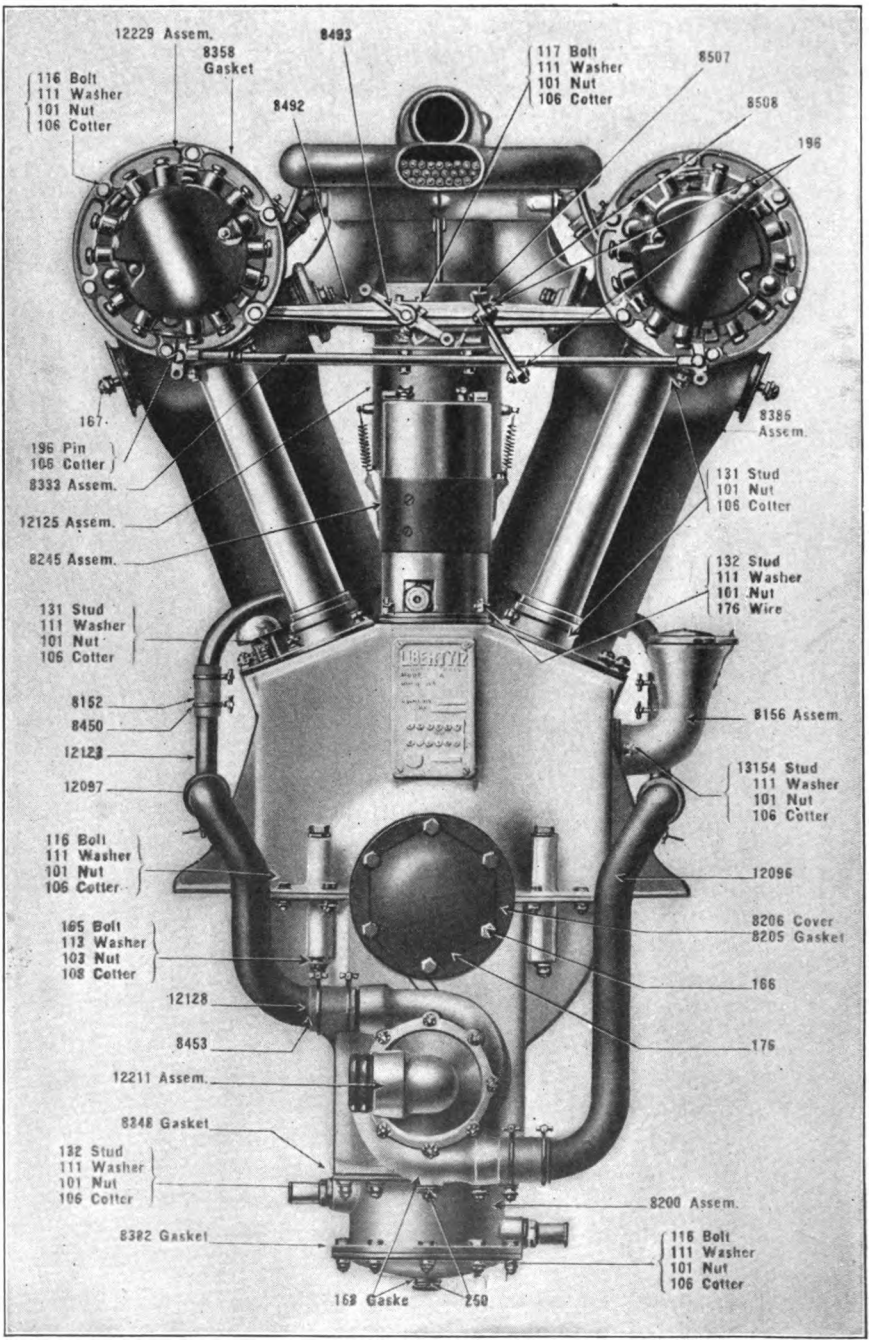
If engine misses:

1. Loss of compression.
   Valve sticking.
   Valve seat caked with carbon.
   Tappet improperly adjusted.
   Valve warped.
   Valve spring broken.
   Cylinder or piston scored.
   Rings broken or sticking.
2. Spark plug loose or defective.
3. Rocker arm too tight.
4. High-tension insulation defective.
5. Moisture or dirt in distributor.
6. Water or dirt in carburetor; examine jets.

If engine fails to develop power:

1. Insufficient throttle opening.
2. Insufficient spark advance.
3. Insufficient gasoline supply.
   Piping or stop-cock capacity too small.
   Obstruction in piping.
   Obstruction in trap.
   Pressure leak.
   Insufficient pressure—if pressure-feed system.
   Obstruction in one or more jets.
4. Improper carburetor adjustment. (See carburetor.)
5. One or more cylinders missing fire. (See above.)
6. Engine overheated. (See below.)
7. Air leaks—intake manifold.
8. Obstruction in carburetor intake.
9. Water in gasoline.

PLATE NO. 41



DISTRIBUTOR END OF ENGINE

10. Excessive carbon.
11. Poor gasoline.
12. Weak battery or defective generator.
13. Exhaust manifold or pipes of insufficient capacity.

If engine overheats:

1. Insufficient water.
2. Insufficient radiator area or capacity due to covered radiator.
3. Water pipes dented or broken.
4. Obstruction in water piping or radiator.
5. Failure of water pump.
6. Insufficient oil.
7. Failure of oiling system.
8. Improper carburetor adjustment.
9. Excessive carbon.

ENGINE INSPECTION

To insure engines rendering the maximum service they must be inspected daily or at least after every five hours' run. It is advisable that these inspections be systematically carried out and that the inspector or squad foreman be provided with a form covering the points set forth in the chapter following. Inspectors should be instructed to rigidly adhere to this form and check the different items off as they are attended to.

1. Examine all valve springs carefully.
2. Squirt a little light oil through the valve springs onto each valve stem.
3. Examine throttle, spark and all other adjustment controls. Be sure that they work freely; permit full throw of throttles and distributors that have not become excessively loose.
4. Test all cylinders for compression.
5. Try rocker arms—they should all be free when the valves which they operate are seated.
6. Check tappet gap of all valves-piston at firing point.
7. Check valve timing with timing disk.

COOLING SYSTEM

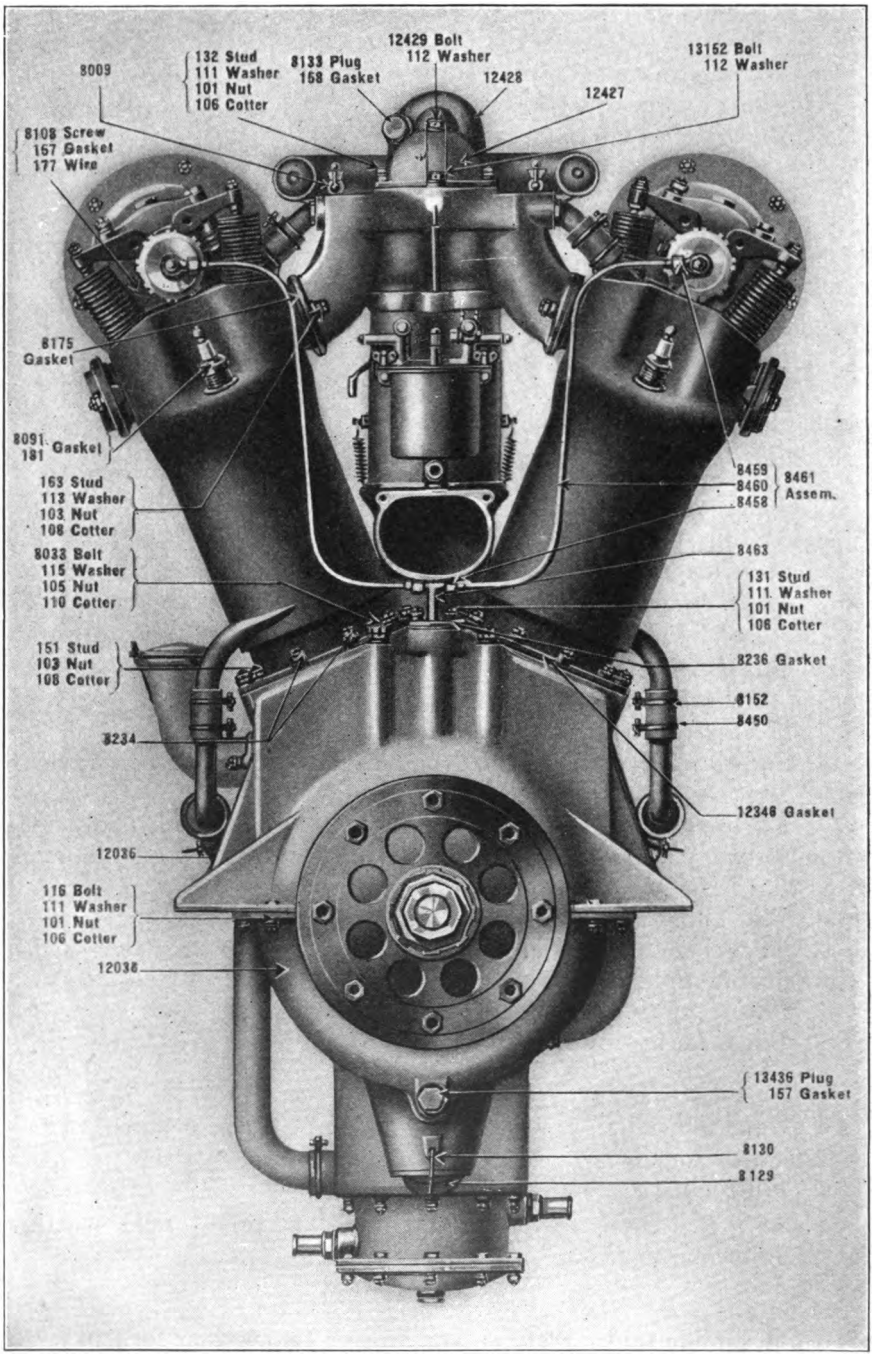
8. Examine radiator, water piping, pump, water jackets, and all connections for leaks.
9. Fill cooling system.

NOTE.—If temperature is below freezing, follow cold weather instructions on page 55.

GASOLINE SYSTEM

10. Examine tanks, trap, piping, and all connections for leaks.
11. Drain water trap.
12. Fill gasoline tanks.

PLATE NO. 42



PROPELLER END OF ENGINE (AVIATION TYPE)

OILING SYSTEM

13. Drain system by taking out plug No. 8133.

14. Remove rear pump cover plate which will release oil-pump screen No. 8220.

15. Clean screen thoroughly with a brush and gasoline.

16. Replace screen and cover plate using a new gasket, No. 8382, if the old one was damaged in removing cover.

17. Examine reservoir, cooler, and all piping and connection for leaks.

18. Oil thrust bearing.

19. Replace all hose connections, either for water, oil, or gasoline, which show any signs of deterioration.

ELECTRICAL EQUIPMENT

20. Examine all electrical connections at generator, regulator, switch, battery, and distributor to see that they are clean and tight.

21. Examine all wiring to see that insulation has not become abraded.

22. Clean distributors as instructed on page 67.

23. Oil generator and tachometer drive.

24. Examine plugs for cracked or loose porcelains. This should preferably be done immediately after the engine is stopped and while the plugs are still hot.

25. Check contact-breaker clearance and examine contact points.

26. Check timing of ignition and synchronization of distributors.

Caution.—Leave the ignition switches and the gasoline shut-off cock in the "off" position.

If the switches are left "on," the battery will discharge through the ignition system and generator, and it will be necessary to either recharge or replace it before the engine can be started again. With both switches turned off, the ammeter needle should stand approximately at zero.

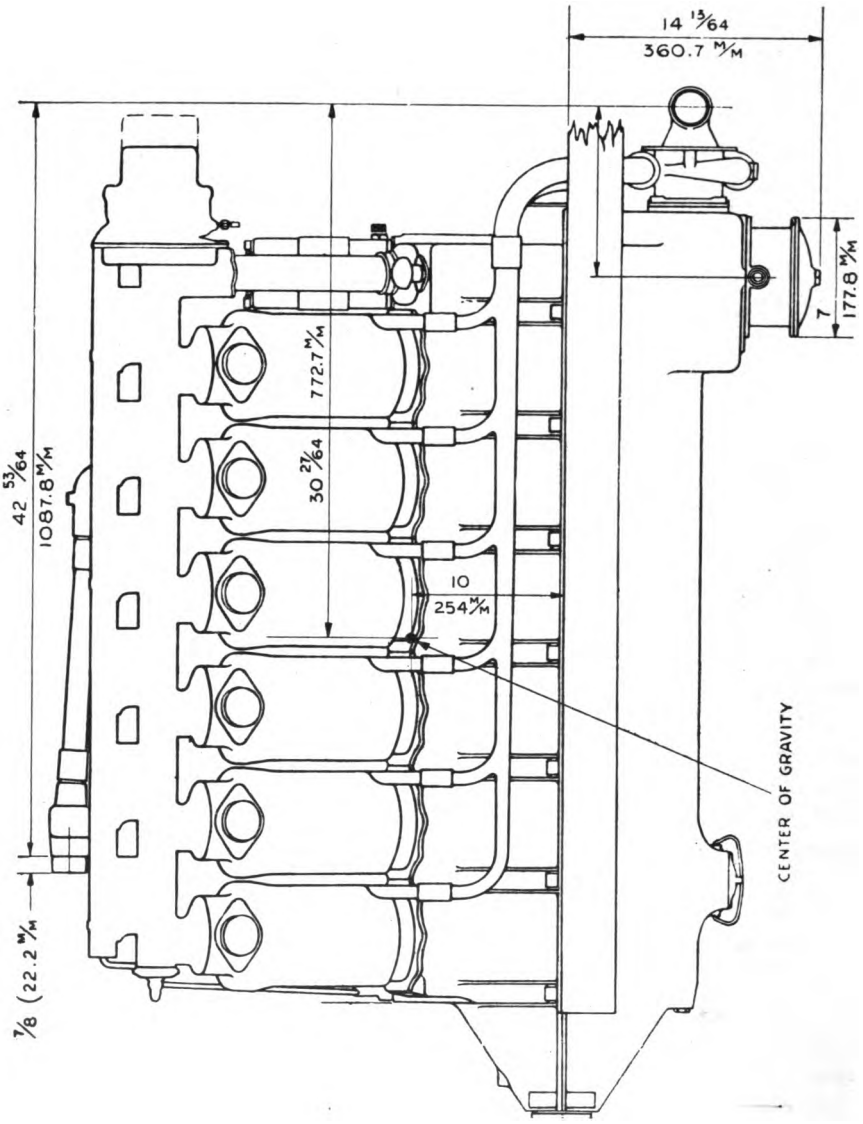
ENGINE OVERHAUL

U. S. A. standardized engines are made up of a combination of units or assemblies, and the units in turn of a number of subassemblies. In the chapters which follow the various units are described in the order in which they should be dismounted.

A list of parts (names and numbers) composing each unit is in the back of the book.

It will be found that time and space can be saved and confusion of parts avoided if each assembly be disassembled, inspected, and overhauled as it is dismounted. Then assembled and laid to one side until such time as the whole engine is ready to reassemble. The combining of the subassemblies into a complete engine is outlined on page 101.

PLATE NO. 43



OUTLINE DIMENSIONS (AVIATION MOUNT SHOWN)

Shorter and better methods of handling the work may be developed, but, in the main, the plan outlined here will be found most satisfactory.

A bench or other suitable place on which parts and tools may be laid out should be provided.

The mechanic should form the habit of laying out his tools in a definite order so that the one desired may be readily reached.

Have a bucket of kerosene handy in which parts may be washed.

Waste should not be used for wiping parts. Threads or lint are likely to stick to the surfaces and eventually find their way into oil passages. Pieces of clean cloth or rags are preferable.

Nuts such as those used to hold the cylinders down on the crank case should be screwed onto their proper studs after disassembling—not only to protect the studs but to avoid confusion in reassembling.

Cotter pins and lock wires which have been badly bent should not be used again.

Great care should be taken to prevent pieces of cotter pins, lock wire, chips, or any small parts from falling into the crank case or any part of the engine. They might work into the gears or oil passages and cause immeasurable damage.

Have an oil can, full of clean oil, handy at all times. Oil all bearing surfaces before assembling.

Oil all parts which are press or drive fit.

Oil all bolt and stud threads.

Exhaust manifold studs should be greased with a graphite paste.

Each step in the process of assembling should be finished as the work progresses. Do not leave a bolt loose or a nut not cottered with the idea of coming back to it later on.

Never "slack off" or loosen a nut in order to line up the notch in the nut with the cotter pin hole in the bolt or stud. If it cannot be tightened still further with reasonable effort in order to bring the next notch in line, replace it with another nut.

All subassemblies, as they are overhauled and put together, should be covered to protect them from dust and dirt.

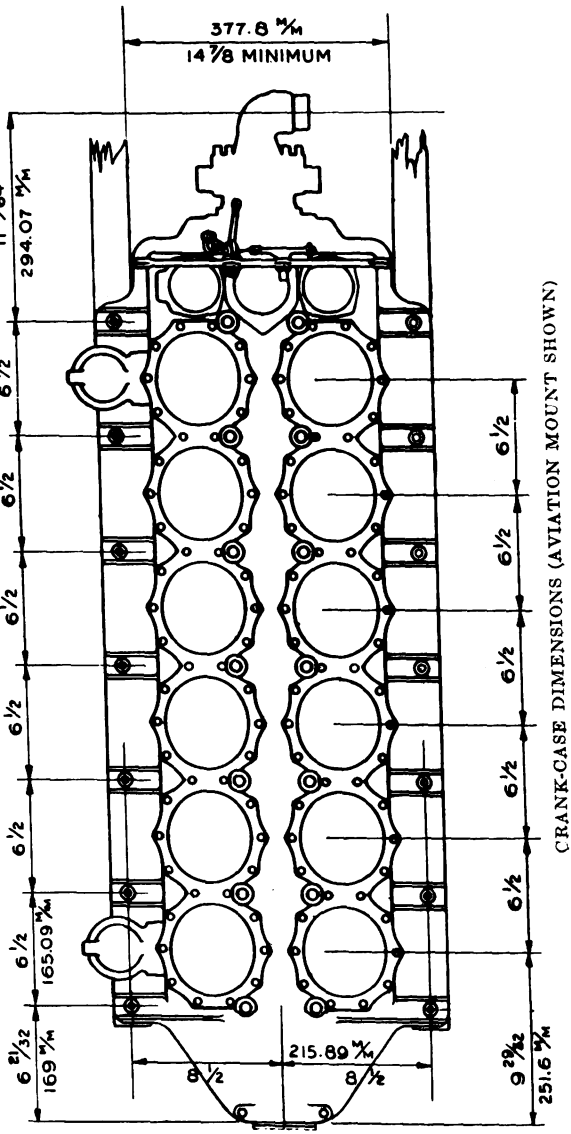
DISTRIBUTORS

To return to the distributors—the circuit-breaker mechanism for each head is identical with that used in any high-grade magneto with two exceptions, as follows:

Two main circuit breakers, connected in parallel, are provided instead of one. The two breakers are timed to operate simultaneously and are provided in duplicate as a precautionary measure.

An auxiliary circuit breaker, the function of which is to prevent the production of a spark when the engine is turned backward or "rocked,"

PLATE No. 44



CRANK-CASE DIMENSIONS (AVIATION MOUNT SHOWN)

is also provided. This auxiliary breaker is connected in parallel with the other two through a resistance unit which reduces the amount of current flowing through it. The breaker is so timed that it opens slightly before the other two when the engine is turned in a forward direction. The opening of the main breakers then results in the production of a spark. When the engine is turned in a *backward* direction the two main breakers open first and no spark is produced, due to the fact that the current continues to flow through the coil through the auxiliary breaker but in diminished quantity, due to the resistance unit. By the time the circuit is opened at the auxiliary breaker, the intensity of the magnetic field of the coil has weakened to such an extent that no spark is produced. A transformer coil is incorporated in the Bakelite cover of each distributor head.

HIGH-TENSION WIRING—DISASSEMBLING AND INSPECTION

Disconnect all high-tension cables from the spark plugs.

Remove the screws No. 201 which hold the cable tube clips No. 12283 in place.

Release four clips and unscrew two composition nuts on each distributor head.

The distributor head, cables, and cable tube may now be lifted off together. They should be handled carefully to prevent any possibility of breaking the distributor covers and damage to the cable.

Examine these cables carefully, especially at any point where they may be sent sharply or where they may come in contact with any metal parts. See that the insulation is intact and that the terminals are firmly attached.

Examine inside surface of distributor cover and particularly the contact segments and the path of the rotor brush. The surface should be smooth and free from scores or scratches.

Wipe out any carbon dust carefully with a soft cloth moistened with alcohol or gasoline.

Examine the distributor shaft for lost motion between the distributor driving flange and the driver. This should not be more than enough to allow about one-sixteenth-inch motion at the end of the rotor arm.

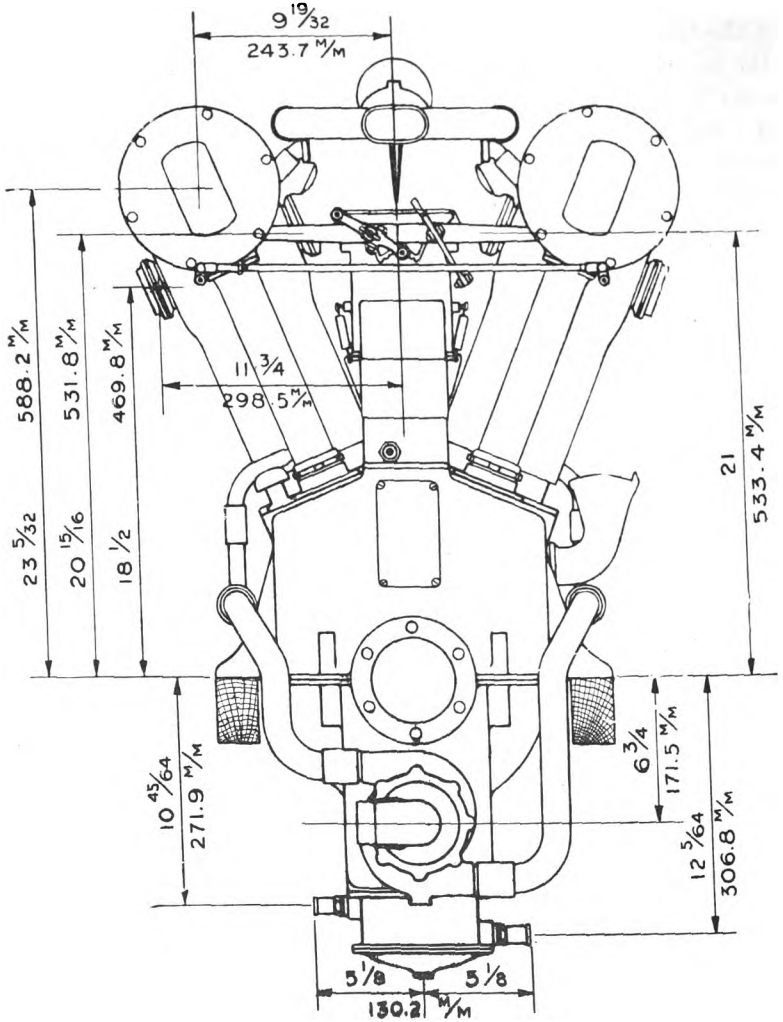
DISTRIBUTOR BASE

Disconnect the cross reach No. 8333 between the two distributor assemblies and take out bolts No. 116 from the distributor-base flanges. This will permit the distributor-base assemblies to be taken off.

Check the gap on each breaker with a thickness gauge. This can best be done with the breaker block on the wide lobe of the cam. The gap for all three breakers should be from 0.010 to 0.013.

Examine the condition of the contact points. These points should be bright, and in case they have become pitted to any extent they can be smoothed down on an oilstone. They are very hard and it will be impossible to file them.

PLATE NO. 45



DIMENSIONS FRONT ELEVATION (AVIATION MOUNTING)

Examine the rubber buffers against which the breaker-arm springs bear. These rubber buffers are vulcanized to the breaker arm, and in case they have deteriorated to any extent due to contact with oil the whole breaker-arm assembly should be replaced.

Examine the breaker-arm springs. Be sure that they have not begun to crack around the slotted hole through which they are bolted to the bus bar. The tension of the spring on the auxiliary or middle

breaker should be from 16 to 20 ounces when the contact is open. The tension on the main breaker-arm springs should be from 28 to 30 ounces when the contact is open.

Examine the resistance unit through which the current passes to the middle breaker. The coils of this resistance unit should be separated throughout the length of the unit. If the coils of resistance wire come in contact with one another, the total resistance of the unit will be decreased and the proper functioning of the middle breaker will be impaired.

Examine the condition of the face of the cam. This should not show excessive wear and should be nicely burnished.

Examine the condition of the fiber blocks which bear against the cam surface. The fiber should extend approximately $\frac{3}{64}$-inch beyond the metal and show a smooth bearing surface.

Examine the carbon brush in the end of the rotor arm. If the brush has worn down to such an extent that it is less than $\frac{1}{4}$-inch long, a new brush should be fitted. In putting in the new brush and spring, press the brush into place in the rotor arm with a small punch as far as possible. This will properly seat the spring and will prevent the brush from extending too far out of the guide. The rotor brush is a special composition and requires no lubrication.

Examine the ball bearings which carry the distributor cam shaft for radial and lateral lost motion. This should be only barely perceptible. If it is deemed advisable to replace one or both of these bearings, the rotor arm should be removed by taking out the screw D (see fig. 16). The shaft may now be driven out through the cam. This should be done with a small punch which will permit the key to remain in the cam. In reassembling the distributor the bearings should be packed with vaseline and the felt washer with which each cam is filled should be thoroughly saturated with a good light oil. This oil will work out through the small holes drilled in the face of the cam and will properly lubricate the contact arm blocks. It is advisable also to put a little vaseline or thin grease on the outside surface of the cam. The studs on which the contact arms are mounted should also be oiled. Be sure that the contact points are properly adjusted and the lock nuts are drawn up snugly.

The transformer coil is built into the distributor housing cover. All connections are made inside and the whole is covered by a fiber plate which is sealed in place. It is not advisable to remove this cover plate for any purpose whatsoever.

In replacing the rotor arm be sure that the drive pin in the cam properly enters the hole in the arm.

Information as to timing and adjusting the distributor assemblies will be found under the heading of "Timing ignition" (p. 107).

TO DISMOUNT THE GENERATOR

Remove the four nuts No. 101 and washers No. 111, which will permit the generator to be lifted off.

DISASSEMBLING AND INSPECTION

Examine the condition of the splines or keys on the lower end of the shaft. These should not show undue wear.

The tachometer drive assembly complete can be removed by screwing out the bearing assembly (see engine illustration). This will permit the worm-gear shaft to be withdrawn. The worm gear and the bronze bushings in which the shaft runs should now be examined as to their condition. They should be free from bad cuts or scores. Before inserting the shaft again in the bearing the recess between the two bushings should be filled with vaseline or other light grease.

Remove the cap from the upper end of the generator by taking off the two terminal nuts.

Examine the condition of the commutator and brushes. In case the commutator is burned or rough it should be polished with a very fine piece of sandpaper. The best possible condition of the commutator is shown when it takes the form of a bluish polish, which should not be mistaken for a burned commutator. When the commutator carries a blue polish on it, it should be allowed to remain this way and only receive an occasional wiping off with a soft rag.

In case the commutator is badly cut or scored, it should be turned down in a lathe a sufficient amount to smooth it up. The mica should then be "undercut." This work should only be done at a base repair shop and by experienced mechanics. If the commutator was found to be scored, the brushes will also be in bad condition. These brushes are soldered to the brush holders and in case of a replacement a new brush holder and brush should be fitted. Brushes that have been roughed up or new brushed should be sanded to fit on the commutator by wrapping a strip of very fine sandpaper at least halfway around the commutator and drawing it through one brush at a time. This will form the brush to the curvature of the commutator. It is essential that the brushes properly fit the commutator and the work should only be done by an experienced mechanic.

Examine the wire leading from the field coils to the generator terminal and its connection with this terminal. Any dirt or excess oil should be wiped off before replacing the cap.

The ball bearing on the upper end of the generator shaft can be lubricated through the oil cup in the cap.

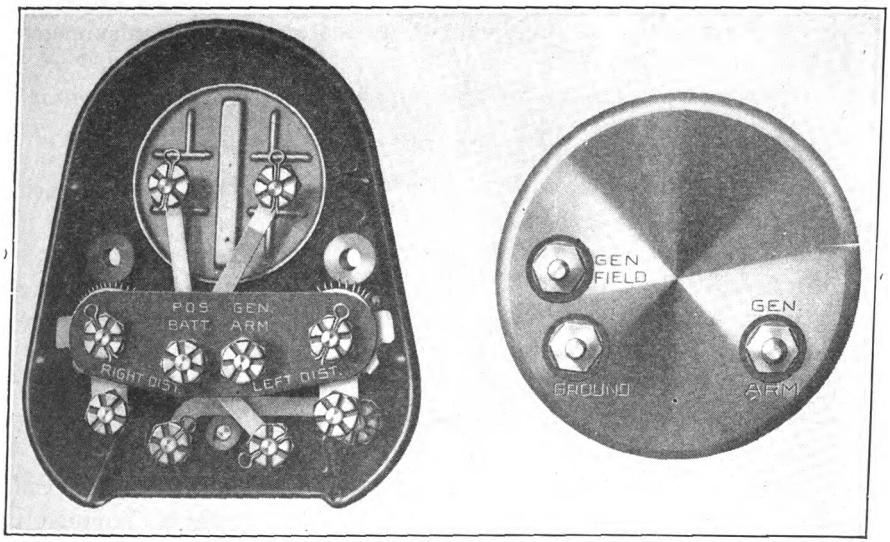
This bearing should receive a few drops of oil after every long run, but should not be lubricated excessively, as the oil is likely to run down over the commutator.

VOLTAGE REGULATOR

This device, which is typical design, consists of an iron core on which are wound three coils, the connections of which are shown on the circuit diagram. The frame of the regulator carries a pivoted armature fitted with adjustable contact points at one end. The contact points are normally held together by an adjustable spring.

The function of the voltage regulator is to prevent the generator from delivering more than a predetermined supply of electricity. The regulator will need practically no attention with the exception of an occasional checking up of the constant separation and the length of the brass pin set into the opposite end of the armature.

PLATE No. 46



IGNITION SWITCH

This pin should extend from 0.043 to 0.045 inch above the surface of the armature. When the armature is pressed down so that this pin bears against the end of the core, the gap between the contact points should be from 0.005 to 0.007 inch. If the contacts are burned or pitted they may be smoothed down with an oilstone. The tension of the adjusting spring should not be altered except by an expert and with the aid of proper instruments. See that all terminals are clean and tight.

IGNITION SWITCH

The ignition switch should be inspected each time the engine is taken down for overhauling.

Two resistance units are mounted on the back of the ignition switch. These units should be examined to see that the coils do not

come in contact with one another. If this should happen the total resistance of each unit would be reduced, which would result in the burning of the distributor contact points. It would also affect the proper functioning of the auxiliary contact arm in the distributor. If these resistance units should burn out entirely it would shut off the ignition.

The three screws A should be removed and the switch contacts under the cover examined to see that they have the proper tension and that they are clean.

The ammeter which is part of the switch should require no attention. In case the pointer sticks the instrument should be replaced, as it is very important that the ammeter should indicate accurately, so that the exact condition of the generator, voltage regulator, and the ignition can be determined.

It is advisable that the replacing of a resistance unit or an ammeter be done at the base repair shop.

Caution.—Always leave the ignition switches in the "off" position.

CARBURETOR

Two ball and ball double vertical carburetors are used on each Mark VIII machine. These operate as follows:

The carburetor has two important functions to perform:

First. To deliver to all the cylinders of the engine at all times a mixture of gasoline and air of the right quality to meet the requirements in the matter of power and economy.

Second. To so thoroughly atomize the gasoline and mix it with air in the carburetor that when it reaches the intake header there will be equal amounts of gasoline going to all the cylinders.

NOTE.—The first function is largely dependent on the efficiency of the second and can not be satisfactory unless the second is properly arranged.

The unusual conditions under which the Mark VIII tractor operates (going into and climbing out of the holes on grades as steep as 50°—degrees not per cent) make it necessary that the carburetor perform another function, i. e., meet satisfactorily functions 1 and 2 when operating on grades of 50° uphill and down.

CARBURETOR DESCRIPTION

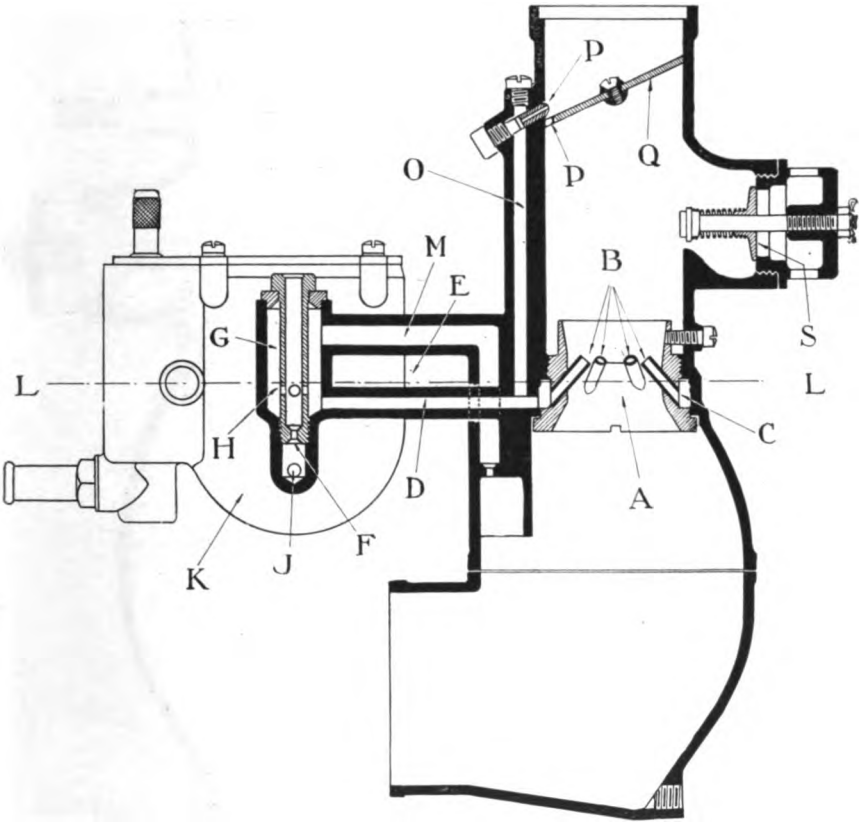
On page 73 is a diagrammatic section intended to illustrate the principle of operation.

The gasoline level is indicated by the line L—L and by means of a pivoted spherical float the level of gasoline remains at the center of the sphere regardless of the angle of the carburetor.

The throat A has tubes B extending well above the gasoline level inside the throat and below it on the outside in the annulus C. This

annulus C is connected by passage D with an intermediate mixing chamber E. The chamber E has in it a vertical hollow screw G closed at the top and having the gasoline orifice F and the overflow orifices H located at or a trifle below the gasoline level. The air passage M connects the chamber E with the space below the throat through the orifice N. The by-pass orifice P connects through O with the passage D, and this orifice P is located just above an orifice

PLATE NO. 47



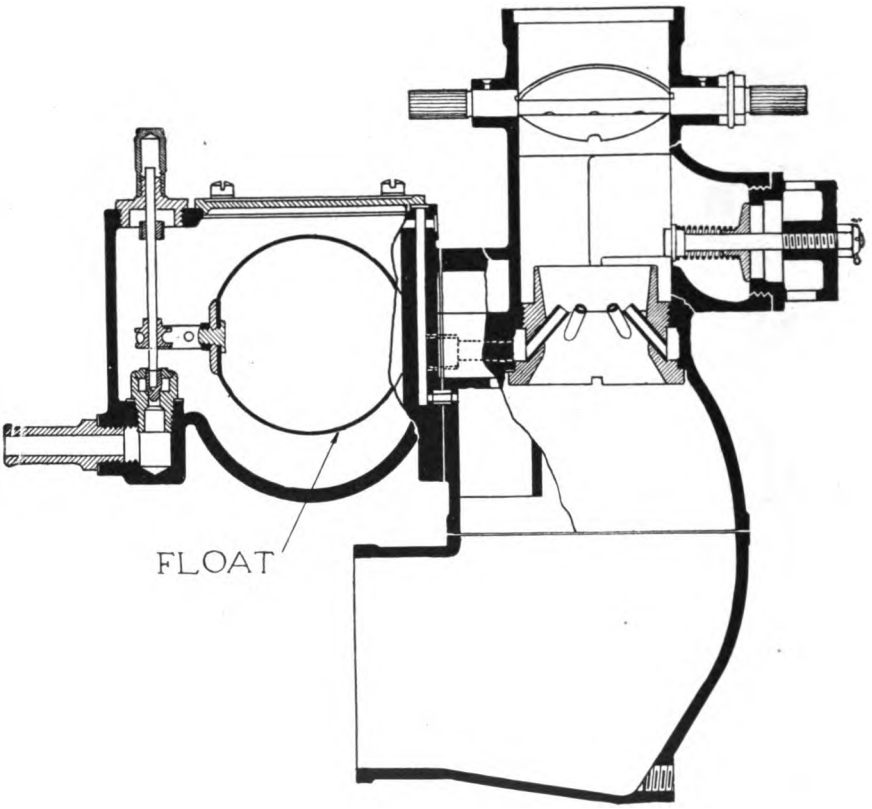
SECTION THROUGH CARBURETOR

R in the throttle Q. An air valve S is shown, but this is not an essential element. Its use and purpose will be explained later.

The suction impulses of the engine produce a partial vacuum in the intake header which is communicated to the carburetor and induces a flow of air through the throat A and the tubes B. The flow of air through A owing to its ejector effect on the tubes B induces a much higher vacuum in B than in the space above the throat A. This added force is of great importance in breaking up the gasoline. The vacuum in the tubes B is communicated through the

annulus C and the passage D to the intermediate mixing chamber E, in which the vacuum is somewhat lower than in the tubes B because of the flow of air through the orifice N and the passage M to E. The vacuum in E extends through the overflow orifices H to the gasoline orifice F and causes gasoline to flow from the float chamber through the hole J and the metering orifice F and the holes H to the chamber E where it is mixed with air from M and in the form of foam is drawn through D and out of the tubes B in such a broken-up con-

PLATE No. 48



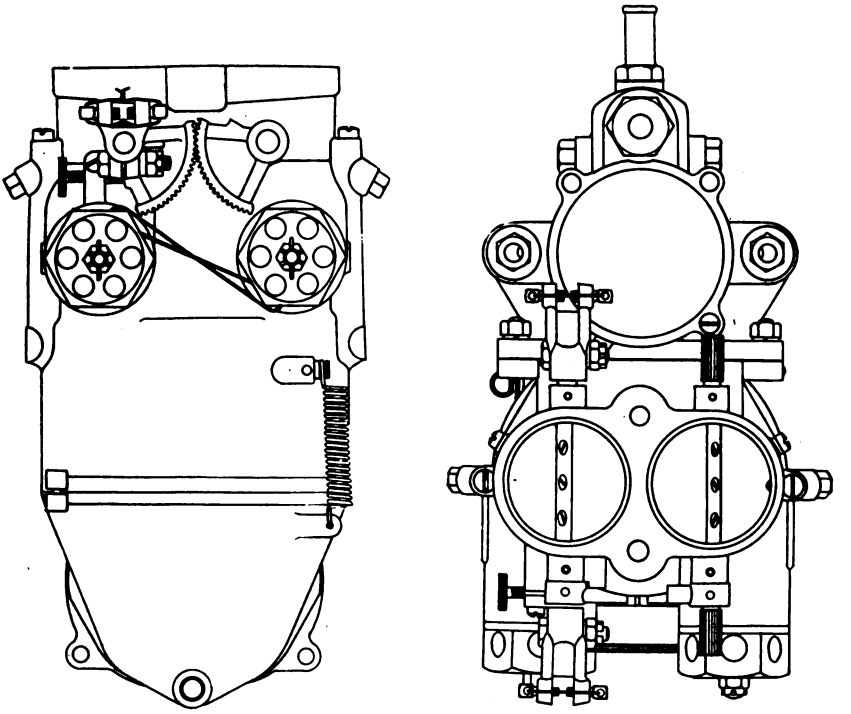
CARBURETOR JETS AND VALVES

dition that complete atomization is easily effected by the main air stream through throat A.

The reason why this carburetor requires no compensating device is that the overflow point is at or a trifle below the gasoline level, and as there is no initial head (or elevation of the overflow point above the gasoline level) to overcome gasoline begins to flow simultaneously with the air flow, and as the law governing the flow of gasoline through the orifice F and air through the throat A are identical it follows that the quality will be uniform throughout the full range of operation.

At idling speeds the velocity of air through the throat A is not great enough to be positive in its action in carrying the gasoline up to the throttle valve Q. To take care of this condition a by-pass P is arranged to discharge just above an opening R in the throttle Q. This by-pass with a very high vacuum at the discharge P draws a rich mixture of gasoline and air through O and D from the intermediate mixing chamber E. This is discharged at an angle across the orifice R in throttle Q, which further breaks it up and at the same time provides the correct amount of air to make the best firing mixture.

PLATE NO. 49



OUTLINE OF CARBURETOR

As the throttle is progressively opened the vacuum at P is reduced and at B is increased until a point is reached where both P and B are discharging. Further opening of the throttle makes all of the gasoline discharge from B, but as the source of the mixture is at all times the intermediate mixing chamber E there is no change of law governing the flow of air or gasoline and the mixture is correct at all times.

AIR VALVE

In all carburetors, and particularly in large ones, one difficulty encountered is the lack of pick-up from slow speed, and "popping back" through the carburetor when accelerating. This condition can

be improved in two ways: First, reducing the throat diameter to get greater velocity of air, or second, increasing the richness of the mixture of gasoline and air. The first reduces the power of the motor except at slow speeds, and the second impairs the economy at all speeds. The air valve S avoids both these difficulties. This air valve is small, having a capacity small in comparison to the throat A. All of the air going through the air valve is added to the amount passing through the throat A so the inside diameter of the throat A can be reduced considerably thereby increasing the air velocities at slow speeds when the air valve is not in action. It is also evident that with the air valve and the throat in action at all intermediate and high speeds the quality of the mixture may be such as to give maximum power and efficiency, and at slow speeds where more torque is required as the air valve is closed by the spring, the mixture must be slightly richer, and the ratio of these can be made to suit the particular conditions encountered.

UNUSUAL CARBURETOR FUNCTION

It must be apparent that any carburetor with a float mechanism back or forward of the air throat and with the discharge nozzle in the throat if the top of the discharge nozzle is the overflow point that carburetor can not function properly except on very small grades.

Attention is called to the fact that in the Mark VIII carburetor the float chamber is back or forward of the air throat A but the discharge nozzles B are not the overflow points. The overflow point is at H, which is at the axis about which the gasoline level changes and is, therefore, not affected by the changing angles.

Under no condition is pure liquid gasoline passing through D and the tubes B but a foamy mixture of gasoline and air, so that owing to its being so largely air it flows equally well through D and the tubes B whether the machine is climbing a steep grade or going down a steep decline.

The butterfly throttle valves in each carburetor are parallel and interconnected by gear sectors pinned to the throttle stems. The forward and rear carburetors have their throttles operated simultaneously by means of a shaft provided with an adjustment at each end by means of which the pairs may be synchronized.

CARBURETOR ADJUSTMENTS

The sizes of the throats, gasoline regulating orifices, etc., having been determined by the engine builder, should not be changed except under extreme conditions. The numbers stamped on these parts indicate their sizes.

The throats are marked in inches and fractions thereof. The gasoline orifices are numbered according to diameter of orifice in hundredths of a millimeter; for instance, 180 indicates a diameter of 1.80 millimeters.

The throat and regulating screw sizes as well as air-valve setting are marked on tag attached to carburetor and on carton in which carburetor is shipped.

INSPECTION AND CARE

Owing to the fact that there are no small orifices in this carburetor there is very little chance of its becoming clogged, but an excess of water might obstruct the flow of gasoline.

The throttles should be examined to see that they operate properly and both close at the same time. Float and mechanism must be in good condition or level will fluctuate and cause unsteady performance. A leaky float causes the gasoline to rise too high in the chamber. Replace with another rather than try to repair it.

Extreme care must be exercised in assembling to see that all joints are tight and all bolts and screws must be secured with lock washers, cotter pins, or lock wires.

TO REMOVE WATER-OUTLET HEADERS

Remove the nuts, No. 101, which hold the water-outlet headers, No. 12427–8, in place, and lift these headers with the extension tube No. 12363 and the two hose connections off.

The clamps on these hose connections should be taken off and the hose examined.

If the hose connections show any signs of deterioration they should be replaced before reassembling.

Lay the outlet-header gaskets, No. 8153, to one side where they will not be damaged.

TO REMOVE INTAKE HEADERS

Disconnect the water-inlet elbows, No. 8173, by removing the cap screws, No. 201.

Remove the intake header nuts, No. 103, and the washers, No. 113. This will permit the intake headers to be dismounted.

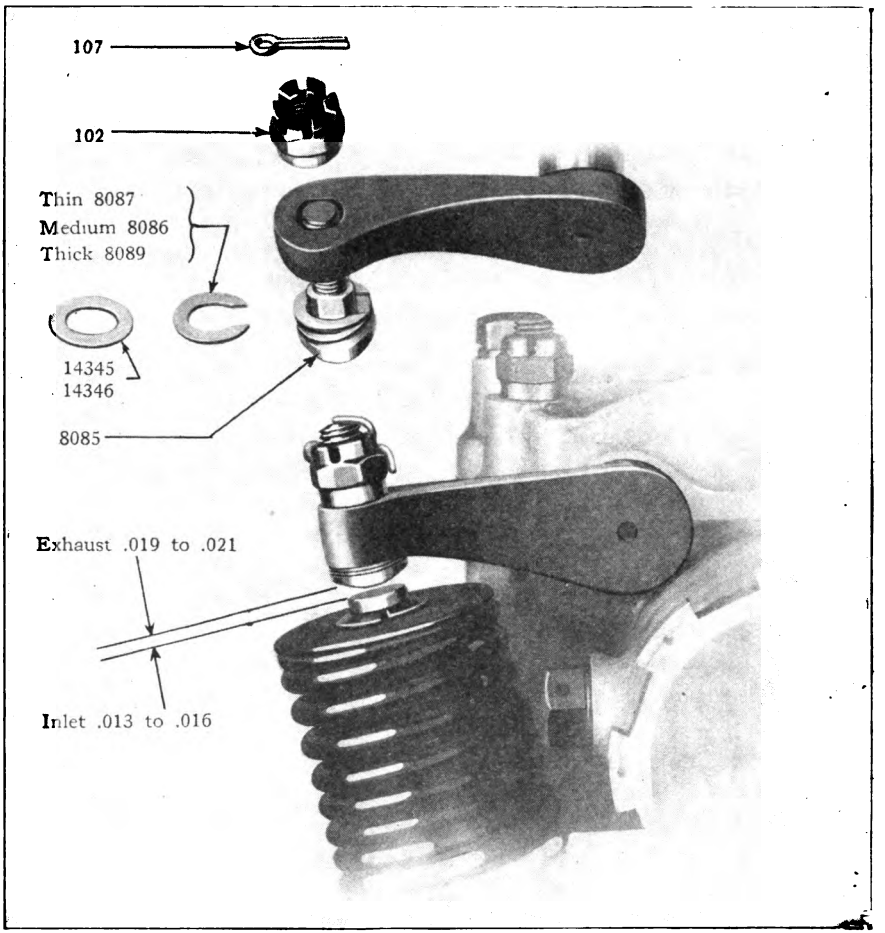
Examine the gaskets, No. 8172, and see that they do not overlap the openings in the elbows, No. 8173, or the holes in the intake header. If the gaskets appear to be in good condition put them back on the studs in their former position and screw on the nuts to hold them in place.

Leave the water-connection elbows and hose connections attached to the cylinders.

CAM-SHAFT HOUSING UNITS

Each of the two assemblies consists of a cam shaft with its bearings and gear—the rocker levers—a cam-shaft housing with its covers and the cam-shaft drive shaft with its gear, bearings, and housing. The assembly also includes all bolts, nuts, cotter pins, and small parts enumerated in the parts list at the end of this chapter.

PLATE No. 50



VALVE ROCKER ARM

All parts of the two assemblies (right and left) are identical and interchangeable with the exception of the cam shafts themselves and the cam-shaft housing covers.

Each shaft is stamped with a serial number on the plug in the end opposite the flanged end. Right-hand shafts bear the letter R and left-hand shafts bear the letter L.

The housing covers are machined in place on the housing and consequently will not interchange.

DISASSEMBLING AND INSPECTING CAM SHAFT

Figure 33 illustrates one of these units.

The following instructions apply to each of them.

The housing assemblies should be dismounted from the engine in the following manner:

1. Disconnect oil pipe by unscrewing nut No. 8122.

The connection No. 812 may then be slipped off. Put the two gaskets, No. 157, back in place and screw on the nut, No. 8122.

2. Unscrew the packing nut No. 8066 and slide it and the felt-packing washing No. 8068 up on the housing. If the felt washer does not fit sufficiently tight to hold both in place, tie them so that they will not slip off.

3. Remove 12 nuts No. 102 and washers No. 112 and lay them to one side in the order in which they were originally assembled.

4. The unit may now be lifted off the engine. Raise it carefully and evenly so as to avoid risk of bending the studs.

5. Put the washers No. 112 and the nuts No. 102 back in place on their proper studs.

6. Examine all rocker lever shafts with respect to the fit in bearings. These shafts should have from 0.005 to 0.010 end play and from 0.001 to 0.0015 clearance in bearings. The bearing fit should be "free running" and the radial clearance or shake should be barely perceptible.

7. Remove cam-shaft housing cover bolts No. 178, washers No. 112, and covers No. 8095 and lay them to one side in the order in which they were originally assembled.

Caution.—The joints between the covers and housing are "lapped" and the covers are marked to fit in their proper place. Care must be exercised in handling these parts so as to avoid marring the surfaces which come in contact.

8. Examine rocker levers. As each tappet has been adjusted as to clearance for the particular valve which it operates, the rocker levers should be laid to one side in the order in which they were originally assembled.

9. Examine the tappets to see that they are tight and that the faces do not show undue wear.

10. Examine the rollers to see that they are not cracked. See that the rollers are free running and show no flat spots. The bearing for the rollers is a steel thimble which is a free fit in the roller. This thimble is pinched tight in the rocker lever fork by the pin No. 8083, which is riveted at assembly in rocker lever. The permissible shake is 0.001. Roller should have 0.010 side play in the fork of the rocker lever.

11. Examine rocker lever bearings. See that they are clean and show no evidences of "scoring." Scored shafts should be smoothed up with a fine file and sandpaper. Bearings should be touched up with a scraper.

12. Remove cam shaft. Take out seven cam-shaft bearing lock screws No. 8108 with their gaskets, No. 157. This will permit the cam shaft and six bearings to be withdrawn through the gear end of the housing. The bearing No. 12250 may be pushed out through the other end of the housing. The cam shaft bearings are so fitted that they should come out easily. Should they stick the four screws No. 8219 and bearing cover plate No. 8376 may be removed and the shaft driven out with a soft plate.

13. Examine cam-shaft bearings. These bearings should have a clearance on the shaft of from 0.001 to 0.003, which means that the "shake" will be just perceptible with an oil film in the bearing.

The gear end bearings should have an end play of from 0.001 to 0.003 between the cam-shaft flanges. All bearings should be clean and free from "scores." The sets of cam-shaft bearings are "stepped." That is, the bearing at the gear end has the greatest outside diameter. The next one is $\frac{1}{32}$ inch smaller; the third bearing is $\frac{1}{32}$ inch smaller than the second, etc. Therefore, to facilitate reassembling, lay the bearings out in the order in which they are disassembled.

14. Examine cam shaft. See that all bearing surfaces are bright and smooth. Inspect it from the shaft carefully for cracks and soft spots.

15. Examine cam-shaft gear. See that the teeth are all intact and do not show undue wear. Unless the gear is defective it should not be necessary to remove it from the shaft.

16. Remove cam-shaft upper drive shaft. Take off nuts No. 101 and washers No. 111, which will permit the removal of housing No. 8109. A gasket No. 8139, $\frac{1}{64}$ inch thick, will be found between the flange of No. 8109 and the cam-shaft housing.

17. Withdraw the drive shaft and examine the bearing surfaces and the bushings in which they run. See that the gear is tight on the shaft and that neither the gear not the splines at the lower end of the shaft show undue wear. Should it be necessary to change either of the cam-shaft drive shaft bearings, the new bushings should be oiled on the outside and pressed in carefully under an arbor press or in a vise. They should then be reamed to size—the upper one, No. 8107, to 0.875-0.0005, and the lower one, No. 8092, to 1.125-0.0005.

All parts should be washed in gasoline or kerosene and blown off with an air jet.

Especial care should be taken that all oil passages are clear and free from dirt.

ASSEMBLING THE CAM SHAFT

1. Fit the cam shafts with their bearings in the cam-shaft housings. If it has been found necessary to replace any of the bearings the new ones should be tried in their proper places in the housings to see that they are what is termed a "wringing" fit. That is, they should be free enough so that they may be turned with a drift to line up the lock screw hole and still there should be no "shake" perceptible. If a new shaft is to be fitted all bearings should be tried in their proper places on the shaft. The diametrical clearance should be from 0.001 to 0.003. Oil all bearing surfaces with clean oil before assembling. Be sure that punched holes in gasket No. 8379 and end plate No. 8376 line up with oil hole in bearing No. 12250, and that screws are wired. Line up the lack screw holes carefully and put the screws in place with their gaskets.

If a new shaft or new gear is to be fitted be sure that cam-shaft gear bolts No. 171 are in place before putting on bearing No. 8111 and No. 8112. In the above case leave the gear off until later on in the process of assembling the engine. (See "Timing Valves," p. 106.)

2. Put the rocker levers and housing covers in place and test each lever for free operation.

3. Screw on the cover No. 8088 against its gasket, No. 169.

4. Put the cam-shaft drive (upper) and its housing in place with the gasket No. 8139 between the flanges. The shaft should turn freely after the housing bolts are drawn up and the end play should not exceed 0.008 inch. If the original gears are used they should be meshed so that the marks come in line.

Permissible "back lash" in these gears is 0.005 inch to 0.010 inch.

LOWER CAM-SHAFT DRIVE SHAFTS

These assemblies, No. 8208, are illustrated on page 56, and each embodies the parts in list below.

Take off four nuts No. 101, which will release the cover No. 8072 and permit the assembly to be lifted out.

Examine gear and splined socket. Try end play in bearings. It should not exceed 0.004 inch.

TO DISASSEMBLE CAM-SHAFT DRIVE

Remove nut No. 8142 and draw off gear with gear puller.

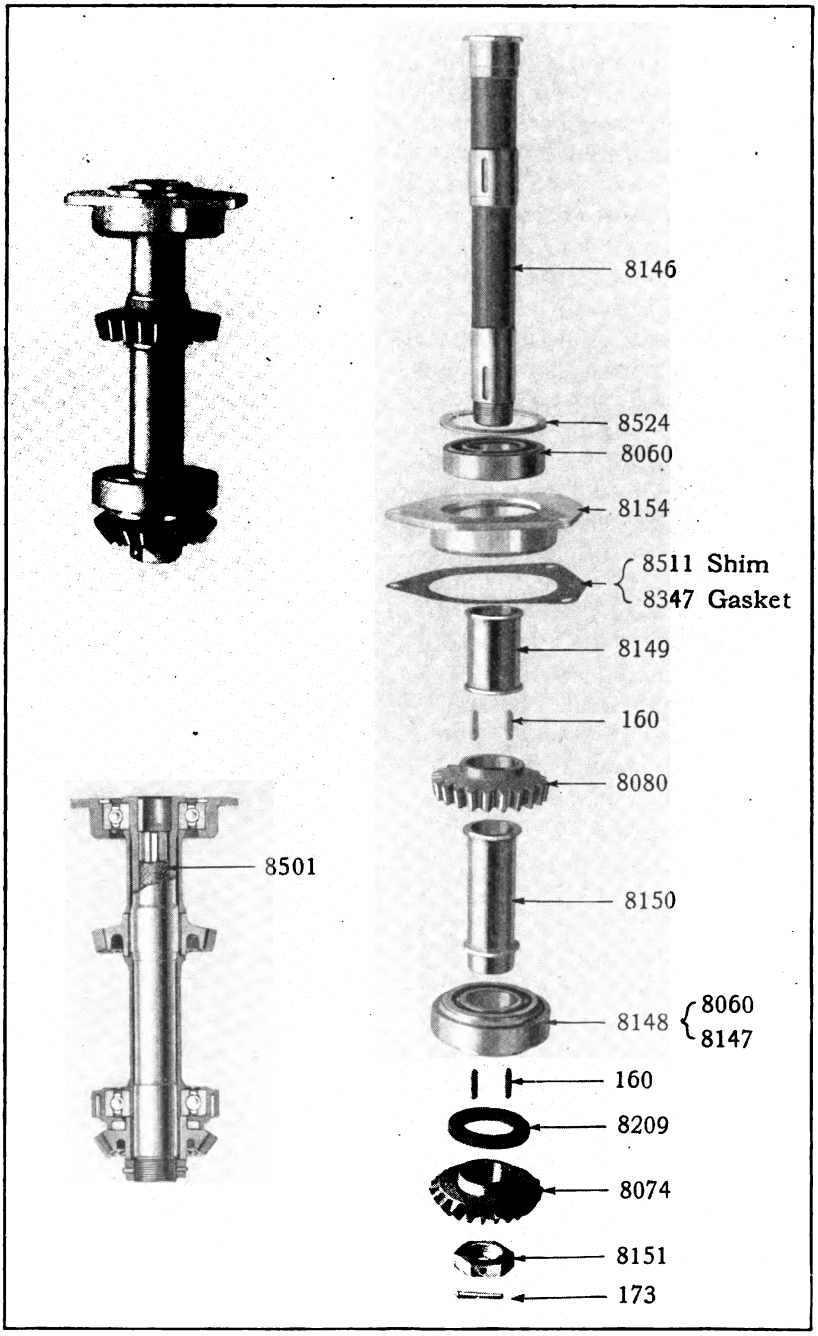
Caution.—Do not attempt to drive shaft out through gear.

The keys in shaft will not pass through the lower ball bearing. After drawing off the gear the keys may be lifted out and the shaft may then be tapped or pressed out through the bearings and spacer.

The parts of this unit should be assembled in the reverse order to the above, care being taken that the keys are properly seated in the shaft and that all parts are drawn up snugly by means of the nut No. 8142.

NOTE.—Unless some part of this assembly is defective it is not advisable to take it apart.

PLATE NO. 51



GENERATOR DRIVE SHAFT

DISASSEMBLING GENERATOR DRIVE

Remove flat-head screw No. 214. This will permit the generator drive-shaft assembly No. 8210 to be lifted out. One or more metal shims 0.002 inch thick will be found between the bearing container No. 8154 and the crank case. The number of shims will be sufficient to insure the proper mesh of the lower generator drive-shaft gear with the crank-shaft gear. They should be tied together and hung up or laid to one side so that they will not be lost or damaged. Examine gears for wear. End play in bearings should not exceed 0.004 inch. Remove nuts No. 8151.

Do not attempt to drive shaft out, but draw off gear No. 8074 with a gear puller. The same construction is employed here as in the lower cam-shaft drive assembly and the same caution applies. Remove keys No. 160 and draw off spacer and bearing assembly No. 8148.

Remove gear No. 8080 and keys No. 160, which will permit the spacer No. 8149 and bearing No. 8060 to be taken off.

The bearing No. 8060 is held in place in the container No. 8154 by means of the lock ring No. 8524. If it should be found necessary to remove this bearing the lock ring may be compressed with a pair of round-nosed pliers.

The parts of this unit should be assembled in the reverse order to the above, care being taken that the keys are properly seated in the shaft and that all parts are drawn up snugly by means of the unit No. 8151.

NOTE.—Unless some part of this assembly is defective it is not advisable to take it apart, as it has been carefully inspected as to proper alignment of gear teeth.

OILING SYSTEM

GENERAL DESCRIPTION

The oil supply is carried in a reservoir provided with a suitable means for cooling it. Oil is led from this reservoir to the connection on the right side of the oil-pump body marked "oil in." It is filtered at this point through a large area fine mesh screen. A delivery pump of the gear type takes the oil up after it has passed through the screen and delivers it under considerable pressure to a distributor pipe running the entire length of the crank case. Opening out of the passage between the pump and the distributor pipe is a pressure regulating valve designed to maintain a pressure not to exceed 50 pounds per square inch on the oiling system.

Pipes are fitted in the case leading from the distributor pipe to the main crank-shaft bushings.

The crank shaft is hollow and in the center of each main bearing a radial hole is drilled through the shaft into the hollow center. This hole in the shaft registers with the corresponding hole in the bearing bushing once every revolution of the shaft, at which time a small quantity of oil is forced through into the hollow crank shaft. A passage leads from each hollow main bearing to the adjacent crank pin, which is also hollow. A radial hole is also drilled through each crank pin and carries the oil out on the surface of the pin. Oil grooves and passages in the connecting-rod bushings insure proper lubrication for both the forked and plain connecting rods.

The excess oil thrown off the rapidly moving connecting-rod ends forms a mist which lubricates the piston pins and the cylinder walls.

Part of the oil conducted to the main crank-shaft bearing at the propeller end of the engine goes through a passage around this bearing and up through pipes to the propeller end of the cam-shaft housings. From the end of the cam-shaft housings it is led around the end cam-shaft bearing to a passage drilled diametrically through the bearing midway of its length. Once every revolution of the cam shaft a hole drilled through the cam shaft into its hollow center registers with the oil passage through the bearing.

Thus once every revolution a small quantity of oil is forced into the hollow cam shaft.

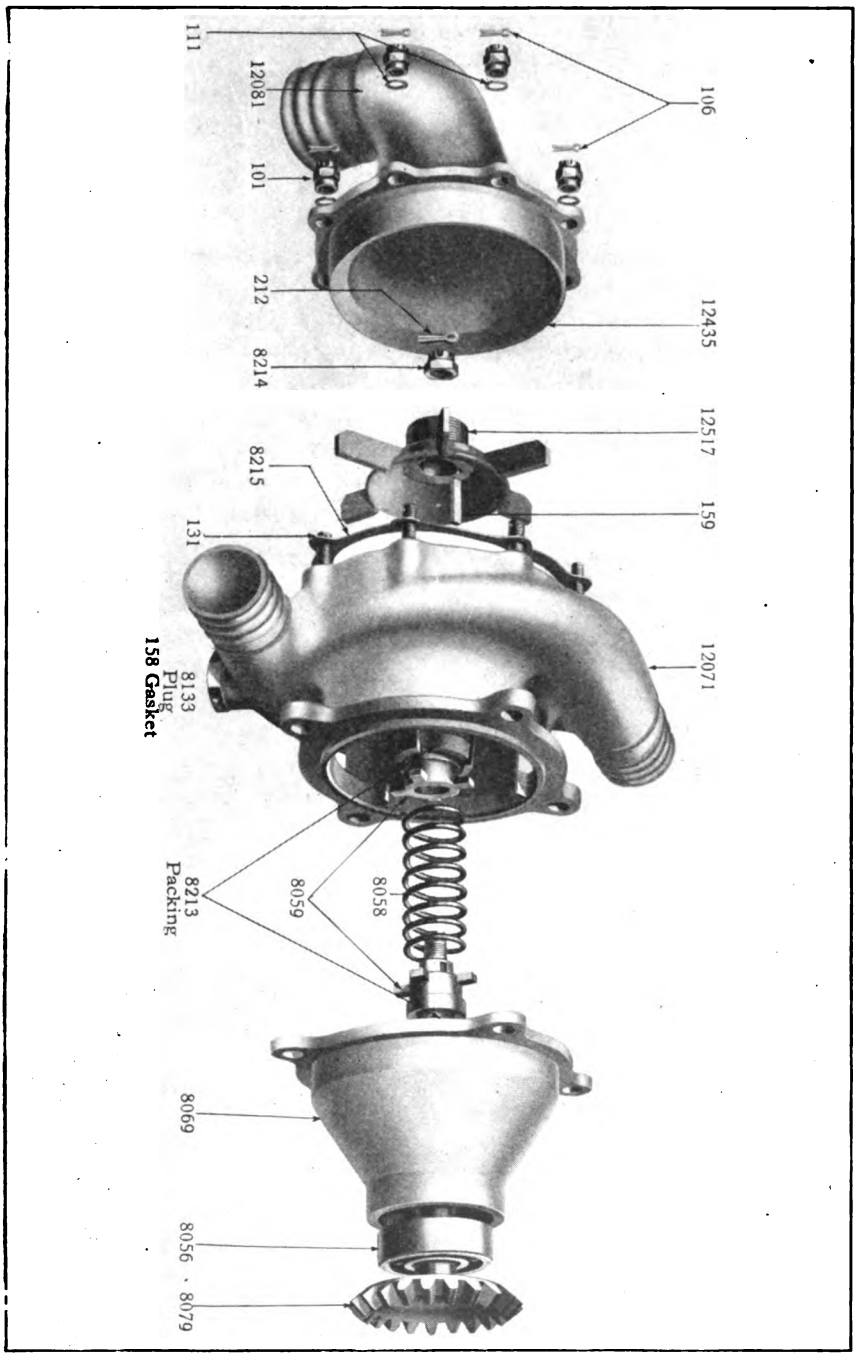
The oil is led through the cam shaft and out through holes drilled in it to each cam-shaft bearing. The excess works out of the ends of these bearings and collects in small reservoirs to a depth of about ¼ inch. The cams, in revolving, dip into this oil and splash it over the cam rollers and into pockets in the rocker lever shafts. From these pockets it is led through the hollow rocker shafts to the rocker-shaft bearings.

The excess oil eventually finds its way to the gear end of the cam-shaft housings, over the gears and down the drive-shaft housing into a chamber just above the oil pump.

The excess oil thrown off in the crank case by the connecting rods collects in this same chamber when the engine is inclined so that the propeller end is high. If the propeller end of the engine is low, this oil collects in a small sump or chamber at the propeller end of the crank case.

Immediately above the oil delivery pump is located an oil-return pump, consisting of three gears, and driven by the same shaft as the delivery pump. The function of this oil-return pump is to draw the excess oil out of the crank case and return it to the oil reservoir. One half of this sump draws oil from the sump at the propeller end of the crank case and the other half draws oil from the sump at the

PLATE NO. 52



WATER PUMP ASSEMBLY

distributer end of the crank case. Both halves of the pump deliver oil to the connection on the left side of the oil-pump body marked "oil out," from which point it returns to the oil reservoir.

OIL PUMP

The oil-pump assembly No. 8200 embodies the parts enumerated in the list at the end of this chapter.

DISASSEMBLING AND INSPECTION

Dismount the oil-pump assembly from the engine by removing nuts No. 101 and washers No. 111. Then:

1. Take out bolts No. 116, nuts No. 101, and washers No. 111. This will permit the cover No. 8381 of the oil-pump body to be taken off, and will release the oil strainer No. 8220.

2. Withdraw the oil-pump shaft No. 8148. Examine the splined ends of this shaft to see that they do not show excessive wear.

3. Bend down the ears of the nut lock No. 8636 and remove the nut No. 8535. This will permit the withdrawal of the upper oil-pump screen.

4. Remove four bolts No. 118, which will permit the upper half of the oil-pump body No. 8189 to be removed. This will expose two driven gears No. 8177 and a driving gear No. 8187. These gears should be examined as to their fit in the housing. This can best be tested by inserting the drive shaft through its bearing in the housing and laying the gears in the housing in their proper position, with their bearing pins No. 8179 and No. 8383 in place. The diametrical clearance of the gears in the housing should not exceed 0.004 inch. The permissible end play of the gears in the housing is 0.003 inch.

5. Lift the separating plate No. 8188. This exposes gears No. 8178 and No. 8186. These also should be examined as to fit in the housing. The above clearances apply to these gears.

6. The pressure relief valve may be unscrewed and the valve No. 8192 and seat No. 8368 should be examined.

ASSEMBLING

The parts should all be washed carefully and assembled in the following order:

(*a*) The driving gear No. 8186 and the driven gear No. 8178 on its pin No. 8383.

(*b*) The separating plate No. 8188.

(*c*) The driven gears No. 8177 and their pins, and the driving gear No. 8187.

(*d*) The oil-pump body upper half No. 8189.

NOTE.—This part of the oil-pump housing is located in its proper position by means of two dowel pins No. 174. Care should be taken that these pins are in their proper places.

(*e*) The four bolts No. 118, with their washers and nuts, may be put in place and tightened up and three of the bolts cottered.

(*f*) The pressure relief valve may now be screwed in against its seat No. 8368. Lock wire should be passed through the relief valve cage and through the bolt No. 118, which was not cottered.

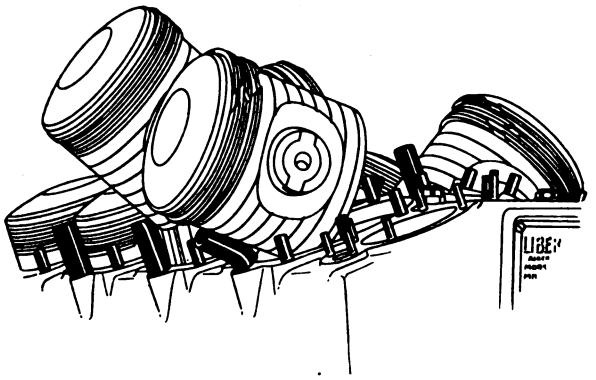
(*g*) Especial care should be taken that the strainer No. 8230 is thoroughly cleaned. It may now be put in place and the cover No. 8381 bolted on. The gasket No. 8382, between the oil-pump body and its cover plate, should be replaced if it has been damaged in any way in disassembling.

(*h*) Clean the upper screen and put it in place. It will be advisable to install a new nut lock No. 8536, which may be bent up to lock the nut No. 8535 after it has been properly screwed down.

CYLINDER ASSEMBLY

Cylinder and valve assemblies may be dismounted by removing the nuts No. 103 and special nuts No. 8224. Cylinder should be

PLATE NO. 53



CYLINDER ASSEMBLY

lifted off carefully and the pistons, when released, should not be allowed to fall over against the sides of the crank case. After removing the cylinder the nuts should be put back on the studs and screwed on just far enough to prevent them from being lost. This will not only protect the studs, but will prevent confusion in reassembling. If some old pieces of hose are available, short sections should be slipped over two studs on opposite sides of each cylinder opening as shown above.

VALVES

TO REMOVE VALVES

To do this the valves must be held up against their seats and the springs compressed sufficiently by means of a valve-spring compressor

supplied in the tool kit to permit the lower collar being moved down far enough to uncover the valve-spring collar keys. These keys (two parts) may now be lifted out and the springs and valves removed. The same inside spring is used on both intake and exhaust valves. The outside spring may be identified by the fact that the exhaust-valve spring has 10 coils while the inlet valve spring has 12 coils. Also the exhaust-valve spring exerts a pressure of 45 pounds when compressed to a length of 2¼ inches, and the intake-valve spring exerts a pressure of 23½ pounds when compressed to a length of 2¼ inches. The valves for each cylinder have the cylinder serial number etched on them and are marked "ex" (exhaust) and "in" (inlet), respectively.

CLEAN VALVES

Clean the valves carefully, and if the valve stems are gummed up with burned oil they should be dressed down with fine sandpaper.

Examine the valve seats in the cylinder and the face of the valves which comes in contact with these seats.

The valves should be tested for gas tightness. This can best be done by inverting the cylinder, with the valves in place, and pouring a small quantity of gasoline in the cylinder. Watch for seepage around the valve. If the valves show any leak they should be carefully ground in. The cylinder for this operation, should be held in position by means of the flange at the bottom. An arrangement for holding the cylinder for valve grinding can be readily made.

Note that in this illustration a light spring is inserted under the valves to partially counterbalance the weight of the tool by means of which the valve is turned. An efficient valve-grinding tool will be found in the tool kit. In grinding the valve it should not be revolved but should be rocked backward and forward, and frequently lifted off its seat and its position on the seat changed in order to distribute the abrasive evenly and to prevent "scoring" the valve. Valves should not be ground any oftener than is absolutely necessary, and then only enough to "clean up" the seat. If a valve is pitted or warped to such an extent that it is necessary to grind it heavily, care should be taken that any ridge or shoulder formed on the edge of the valve seat be dressed down with a fine mill file. The abrasive should be carefully washed off the valve, the seat, and the inside of the cylinder. Test seating of valve with Prussian blue.

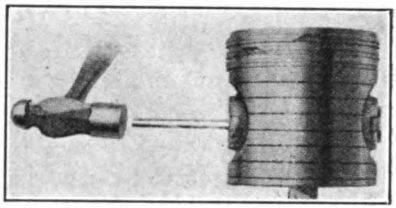
Any valves which are badly warped should be replaced and the valve seat in the cylinder should be trued up with a valve seat reamer before grinding in the new valve.

Replace the valves, the lower collars, the springs, the upper collars, and the collar keys.

PISTONS

DISMOUNTING THE PISTONS

PLATE No. 54



REMOVING PISTON PIN

Remove the piston-pin retainers by either one of the methods shown herewith. Press out the piston pins with a brass drift supplied in the tool kit. The fit of the piston pin in the piston should be from a free running fit without play to a light drive fit. It is preferable to have the piston pin a free fit in the piston than to have it drive out hard.

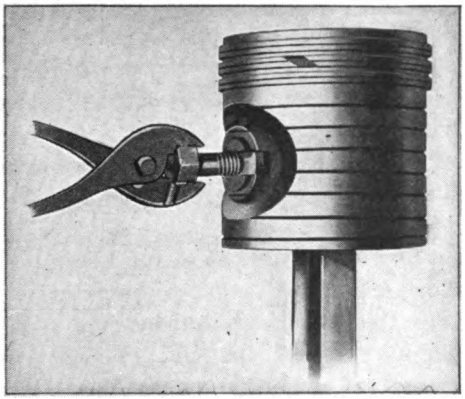
Clean the carbon deposit off from the piston head both on the top and on the under side. The polished surface of the top of the piston head should not be marred or scratched if it can be avoided.

Examine the piston for scores. It is very likely that the pistons will show scratches which were caused during the first run in of the engine. It is difficult to draw a line of distinction between what is termed a scratch and a score. A piston should not be discarded unless the scores extend part of the piston rings and seem to be of recent origin.

Examine the piston for even bearing on its outside surface. If any piston shows excessive wear on one side, at the bottom and not at the top, it is an indication that the connecting rod is twisted or bent.

RINGS

PLATE No. 55



REMOVING PIN (ALTERNATIVE METHOD)

Examine the piston ring for even bearing on the outside surfaces. The rings should be a free fit in the grooves, and should not be so loose that any shake is noticeable.

Inspect condition of ring grooves through the gap as to carbon deposit. If the carbon is soft and not of great amount it may be wiped out with a soft rag over a splinter of wood inserted through the gap in the ring. If the amount of carbon is excessive, and caked exceptionally hard the ring should always be taken off.

Extreme care should be exercised in removing the rings. They should not be expanded more than is absolutely necessary to pass them over the top of the piston. As the piston material is comparatively soft, care should be taken not to mar or scratch its outside surface.

Ring grooves should be wiped out with a soft cloth moistened with gasoline, and any carbon caked in these grooves may be scraped out with a piece of wood.

It is preferable to put back the old rings if the wear has not been too excessive than to fit new rings which have not been run in.

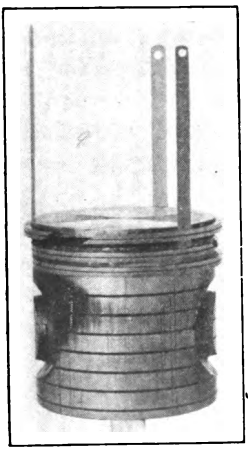
In refitting the rings in the grooves the same care should be exercised as in removing them, in order that the piston surface may not be scratched or marred. The gap between the ends of the ring should be not less than 0.025 inch when the ring is fitted in the cylinder.

The pistons are marked as to their location in the engine 1L, 1R, etc. These marks are stamped in the depression on the side of the piston. In reassembling pistons on rods, the marked side should be toward the distributor end of the engine. The number of ounces which each piston weighs over 3 pounds is also stamped in this depression.

If it was found necessary to replace any pistons, new ones of exactly the same weight should be selected from the stock.

Caution.—Great care should be exercised in handling pistons to prevent them from being subjected to any sort of rough usage which would be likely to spring them "out of round."

PLATE NO. 56



FITTING RINGS

Do not allow piston with rings to slip by the counter bore at the top of the cylinder. It is almost impossible to compress the rings enough to push the piston down again without damaging the surface of the piston or the cylinder wall.

To apply or remove piston rings, use hacksaw blades with the teeth ground off and the sharp edges rounded.

The bearing surface on the piston here illustrated indicates a bent or twisted connecting rod. Note that the heaviest bearing is at the top right and bottom left. The scores are characteristic of aluminum pistons. The piston shown should not be condemned on account of these scores.

CONNECTING RODS

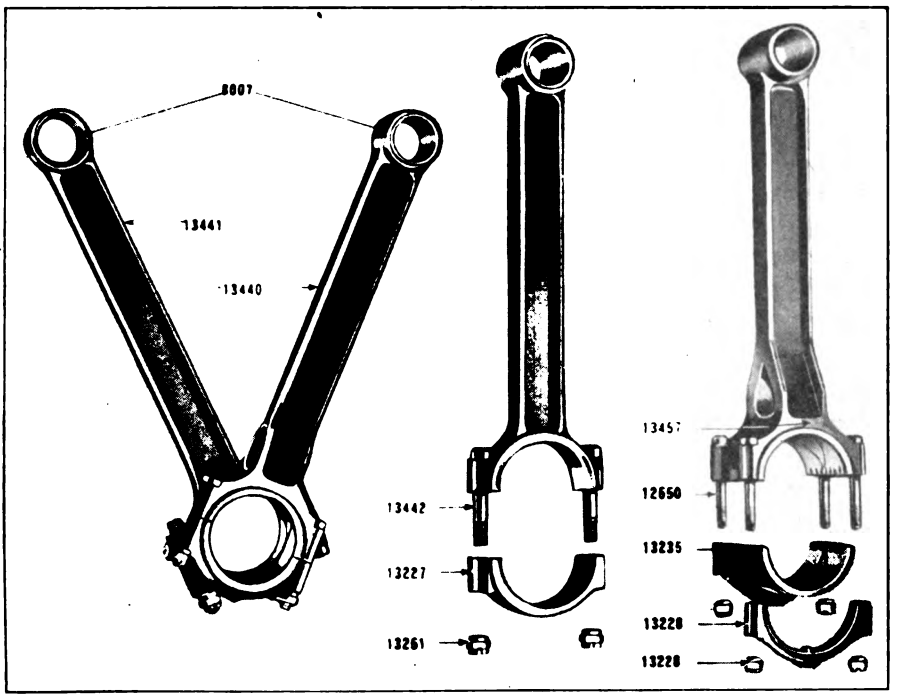
DISASSEMBLING AND INSPECTION

1. After the pistons are all removed, take off nuts No. 105.

2. Turn the crank case bottom side up and take out the small bolts No. 116 which fasten the two halves of the crank case together.

3. Lift off the bottom half of the crank case, being careful to raise it steadily and evenly so as not to spring or bend the crank-shaft bearing bolts.

PLATE NO. 57



CONNECTING RODS

4. Examine the connecting rod bearings for side play. The bushing carried by the forked rod should have from 0.010 to 0.020 inch side play on the crank pin. This may be checked with a thickness gauge. The plain end connecting rod should have from 0.004 to 0.008 inch side play in the forked rod.

5. Remove each pair of connecting rods by first taking off the nuts No. 13251 and the cap of the plain end rod, then take off nuts No. 13220 and the caps of the forked end rod.

NOTE.—That the caps and rods are each numbered at the joint on one side. The caps should always be replaced on the rod with like numbers adjacent. The bushings are also marked with small

numbers on the flange. These numbers should always be adjacent and on the side of the rod which bears the cap numbers. Each connecting rod is also numbered on the web near the piston-pin end. The upper number at this point indicates the serial number of the crank shaft to which the rods have been fitted. The lower number indicates the position of the rod in the engine, as 1, 2, 3, etc., numbering from the distributor end of the engine.

6. Examine the crank-pin bushing carefully. It should show a 75 per cent bearing free from dirt and scratches or scores. Any dirt or foreign matter should be carefully scraped out. The outside of the crank-pin bushing on which the plain end rod bears should also be carefully examined. Any roughness on its surface should be dressed down with a fine mill file. Oil grooves and oil holes should be cleaned out.

FITTING CONNECTING-ROD BEARINGS

If the bearing has been damaged or shows wear to such an extent that it is advisable to replace it, the new bushings should first be fitted in the forked end rod. Be sure that the bushing seats properly in the rod and that the dowel does not hold it away at any point. The caps of the forked end rod should be put in place and drawn up tightly. Examine the joints between the cap and the rod and between the two halves of the bushings. Caps and bushings should bear equally hard at the joints. The bushings should then be scraped to a free fit on a mandrel 0.003 to 0.004 inch larger than the crank pin. The cap should now be removed and the rod tried on the crank pin on which it is to run. The ends of the bushing should be dressed off with a fine mill file and a sufficient amount removed to permit from 0.010 to 0.020 inch side play. Touch up the radius at each end of the bushing with a scraper until it clears the fillet of the crank pin. Test this point by coating the crank pin and each fillet lightly with red lead or Prussian blue.

Clamp the rod with its bushing on the crank pin. Revolve it on the crank pin two or three times, meanwhile pressing it first toward one end of the crank pin and then toward the other end. Remove the rod and carefully scrape off any high spots to which the color has been transferred. It is very essential that these bushings do not bear on the fillet.

7. With the bushing clamped in the forked end rod dress down the outside surface at the joints with a fine mill file until they are perfectly smooth. Coat the bearing surfaces of the plain end rod lightly with red lead or Prussian blue and fit it in place on the bushing. Any high spots on the bearing to which the color is transferred should be dressed down until the plain end rod has 0.005 to 0.0065 inch diametrical clearance. The roundness of the bushing should meanwhile be tested with micrometers.

PLATE No. 58

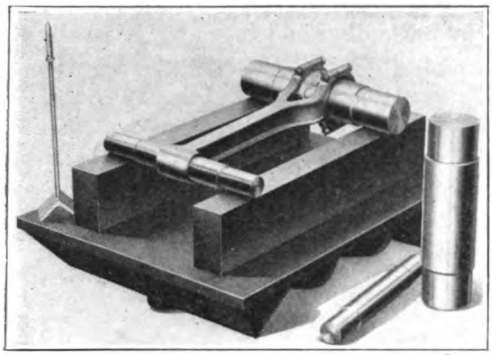


PLATE No. 59

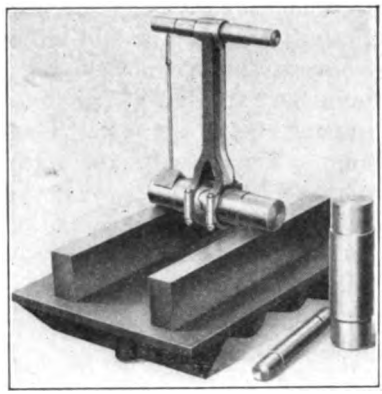
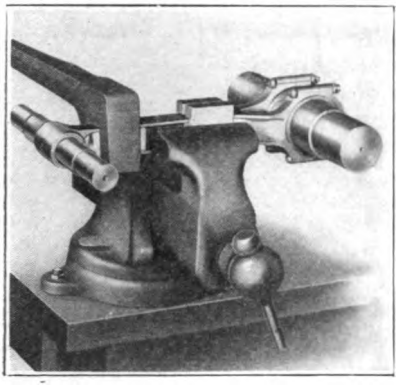


PLATE No. 60



ALIGNING RODS

Determine whether or not the mandrels lie in the same plane by laying them on parallel bars on a surface plate.

Check the distance between the mandrels at each end by means of a gauge as shown.

To straighten a rod clamp it in a vise between blocks to protect the flanges.

To determine the diametrical clearance which a connecting-rod bearing has, the crank pin and the outside of the connecting-rod bushing should be carefully measured with micrometers. The connecting rods should then be clamped on to test mandrels, the diameter of which may readily be determined. Connecting-rod bearings should be fitted at base repair shops equipped with a complete set of such mandrels.

8. Examine the bushing at the top end of the connecting rod. This should show a burnished bearing surface free from scratches or scores. The radial clearance of this bushing and its proper piston pin should be 0.001 inch. If it has been necessary to replace this bushing, the new one should be oiled on its outside surface and carefully pressed into place under an arbor press or in a vise. After being pressed into place it should be reamed with an expansion reamer until it has the proper clearance on the piston pin.

ALIGNING CONNECTING RODS

When new bushings are fitted in a connecting rod, or if an inspection of the piston would indicate that the connecting rod was twisted or bent, the rod should be checked for alignment in the following manner. A snug-fitting mandrel should be put through the bearing in each end of the rod. These mandrels should be at least 12 inches long. The rod with the mandrels in place should be laid on a surface plate and the mandrels checked as to whether or not they are parallel and in the same plane, as illustrated on page 93. A twisted or bent rod may be straightened by clamping one end of it in a heavy vise and springing it with a bending bar. A rod which has been badly bent should not be used, nor should it be heated in order to facilitate straightening.

CRANK SHAFT

After the connecting rods have been inspected, overhauled, and laid to one side, the crank shaft may be lifted out of its bearings.

All bearing surfaces on the crank shaft should be carefully examined. Unless one or more of the bearings have been completely destroyed, the crank-shaft surface will be in good condition.

If any crank pin or bearing surface on the crank shaft is roughened or scored, it should be dressed down with a fine mill file and fine sandpaper and oil, meanwhile being tested as to roundness with a micrometer.

Examine the ball thrust bearing. This should show not to exceed 0.008 inch end play. Unless the thrust bearing shows damage or excessive end play after being washed, it should not be necessary to remove it. Be sure that it is packed with grease before engine is finally assembled.

Examine the lock screw through the thrust-bearing retaining nut. Be sure that it is tightly drawn up and that the lock wire sets fairly in the slot.

If it is considered advisable to remove the clutch shaft, follow the instructions given on page 118.

Examine the tapered end of the shaft on which the clutch shaft fits. If this has been marred or roughened up in any way the key should be removed and the rough spot smoothed up.

The connection should then be lapped.

Examine the condition of the key and its fit in the shaft.

Examine the crank-shaft gear to see that it does not show excessive wear.

Examine the plug in the clutch end of the shaft and the plugs in the ends of each main bearing and crank pin. They should all be tight and show no indications of oil leakage.

Clean out the oil cavities and passages in the crank shaft and crank pins. This can best be done by filling each one with gasoline or kerosene, allowing it to stand for a short time and then blowing out withcompressed air.

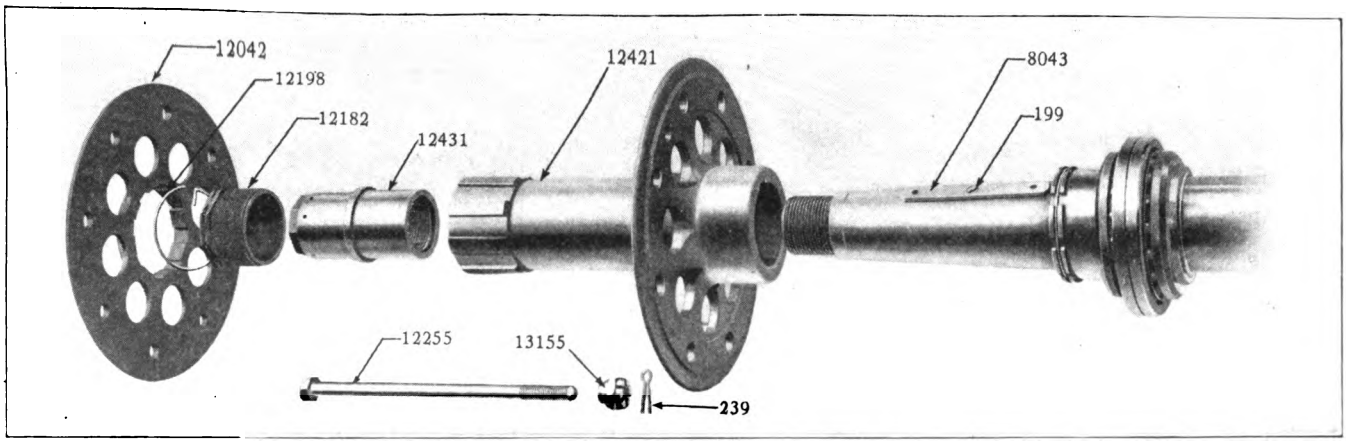
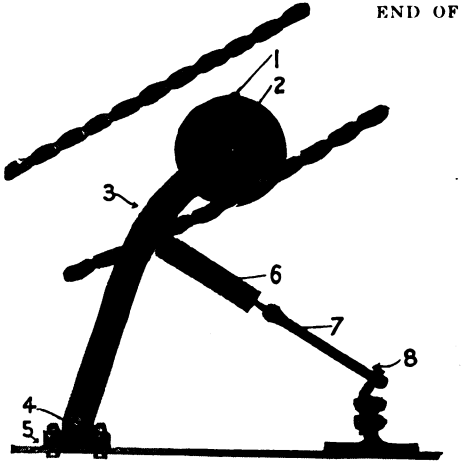


PLATE No. 61

END OF CRANK SHAFT (PROPELLER HUB SHOWN DOES NOT APPLY TO ORDNANCE ENGINE



JOCKEY PULLEY

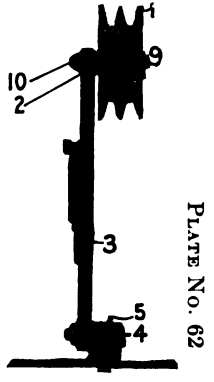


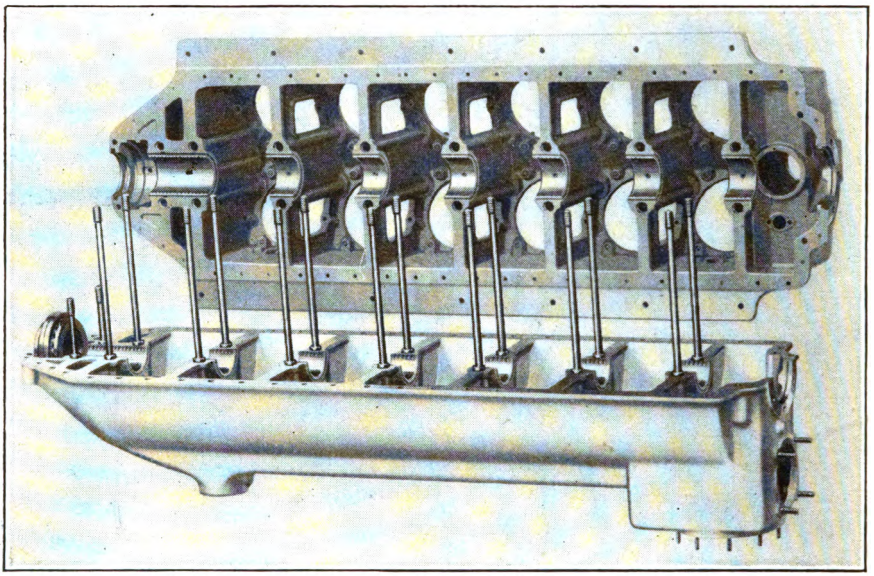
PLATE No. 62

Ref. No.	Part No.	Name.
1	M-1030	Jockey pulley for large fan.
2	M-1047	Cover plate for jockey pulley.
3	M-1031	Arm for jockey pulley.
4	M-1045	Pin for jockey pulley.
5	M-1048	Bracket for jockey pulley.
6	M-564	Tension spring for jockey pulley.
7	M-1050	Adjusting rod for jockey pulley.
8	M-1049	Adjusting plate for jockey pulley.
9	M-1045A	Pin for jockey pulley.
10	M-1046	Distance tube for jockey pulley.

Examine all bearing bushings in both the upper and lower halves of the crank case. The bushings should show a 75 per cent bearing and should be free from dirt, scratches, and scores. Should it be necessary to replace any of these bearings, new bushings should be carefully fitted in each half of the crank case. They should then be carefully scraped to a free fit on a mandrel 0.0025 inch to 0.00325 inch larger in diameter than the crank shaft.

In scraping the bushings to a fit on this mandrel, care should be taken that the case is supported and clamped down in such a manner that it will not be sprung or twisted out of shape. It is advisable to clamp the case at only one point and that only rigidly enough to

PLATE NO. 63



hold it steady. Contact between the two halves of the bushing and the two halves of the crank case should be equal when they are clamped together.

Examine the crank-shaft bearing bolts and see that the nuts at the lower end of these bolts are drawn up tightly and properly cotter pinned.

Examine the threads on the top of these bolts to see that they are not stripped.

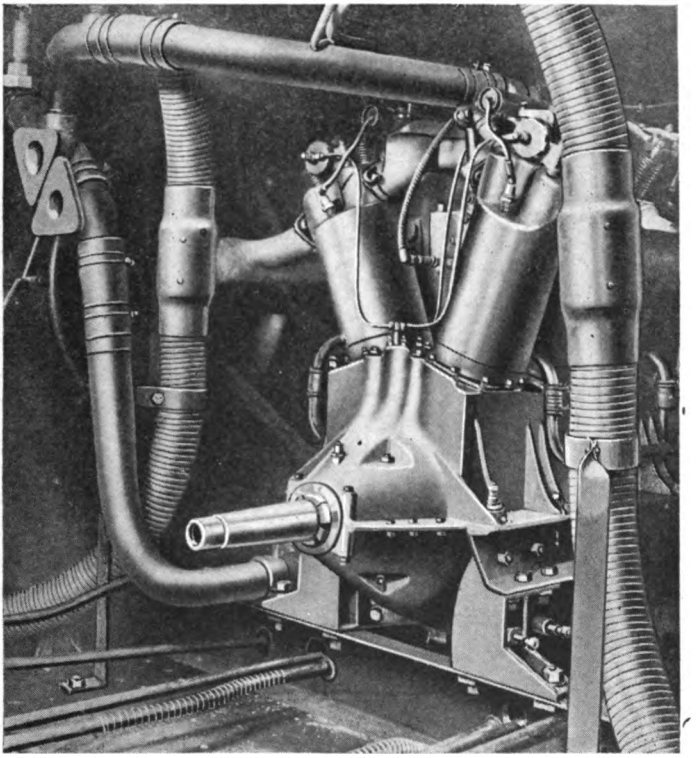
Wash the inside of the case thoroughly and clean and blow out all oil passages. Extreme care should be exercised in carrying out this part of the work.

Caution.—The joint between the two halves of the case is "lapped" and the parts should be carefully handled to avoid possibility of marring the surfaces.

COOLING SYSTEM

The engine-cooling system on this tank is comprised of a tubular type of radiator, a Sirocco blower fan, and the water pump which maintains circulation. There is an auxiliary tank adjoining the radiator. The radiator is placed horizontally, just aft of the engine on the port side of the hull, near the top of the engine compartment. The water is circulated through the jackets, and thence to the radiators by the pump described on page 98. The air for cooling is

PLATE No. 64



PIPE INSTALLATION

forced through the radiator by the ventilating system, which draws air through a louver in the top of the machine, just aft of the main turret. The air is drawn through the air ducts and forced through the outlet louver, which is located aft of the inlet louver, by the Sirocco fan, having a capacity of 11,000 cubic feet of air per minute. The radiator has 296 tubes, $38\frac{3}{16}$ inches in length of seamless drawn copper tubing, giving an actual area of 12,902 square inches or 89.5 square feet.

The Sirocco blower is driven by means of a link belt from the engine to a bevel gear box, and from the bevel gear box to the fan shaft by means of a V belt. The ratio of the crank shaft to the blower shaft is 1.561 to 1.

TO REMOVE THE RADIATOR

Unbolt and remove the air ducts. Disconnect the water, drain, and steam pipes. Unbolt the front and rear radiator support brackets. Remove the radiator through the outlet louver. For access to the work the side plates along the side of the epicyclic gear and the outlet louver should be removed before starting the work.

TO REMOVE THE SIROCCO FAN

Disconnect the driving belts and allow the jockey pulley to lay on the floor. Unbolt the air ducts attached to the fan. Remove the handhole plate on the side of the hull, opposite the fan-rotor spindle, by unscrewing the bolts.

Remove the nuts at the inner end of spindle and take off driving pulley, removing outer nut and ball race. Draw spindle out through the handhole.

Take off the legs (bolted to floor and engine frame) and remove fan through engine-room bulkhead door. After getting it into the fighting compartment, turn it around to pass through the side door of fighting compartment.

ENGINE-COOLING SYSTEM

Cooling water is circulated through the Liberty engine by means of a centrifugal pump running at one and one-half times engine speed. The capacity of this pump is 100 gallons per minute at 1,700 r. p. m. The cooling system from the pump inlet to and including the water-outlet header will hold 5½ gallons of water.

The water pump is provided with a single inlet, the outside diameter of which is 2 inches, and two outlets, each one delivering water to a header supplying the right and left hand cylinders, respectively. Water is forced into each cylinder-jacket tangent to its outside surface. This construction gives the water a whirling motion inside the jacket and insures uniform cooling.

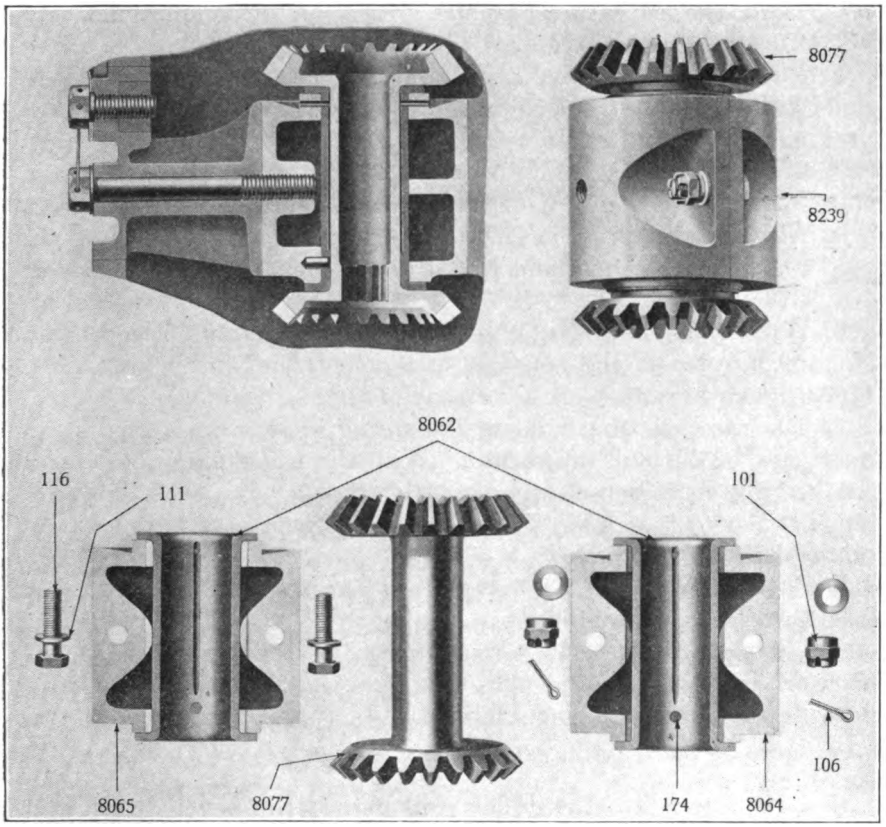
The water-outlet pipe for each cylinder extends inside the jacket to a point very close to the exhaust-valve chamber, which guarantees the proper cooling of the exhaust valve. The cooling water then goes through a passage cored in the intake headers. This serves to warm and further vaporize the incoming gas as well as assist in cooling the water. These passages in the intake headers are connected by two water-outlet headers, the final outlet of which has an outside diameter of 2 inches.

DISASSEMBLING AND INSPECTION

Loosen the hose clamps No. 8453 and pull the hose off the pump.

Loosen the hose clamps No. 8450 and remove the water inlet manifolds No. 12123 with the cylinder hose connections No. 8152 and the extensions No. 12096 and No. 12097 with their hose connections. All rubber hose should be carefully examined for defects—especially on the inside. It sometimes happens that the inside layer of rubber will become loosened and will wholly or partially obstruct the passage.

PLATE No. 65.



FAN BEVEL GEAR DRIVE

1. Remove four nuts No. 103 and washers No. 113. This will permit the water pump to be dismounted from the engine.

2. Remove eight nuts No. 101 and the washers No. 111 and take off the water pump cover No. 12078.

3. Remove nut No. 8214 from the end of the water-pump shaft and draw off impeller by means of the special tool.

4. Now lift the key No. 159, which will permit the water pump to be withdrawn.

5. Examine the water-pump shaft. If it is rusted to such an extent that it is very rough it should be replaced. Examine key and key seat.

6. Examine the impeller to see that it has not been bent or damaged in any way.

7. Examine bearing No. 8056. This should be allowed end play to extent of 0.005 inch.

TO REASSEMBLE

1. Put the pump shaft with its bearing in place in the container No. 8069. It would be advisable to use new packing in the packing boxes. A $\frac{3}{16}$-inch soft round tope tweed packing is recommended for this place, impregnated with a graphite grease. A piece approximately 8½ inches long will be required for each packing box.

2. One piece of this packing should now be wrapped around the shaft and the gland No. 8059 put in place and pressed down until the packing is properly seated.

3. Compress the coil spring No. 8058 and fasten it in the compressed state, on opposite sides, by means of twine or soft wire.

4. Now slip the spring in place on the shaft.

5. Put on the second gland No. 8059 and another piece of packing No. 8213.

6. Water-pump body No. 12071 should now be put in place, the key No. 159 inserted in the key seat in the shaft and the impeller No. 12073 drawn up into place by means of the nut No. 8214.

7. The wire or string holding the spring in the compressed state must now be cut and drawn out. With the water-pump body and the bearing container clamped tightly together the shaft and the impeller should turn freely. The permissible end play in the water-pump shaft is 0.010 inch.

8. Put the gasket No. 8215 in place. This should be replaced if it has been at all damaged in disassembling.

9. Complete the assembly by putting the water-pump cover in place with its washers and nuts. Be sure that these are all evenly drawn up and properly cotter pinned.

WATER-PUMP BEVEL DRIVER

Remove screw No. 154. This will permit the bevel driver and housing assembly to be withdrawn through the opening in the bottom of the crank case which receives the oil pump.

Remove the two clamp bolts No. 116.

Examine the shaft of the bevel driver and the bushing in which it runs. Both should be free from scores and indications of cutting. Remove any dirt in the bushing with a scraper. End play of the driver in its bearing should be from 0.005 to 0.008 inch. Diametrical clearance should be 0.0015 to 0.0025 inch.

In assembling this unit, the bevel driver should be laid in the housing with the gear with the widest face at the cupped or recessed end of the housing. The two halves of the housing must be properly put together also.

TO ASSEMBLE THE ENGINE

CRANK CASE, UPPER HALF

1. Place the upper half of the crank case in the inspecting stand bottom side up.

2. Wipe out all bearings carefully.

CRANK SHAFT

3. Oil all bushings with fresh, clean oil and lay the crank shaft with its thrust bearing in place. Be sure that the thrust bearing is properly seated in the case and that the sleeves do not permit end play.

NOTE.—The thrust bearing sleeves are made in different thicknesses, No. 12252 being the thick one and No. 12238 the thin one. A combination of these sleeves may be obtained, which will insure the proper fit in the case.

CONNECTING RODS

4. The connecting rods may now be assembled on the crank shaft. The rods are numbered on the web at the piston end, 1, 2, 3, etc., indicating their location on the crank shaft beginning at the gear end. The side of the rods on which the numbers are stamped should be toward the gear end of the shaft.

All forked rods should be so fitted that they will be on the right-hand side of the engine looking from the gear end toward the propeller end when the engine is right side up. Crank pins should be liberally oiled before the rods are put in place, as should also the outside of the connecting rod bushings before the plain end rods are assembled. The hollow crank pins and main bearings should be filled with clean oil.

Draw up all connecting rod bolts snugly and cotter-pin them.

NOTE.—The cotter pins in the bolts through the forked end rod should be inserted so that the heads will be on the inside or toward the plain end rod. Otherwise the bent-over ends of the cotter pins will interfere with the plain end rod.

Be sure that none of these bolts are overlooked.

CRANK CASE, LOWER HALF

The lower half of the crank case may now be put in place.

5. Put the washers No. 115 and nuts No. 105 on the front and rear bearing bolts and draw them tight.

WATER-PUMP BEVEL DRIVER

6. Put the water-pump bevel driver with its bushing in place and fasten with the lock screw No. 174. Test the backlash of the water-pump bevel driver gear and the crank-shaft gear.

This should be 0.005 inch minimum and 0.010 inch maximum.

If these gears mesh too tightly, shims No. 8502, 0.002 inch thick, may be placed between the crank-shaft gear and the crank-shaft flange in sufficient number to produce the proper backlash.

7. Now turn the whole assembly right side up and complete the installation of the bearing-bolt washers No. 115 and nuts No. 105. Draw up these nuts snugly and cotter-pin them.

8. Install bolts No. 116 and tighten and cotter-pin them.

PISTONS

9. Proceed to fit the pistons on their proper rods. Remember that the pistons are marked right and left and numbered 1, 2, 3, 4, 5, and 6, and that the pistons should be so placed on the rods that the numbers are toward the gear end of the engine.

The piston pins should be oiled before being pressed into place.

10. Insert the piston-pin retainers No. 12547. These should be a light tapping fit in the piston bosses.

CYLINDERS

11. Oil the inside walls of the cylinders and the outside of the pistons. The cylinders are numbered 1, 2, 3, 4, etc., and are marked right and left, indicating their position on the crank case. These marks will be found on the edge of the base flange near the water inlet. Be sure that the gasket No. 12346 is in place on the crank-case studs. The crank should be turned over so that the piston on which the cylinder is being placed is at the top of its stroke.

The rings should be compressed in the grooves as the cylinder is slipped down over them.

12. Push the cylinder carefully down into place, put on the nuts No. 103 and run them down on the studs, but do not tighten them.

13. After all the cylinders are in place put on the gaskets No. 8175 and the intake headers No. 12045.

Caution.—Insert loose-fitting wooden plugs in spark-plug holes to prevent any small parts from falling into cylinders.

INTAKE HEADERS

14. Now put on the intake-head stud washers No. 113 and the intake-header nuts No. 103. The intake-header nuts and the cylinder to crank-case nuts on each set of three cylinders should all be tightened up at the same time; i. e., each nut should be drawn down one after another about one-fourth turn at a time until all are tight with an equal tension.

15. The special nuts No. 8234 may now be put in place and tightened up with a special long-shanked socket wrench.

16. Tighten all nuts and properly cotter-pin them.

17. Put the gaskets No. 8172 between the intake header and the water-inlet elbows No. 8173 and tighten these up with the cap screws No. 201. The gaskets No. 8172 should be soaked in water before putting them in place. Leave three screws No. 201 on each side (one at each end of the engine and one about midway between these two) loose until the cable tube has been installed.

OUTLET HEADERS

18. Put the water-outlet header gaskets No. 8153 in place and bolt on the front and rear water outlets No. 12402 and 12401, respectively. Before these water outlets are bolted down the extension tube No. 12363 and the two pieces of hose No. 12128 should be slipped in place.

19. Now fasten down the water outlets with nuts No. 101 and cotter-pin them.

20. Slip the carburetor to intake-header bolts No. 8398–No. 8399 in place.

CARBURETORS

21. Attach the two carburetors. Be sure that the unions No. 12367 and gaskets No. 182 are in place. With respect to these gaskets it is advisable to fit new ones after an engine has been overhauled.

Care should be taken that the carburetors are mounted in their proper position on the engine (propeller end and gear end) and that the air intake scoops open toward the propeller end.

THROTTLES

22. The carburetor throttle coupling shaft No. 12498 may now be put in place and the two sets of throttles synchronized as follows:

Screw out the throttle stop screw on each carburetor until it clears the gear sector when the throttles are entirely closed. Slack off the adjusting screws No. 13416 until the lever No. 12498 clears each one of them by approximately $\frac{1}{16}$ inch.

Now entirely close the throttles on both carburetors and holding them firmly in a closed position screw up the adjusting screws No. 13416 until they just touch each side of the lever No. 12498 and lock the screws by means of a wire through the head of each. Connect up the altitude adjustment coupling rod in such a manner that both altitude adjustments will get the full throw in each direction.

TIMING ENGINE

A part of the equipment of every Liberty engine is a timing disk, so designed that it may be mounted on the flywheel as a permanent

fixture or used only in the hangar or repair shop as a means of checking the setting of valves and distributors. To use this timing disk, proceed as follows:

1. If the timing disk is not already mounted on the flywheel install it in such a manner that the dowel in the propeller-hub flange enters the dowel hole in the disk. It may be clamped in this position by means of two bolts through the propeller-hub bolt holes.

2. Remove the spark plug from the flywheel of No. 6 L cylinder.

3. Insert a pencil or scale through the spark-plug hole and turn the engine over until the piston on its upstroke touches the pencil and causes it to ride up. Continue to turn the engine over slowly until the piston as indicated by the travel of the pencil stops moving upward and is just about to start down. This will be approximately the top dead center.

4. Allow the crank shaft to remain in this position temporarily and clamp the timing pointers, which will be found in the tool kit under the special cylinder base flange nuts No. 8234, so that the pointers extend over the edge of the timing disk.

5. With the end of the pencil resting on the top of the piston make a mark with a knife blade about one-half inch above the edge of the spark-plug hole.

6. Turn the engine over in a forward direction until the pencil has moved down so that the mark is even with the top edge of the hole, and with a piece of chalk or a pencil mark the disk in line with one of the pointers.

7. Turn the engine backward until the pencil has moved up and down to the point where the mark is again even with the top of the spark-plug hole, and mark the disk in line with the pointer.

8. With a pair of dividers find the point midway between the two marks on the disk. This point will indicate the exact dead center of No. 1 and No. 6 cranks and should be marked with chalk or pencil.

9. Turn the engine over until this dead-center mark is in line with the pointer. Allow the crank shaft to remain in this position; and

10. Reset the pointers so that they come in line with the dead-center marks stamped on the disk.

11. Turn the engine over in the direction of rotation through 10° as indicated by the scale on the disk.

NEUTRAL POINT

The crank shaft is now set on the neutral point of No. 6 left cylinder and the firing point-spark retarded of No. 1 left cylinder. Reference to the timing instructions will explain what is meant by "neutral point." It is the point 10° past the top dead center which marks the beginning and end of the cycle of operations. The exhaust valve closes and the inlet valve opens at this point.

Mount the generator drive-shaft assembly No. 8210, being careful that the gasket No. 8347 is in place and a sufficient number of shims No. 8511 (0.002 inch thick) to insure proper mesh of the generator drive-shaft lower gear with the crank-shaft gear. These gears should have a minimum back lash of 0.005 inch and a maximum of 0.010 inch.

Mount the two cam-shaft drive shafts No. 8208, meshing the gears in such a manner that the mark on the splined coupling is "fore and aft" or parallel with the center line of the engine.

Now mount the cam-shaft housing assemblies.

If it was not found necessary to replace either the cam shaft or gear, be sure that the marked teeth on both gear and pinion are in line. This should bring the mark on the splined end of the drive shaft "fore and aft."

The assemblies may now be set in place with the splined coupling marks in line.

NOTE.—All marks for both right and left cylinders are located with No. 1–6 cranks 10° past left dead center.

Complete the installation of these assemblies by replacing the washers No. 112 and the nuts No. 102 and properly cotter pinning them.

Slip the felt washers No. 8068 into place and tighten up the stuffing boxes No. 8066.

TAPPET GAP AND FIRING POINT

Test the gap between all tappets and the valves which they operate. The tappet gap for each cylinder should be checked when that cylinder is on the firing point. The firing point of No. 1 cylinder is the neutral point of No. 6 on the same side. The firing point of No. 2 is the neutral point of No. 5. The firing point of No. 3 is the neutral point of No. 4. The firing point of No. 4 is the neutral point of No. 3. The firing point of No. 5 is the neutral point of No. 2. The firing point of No. 6 is the neutral point of No. 1. It will be noticed that the sum of the numbers of these pair of cylinders is always seven. For example: to find the firing point of No. 4 cylinder, turn the engine over, meanwhile watching the No. 3 exhaust valve. When this valve has just closed and before No. 3 inlet valve has opened, the neutral point of No. 3 cylinder will have been reached. This will be the firing point of No. 4. With the engine cold the clearance between the inlet valve tappets and the valve stems should be 0.014 to 0.016. The clearance between the exhaust valve tappets and valve stems should be 0.019 to 0.021. This clearance should be adjusted by adding or taking out shims under the tappet head. These shims are made in varying thicknesses; the thick shim No. 8089 being 0.015 inch thick, the medium shim No. 8086 being 0.008 inch, and the thin shim No. 8087 being 0.003 inch. The combination of

these shims will permit of a very accurate adjustment of the gap. Be sure that the shims are properly placed and that the nuts on the tappets are tightly drawn up and cottered.

If it was found necessary to replace either the cam shaft or the cam-shaft gear, the gear should have been left unmounted as instructed. In this case proceed as follows:

1. With No. 1–6 crank set 10° past the left dead center, the marked splines on the cam-shaft drive shaft set "fore and aft," the marked splines on the upper cam-shaft drive shaft in line with them, the marked tooth on the upper cam-shaft drive shaft gear should be toward the observer and on the center line of the cylinders.

2. Without moving any of this assembly rotate the left cam shaft in a clockwise direction until the No. 6 exhaust valve is just closed and the inlet valve is just about to open.

3. Now mesh the cam-shaft gear in such a manner that the teeth and the flange bolt holes will line up perfectly.

The cam-shaft gear has 48 teeth and is bolted to the flange by means of seven bolts. This will permit an adjustment of one-seventh of one tooth space or $2\,^1/_7°$ of crank-shaft travel.

4. Tighten up two of the cam-shaft gear bolts and check the tapped clearance on all left cylinders.

TO ADVANCE OR RETARD VALVE SETTING

5. Now check the opening and closing of the exhaust and inlet valves as shown on the timing diagram. If it is found that the valves are late in opening and closing, the number of degrees should be noted and the cam-shaft gear moved one or more holes in the direction of rotation without moving the cam-shaft drive shaft or the cam shaft. Remember that for each hole moved forward the cam shaft is advanced $2\,^1/_7°$ of crank-shaft rotation. If the valves are found to open early, set the cam-shaft gear backward one or more holes.

Always check valve timing by turning engine in forward direction of rotation so as to take up all backlash in gears and lost motion in couplings.

After the gear has been properly located, set the left distributor driving flange over the bolts in such a position that the marked notch is in line with the marked tooth on the drive pinion.

Now tighten up and cotter pin the bolts and mark the gear in line with marked tooth on the drive pinion.

To set the right cam shaft, turn the engine over in the direction of rotation through 45° or until the No. 1 crank is 10° past the right dead center. With the crank shaft in this position turn the cam shaft over in a clockwise direction until the No. 1 exhaust valve is just closed and the inlet valve is just about to open. Locate the gear in the same manner as in setting the left cam shaft.

Before mounting the right distributor driving flange, turn the crank shaft back through 45° or to its original position and set the distributor drive flange so that the marked notch comes in line with the marked tooth on the drive pinion, or, in other words, in line with the center line of the right cylinders.

Now tighten up the cam-shaft gear bolts and cotter pin as before.

TIMING IGNITION

Set the two distributor assemblies in place, being careful to get them on the proper housings right and left.

These distributors are marked R and L on the outside surface of the spark-control arms. They should be fastened temporarily by means of two bolts No. 116 each in such a position that the notch on the distributur base flange coincides with the notch on the cam-shaft housing flange.

If it has been found necessary to replace either the cam-shaft housing or the distributor head, and the new parts do not carry these identifying notches, the distributor should be so set that with the spark retarded the center line of the cylinders will be midway between 1 L and 6 R terminals.

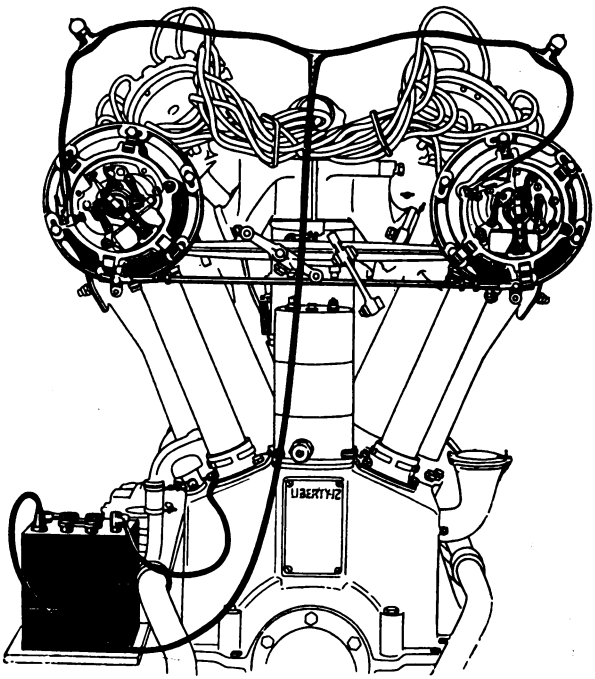
1. Set the engine on the firing point, spark retarded, No. 1 L cylinder; in other words, the neutral point of No. 6 L. Reference to the timing diagram shows that this is 10° past the top dead center.

SYNCHRONIZING BREAKERS

It is assumed that the contact separation or gap was properly adjusted (0.010 to 0.013 inch) at the time the distributor heads were overhauled. The synchronization of the two main breakers on each distributor may be checked by inserting a card between the contact points of one breaker and noting the timing of the other. Then repeating the procedure on the other breaker. If the two main breakers on a distributor do not open within 1½° of each other, they may be synchronized in the following manner: Remove the cotter pin and loosen nut on the bracket, which will allow the complete breaker-arm bracket assembly to be shifted around the stud as a center. This will vary the setting of the contact separation or gap, which should be brought back to the proper limits and the breaker arms tried again for time of opening. By shifting the breaker-arm bracket assembly and each time bringing the opening of the contact points back to the proper limits, a point can be reached where the two parallel breaker arms will open at exactly the same time, which is the proper setting for these arms. The auxiliary breaker arm must open before the parallel breaker arms when the cam is being rotated in a clockwise direction, as previously explained. If this breaker arm is not adjusted so that it will open in the above manner, it will not

prevent the back firing of the engine when being rocked on compression preparatory to starting. After the distributor breaker-arm bracket assembly has been shifted to such a position so as to give the proper opening of the parallel breaker arms, nut Q should be screwed down tight and locked in place by cotter pin P. The countact screws should be adjusted to line up and meet squarely with the contact points in the breaker arms when the contact points are closed. This can be accomplished by slightly bending and twisting the brackets which hold the contact screws.

PLATE No. 66



TEST LAMPS AND CONNECTIONS

2. Swing the timing lever on the distributor to the full retarded position or as far in a clockwise direction as is possible.

3. Loosen the bolts No. 116 sufficiently that the distributor base flange can be rotated on the slotted holes.

4. Connect battery and electric light across the distributor terminals as shown on Plate 66, and rotate the distributor base flange in a counterclockwise direction until the light just goes out.

Tighten the bolts with the distributor in this position and complete the installation of the bolts No. 116.

5. Without changing the position of the crank shaft install and set the right-hand distributor in a similar manner.

6. The accuracy of the timing should now be checked up by rotating the crank shaft backward 15° or 20°; then forward very slowly, meanwhile watching the electric lights. They should both go out at the same time within a limit of 1½° on the timing disk. If the pocket flashlight is used instead of the two electric lights and battery, each distributor head will have to be checked separately and the time of the break noted according to the timing disk.

7. Install the cross reach No. 8333 and adjust it so that both distributor heads will be fully retarded. Check the synchronization of the two distributor heads with spark lever in advanced position also.

8. Install the high-tension cable tube and cable assembly, fastening it by means of the screws No. 201 to the intake headers.

9. Wire the heads of all these screws so that they will not loosen up.

Caution.—Care should be exercised in placing the distributor head assembly on the distributor to keep from breaking the rotor brush. It can best be done by putting the distributor-head assembly over the two studs upon which it is mounted and slightly rocking it back and forth with the rotor in the right-angle position to the center line of the two studs. This will gradually work the brush back into the rotor and allow the distributor head to slip down into place.

Remove wooden plugs from the spark-plug holes and install spark plugs. Connect the high-tension wires to them and to the distributors, being careful that each plug is connected to the proper terminal. Remember that plugs on the side of the cylinders toward the propeller are connected to the left-hand distributor and those on the side of the cylinders toward the gear end of the engine are connected to the right-hand distributor.

Install the water-pump assembly, being careful to see that the gasket No. 8345 is in place. Try the mesh of the water-pump gear with the water-pump bevel drive gear. This should be 0.005 inch minimum and 0.010 inch maximum. If these gears mesh too tightly, shims No. 8510 may be inserted between the bearing retainer No. 8345 and the gasket in sufficient number to produce the proper back lash.

WATER-INLET MANIFOLDS

Install the water-inlet manifolds No. 12123, replacing the hose connections and clamps wherever the original ones were found to be defective.

Put on the inlet manifold extensions No. 12096 and No. 12097 with their hose connections.

In tightening up hose clamps be careful that the clamp is bent so as to fit snugly around the hose and bear against it at all points. Do not draw up the clamps so tightly that the clamp cuts into the rubber.

It is advisable before installing the engine in the tank to tape these hose connections with a good rubber friction tape and shellac them, putting clamps on over the shellacked tape. The shellacked tape will protect the hose from oil and gasoline.

OIL-PUMP ASSEMBLY

Install the oil-pump assembly. See that the gasket No. 8348 is in good condition and is so placed that the gasket does not overlap the oil passages either in the oil pump housing or the crank case.

Install the nuts No. 101 and tighten them up evenly and cotter-pin them.

CRANK-CASE BREATHERS

Install the crank-case breather. See that the gasket No. 8172 is in place and fasten with nuts No. 101.

Install the crank-case oil fillers No. 8156 with gaskets No. 8158 and fasten in place with nuts No. 101.

Install crank-case sump cover No. 8129. Be sure that the lock No. 8130 is in its proper place.

The whole engine should now be given a careful final inspection. Make sure that all bolts have been properly drawn up and locked either by means of cotter pins or lock wires.

GOVERNOR

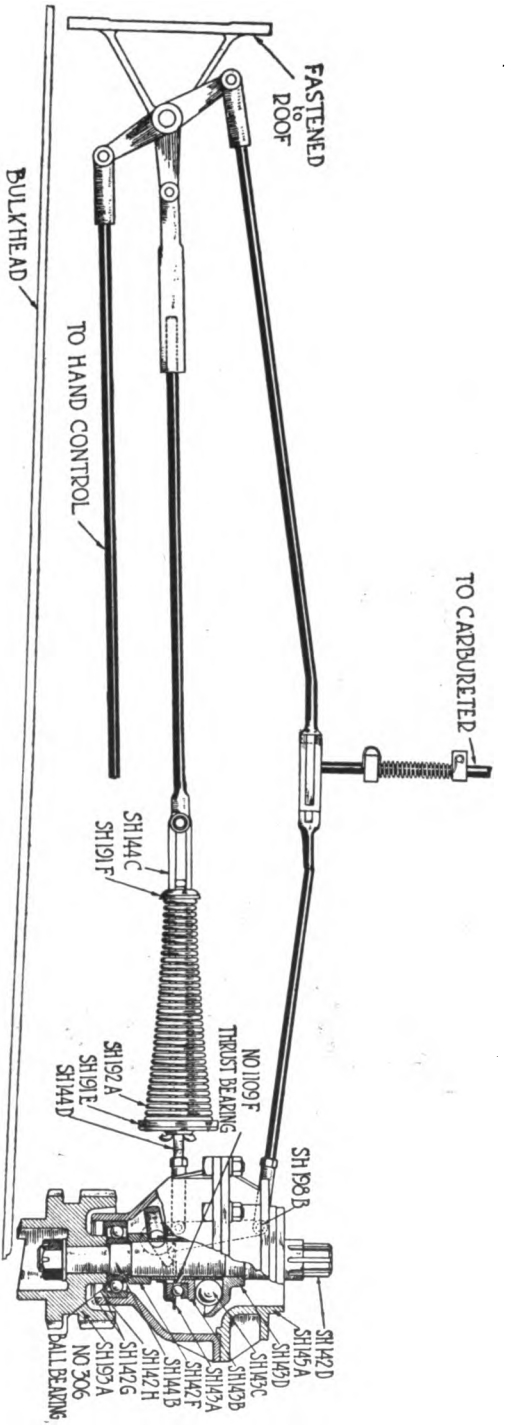
The governor is mounted on the front end of the engine, and operates on the carburetor throttle. It is designed to hold the speed of the engine below 1,400 r. p. m. A part sectional view of the governor is shown on page 111. Its method of operation is as follows:

The shaft (No. 1) rotates with the crank shaft of the engine, carrying with it the sleeve (No. 2) and the balls (No. 3). As the speed of the shaft increases the balls (No. 3) tend to fly from the center, due to the centrifugal force, moving the collar (No. 4) along the shaft and imparting a motion to the linkage (No. 5) which is connected to the carburetor throttle. The spring (No. 6) is so designed as to provide a preliminary resistance against the action of the governor, permitting the engine to reach its designed speed before the governor comes into action.

TO REMOVE ENGINE

To remove the engine all the electric wires should be disconnected as well as the feed pipes and manifold connections. Disconnect the fan drive and generator drive and the connections with the cardan shaft. The plates holding the engine to its foundation should then be removed, and the engine can be lifted through the top of the hull by taking off the two bolts directly over the engine.

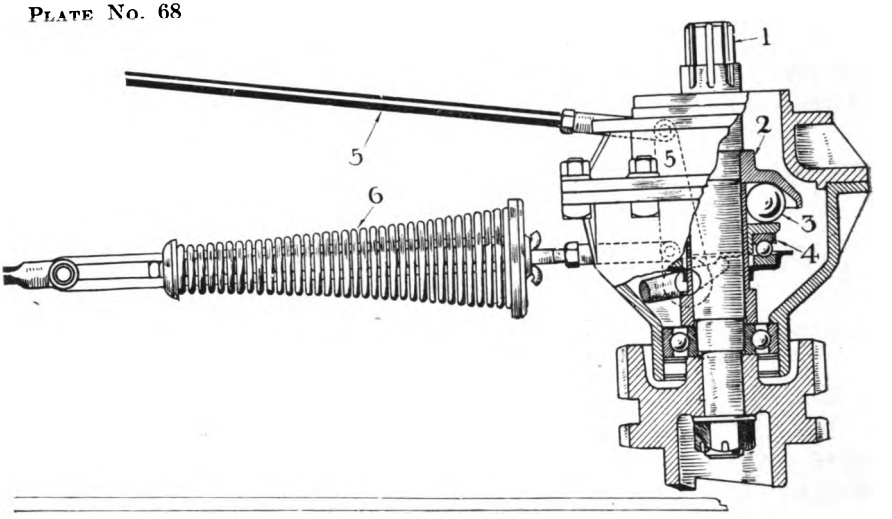
PLATE No. 67



SECTION OF GOVERNOR AND LINKAGE

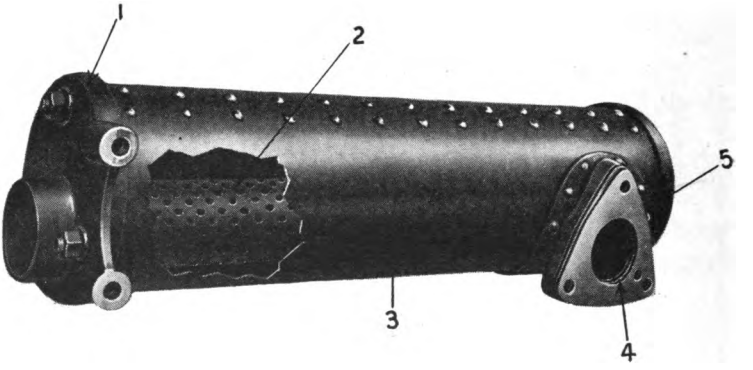
Ref. No.	Part No.	Name
1	SH-142D	Governor shaft.
2	SH-143D	Governor ball cup hub.
3	SH-143C	Governor ball retainer.
4	SH-143B	Governor thrust bearing mount.
5	SH-198B	Governor arm.
6	SH-192A	Governor spring.

PLATE No. 68



SECTION THROUGH GOVERNOR

PLATE No. 69



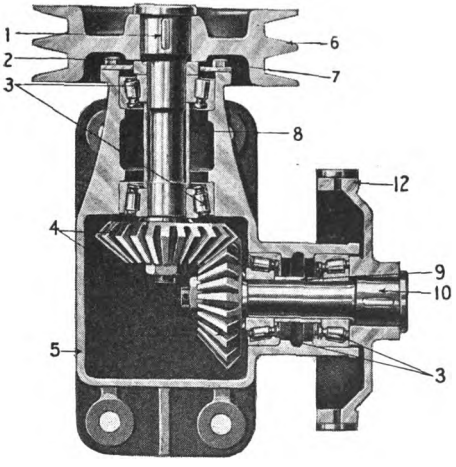
MUFFLER

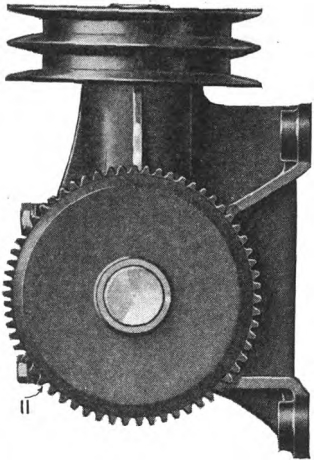
Ref. No.	Part No.	Name
1	M–39	Silencer end.
2	M–43	Silencer inlet pipe.
3	M–38	Silencer body.
4	M–48	Washer for silencer outlet flange.
5	M–41	Silencer end.

Summary of clearances

	Minimum	Maximum	Desired
Crankshaft:			
Diametrical clearance	0.0025	0.00325	
End play	.0575	.0775	
Connecting rods:			
Forked end—			
Diametrical clearance	.003	.004	
End play	.008	.020	
Plain end—			
Diametrical clearance	.005	.0065	
End play	.004	.008	
Piston pin:			
Fit in rod	.00025	.00125	Select for 0.001 clearance.
Fit in piston	.00025 (loose.)	.00075 (tight.)	Select for light drive fit.
Piston rings:			
Fit in grooves	.00125	.003	Top, 0.003; middle and bottom, 0.002.
Gap	.021	.041	0.030.
Piston:			
Fit in cylinder	.018	.022	Select for 0.020 clearance.
Cam shaft:			
Diametrical clearance	.001	.003	
End play	.000	.004	Min., 0.002.
Cam shaft, upper drive shaft:			
Diametrical clearance—			
Large bushing	.0005	.0025	Min., 0.0015.
Small bushing	.0005	.0025	Min., 0.0015.
End play	.002	.008	Min., 0.004.
Rocker levers:			
Diametrical clearance	.00025	.00175	Min., 0.001.
End play	.005	.010	0.0075.
Valves:			
Fit of stems in guides; diametrical clearance—			
Exhaust valve	.004	.0065	0.005.
Inlet valve	.002	.0045	0.003.
Water-pump shaft:			
Diametrical clearance	.0015	.0035	Min., 0.0025.
End play	.006	.010	0.010.
Water-pump bevel driver:			
Diametrical clearance	.001	.0025	
End play	.005	.008	
Oil pump:			
Fit of gears in housing			
Diametrical clearance	.001	.005	Select for 0.004 clearance.
End play	.002	.007	Select for 0.003 clearance.
Tappet gap:			
Exhaust valve	.019	.021	
Inlet valve	.013	.016	
Breaker gap	.010	.013	
Spark-plug gap	.015	.017	0.015.
Regulator:			
Contact gap	.005	.007	
Height of pin	.043	.045	

PLATE NO. 70





FAN BEVEL BOX

Ref. No.	Part No.	Name
1	M-1132	Pulley spindle.
2	M-1129	Pulley distance piece.
3	M-1133	Timken roller bearing 316-312.
4	M-1125	Bevel wheel.
5	M-1123	Bevel box.
6	B-113 21153	Driving pulley.
7	M-1126	Bearing cover plate.
8	M-1128	Long-distance tube.
9	M-1127	Short-distance tube.
10	M-1131	Chain-wheel spindle.
11	M-1124	Cover for bevel box.
12	SH193C	Chain wheel for bevel box.

CHAPTER IV
COMPOUND CLUTCH

Outline specifications

Type of clutch	Compound.
Slipping engagement	Asbestos cone.
Positive engagement	Driving teeth.
Cone diameter—large	19.186 inches.
Cone diameter—small	17.887 inches.
Face width of cone	2.5 inches.
Length of facing expanded	58.5 inches.
Material used in facing	Asbestos.
Material of cone	Carbon steel.
Largest diameter of flywheel	19.811 inches.
Length of clutch unit, complete	19.875 inches.
Length of cardan shaft	11.25 inches.
Diameter of cardan shaft	2 inches.
Clutch stop drum diameter	9.25 inches.

COMPOUND CLUTCH

GENERAL DESCRIPTION

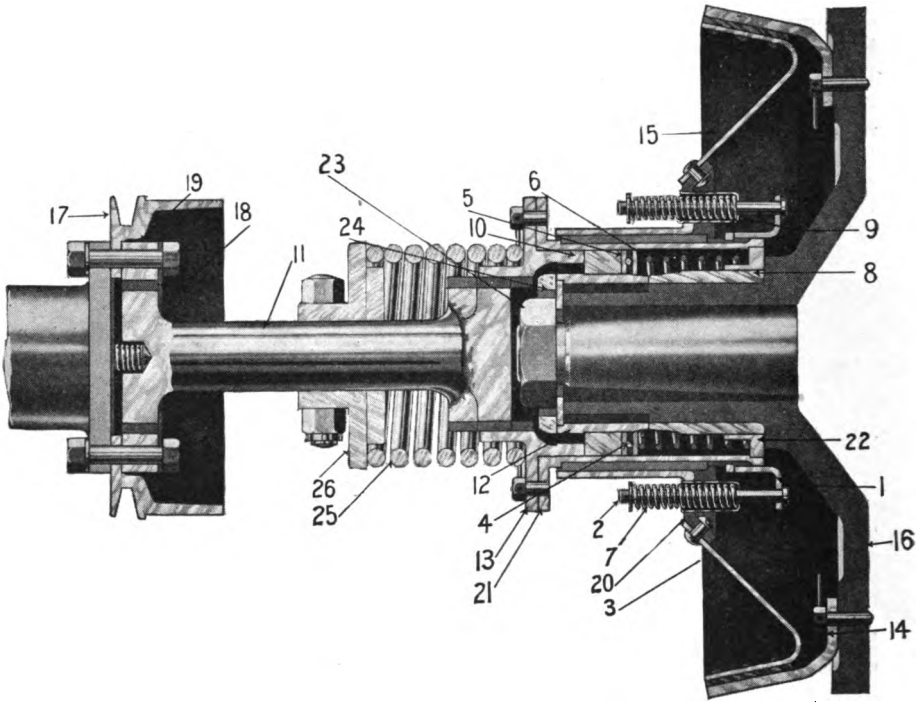
The drive is communicated from the engine to the transmission units by means of a compound clutch. Inasmuch as the complete machine weighs approximately 40 tons, the clutch has been designed to gradually overcome the inertia of the heavy mass, and for this reason provides first a slipping and then a positive engagement. The slipping engagement is secured by means of asbestos-faced cone clutch which first comes into play, due to the frictional contact between the leather facing and the cone-shaped flywheel. The positive engagement of the clutch is secured by the splines or teeth on the clutch sleeve, which in turn mesh with corresponding splines or teeth on the end of the crank shaft.

The function of the cone clutch part of the compound clutch is to simply pick up and start rotating the transmission drums. After the friction part of the clutch has accomplished this the positive drive part then is engaged. The point should be made that the epicyclic bands should and *must be* free to operate the clutch properly.

The driving-clutch unit is bolted to the flywheel member of the engine, and is a cone frustrum of carbon steel. The driving cone carrying the asbestos facing is forced into frictional contact with the driving member by means of coil springs $\frac{5}{8}$-inch in diameter, 5.85 inches long and having 32 coils. These springs are mounted on plungers of carbon steel, $4\frac{7}{8}$ inches long, and $\frac{3}{8}$-inch in diameter. Engagement of the clutch is secured by playing back on the clutch lever, which forces the clutch collar to slide along the clutch shaft, first engaging the cone and then engaging the splines on the collar with the splines on the crank shaft.

Additional pressure is placed upon the cone by the movement of the clutch collar by means of the large clutch spring, which is concentric upon the clutch shaft, and is composed of the coil spring, having a 5⅜-inch diameter of spiral and a 4¼-inch length of coil. The spring is composed of five free coils, and two seating coils. Engagement between the clutch sliding collar or sleeve and the

PLATE No. 71



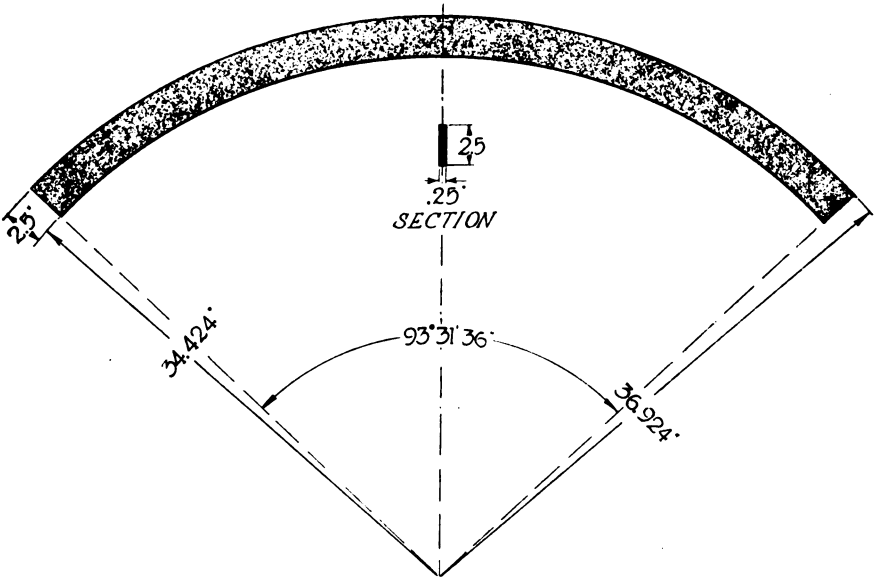
COMPOUND CLUTCH

Ref. No.	Part No.	Name
1	SH861E	Clutch-spring stop ring.
2	SH861A	Spring plunger.
3	SH861C	Spring retainer.
4	SH865A	Bearing race.
5	SH865B	Ball retainer.
6	SH865C	Spring, large.
7	SH865D	Spring, small.
8	SH863A	Clutch front bearing.
9	SH863C	Clutch snap ring.
10	SH863B	Clutch rear bearing.
11	SH864A	Cardan shaft.
12	SH864C	Clutch sleeve.
13	SH864B	Clutch coupling.
14	SH866A	Outer clutch drum.
15	SH867A	Inner clutch drum.
16	SH868A	Flywheel.
17	M-858	Clutch-stop drum.
18	M-856	Coupling cover.
19	M-855	Coupling box.
20	SH869A	Cone clutch-drum supporting collar.
21	SH862A	Clutch sliding collar.
22	SH862B	Clutch sliding-collar cap.
23	SH136A	Crank-shaft nut.
24	SH863D	Gear-lock washer.
25	SH849B	Clutch spring.
26	SH849A	Spring flange.

cardan shaft is secured by means of a coupling of nickel steel. The coupling is a 9-inch flange, in diameter, and a diameter of 5 inches at the point of engagement with the splined end of the cardan shaft. The cardan shaft is nickel steel, 11¼ inches long, with 10 splined teeth, and a diameter of 2 inches. The diameter of the splined section is enlarged to 4.359 inches.

The drive is thus imparted through the cone and through the splines on the crank shaft to the clutch collar. From the clutch collar it passes to the clutch coupling and thence by means of the splines on the coupling to the cardan shaft. The preliminary drive passes from the cone, through the carbon steel key, 4¼ inches long and ¾ inches thick and ⅜ inches wide to the clutch coupling, and thence to the cardan shaft. On the rear end of the cardan shaft is located the clutch pull drum, this being bolted to the flange on the cardan shaft. A clutch brake or cardan-shaft brake operates on this drum, stopping the spinning of the cardan shaft in shifting gears.

PLATE NO. 72



PATTERN OF CLUTCH

It is because the cardan shaft is connected directly with the shaft of the epicyclic gear that it is very necessary that the cardan-shaft brake be properly adjusted before the machine is driven. It is quite evident that if the attempt is made to shift into reverse with this shaft spinning ahead, the driving teeth are apt to be stripped. Directions of how to adjust the cardan-shaft brake are found on page 150. The clutch-stop drum is of malleable iron.

When the clutch is thrown out of engagement the crank shaft rotates freely on the phosphor bronze clutch front bearing. This has an outside diameter of 4.684 inches, and an inside diameter of 4.002 inches. The clutch sleeve through which the main drive is transmitted is nickel steel, having a length of 2.687 inches, and inside diameter of 3.531 inches and 24 splines.

TO REMOVE CLUTCH

When removing clutch, first wire the clutch spring (exterior) to prevent it from expanding when the pressure is released. Remove the spring flange bolts.

Remove the air-pump belt from the clutch-stop drum, also the clutch-stop band pin, and the bolts connecting the band to the clutch-shaft bracket.

Remove the eight bolts holding the coupling box to the bevel-pinion shaft and the six bolts holding the clutch coupling to the clutch sliding collar.

Pull out the pin for fork ends, holding the fork end of the clutch auxiliary rod to the clutch-operating lever, enabling the clutch shaft to rotate. The cardan shaft can then be removed by dropping the rear end and allowing the ball bearings to roll clear of the shaft.

Then remove the crank-shaft nut and gear-lock washer, and pull the clutch off the crank shaft.

TO RELINE CLUTCH

Remove the old lining and chip off the rivets. New lining is provided, cut to proper size. If this is not available, a new lining can be cut to proper size, using page 117 as a pattern. New rivets should be put in in such a way that they are countersunk below the surface of the lining so that the metal of the rivet will not bear against the metal clutch-driving face, or split rivets driven from inside are used.

Chapter V

EPICYCLIC TRANSMISSION

General specifications

Type of reduction gear	Epicyclic.
Number of forward speeds	2.
Number of reverse speeds	2.
Double-gear pitch	3–4.
High-speed gear pitch	5–7.
Low-gear pitch	4–5.

GENERAL DESCRIPTION

The epicyclic gear set has two forward speeds and two reverse speeds. It is mounted transversely across the machine in the rear end of the engine compartment. It provides the necessary gear reduction between the engine drive and the track propulsion units, and also carries the drive outward on both sides from the center line of the machine to the exterior track mechanism.

The drive enters the epicyclic gear set by means of a bevel pinion drive over the engine and clutch, and leaves it in the form of a general drive to the track propulsion gearing. The gears are shifted in relation to one another by means of a shifter-fork mechanism which takes care of the forward and reverse movements, and, in addition to this, the high and low speed ratio are secured by means of brakes, which act on drums governing the ratio of the planetary trains contained in the epicyclic gear box.

The reductions in the box are 5 to 1 on low, and 1.285 to 1 on high. The reduction at the bevel gear is 14.46. The reduction between the chain sprocket and the roller pinion is 12 to 23, and between the roller pinion and the track driving wheel 9 to 37. This gives a total reduction between the engine and track of 32.545 to 1 on high speed, and 126.64 to 1 on low speed.

The use of the planetary or epicyclic type of gear box on a machine of this weight does away with the necessity of employing shifting gears except in the case of changing from forward to reverse. It is highly necessary, therefore, that the precautions mentioned on allowing all moving parts to come to rest before shifting from forward to reverse, be observed. The drive through the various units can be traced on page 123 and in the chapters dealing with drive units.

The drive from the engine enters the epicyclic gear set by means of a bevel pinion, and passes to either bevel wheel, depending on whether it is desired to run the machine backward or forward. Facing toward the front of the machine, the left bevel wheel provides a reverse motion, and the right bevel wheel gives ahead motion. Engagement

between the required bevel wheel and the shift is secured by means of a dog clutch, which slides on the splines of the bevel and epicyclic cross shaft. Both bevel wheels are in constant mesh with the bevel pinion, but only one is the driving engagement, due to the position of the clutch, the other is simply an idler, and has no part in the driving.

From the bevel wheel, in engagement with the dog clutch, the drive passes to the cross shaft, thence to the sun pinion, mounted at the opposite extremity of the cross shaft, from the bevel wheels. The sun pinion meshes with the large planet pinion, and this in turn meshes with the annular ring gear, secured to the gear casing. This casing carries with it the low-speed brake, the same bolt passing through the annular ring, and the two halves of the epicyclic casing.

The casing also carries the drive back to the chain-drive sprocket, when it is not restrained in doing so by the application of the brake mounted upon it. The epicycle gear casing also carries a pin, upon which is mounted the small epicyclic planet pinion, which meshes with a small epicyclic spur ring, carried on an epicyclic spur disk, which in turn is splined to the epicyclic cross shaft. Revolving with the face which carries the spindle for the small epicyclic pinion is the high-speed brake, which acts as part of the gear-changing mechanism, as illustrated in plates.

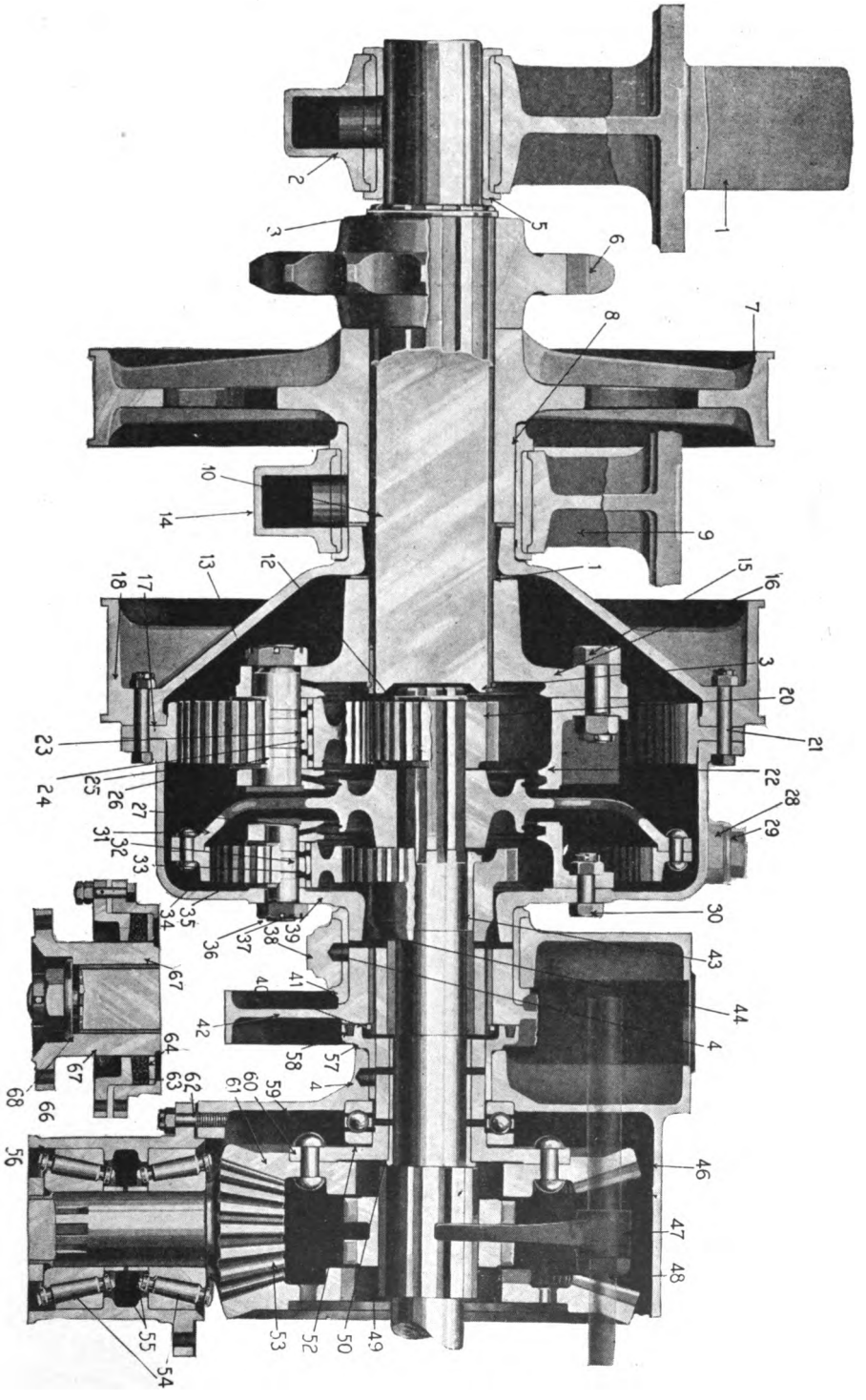
PROGRESS OF EPICYCLIC DRIVE

The drive through the epicyclic gears is similar on forward and reverse speeds, except that of the bevel gears. Referring to page —, the clutch X is shifted by the fork Z so that the clutch engages with the bevel wheel B for forward speeds, and with the bevel wheel W for reverse speeds. Other than this, the progress of the drive on high and low gear is the same.

HIGH-SPEED PROGRESSION

The epicyclic transmission gears are arranged for high-speed ratio when the high-speed brake is applied on the band G, and the low-speed brake on the band N is released. Due to the position of these two brakes and the clutch X being in mesh with the bevel wheel B, the drive progresses from the bevel pinion A to the bevel wheel B, and thence through the clutch X to the cross shaft C. From the cross shaft C the drive goes to the epicyclic disk D, and thence to the spur ring V. The spur ring V meshes with the three planetary pinions E, causing them to rotate about the planet pins P, as an axis, and also to roll around the circumference of the sun pinion F. This pinion is locked in position, due to the application of the high-speed brake G. As the planet pinions E rotate about the circumference of the sun pinion F, they carry with them the pinion pins P, which in turn carry the housing Q. This housing Q is rotating about

PLATE No. 73

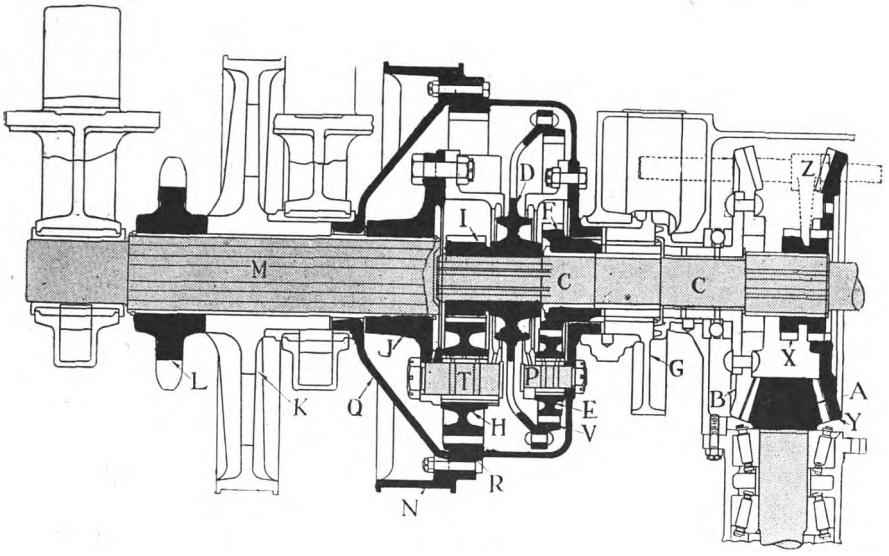


the cross shaft. The housing Q carries the epicyclic spur ring R, which meshes with the large planet pinions H, of which there are three. The rotation of the spur ring R causes the planet pinion H to roll around the sun pinion I, and as it rolls around it carries with it by means of the large planet pinion T the disk J, which communicates the drive to the shaft M and thence to the track brake K and to the chain sprocket L.

EPICYCLIC TRANSMISSION

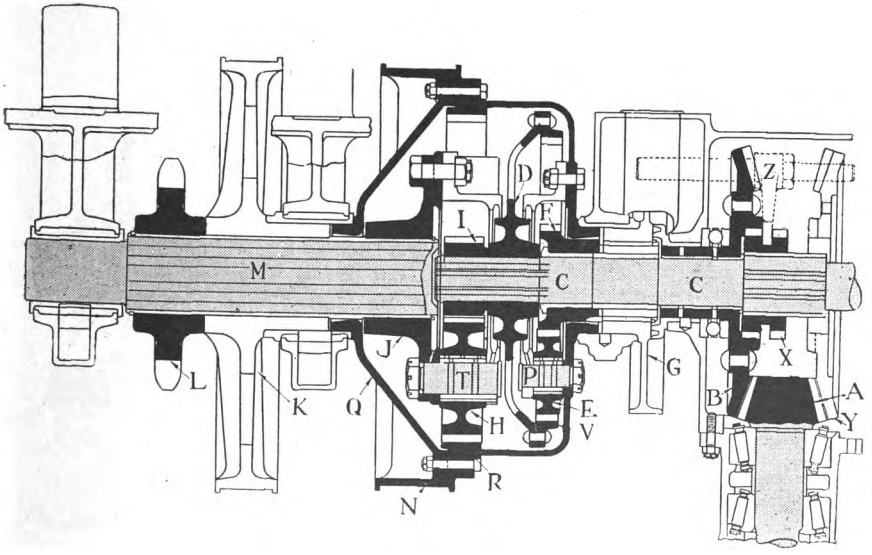
Ref. No.	Part No.	Name
1	M-297	Sprocket-bearing brackets—outside.
2	M-298	Sprocket-bearing cups.
3	M-290	Retaining rings for shaft.
4	M-300	Dowels for bearing bushes.
5	M-299	Sprocket-bearing bushes.
6	M-291	Chain sprocket pinions.
7	M-292	Brake wheels for sprocket shaft.
8	M-296	Sprocket-bearing bushes.
9	M-293	Sprocket-bearing brackets—inside.
10	M-289	Sprocket shaft.
11	M-288	Washers for planet disk.
12	M-256	Retaining rings for cross shaft.
13	M-313	Nuts for planet pinion, large.
14	M-294	Sprocket-bearing caps—inside.
15	M-318	Bolts for planet pinion ring, large.
16	M-286	Disks for planet pinion, large.
17	M-279	Epicyclic spur rings, large.
18	M-278	Epicyclic gear case and brake.
20	M-287	Sun pinions, large.
21	M-315	Joint for epicyclic gear case.
22	M-285	Rings for planet pinions, large.
23	M-282	Bushes for planet pinions, large.
24	M-283	Bushes for planet pinions, large.
25	M-280	Epicyclic planet pinion, large.
26	M-284	Pins for planet pinion, large.
27	M-273	Rings for planet pinion, large.
28	M-316	Joint ring for oil-filling cap.
29	M-311	Oil-filling cap for gear case.
30	M-317	Bolts for planet pinion ring, small.
31	M-276	Disks for epicyclic spur ring.
32	M-272	Bushes for planet pinion, small.
33	M-271	Bushes for planet pinion, small.
34	M-275	Epicyclic spur rings, small.
35	M-270	Epicyclic planet pinions, small.
36	M-274	Pins for planet pinion, small.
37	M-314	Nuts for planet pinion, small.
38	M-266	Cap for brake bearing.
39	M-277	Epicyclic gear case.
40	M-290	Retaining rings for shaft.
41	M-265	Bush for brake bearing.
42	M-269	Brake wheel for sun pinions.
43	M-268	Bush for sun pinion.
44	M-267	Epicyclic sun pinion and sleeve, small.
46	M-263	Bevel-gear case.
47	M-301	Clutch fork for reversing gear.
48	M-302	Striking stud for reversing gear.
49	M-257	Clutch for cross shaft.
50	M-261	Bush for flanged sleeve, internal.
52	M-260	Packing washers for bevel-wheel adjustment.
53	M-247	Bevel pinion and shaft.
54	M-281	Timken bearing.
55	M-249	Distance piece for bevel-pinion shaft.
56	M-250	Stuffing box and Timken bearing case.
57	M-262	Bush for flanged sleeve bearing, external.
58	M-310	Oil-retaining washer for bush.
59	M-264	Bevel-gear case cover.
60	M-259	Flanged sleeve for bevel wheel.
61	M-258	Bevel wheel.
62	M-254	Packing washers for bevel-pinion adjustment.
63	M-253	Oil-retaining washer for stuffing box.
64	M-252	Stuffing-box disk.
66	M-251	Stuffing-box gland.
67	M-246	Flange coupling for bevel-pinion shaft.
68	M-248	Washer for bevel-pinion shaft.

PLATE No. 74



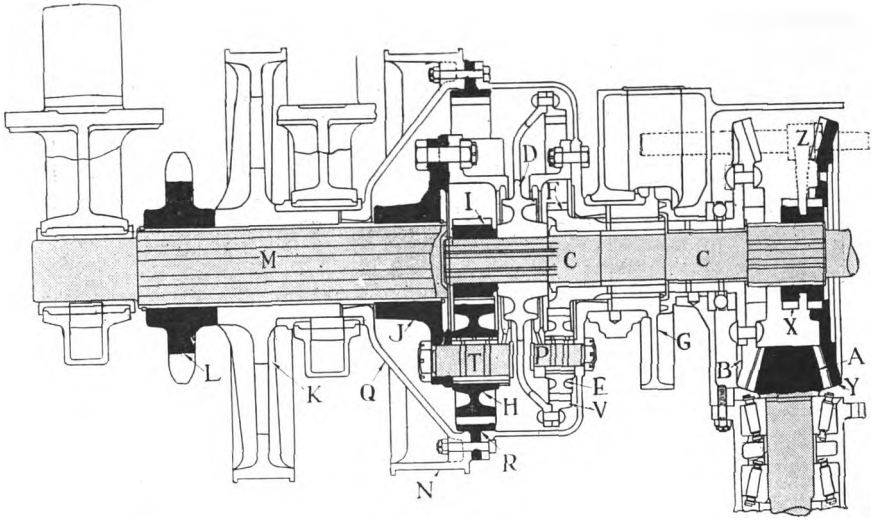
HIGH-SPEED FORWARD

PLATE No. 75



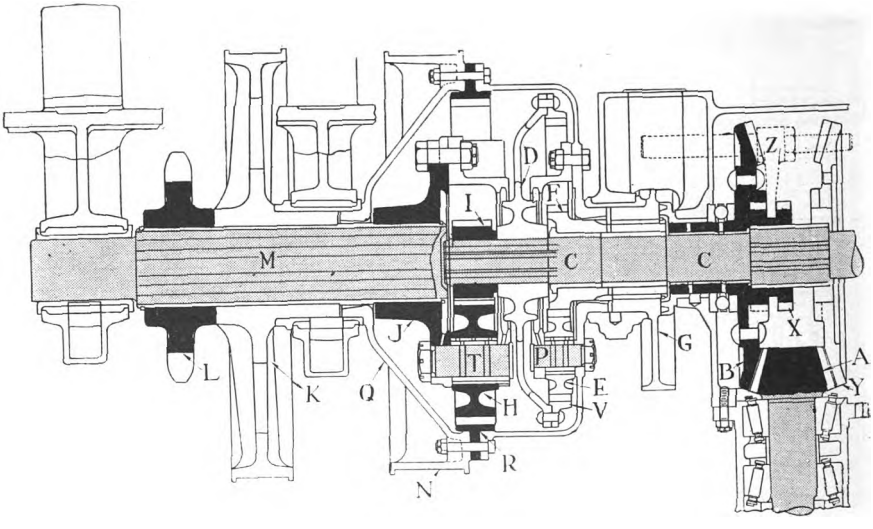
HIGH-SPEED REVERSE

PLATE No. 76



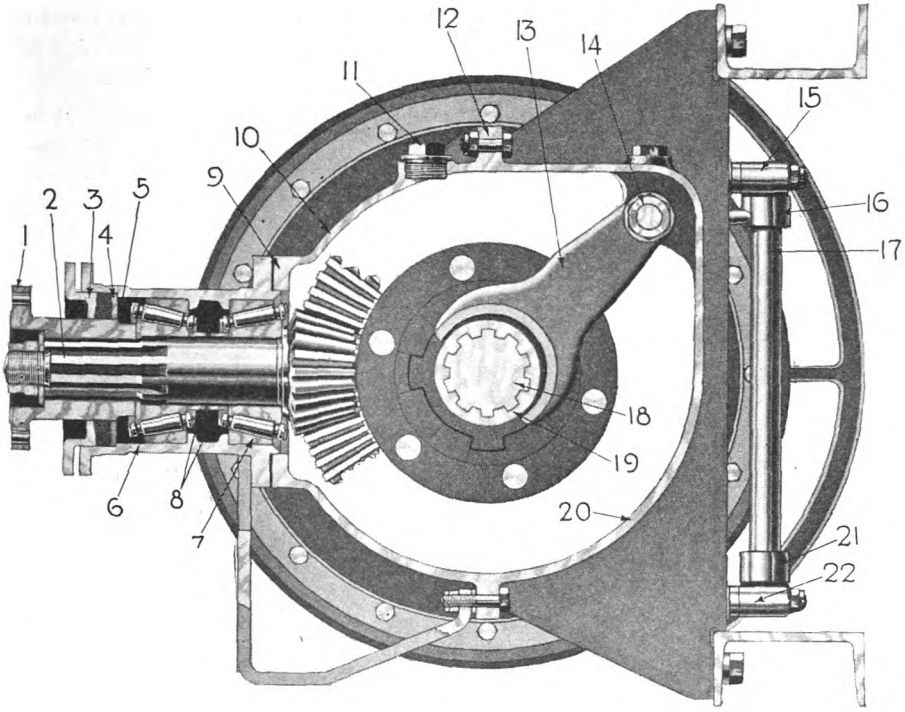
LOW-SPEED FORWARD

PLATE No. 77



LOW-SPEED REVERSE

PLATE No. 78



EPICYCLIC DRIVE

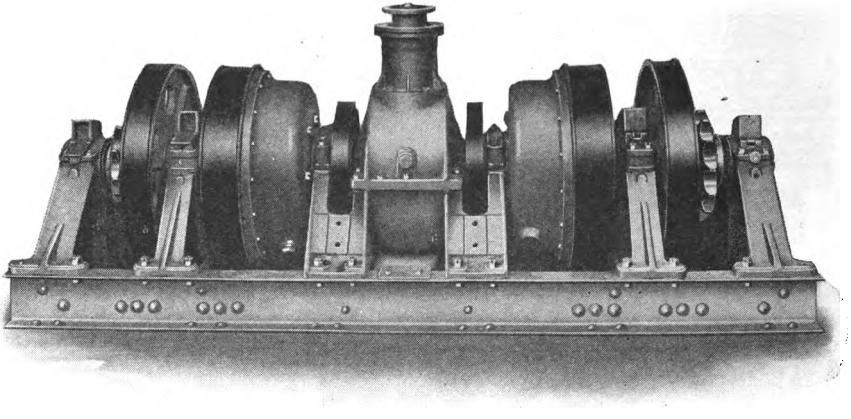
Ref. No.	Part No.	Name
1	M-246	Flange coupling for bevel-pinion shaft.
2	M-247	Bevel pinion and shaft.
3	M-251	Stuffing-box gland.
4	M-253	Oil-retaining washer for stuffing box.
5	M-252	Stuffing-box disk.
6	M-250	Stuffing box and Timken bearing casing.
7	M-281	Timken bearing.
8	M-249	Distance piece for bevel-pinion shaft.
9	M-254	Packing washers for bevel-pinion adjustment.
10	M-264	Bevel-gear case cover.
11	M-311	Oil-filling cap.
12	M-326	Joint for bevel-gear case.
13	M-301	Clutch fork for reversing gear.
14	M-302	Striking rod for reversing gear.
15	M-306	Vertical shaft bearings for reversing gear.
16	M-303	Top lever for reversing gear.
17	M-305	Vertical shaft for reversing gear.
18	M-255	Epicyclic cross shaft.
18	M-255	Bevel and epicyclic cross shaft.
19	M-257	Clutch for cross shaft.
20	M-263	Bevel-gear case.
21	M-304	Bottom lever for reversing gear.
22	M-306	Vertical shaft bearings for reversing gear.

LOW-GEAR DRIVE

On low gear the brake is applied to the low-speed brake band, while the high-speed brake G is released. This condition of the brakes which control the speeds permits of the following progress of drive for low gear:

The bevel pinion A meshes with and drives the bevel-ring gear B, and by means of the clutch X the cross shaft C. This carries with it, idly, the parts D, V, E, F, and G, these being all free to revolve, due to the release of the high-speed brake G. The pin P, however, is fixed, due to the application of the low-speed brake N. Thus the drive goes from the cross shaft C to the sun pinion I, to which it is splined; thence to the planet pinion H, which rotates within the epi-

PLATE NO. 79



EXTERIOR VIEW EPICYCLIC TRANSMISSION

cyclic spur ring R, which is fixed by reason of the application of the low-speed brake. As the planet pinion H travels around within the epicyclic spur ring R it carries with the pin T and the planet disk J, by means of which the drive is communicated to the shaft M.

REVERSE SPEEDS

As stated, the progress of the drive on high reverse and low reverse is exactly the same as for high forward and low forward, except for the meshing of the clutch X with the bevel wheel Y instead of the bevel wheel B.

DRIVING-MEMBER SPECIFICATIONS

Ref. letter	Part No.	Specifications
A	M-247	14 stub teeth, 3-4 D. P.
B	M-258	46 stub teeth, 3-4, D. P.
X	M-257	4 teeth, 10 splines.
C	M-255	Epicyclic cross shaft, 10 splines.
D	M-276	30 stub teeth, 5-7 D. P.
R	M-275	78 stub teeth, 5-7 D. P.

Ref. letter	Part No.	Specifications
F	M-267	30 stub teeth, 5-7 D. P.
G	M-269	10 splines, 15 inches in diameter.
R	M-279	72 stub teeth, 4-5 D. P.
H	M-280	27 stub teeth, 4-5 D. P.
I	M-287	18 stub teeth, 4-5, D. P.

TO REMOVE THE EPICYCLIC GEAR

To remove the epicyclic gear from the hull the following operations should take place:

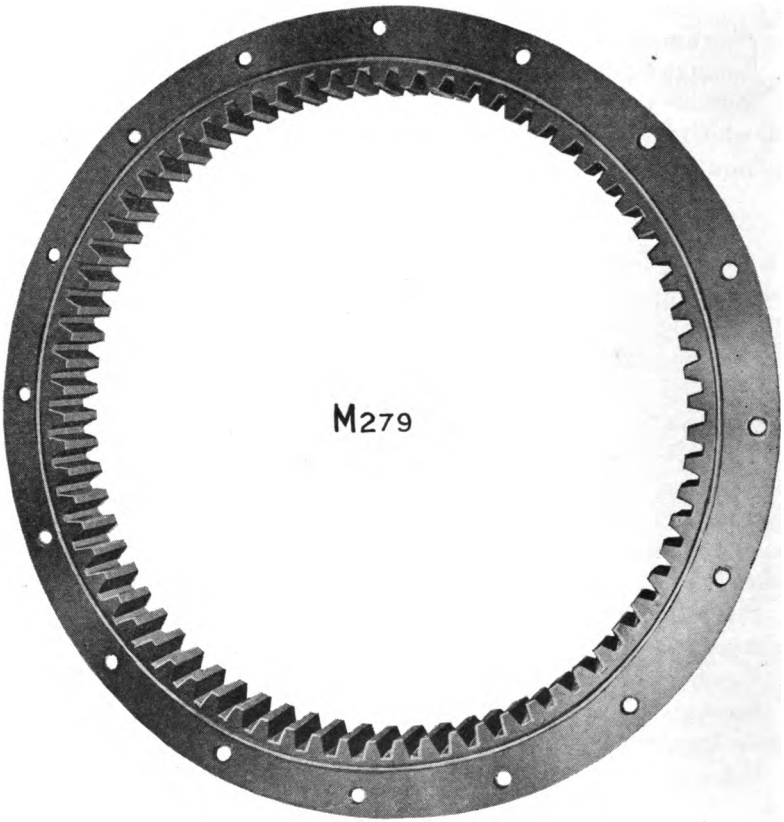
1. Remove from the hull the side plates on the right and left end of the epicyclic gear set and also the outlet louver.
2. Disconnect and remove the oil pump.
3. Disconnect and remove the gasoline-feed pipes running above the epicyclic gear set, and also remove the radiator and fan, together with the air duct.
4. Disconnect all control rods,
5. Disconnect and remove the driving shaft.
6. Remove both driving chains so as to release the chain sprocket.
7. Remove the bolts holding the epicyclic gear set to the rear bulkhead, which leaves the epicyclic gear free to be removed as a complete unit from either side of the hull.

TO MOUNT EPICYCLIC GEAR SET

To put the epicyclic gear set into position in the hull the space which it occupies should be cleared of all obstructions and the chain casing should be in position. After these precautions have been taken the operations for mounting the epicyclic gears in position is as follows:

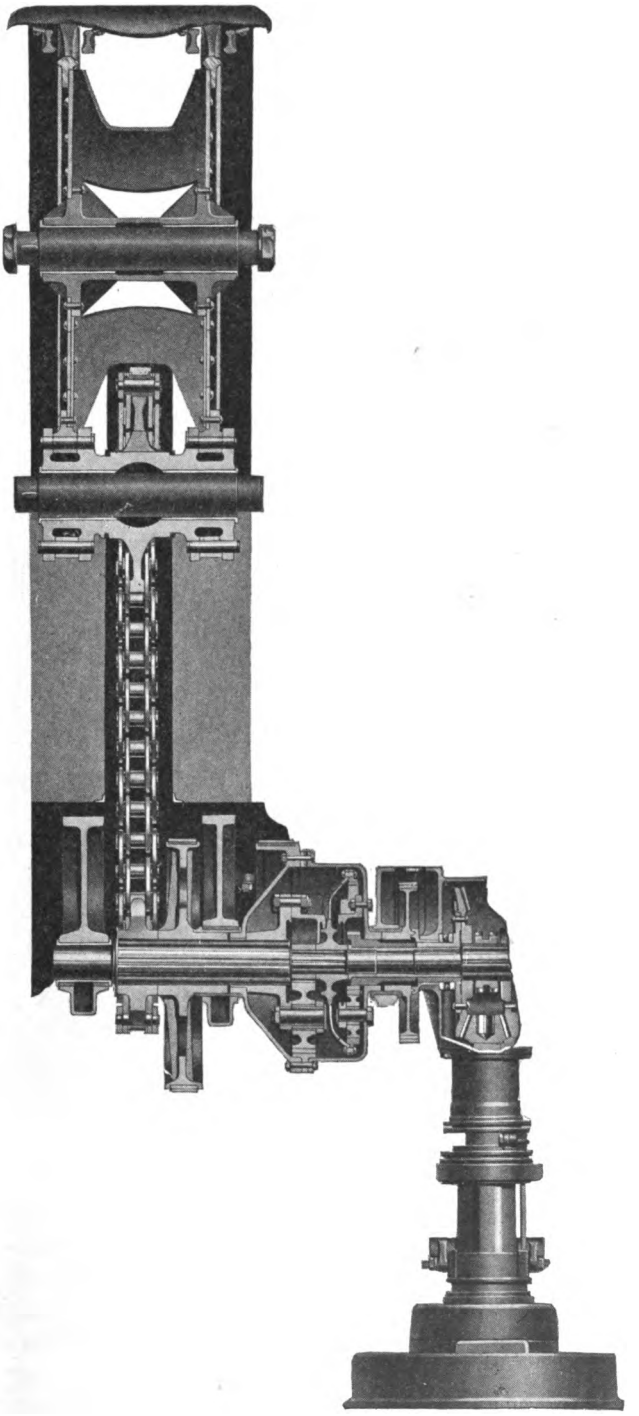
1. Remove from the hull the side plates and outlet louver on the right and left end of the epicyclic position.
2. By means of a chain hoist or other convenient apparatus lift the epicyclic gear set into position and place it transversely across the hull. Place the bolts in position holding the epicyclic gear to the rear bulkhead.
3. Place the driving chains in position.
4. Assemble the connecting and driving shaft.
5. Connect all the control rods.
6. Connect all the gasoline-feed pipes and place the radiator in position together with fan air duct.
7. Place the oil pump in position and make the necessary connections.
8. Replace the side plates on the hull and the outlet louver.

PLATE NO. 80



EPICYCLIC PLANETARY RING

PLATE No. 81



PROGRESS OF DRIVE THROUGH THE VARIOUS PROPELLING UNITS OF THE 35-TON TANK, MARK VIII. THE DRIVE PASSES FROM THE CLUTCH TO THE BEVEL GEARS, THEN TO THE EPICYCLIC TRANSMISSION, FROM WHICH IT PASSES TO THE TRACK BY MEANS OF THE CHAIN, ROLLER SPROCKET, AND ROAD TRACK DRIVING WHEEL.

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Chapter VI

CHAIN DRIVE

Outline specifications

Final drive	Driving sprocket chain.
Number of chains	2.
Breaking load of chains	150,000 pounds.
Maximum working load of chains	53,000 pounds.
Chain pitch	3.
Chain, inside width	1 9/16 inches.
Roller diameter	2 inches.
Maximum chain width	4 9/16 inches.
Chain length	50 pitches.
Chain pin material	Nickel steel.
Chain bushings	Open-hearth steel.
Teeth of driving sprocket	12.
Teeth of roller pinion	23.
Roller diameter	2 inches.
Roller length	2.37 inches.
Roller material	Nickel steel
Chain-sprocket diameter	23.031 inches.
Road track driving wheel diameter, outside	39.237 inches.
Road track driving wheel diameter, inside	32.75 inches.
Number of road track driving-wheel teeth	35.

CHAIN DRIVE

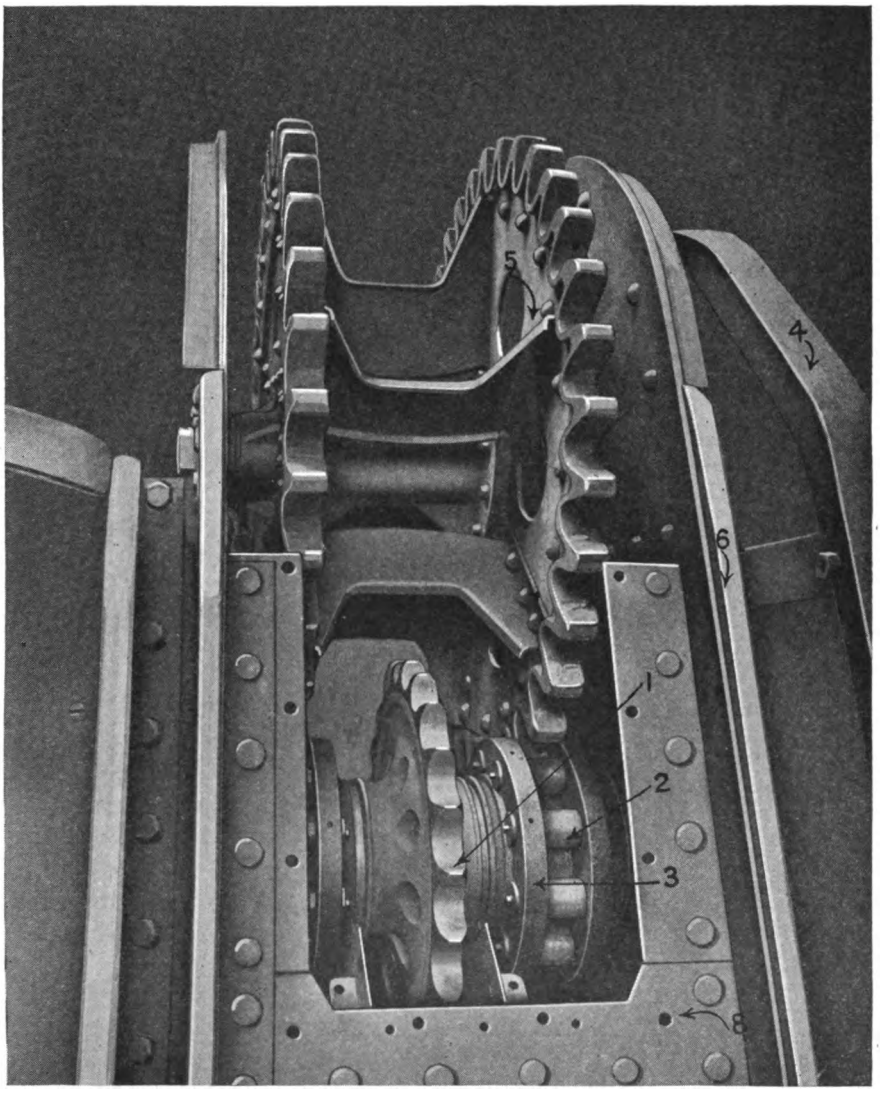
GENERAL DESCRIPTION

The drive is taken from the epicyclic gear and transmitted to the track by means of a driving chain. The driving sprocket is mounted on the epicyclic cross shaft and takes the drive directly from the epicyclic gear. From this point it passes to the roller pinion which has the sprocket wheel at its center and the roller-pinion drive on each side of the center. These roller pinions mesh in turn with the road track driving wheel, which engages directly with the track; so that the progress of the drive is from the epicyclic gears through the driving sprocket; thence by chain to the sprocket on the roller pinion, and from the roller pinion to the road track driving wheel which is driven by the rollers on the roller pinion. This drives in turn the track.

CHAIN-SPROCKET PINION

The chain-sprocket pinion is mounted on the epicyclic driving shaft and is driven by it. It has 12 teeth of three pitch for driving the roller chain. This pinion can be slipped off the end of the shaft after the epicyclic assembly is removed from its case. It is a part of this assembly and is the unit which transmits the drive from the epicyclic

PLATE NO. 82



ROLLER PINION AND TRACK DRIVE

Ref. No.	Part No.	Name
1	M-1541B	Chain sprocket and roller pinion.
2	M-1542	Roller.
	M-1543	Pin for roller-pinion rollers.
	M-1550	1/8-inch taper plug for roller pin.
	M-1409	Driving wheel.
	M-1544	Shaft for roller pinion.
	M-1407	Outer shaft bearing.
	M-1546	Inner shaft bearing.
	M-1552	Plate for shaft bearing.
	20297-D89	Wheel shaft.
	M-1549	3/4-inch taper plug in shaft.
	M-1541A	Roller-pinion sprocket.
4		Guide rail.
5		Road track driving wheel.
6		Upper track rail.

gearset to the chain. The chain sprocket pinion is a drop forging and engages with the epicyclic shaft by means of 10 splines. It has a total width on the shaft of 4 inches. Its pitch is 11.592-inch and its teeth are 1½ inches wide.

DRIVING SPROCKET CHAIN

The driving sprocket chain is a chain which connects the chain sprocket pinion on the epicyclic transmission system with the roller pinion which in turn drives the track driving wheel. The driving sprocket chain is designed to operate under a maximum working load of 53,000 pounds and has a breaking load of 150,000 pounds. It is a 3-pitch chain, and has a length of 50 pitches. The chain is made up of outer and inner bars which connect the rollers. The outside and inside bars are of 40 carbon, hot-rolled steel. The distance between the outside bars is 2⅞ inches and between the inside bars $1\frac{9}{16}$ inches. The outside bars are ½ inch thick and the inside bars are ⅝ inch thick. The pins are $1\frac{7}{32}$ inches in diameter, and are of nickel steel. The pins are held in place by a ⅜ inch by 1¾ inch split pin. The holes through which the pins pass are reamed to 1.231 inches, giving a 0.005 clearance between the pin and the hole. Surrounding each pin is an open-hearth steel bushing which takes the wear.

CHAIN SPROCKET AND ROLLER PINION

The chain sprocket and roller pinion is one assembly, being cast iron and carrying the roller sprocket in the center, and the roller pinions on each side of the center. The drive is transmitted by the chain to the chain sprocket, which is an iron casting, also carrying the roller pinions shaft which is fixed and screwed to the inside and outside plating of the hull. The chain case surrounds the central portion of the casing, or that portion that is known as the chain sprocket.

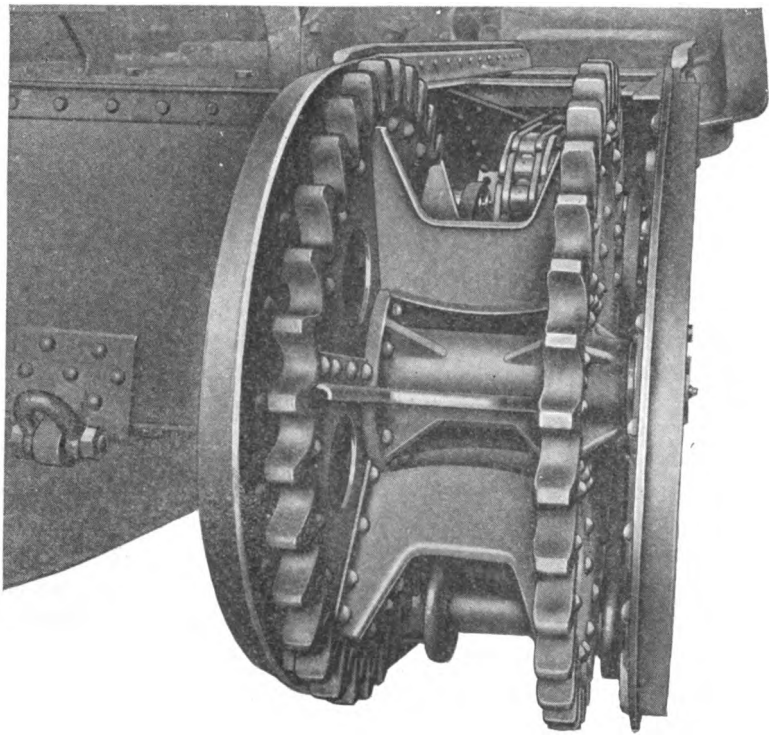
The length over all of this unit casting which acts as a chain sprocket and a carrying part for the roller pinion is 19½ inches. The diameter at the roller-pin bosses is 13.687 inches, and the diameter of the sprocket is 23.031 inches. The sprocket has 23 teeth, 1.39 inches wide. The rollers are nickel steel, 2 inches in diameter, and 2.37 inches long. They revolve on pins, pasisng between the bosses, these pins being nickel steel 5.593 inches long and 1¾ inches in diameter. The shaft about which the roller pinion revolves is carbon steel 25¼ inches long and 4.434 inches in diameter.

The casting revolves on the bronze bushing, and is lubricated by the hole drilled through the center of the shaft, and having leads from the center out to the bushing. The ends of the hole through the center of the shaft are sealed by ¾ inch pipe plugs, the one on the inside being cut off flush after being screwed in, and the one on the outside being left with its head so that it can be removed for the purpose of introducing oil.

ROAD TRACK DRIVING WHEEL

The roller pinions mesh with the road track driving wheel. This is of cast manganese steel, 39.237 inches in diameter, having 35 teeth, 3.735 pitch and 2 inches in width. The tooth operation of the steel is a manganese steel casting, these two tooth rings are riveted to a series of diaphragm plates which are in turn riveted to the road track driving wheel disks. The disks are riveted to bosses of the

PLATE NO. 83



ROAD TRACK DRIVING WHEEL

Part No.	Name
M-1401	Teeth for road track wheel.
M-1402	Shaft for road track wheel.
M-1403	Boss for road track wheel.
M-1404	Disk for road track wheel.
M-1405	Diaphragm for road track wheel.
M-1406	Shaft bearing inner end.
M-1407	Shaft bearing outer end.
M-1409	Bushing for road track wheel.
M-1410	Plug in end of shaft.
M-1411	Locking plate for shaft nut.
M-1552	Stud plate for shaft bearing.
20297-D89	Key for road track driving wheel shaft.
M-1477	Nut for shaft.

road track driving wheel, and this entire assembly revolves on the road track driving-wheel shaft bronze bushing. This bushing is lubricated similar to the bushing of the roller pinion and chain sprocket by means of a lead drilled through the axis of the driving-wheel shaft to about the center of its length. From this point there is a lead to the bushing. The opening to the oil lead is sealed by a pipe plug which is removed when oil is introduced.

The road track driving-wheel shaft is carbon steel, 27.625 inches long and 4.434 inches in diameter. The bushing upon which the road track driving wheel rotates is bronze, 5.118 inches in diameter, and 8 inches long, and interchangeable with the bushing upon which the chain sprocket and roller pinion rotates. This bushing is renewable after wear by simply driving them off the shafts and replacing them.

TO REMOVE THE DRIVE CHAIN

To remove the drive chain, the following operations should be followed in the order given:

1. Break the track over the rear mud pocket by removing one of the connecting links at this point.
2. Roll drive chain around until the key link is on the top.
3. Remove the key link.
4. Secure hold on the end of the chain coming from the under side and pull it through.

NOTE.—It must be remembered in replacing the chain that the oil holes must be on top and the cotter pins on the outside. If this is not done the cotter pins will catch on the gusset plate of the epicyclic which have been cut away for the chain links, but which will not allow the cotter pins to pass by freely.

CHAIN CASING

The track driving chain is surrounded by a sheet steel casing, 6⅝ inches wide and extending around the chain for its entire length. This case is supported from the outside and inside plating of the track extensions of the hull. It is bolted in place by means of angle irons, and is so shaped as to follow the contour of the chain and to clear the web on the track sprocket. It is housed within the track-extension plates of the hull.

TO REMOVE CHAIN CASINGS

The chain casing is in two parts, the outer end being a removable cap fitting over the sprocket of the roller pinion. In removing the chain casing the following operations should be followed:

1. Remove track over the roller pinion.
2. Remove the bolts from the angle-iron cleats on both sides of the cap.
3. Remove the cap.

In removing the main casing, it is necessary to remove the track driving wheel, roller pinion, driving chain, and epicyclic gear. After these are taken out, the nuts fastening the chain casing to the back-plates of the hull and the supporting bracket must be removed. The casing can then be taken out.

NOTE.—In reassembling, the chain casing must be fixed in position before the epicyclic gear is mounted.

TO REMOVE ROLLER PINION

To remove the roller pinion, the following operations should be followed:

1. Break the track and remove the drive wheel.
2. Unbolt the chain casing and disconnect and remove the drive chain.
3. Remove the nuts holding the shaft bearing (outer end).
4. Insert screws in the tap holes in the shaft bearing at the outer end and screw them, forcing the shaft bearing out.
5. After the shaft bearing has been removed, the shaft can be drawn out and the roller pinion removed. This also permits the floating bushing to be taken out.

Chapter VII

ROAD TRACK AND TRACK DRIVE

Outline specifications

Type of track	Continuous, linked.
Length of ground contact (normal)	9 feet 3½ inches.
Length of track expanded	72 feet 6 inches.
Number of track links	78.
Road track drive	Roller sprocket.
Track shoe material	Armor steel.
Diameter of track adjusting steel	40.187 inches.
Diameter of road track driving wheel	23.031.

GENERAL DESCRIPTION

The road track passes in the form of a continuous belt, running around the entire exterior of the hull. There are two of these tracks, one on each side of the machine. The tracks are propelled by means of a road-track driving wheel which carrying the sprocket engages with the pins on the track links. As the track is driven around the hull, it carries with it the track links which lay down before the machine a railbed, over which the machine rolls, by means of the road-track rollers.

These road-track rollers run on the rail faces of the track links, giving a continuous rail surface, regardless of road conditions. Thus the road-track driving wheel through its mesh with the road-track chain, not only propels the machine but also supplies the continuous surface necessary for the rollers.

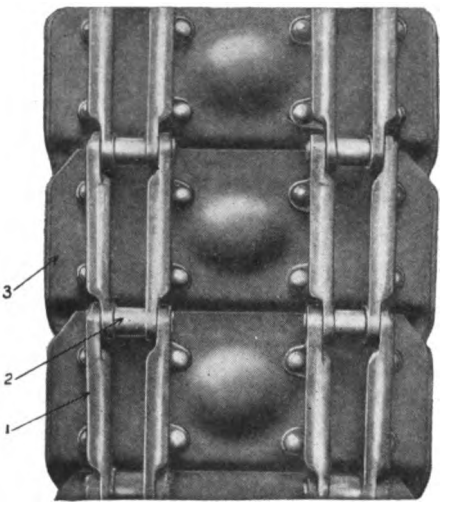
The road-track driving wheel is at the rear of the machine. At the forward end of the machine there is an idler wheel, which serves as a guide for the track, and at the same time provides a means of adjustment. The position of the idler wheel fore and aft determines the center to center distance between the idler and adjusting wheel, and the sprocket, and hence governs the tension on the track. Moving the road track adjusting wheel forward tightens the chain, and moving it toward the rear loosens the chain.

There are 58 rollers which carry the weight of the machine. These are known as lower rollers, as distinguished from the top road track rollers, of which there are two. Of the 58 rollers, 28 are fitted with spring plates which act as spacers, and 30 are plain without the spring plates. Since the road track is double, these spacers keep the rollers which roll upon the track at the proper distance apart. The two top road-track rollers are alike, one on each side at the point where the track makes its sharpest angle and where, consequently, the greatest strains may be expected. Elsewhere along the top the track slides on the top track rails.

TRACK LINKS

The track links are drop forged steel, having a length from pin center to pin center of 11.154 inches. The assembly of these links must be very accurate, and the allowable limit in assembly is 0.004 inches between pin centers; i. e., when links are assembled in pairs they must agree to within 0.004 inches between pin centers. The links perform the double duty of binding the chain together, and also of forming a rail surface upon which the machine rolls. It takes a left and right link bar to make up one link assembly. These bars are connected by the pins which are driven through. The pins are sur-

PLATE No. 84



ROAD-TRACK LINK

Ref. No.	Part No.	Name
1	M-1265	Road-track link.
2	M-1263	Bushing for road-track link.
3	1264	Road-track shoe.

rounded by carbon-steel bushings, which take the wearing stresses, due to meshing with the road-track driving wheel. Riveted to the links are the track shoes, which are in contact with the ground. The track shoes are presssed from armor plate, and so shaped that they link one over the other. The shape of the track shoe, and the method, of overlapping is clearly shown above. The track shoe is 26½ inches in width. Under normal conditions there is a total area of 41.052 square feet of track surface in contact with the ground.

ROAD-TRACK DRIVING WHEEL

The road-track driving wheel has been described in Chapter VI, see page 133.

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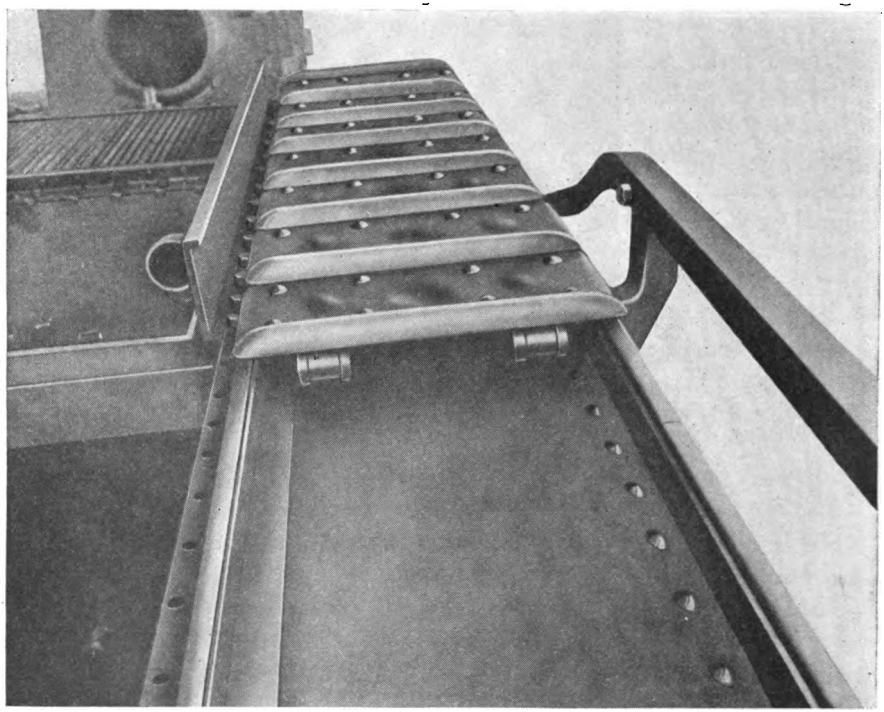
ROAD-TRACK ADJUSTING WHEEL

The road-track adjusting wheel is an idler wheel, having no teeth and running idly with the track. Its sole function is to act as a guide for the front end of the track, and also act as a track adjustment, by means of the belt which allows it to be moved lengthwise, thus increasing or decreasing its distance from the road-track driving wheel. The road-track adjusting wheel has a diameter of 40.187 inches. It is of diaphragm construction, the units composing it being a solid rim which runs upon the track surface of the links. The disc connects the diaphragm with the rim and with the boss which acts as a hub.

PLATE No. 85



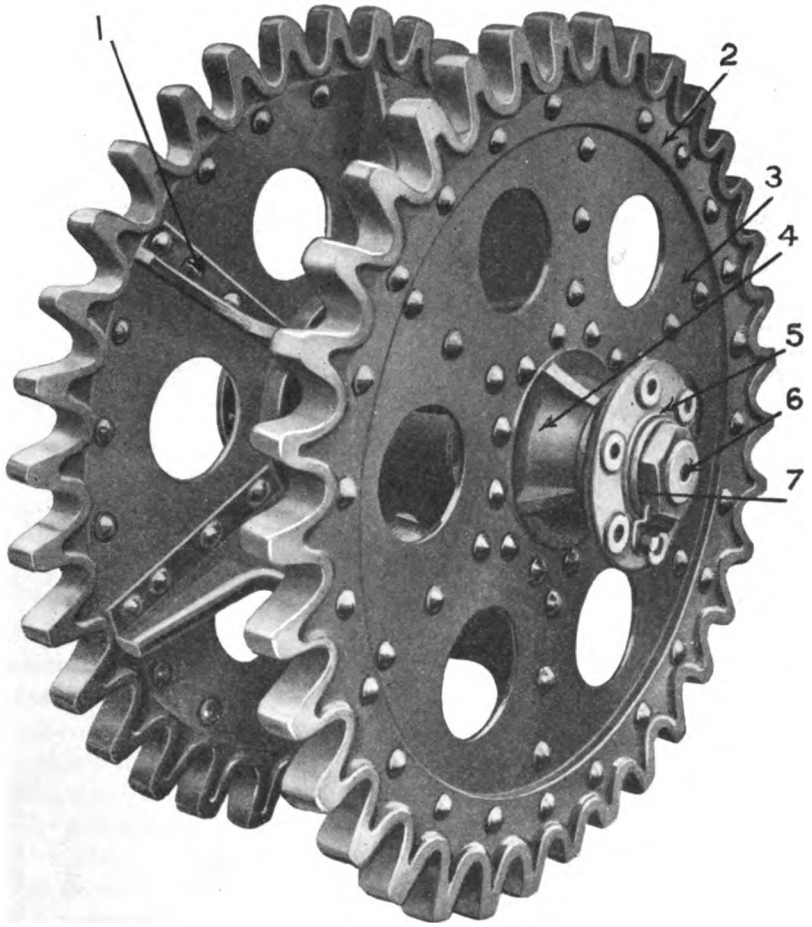
TOP TRACK RAIL UPON WHICH TRACK SLIDES. TRACK SHOWN BROKEN

These combined units make up the road-track adjusting wheel proper and in addition there is the adjustment feature, consisting of an adjusting screw which moves the entire action of the adjusting wheel forward or backward as desired. In order to preserve the alignment of the wheel there is one of these adjusting screws on each side of each adjusting wheel. The tension adjusting screw is nickel steel, 15⅜ inches long, 1⅞ inches in diameter. It is located within a bracket of cast steel, and there is a guard in the hull plate for the track-adjusting screw. This guard or opening is 6¾ inches long and 4¾ inches wide.

TRACK-ADJUSTING SHAFT

The track-adjusting shaft is surrounded by a bronze bushing upon which the track-adjusting wheel rotates. This bushing is interchangeable with the bronze bushing on the track driving wheel and

PLATE NO. 86



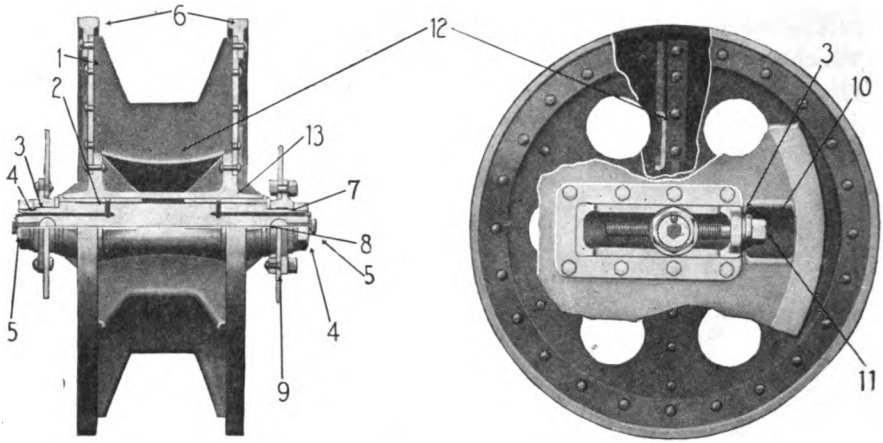
ROAD-TRACK DRIVING WHEEL

Ref. No.	Part No.	Name
1	M-1411	Locking Plate for shaft nut.
2	M-1401	Teeth for road-track wheel.
3	M-1405 xy	Diaphragm road-track wheel.
4	M-1404	Disc for road-track wheel.
5	M-1403	Boss for road-track wheel.
6	M-1552	Stud plate for shaft bearing.
7	M-1407	Shaft bearing, outer end.
8	M-1410	Plug in end of shaft.
9	2097-D89	Key for road track driving-wheel shaft.
10	M-1409	Bush for road-track driving wheel.
11	M-1406	Shaft bearing, inner end.
12	M-1402	Shaft for road track wheel.
13	M-1477	Nut for shaft.

on the roller sprocket. The track-adjusting shaft is drilled for oil passages, the holes being sealed by pipe plugs, which are removed for the purpose of injecting oil. These plugs are ⅜-inch pipe plugs.

The nuts of the track-adjusting shafts are hexagonal, 4⅞ inches in diameter and 4.18 inches across flats. Inserted in the shaft on the

PLATE No. 87



ROAD-TRACK ADJUSTING WHEEL

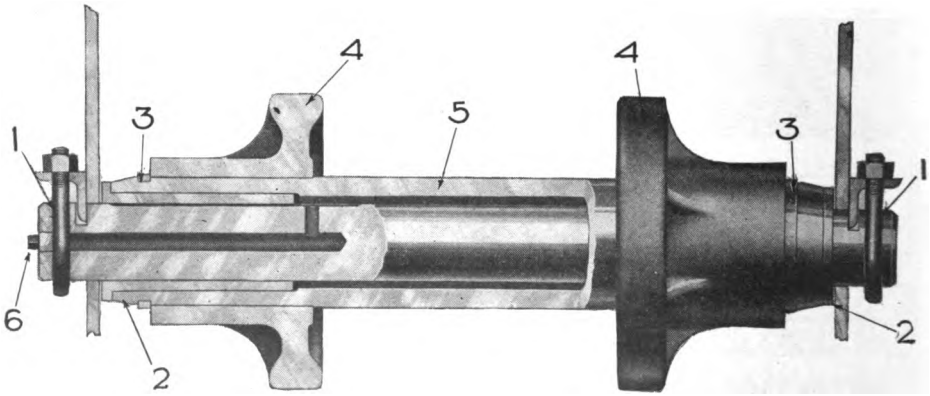
Ref. No.	Part No.	Name
1	M-1404	Disc for road-track adjusting wheel.
2	M-1409	Bush for road-track adjusting wheel.
3	M-1472	Bracket for tension-adjusting screw.
4	M-1477	Nut for shaft for track-adjusting wheel.
5	M-1475	Locking screw for adjusting wheel.
6	M-1471	Rim for road track.
7	M-1472	Bracket for tension-adjusting screw.
8	M-1474	Shaft for tension-adjusting screw.
9	M-1484	Plate for track-adjusting bracket.
10	M-1479	Guard in hull plate for adjusting screw.
11	M-1473	Tension-adjusting screw.
12	M-1405	Diaphragm road-track adjusting wheel.
13	M-1403	Boss for road-track adjusting wheel.

side is a hard copper plug for locking the track-adjusting screw. As the adjusting screw is turned it moves its entire shaft lengthwise, as will be explained.

ROAD-TRACK ROLLERS

There are three types of road-track rollers. Two of these are lower road-track rollers and the other is the top or upper rollers. The two

PLATE No. 88



TOP ROAD-TRACK ROLLER

Ref. No.	Part No.	Name
1	M-1338	U bolt.
2	M-1339	Floating bushing.
3	M-1335	Spring ring.
4	M-1341	Top roller.
5	M-1333	Tube.
6	M-1410	Tap plug in roller pin for oil.

types of lower road-track rollers are similar with the exception that one has spring plates and the other has not. The three types of rollers are shown on pages 140 and 143. The purpose of the lower road-track roller is to carry the weight of the machine and provide the wearing surface which bears upon the tracks, held down by the road-track links. The machine rolls on this surface upon the steel roller provided by the track linkage.

LOWER ROAD-TRACK ROLLERS WITH SPRING PLATES

The road-track rollers are mounted between the outer and inner shell plating of the hull and are carried on shafts which are secured in position by means of angle brackets and U bolts which suspend the shafts and hold them in position. The shafts are shaped to fit the toe of the angle bracket, thus locking them securely against turning, as well as providing a clearance for the tracks. (Page 143.) The distance between the inner and outer shell plating along the line of the lower road-track roller is 22¼ inches. The rollers themselves roll upon the two double tracks provided by the double set of links in the track chain.

The rollers are 8¾ inches in diameter and are 4⅞ inches wide. Holding these rollers in their proper relationship on the shaft, on 28 of the lower road-track rollers there are spring plates. Between these plates are the road-track-roller springs, 1 inch in diameter, having three coils 6.652 inches long under a load of 2,500 pounds. The spring has an outside diameter of 3.937 inches.

The road-track-roller pin which acts as a shaft for the rollers extends entirely across the housing formed by the inner and outer shell plates and is 25¾ inches in length and 2.247 inches in diameter. At its inner and outer ends it carries a bronze bushing, known as the road-track-roller tube bushing, upon which the road-track-roller tube together with the two road-track rollers, rotate.

The road-track-roller pin is drilled partially at each end, providing an oil passage, and is also drilled radially to provide an oil passage to the bushing. The road-track-roller tube or sleeve is 21½ inches long, 3.812 inches outside diameter, and 2.75 inches inside diameter. It carries the rollers, the spring plates, and the spring, all of which revolve as a unit, together with the tube. The rollers are locked to the tube by means of a spring-steel split ring of carbon steel, 0.187 inch thick, 0.375 inch wide, and 3.531 inches in diameter.

LOWER ROAD-TRACK ROLLERS WITHOUT SPRING PLATES

The lower road-track-rollers without spring plates are 30 in number and are similar to the lower road-track rollers with spring plates in all respects except that the plates and spring are omitted. These rollers are placed alternately with the spring rollers.

TOP ROAD-TRACK ROLLERS

There are two top road-track rollers, located one on each side of the machine at the top, at the point where the track has an angle, due to the contour of the machine. These road-track rollers are similar in most respects to the lower road track rollers, without spring plates. The rollers are cast iron, 8¾ inches in diameter, operating on the tube or cylinder in the same way as the lower road-track rollers, the sleeve being interchangeable. The top road-track-roller pin is also interchangeable with the lower road-track-roller pin, and the assembly is quite similar throughout, except for the shape of the roller.

TO REMOVE THE TRACK

To remove the track, slacken the locking screw and the track-adjusting screws. These are the small nuts in the center of the nut on the end of the track-adjusting wheel shaft. Also slacken the nuts for the shaft of the track-adjusting wheel on each side of the track. This allows the following operations to be carried out in removing the track:

1. Unscrew the adjusting screws on each side of the track-adjusting wheel until there is considerable slack.
2. Raise the track links over the mud chute until the road-track link pins are clear of the bulb rail upon which the track slides at the top of the machine. Pull the two links together as far as possible to reduce the pressure on the link pins.
3. Remove the road-track-link cotter pins and drive out the link pin with a drift.
4. Remove the track from the top by pinching the bars or lifting the ends by means of a crane.

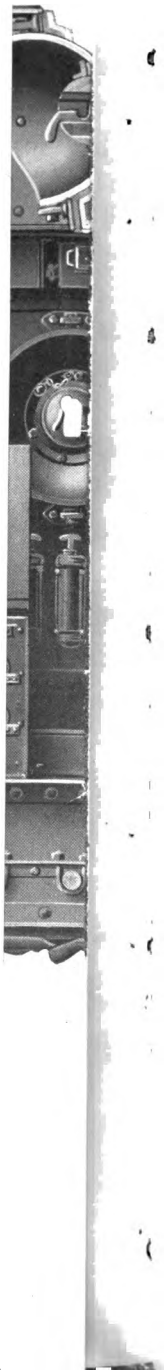
The machine is then jacked up and the track removed from beneath.

TO REMOVE TRACK LINK

If it is necessary to remove a link in any part of the track, the easiest way is to break the track over the mud pocket, in order to get plenty of slack where the link is to be taken out, rather than to have the slack obtained merely by releasing the tension of the track-adjusting screw. This will greatly simplify the removal of the link.

TO ADJUST THE TRACK

The track adjustment is accomplished by moving the road-track-adjusting wheel forward to increase the tension on the track, or backward to decrease the tension. In other words, moving the adjusting wheel forward is increasing the center distance between the road-track wheels, thereby drawing the track tighter. This is accomplished by slackening the locking screw for the track-adjusting screw; that is, the small screw in the center of the nut on the end of the shaft



of track-adjusting wheel. The adjustment is then made by screwing up on the tension-adjusting screw until the desired tension is obtained.

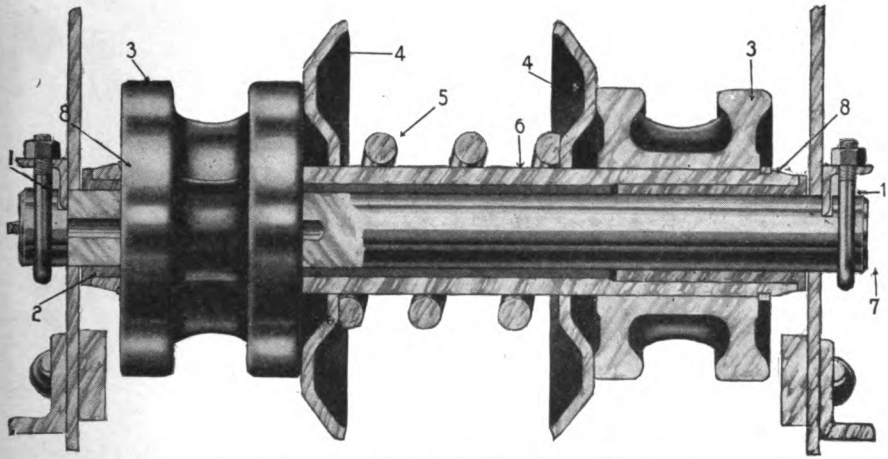
TO REMOVE THE ROAD-TRACK-ADJUSTING WHEEL

After removing the track, slacken the locking screws and remove the nuts from both ends of the shaft. Unscrew both tension-adjusting screws until clear of the shaft. Remove the outside track-adjusting bracket and drive the shaft through the opening. The adjusting wheel should be blocked up before drawing the shaft.

TO REMOVE THE ROAD TRACK DRIVING WHEEL

After removing the track, block up the driving wheel. Remove the locking plates for shaft ends on both sides of the wheel. Unscrew the

PLATE No. 89



LOWER ROAD-TRACK ROLLER WITH SPRING

Ref. No.	Part No.	Name
1	M-1338	U bolt.
2	M-1339	Floating bushings.
3	M-1332	Roller.
4	M-1334	Spring plate.
5	M-1336	Spring.
6	M-1333	Tube.
7	M-1337	Roller pin.
8	M-1335	Spring ring.

track driving wheel nuts. Remove the bolts holding the shaft bearingr (outer end).

Insert screws in the tap holes in the shaft bearing (outer end) and screw them in, forcing the shaft bearing out. After removing the outer shaft bearing the shaft can readily be pushed out from the inner end.

The driving wheel is then removed and the floating bushing taken out.

TO REMOVE TOP ROAD TRACK ROLLER

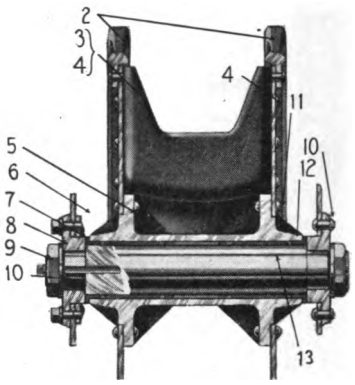
After removing the track, remove the nuts from the road track roller pin staple, or U bolt, removing the staple. Remove the bolts on the roller support angles and remove the angles themselves, after

which the road track roller pin can be forced out the outer side of the hull. The road track rollers can then be removed and the floating bushings taken out. The inner end of the rollers can be reached through the engine room.

TO REMOVE LOWER ROAD TRACK ROLLERS

Jack up the machine from the ground by placing jacks so as to put the weight of the machine on the hull plating. Then remove the track in accordance with the directions given on page 142. Remove the nuts on the road track roller pin staple and take off the staple. Unscrew the plates on the roller support angle and remove them, after which the lower road track roller pin can be driven out of the end. The road track roller can then be removed and the floating bushing taken out.

PLATE No. 90



ROAD TRACK WHEEL

Ref. No.	Part No.	Name	Ref. No.	Part No.	Name
1	M-1405xy	Diaphragm road track wheel.	5	M-1407	Shaft bearing, outer end.
2	M-1401	Teeth for road track wheel.	6	M-1402	Shaft for road track wheel.
3	M-1404	Disk for road track wheel.	7	M-1477	Nut for shaft.
4	M-1403	Boss for road track wheel.	8	M-1411	Locking plate for shaft nut.

TO REMOVE ROLLER SPRING

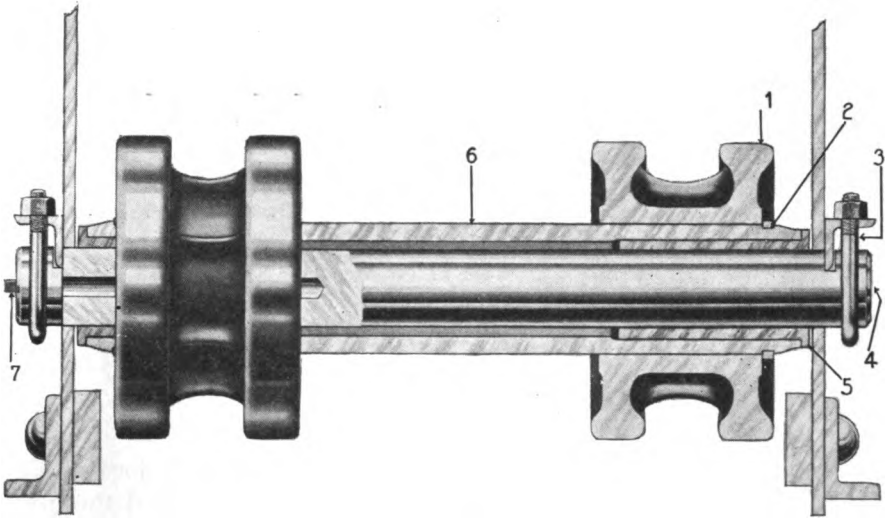
Remove the roller from the machine in accordance with directions given alone. Apply pressure on the road track roller spring plate, compressing the spring and removing the tension on the road track rollers. Separate the nuts of the spring steel split spring on the roller pin outside the roller until it is expanded to pass over the shoulder in the road track roller pin. The road track roller and roller spring plate can then be removed and the spring taken off.

TO REMOVE ROLLER PINION

After removing the track and drive wheel, unbolt the chain casing and disconnect and remove the drive chain. Unscrew the nuts holding the shaft bearing (outer end).

Insert screws in the tap holes in the shaft bearing (outer end) and screw them in, forcing the shaft bearing out. After the shaft bearing has been removed the shaft can be drawn out and the roller pinion removed and the floating bushings taken out.

PLATE NO. 91



LOWER TRACK ROLLLER WITHOUT SPRING

Ref. No.	Part No.	Name
1	M-1332	Roller.
2	M-1335	Spring ring.
3	M-1338	U bolt.
4	M-1337	Roller pin.
5	M-1339	Floating bushes.
6	M-1333	Tube.
7	M-1410	Tap plug in roller pin for oil.

Chapter VIII

CONTROL SYSTEM

Outline specifications

Control location	At driver's seat.
Number of brake pedals	1.
Number of shifter levers	2.
Number of reverse levers	1.
Number of clutch levers	1.
Number of forward speeds	2.
Number of reverse speeds	2.
Method of steer	By relative track speeds.
Spark control	Hand lever.
Throttle control	Hand lever.
Total high-speed ratio	32.545 to 1.
Total low-speed ratio	126.64 to 1.
Reverse ratio	Same as forward.

CONTROL SYSTEM

GENERAL DESCRIPTION

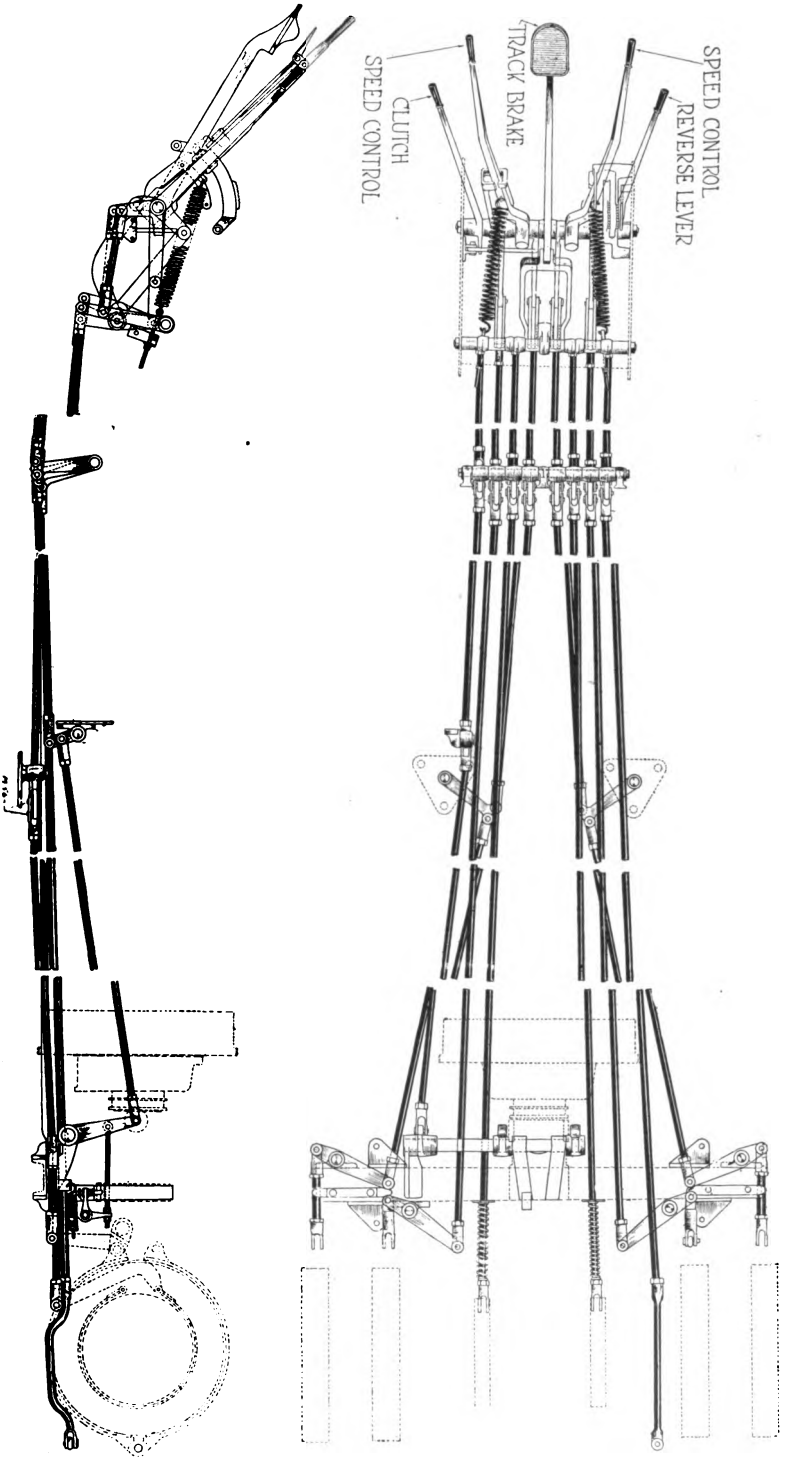
The entire control is operated from the driver's seat, located at the forward end of the hull proper. The driver's seat and the forward control unit, including the necessary levers, shafts, and linkage, are made up as a single assembly. The driver has a pedal and four levers to operate, exclusive of the spark and throttle levers. The pedal is the brake. The inner left lever is a speed control for the left track and the inner right lever is the speed control for the right track. The outer left lever is the clutch and the outer right lever the reverse.

The change-speed levers are similar for the left and right tracks. The lever engages in two quadrant jaws, the outside taking care of high speed and the inside taking care of low speed. When the lever is engaged with the high or low speed jaw of the quadrant and pulled back, the speed is engaged. Directions for starting and stopping are given on page 14, together with driving instructions. A description of the method of operation of the control system is taken up in this chapter.

SPEED CONTROLS

High or low speed controls and reverse are accomplished by moving the speed control and reverse levers to the proper position, which in turn moves a series of links which apply the high-speed or low-speed brakes in the epicyclic gear, or, in the case of the reverse, mesh the driving clutch on the epicyclic shaft so that the proper bevel ring gear is driven.

PLATE No. 92



LAYOUT OF THE CONTROL SYSTEM SHOWING LINKAGE AND LEVERS

The clutch lever operates the compound clutch by means of linkage which extends to the throw-out-collar, and so connects that the clutch is out when the lever is pulled back. As the lever is pulled back it applies the brake on the cardan shaft of the clutch, as well as disengaging the clutch itself.

The brake pedal is interconnected by means of a swing link with the shifter levers so that the brake only applies to the track which is in neutral. This is accomplished by arranging the links so that they are end to end when the shifter lever is in neutral position, and at an angle when in high or low speed. Thus when the brake pedal is applied, the links which are in a straight line or end to end transmit the motion to the brake, whereas in the high or low position of the shifter lever the motion of the brake pedal simply takes up the linkage which is at the angle and does not communicate any motion to the track brake.

STEERING

This interconnection of the linkages is made use of to accomplish steering. If one track is put in neutral and the other in a forward position, either high or low, and the brake is applied, the track which is in neutral will be stopped, allowing the machine to be slid around in the direction of the stationary track. In making turns which are not as sharp it is only necessary to put one track in neutral, leaving the other engaged, which will cause the machine to swing around. Another method of turning in a long arc would be to have one track engaged in high and the other in low, which would make one track move faster than the other and consequently causing the machine to turn. In other words, any difference in speed between the two tracks causes the machine to swing around, and thus it is steered.

SPARK AND THROTTLE

Mounted near the driver's seat on the inside of the hull are the spark and throttle levers as shown on page 16. These levers are exactly similar, the throttle being to the right and the spark to the left.

CONTROL LINKAGE

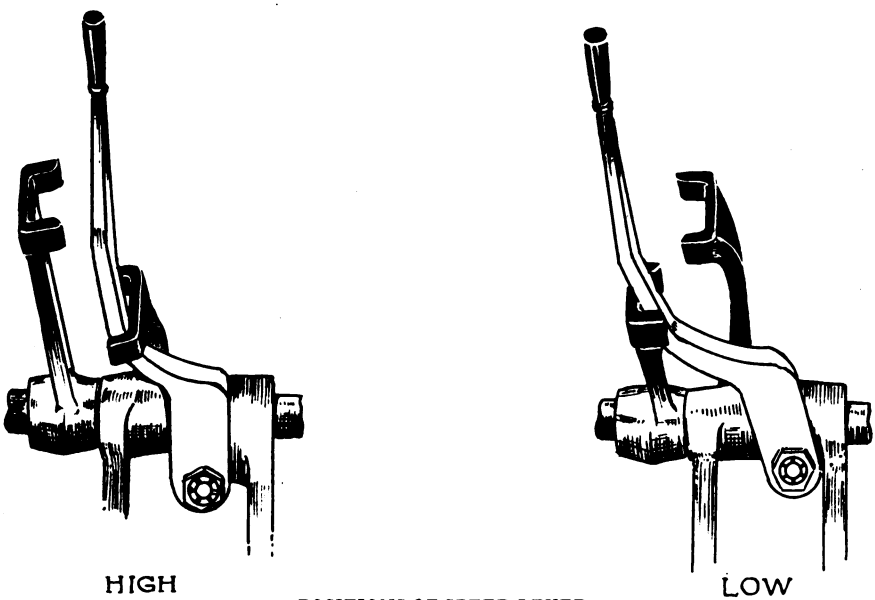
The layout of the control linkage is shown on page 147. The control levers for operating the speeds are 37 inches in length, and are of carbon steel, engaging with the carbon steel selector levers. These are so shaped that they form a gate for the lever, allowing it to move either the low-speed selector or the high-speed selector. As the high-speed lever is pulled back it moves about a fulcrum shaft, which is of carbon steel, 24¾ inches long and 1.497 inches in diameter. The linkage leads back from this fulcrum shaft to a shaft in the center of the machine, which serves to break the length of the link rods. By

means of clevis connections and toggle joints the control is passed along backward to the high and low speed brake toggles, which operate the control brakes on the high and low speed drums of the epicyclic gear.

BRAKE CONNECTIONS

The track brakes are on each side of the epicyclic, just inside the chain sprocket, on the epicyclic shaft. As briefly explained, the linkage of the brake is so arranged that only the brake on the side in neutral is applied. The linkage is so interconnected that when the shifter lever is moved to neutral, the brake bands just clear the drum. Application of pressure on the pedal, therefore, results in immediate

PLATE NO. 93



POSITIONS OF SPEED LEVER

pressure on the drum. The brake pedal is a malleable-iron casting 35¼ inches long over all, the pedal being 8 inches long by 5 inches wide, I-section. The connections of this pedal, which is a bell crank, connected with a series of toggles and links, are clearly illustrated on page 147. The brake rods are held back in three sections as in the case of the other control rods, so as to break their length, and at the same time secure the necessary reduction.

THE CLUTCH LEVER

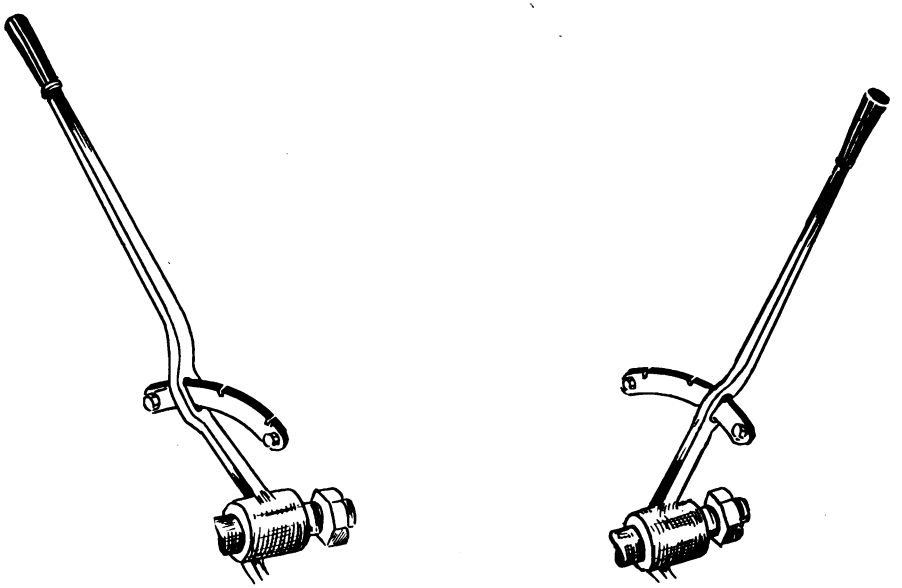
The clutch lever is a carbon steel lever in the form of a bell crank. The hand end is 28½ inches long from the center of the fulcrum to the end. The bell-crank end is 5 inches long. This connects with the toggle joint, mounted on the shaft, directly behind the lever

fulcrum shaft, and the rods extent backward to the main clutch operating the clutch throw-out lever, which removes the cone from engagement with the flywheel and also the driving box on the clutch shaft.

REVERSE LEVERS

The reverse lever is a carbon steel piece of bell-crank form, being 27.968 inches long on the hand side of the fulcrum and 6 inches on the bell crank. It engages with the reverse rod, which is 52 inches long, and made of extra strong ¾-inch wrought-iron pipe. Similar to the other control rods, this is in three sections, front, center, and rear, carrying the motion of the reverse lever back to the rear control

PLATE No. 94



POSITIONS OF REVERSING LEVER

assembly, where the necessary motion is imparted to operate the shifter fork for the clutch in the epicyclic gear. The linkage is outlined clearly on page 147. The necessary motion for shifting the fork is transverse, and thus secured by bell-crank levers from the reverse rods.

TO ADJUST THE CARDAN BRAKE

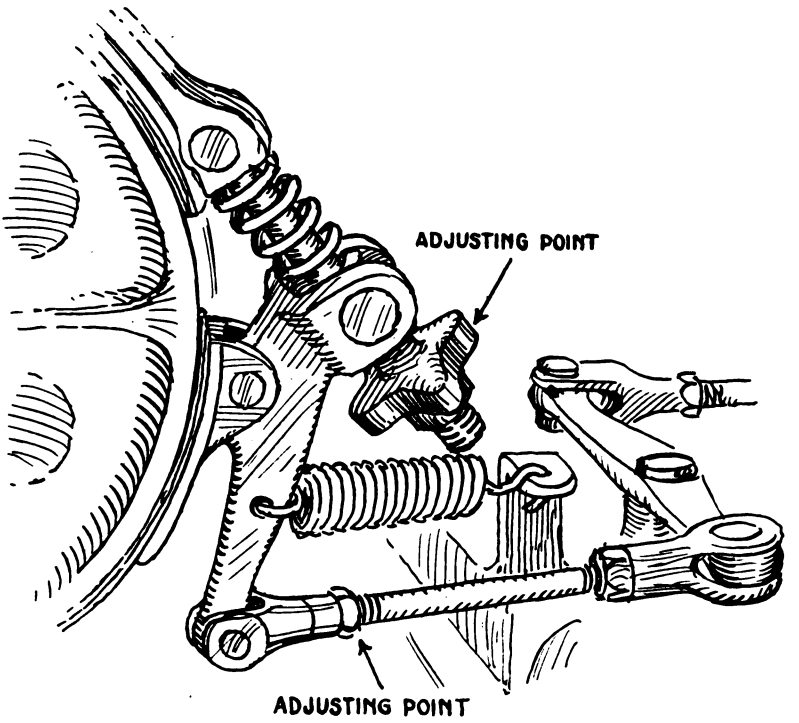
The cardan brake is operated by means of the clutch stop rod. This is coupled at one end to the left clutch lever, which is threaded and has two nuts between which is the clutch-stop bell crank. Through the opposite end of the left clutch lever passes the clutch-stop eye-rod bolt with the end of the clutch band.

The bell crank operates against the clutch-stop spring. By regulating the length of the spring and also the position of the bell crank between the clutch-stop rod nuts, the cardan brake can be adjusted. (See Plate 95.)

TO ADJUST THE CLUTCH THROW-OUT

The clutch throw-out is adjusted by means of the fork ends or clevices on the clutch-control rods. The adjustment is made as nearly as possible by the use of the fork ends. The final adjustment is made by screwing up on the fork end of the rear clutch auxiliary

PLATE NO. 95



BRAKE ADJUSTMENT

rod, which connects the clutch auxiliary operating lever to the clutch operating lever.

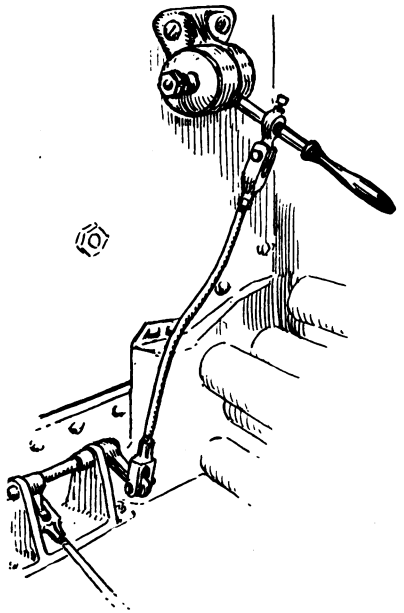
TO ADJUST THE HIGH-SPEED BRAKE

The first adjustments are made by screwing up on the fork ends or clevices of the control rods. The adjustment can most easily be made underneath the center ammunition storage by slacking the lock nut and turning the fork end to the desired location.

The above adjustments are what might be called permanent adjustments.

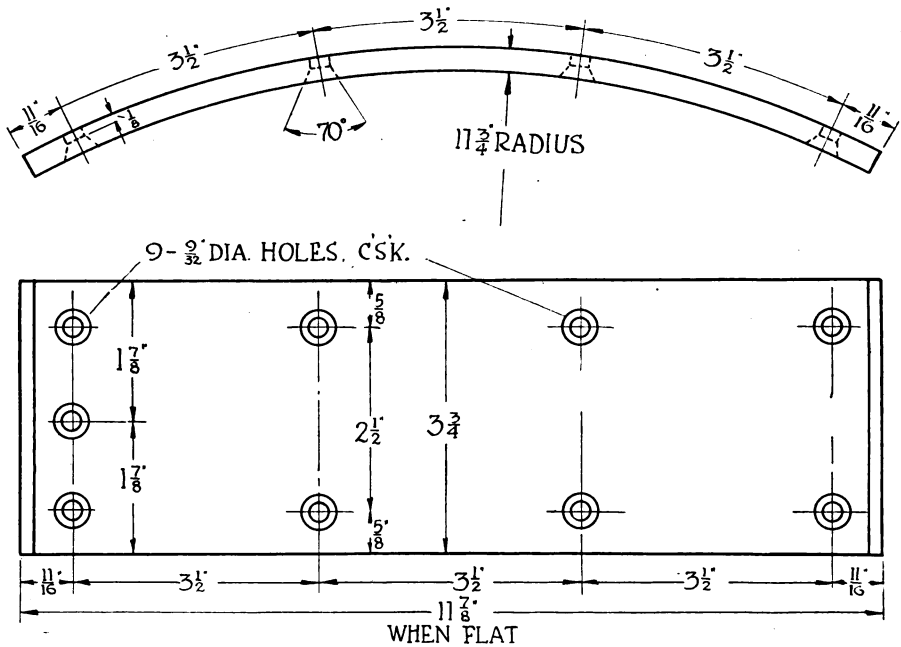
The final adjustment is made on the high-speed brake band by means of the adjusting screw (high-speed brake) which passes

PLATE No. 96



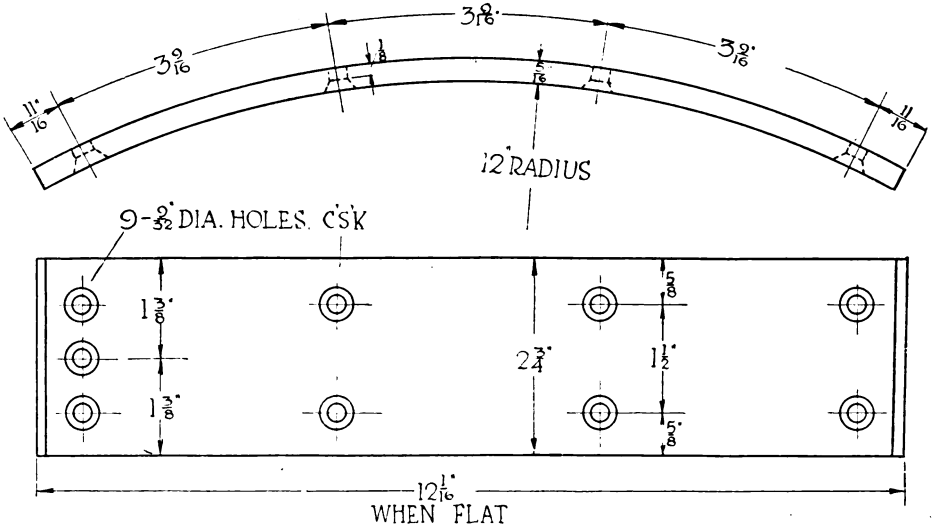
SPARK OR THROTTLE LEVER

PLATE No. 97



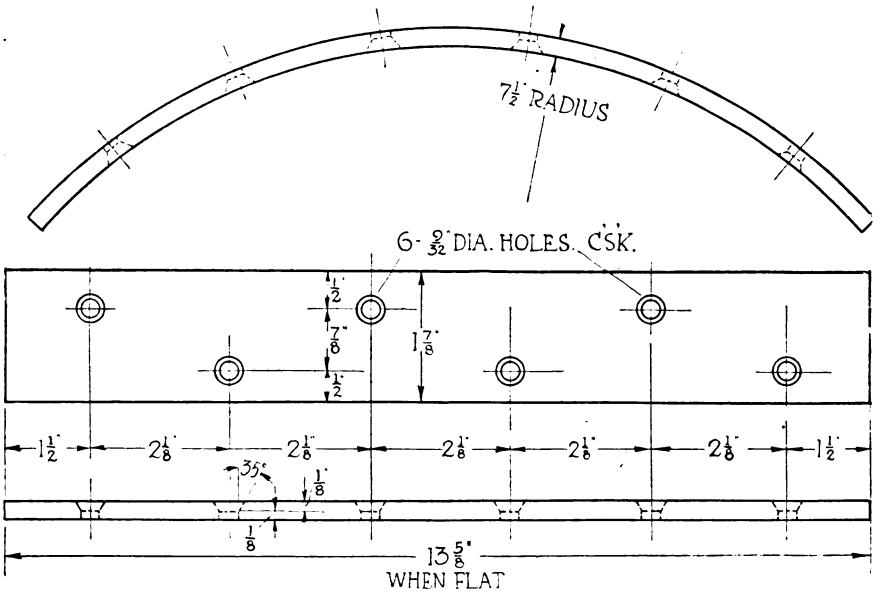
LOW GEAR BRAKE LINING

PLATE No. 98



TRACK BRAKE LINING

PLATE No. 99



HIGH SPEED BRAKE LINING

through the brake lever and connected by a pin to the high-speed brake band (short end), passing up from the under side of brake. One end of the brake lever is connected with the rear control rod; the other with the high-speed brake band (long end). The adjustment is made by screwing the adjusting nut which compresses the high-speed brake suspension spring between the brake lever and the shoulder on the adjusting screw on page 155.

TO ADJUST THE LOW-SPEED BRAKE

The first adjustments are made by screwing up on the fork ends or clevices of the control rods, the fork ends between the front and center control rods, underneath the center ammunition storage being where the adjustment can most easily be made, by slacking the lock nut and turning the fork end or clevice to the desired location.

The final adjustment is made on the low-speed brake band by means of the brake-adjusting screw which passes through the brake lever and is fastened by a pin to the low-gear brake-band ear (upper), the brake lever.

TO RELINE HIGH-SPEED BRAKE

After removing the epicyclic gear from machine, disconnect the high-speed brake and remove in the following order:

Remove cotter pins from the free end pins and drive out the pins with a drift.

Remove the bottom band stop by unscrewing the top bolt holding it to the anchor bracket.

Unscrew the tap bolts holding the top band stop to the epicyclic frame. The top band stop and backband stop can then be removed.

Remove cotter pin and drive out anchor pin. Unscrew tap bolts fastening the anchor bracket to frame and remove the anchor bracket.

Rotate strap around clockwise to remove the six ⅜-inch set screws, uncoupling the long and short end brake bands which would then be free to be removed.

Shear the rivet heads and remove the old lining.

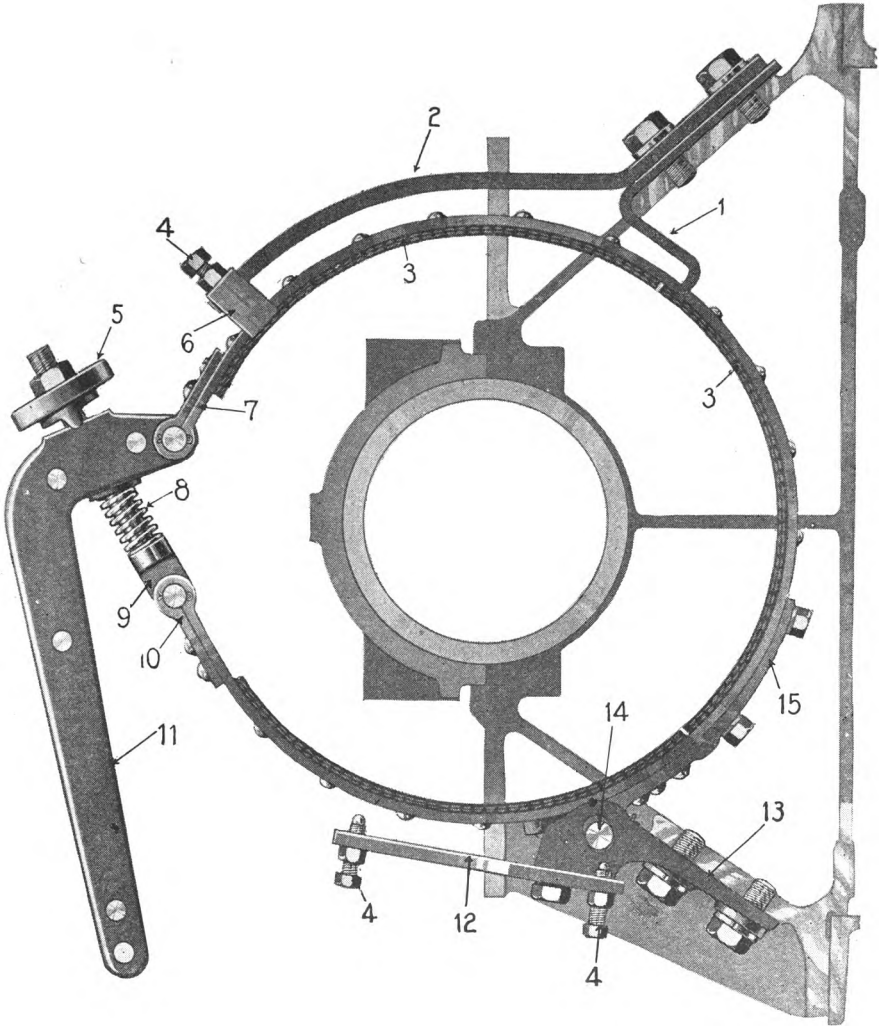
The new lining to be cut, if necessary, to page 153, the holes drilled as shown.

TO RELINE LOW-GEAR BRAKE

After removing the epicyclic gear from the machine, slacken the tension on the brake-adjustment spring and remove the cotter pins and drive out the brake pins from the upper and lower free ends of the brake band.

Remove the brake stop by unscrewing the nut of the bolt fastening it to the epicyclic frame.

PLATE NO. 100



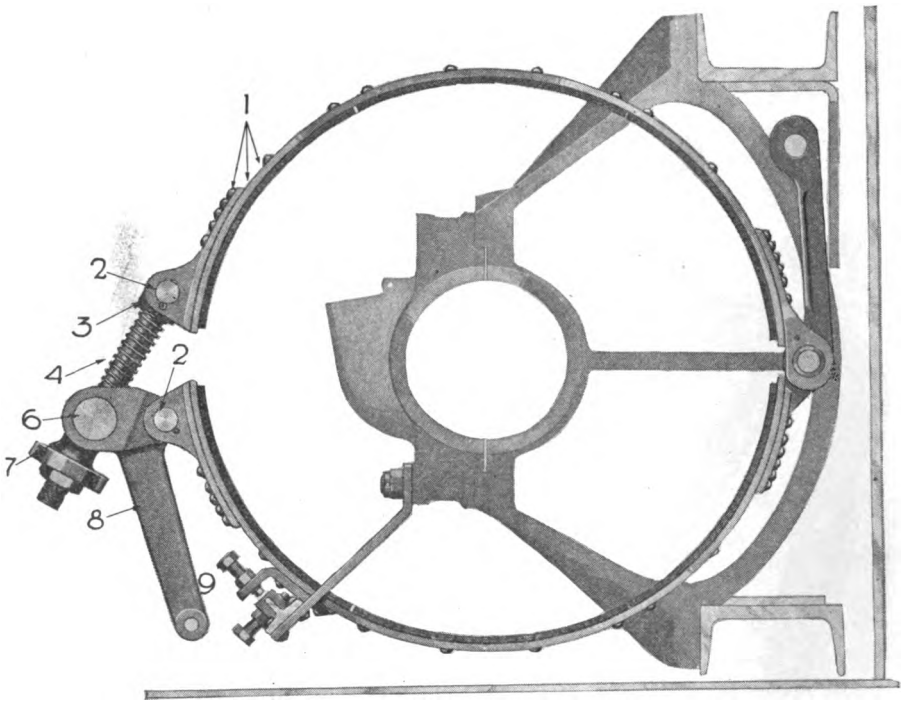
HIGH-SPEED BRAKE

Ref. No.	Part No.	Name
1	M-398	Backband stop, high-speed brake.
2	M-399	Top-band stop, high-speed brake.
3	M-364	High-speed brake lining.
4	M-400	Set screw stop, high-speed brake.
5	M-357	Adjusting nut, high-speed brake.
6	M-365	High-speed brake-band clip.
7	M-359	High-speed brake band, long end.
8	M-369	High-speed brake suspension spring.
9	M-358	Adjusting screw, high-speed brake.
10	M-360	High-speed brake band, short end.
11	M-355	High-speed brake lever.
12	M-366	High-speed brake bottom-band stop.
13	M-362	Anchor bracket, high-speed brake.
14	M-363	Anchor pin, high-speed brake.
15	M-361	Anchor end, high-speed brake.

Remove the anchor pin, freeing the brake band from the brake-suspension link, and the brake band can then be rotated clockwise to remove the set screws, uncoupling the top and bottom brake bands which would then be free to be removed.

The new lining is to be cut, if necessary, and holes drilled.

PLATE No. 101



TRACK BRAKE

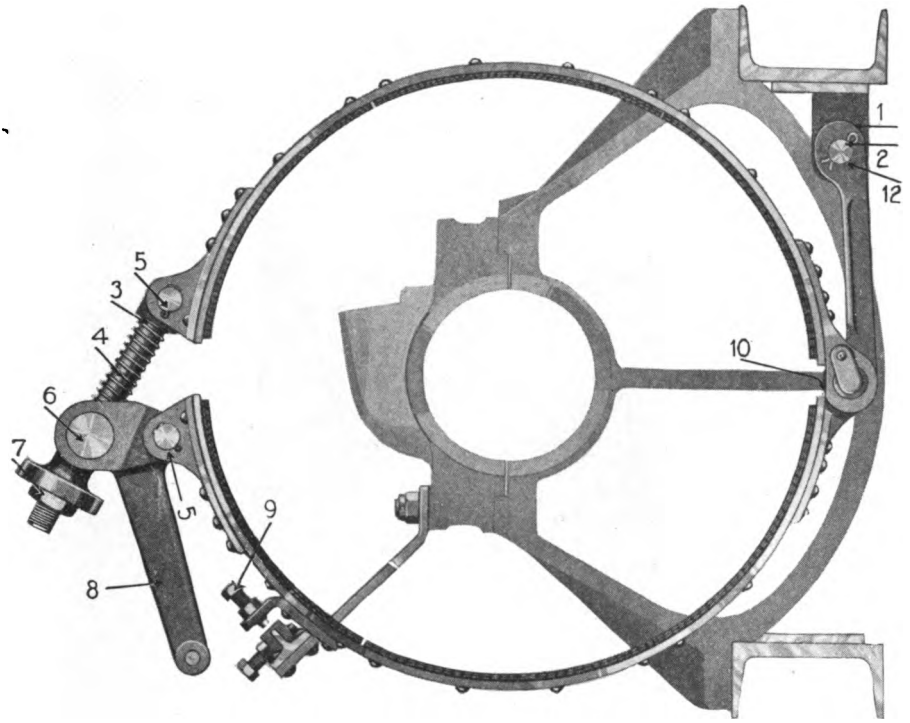
Ref. No.	Part No.	Name
1	M-352	Track brake strap, complete.
2	M-336	Brake pin, free end.
3	M-333	Brake-adjusting screw.
4	M-335	Brake-adjusting spring.
6	M-331	Brake-adjusting swivel pin.
7	M-332	Brake-adjusting nut.
8	M-330	Brake lever.
9	M-343	Brake-stop screw.

TRACK BRAKE

The track brake is to be removed the same as low-gear brake, the new lining to be cut and drilled to sketch being fastened to the lower low-gear brake-band ear.

The adjustment is made by screwing the adjusting nut which compresses the brake-adjusting spring between the brake lever and a shoulder on the brake-adjusting screw.

PLATE No. 102



ARRANGEMENT OF LOW-GEAR BRAKE

Ref. No.	Part No.	Name
1	M-338	Brake-suspension bracket.
2	M-337	Brake-suspension link.
3	M-333	Brake-adjusting screw.
4	M-335	Brake-adjusting spring.
5	M-336	Brake pin-free end.
6	M-331	Brake-adjusting swivel pin.
7	M-332	Brake-adjusting nut.
8	M-330	Brake lever.
9	M-343	Brake-stop screw.
10	M-348	Low-gear brake anchor pin.
12	M-339	Brake-suspension pin.

TO ADJUST THE TRACK BRAKE

The track brake is adjusted in a similar manner to the low-speed brake, the same nomenclature and method being used.

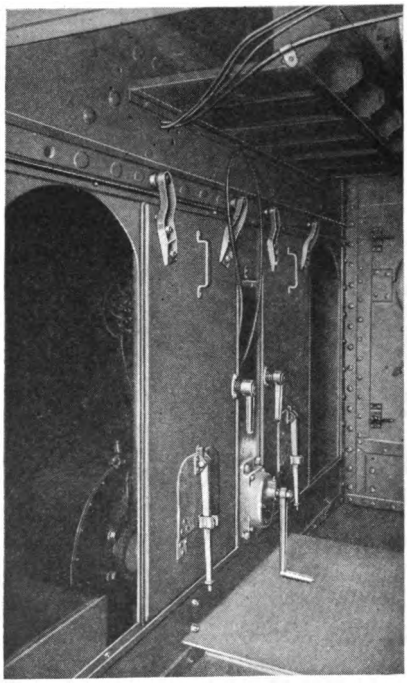
BRAKE-CONTROL LINKAGE REDUCTION

The reduction of the brake linkage for the epicyclic gear and for the tracks is as follows:

Low-speed brake	52 to 1
High-speed brake	26 to 1
Track brake	30 to 1

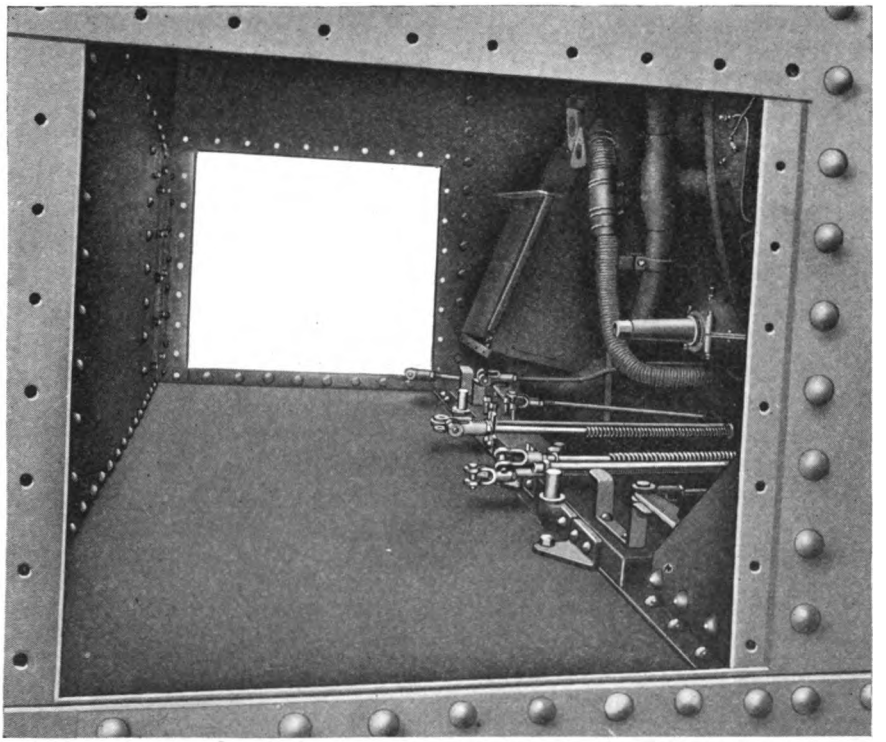
The track pedal throw, measured to the center of the foot pedal, is 11.088 inches. The movement of the brake band is 0.3696 inch. These dimensions are approximate.

PLATE No. 103



BULKHEAD WITH INSTRUMENT BOARD REMOVED

PLATE No. 104



CONTROL ROD ENDS WITH EPICYCLIC TRANSMISSION REMOVED FROM HULL

Chapter IX

ELECTRICAL EQUIPMENT

Outline specifications

Starting voltage	6.
Lighting voltage	6.
Maximum generator voltage	6.5.
Starting motor winding	Series.
Generator winding	Shunt.
Generator rotation	Anticlockwise.
Starting motor rotation	Anticlockwise.
Battery capacity	140 ampere hours.
Battery voltage	6.

ELECTRICAL EQUIPMENT

GENERAL DESCRIPTION

The Mark VIII machine is equipped with Bijur starting and lighting apparatus designed for operation with a 6-volt battery and consisting of:

One (1) type L–61 M–1108 anticlock rotation lighting generator;

One (1) type AD–200 M–923 anticlock rotation starting motor;

One (1) type TI–61 M–865 motor starting switch.

The generator is in operation at all times the engine is in operation.

The starting motor is in operation only during the period of starting.

WIRING

Page 161 shows the wiring layout on the machine and covers the ignition generator (Delco make) as well as the wiring for the Bijur apparatus, heretofore mentioned.

The Bijur generator is grounded internally and only one cable leads from same, the frame of the machine acting as a common return conductor. The generator is connected direct to the battery, as no fuse is required in the generator battery circuit.

The circuit between the storage battery, starting switch, and the starting motor is made up with heavy cable, and this circuit does not make use of the machine frame as a return circuit.

SPECIAL STARTING INSTRUCTION

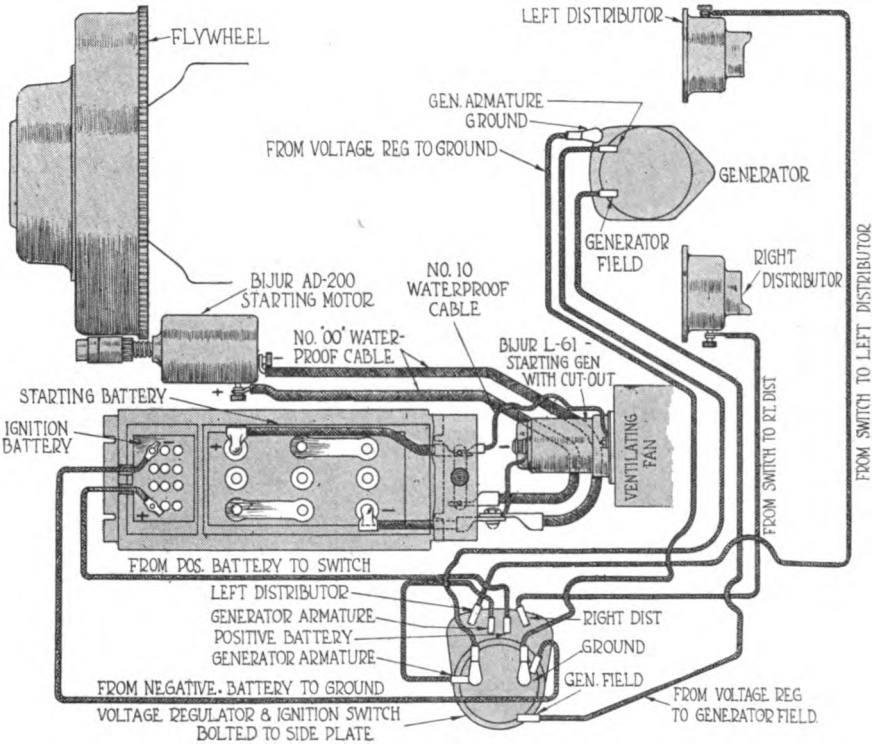
The starting motor using a 6-volt 140-ampere hour battery is not intended to crank the gas motor when cold without manual help at the hand crank.

TO START THE GAS MOTOR

First, see that all necessary adjustments for the gas motor have been made; insert the hand crank and exert upward; pull on crank. When ready to start, signal operator at the starting switch to depress starting-switch button, at the same time giving the motor all possible assistance in turning over.

The starting switch should be depressed downward as far as it will go and held firmly in place until the gas engine begins firing. The

PLATE No. 105



WIRING OF LIGHTING, STARTING, AND IGNITION

instant the gas engine begins firing, release the starting-switch button. Should the gas motor fail to start promptly after cranking it with the starting motor, do not continue to crank it, but first see that proper adjustments for starting have been made, that there is gasoline in the carburetor, and that the ignition is in working order.

Continued cranking of the gas engine with the electric starter will not damage the electrical equipment but constitutes a useless drain on the battery and should be avoided.

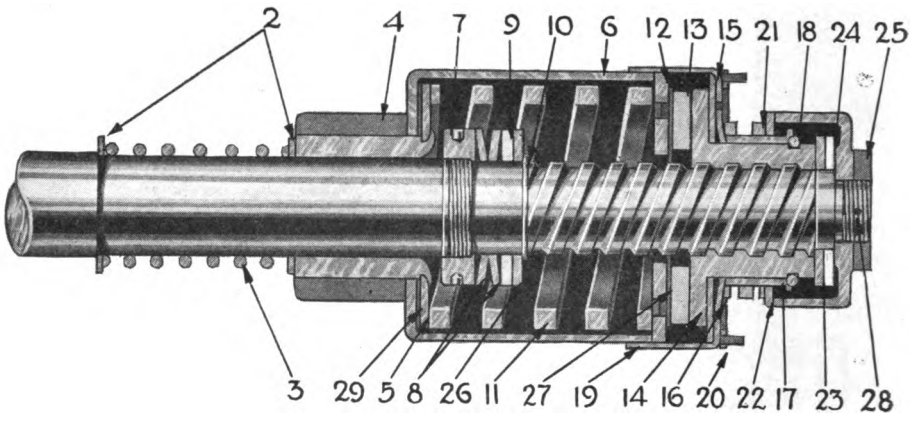
STARTING MOTOR

OPERATION AND DESCRIPTION

The starting motor is a series wound, four-pole machine designed for operation on a 6-volt battery, and is equipped with a Bijur automatic pinion-shifting device mounted on its armature shaft for transmitting power from the starting motor to the flywheel.

No intermediate linkage or preliminary contact resistance switch is required to bring the pinion of the starter motor into mesh with the flywheel teeth to crank the gas motor. A double-contact single-pole switch connects the starting motor directly across the battery and the instant that the switch is closed cranking is automatically accomplished.

PLATE No. 106



STARTER PINION SHIFT

Ref. No.	Name.
3	Weak spring.
4	Pinion.
6	Barrel.
8	Dished washers.
9	Thrust washer.
11	Spring.
12	Clutch plate.
13	Cork clutch.
14	Flanged nut.
15	Pinion flange.
15	Clutch plate.
16	Spring washer.
17	Sleeve.
18	Wire lock spring.
19	Cover.
20	Cover lock.
26	Thrust washer.
27	Retainer.
28	Threaded shaft.

When the starting-switch pedal is depressed the starting motor to battery circuit is closed and the machine begins to operate under full power, the pinion shifting device mounted on the threaded end of the armature shaft automatically meshing with and transmitting power to the flywheel teeth, thus cranking the gas motor.

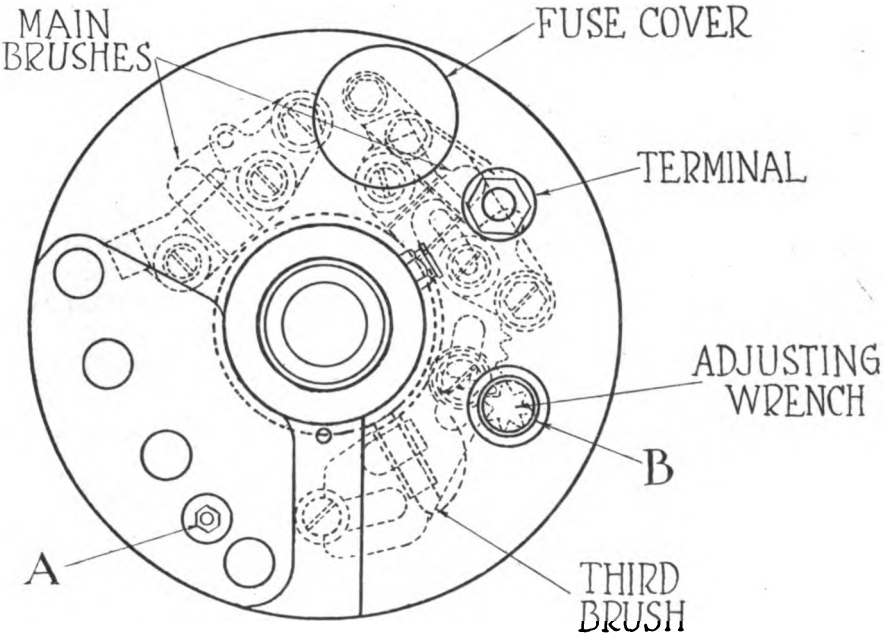
The instant that gas motor begins firing, the overriding speed at which the starter pinion is driven by the flywheel with respect to the armature shaft causes the device automatically to travel along the threaded shaft and disengage the flywheel teeth.

STARTER PINION SHIFT

The pinion-shifting device is positive in every respect and will crank the gas motor every time the starting switch is closed. It is impossible under normal operating conditions for the starting pinion to "butt" or "jam" against the teeth of the flywheel, as the pinion will always go into mesh with the flywheel teeth for reasons which will be fully described later.

The operation and construction of the automatic gear-shifting device used in connection with the starting motor may be best understood by reference to B/P 138 and the description that is to follow:

PLATE No. 107



THIRD BRUSH REGULATION

Referring to page 162, the pinion mentioned above shown by Figure No. 4 is driven by notches in the barrel (6) registering with the pinion teeth. This barrel has 6 slots cut about ¾ inch deep in its other end, in which the notched clutch plate (12) registers. The cork clutch (13) is held in place against (12) by means of the notched retainer (27) and its right-hand face can slip slightly against the smooth ground face of the flanged nut (14) whenever the torque exceeds the frictional hold between the cork and steel faces, this holding force being set up by the initially compressed spring (11). Power is thus transmitted in the working position from the shaft to the flanged nut (14), thence to the clutch (13), the retainer (27), clutch plate (12), barrel (6), and thus to pinion (4).

The cover (19), which fits into and over the notched barrel (6), effects closure of the shift when locked in place by spring cover lock (20).

In addition to the cork clutch there is a fixed clutch mounted on the other face of the pinion flange and shown at (15). This clutch is held against the flange by means of the clutch-spring washer (16), sleeve (17) and wire-lock spring (18). It is called "fixed" because the torque necessary to cause it to slip is constant irrespective of the position of the flanged nut.

Normal entrance is effected by depressing the starting-switch pedal, causing the shaft to rotate within the flanged nut (14), the inertia of which causes a difference in speed between the shaft and the nut with the result that the nut travels along the threaded shaft (28) and urges the entire assembly of barrel and pinion through the spring (11) into mesh. The spring (11) rests at its left-hand end against a flanged plate (5) riveted to the pinion. When the nut gets to the end of its stroke it first compresses a pair of dished washers (shown at 8) through a pair of thrust-bearing washers (9) and (26). It is the combined object of the dished washers, as well as the clutch, to take up the shock of starting. The helical spring (11) plays little, if any, rôle in this. Of course, when the clutch face rises enormously, that is, to say, the clutch becomes self-tightening to meet the load applied.

Coming out of mesh is caused by the overriding speed of the pinion barrel and flanged nut assembly with respect to the revolving armature shaft. The outcoming blow is cushioned by the spring (21) mounted on the flanged nut.

The purpose of the clutch plate (15) is to get sufficient initial clutch tension added to the clutch (13) to avoid slippage when a "butt" occurs.

Whenever a pinion tooth "butts," that is, strikes the corresponding end of a flywheel tooth, this interference is almost constantly overcome by the following action which takes place: The pinion is now kept from entering the flywheel teeth and the traveling nut compresses the spring (11), urging the notched barrel (6) forward along the teeth of the pinion. Finally, the clutch plate (12) strikes the washer (26) locking up, or rather tightening, the clutch (13), and in turn causes the nut (14) to turn with the shaft. The barrel (6) is therefore turned by the notched plate (12) and in turn transmits its rotative effort to the pinion (4), releasing the "butting" pinion tooth from its interference. The instant this happens the spring (11) having been greatly compressed by the previous action, snaps the offending tooth into mesh with the flywheel and normal cranking takes place.

The function of the weak springs (3) is to prevent "ticking in" of the barrel and pinion, especially when the tank is running down hill.

TESTS TO INSURE CORRECT FUNCTIONING

The shift should always be checked for the gap between the edge of the flywheel and the pinion teeth. This distance must always be ⅜ inch. In testing the shift, run the barrel along the threads by hand and note whether there is the proper freedom of action, that is, whether the shaft is free from burrs or rust. Care should be taken that there is sufficient lubricant, oil, or graphite on the threads of the armature shaft (28) and between washers (9) and (26), washers (23) and (24).

In order to test the shift for initial torque of its clutches, a brake should be made to fit over the pinion (4) having a lever arm 1 foot in length. The armature shaft can then be held from turning by means of an open wrench on the commutator end hexagon shaft nut and force applied by hand to the end of the brake arm through a spring scale with the barrel in the "out" position. The number of foot-pounds necessary to slip the barrel in this "out" position should always be greater than 4½ to 5 pounds on the scale and may, however, be as much as to 12 or 15 pounds without affecting the correct functioning of the shift. If it is less than 4½ pounds a dangerous condition arises in case there is too tight meshing of the pinion in the flywheel. Such cases frequently require 8 to 10 pounds initial clutch torque to cause the pinion to enter and a 4½-pound clutch under such conditions would slip.

TROUBLES AND REMEDIES

(1) *Slipping clutches.*—There are two forms of clutch slip. The first is *initial* clutch slip, which has just been described, and the second is *clutch* slip, which takes place in the "in" position.

In the first case three-quarters of the initial clutch value lies in the outside or fixed clutch applied through the dished spring washer (16). It is usual to look here or in the length of the sleeve (17) for the cause of intial clutch torque weakness. In the case of clutch slipping when in cranking or "in" position this can be attributed either to a great excess of oil or lubricant on the cork face of the clutch or to a mutilated cork surface. In case the projections on back of retainer (27) shear in clutch plate (12), slippage is likely to occur, and can be remedied only by supplying a new retainer.

(2) *Sticking.*—This can happen either in the "in" or "out" position. In the "out" position it is usually caused by too tight a fit of the flanged nut on the armature-shaft threads, and can be determined as aforesaid by revolving the barrel on the threads, to feel if the mechanism is free, or it may be due to dirt on the face of the thrust washer (23) which the flanged nut strikes in this position. The remedy is this: Remove the nut (25) and thoroughly clean parts (23) and (24) as well as the back of the flanged nut. Be sure

to place graphite between washers (23) and (24) when reassembling. If the flanged nut is not perfectly free on the threaded shaft, disassemble the entire shift, beginning with spring lock (20), and "lap in" the nut on the threads, using a mixture of kerosene and emery dust. Be sure to clean the shaft and nut carefully with gasoline before reassembling. Washers (9) and (26) leave the factory with graphite between their faces and it is always well to make sure that some is put between them before reassembling, especially after cleaning the shaft with gasoline. When disassembling it is not necessary to disturb the various parts mounted on the flanged nut.

Stick in the "out" position can also be caused by the back nut (25) becoming loose. This makes the "out" stop take place between the back end of pinion (4) and shaft nut (7) instead of between the faces of (24) and (25). Sticking here occurs because the parts (4) and (7) are relatively soft, and any hammering or rubbing of the pinion (4) against the face of shaft collar (25) will roughen the butting faces, causing sticking. There is a gap between (4) and (7) in normal working of the device.

Sticking in the "in" position may be due to dirt or grit getting between the washers (9) and (26) on inside of the barrel, spring lock (10) becoming dislocated, or clutch plate (12) cutting into washer (26). Be sure that the striking face of clutch plate (12) is polished clean and that plenty of graphite and lubricant are between washers (9) and (26). In case the striking face of (12) and the inside washer (26) are cutting each other, it is best to communicate with the factory and order new parts.

(3) *Shock.*—This may be due to the flattening of washers (8), or, where too tight, gripping action of clutch (13) occurs. In the case of washer flattening, do not attempt to repair these, but replace with new ones. A very little graphite or oil applied to the cork clutch surface will usually remedy a tight clutch and reduce shock.

(4) *Precautions.*—In making repairs to shift do not replace any defective or worn parts other than those supplied directly from the Bijur factory. All the parts making up complete assembly are either made of special material or are given a special heat treatment, and the substitution of inferior or improperly treated materials will not allow the satisfactory operation of the shift.

CONSTANT CURRENT GENERATOR

OPERATION AND DESCRIPTION

This is a self-contained unit with no regulator or automatic cut-out requiring separate mounting and adjusting. The automatic switch for opening and closing the circuit between the storage battery and the generator is mounted inside of the generator. The regulation of the so-called constant current generator is inherent and no separate regulator is required.

The amount of current generated is, to a large extent, independent of the state of charge of the storage battery or the amount of lamp load connected, but depends primarily upon the speed at which machine is driven and the position of the regulating brush with respect to the two main brushes.

Beginning at zero speed, the voltage is of course zero, and with increasing speed the voltage increases until the armature develops 6.5 volts, at which value the shunt coil of the cut-out is sufficiently energized to cause the cut-out switch to close.

After the cut-out is closed the generator begins to deliver current to the battery or to both the battery and the light, if lights are in use. The point at which the cut-out closes (6.5 volts) corresponds to approximately 500 to 600 generator r. p. m. With increasing speed the current increases to a maximum value, at speeds of about 1,400 to 1,600 r. p. m.; at higher speeds the current decreases slightly.

The constant current generator has a single shunt winding distributed over four poles and the regulation is effected by having this winding connected between one of the main generator brushes and an auxiliary or regulating brush, and about 60° from this main brush. The maximum current generated depends upon the location of the third brush with respect to the main brush to which one side of the shunt field is connected. Moving the third, or regulating brush, in the direction of rotation of the armature increases the generator output, and in direction opposite to the rotation of armature decreases the output.

REGULATOR

Referring to page 163, showing the commutator end housing of the type L–61 generator, and considered for clearness to be transparent, the third brush and the two main brushes are indicated by name, the third brush adjusting hole at B, and the main switch-adjusting nut at A. Figure 165 shows all internal connections for the shunt winding, brushes, and the main switch.

Due to the fact that the voltage regulation of all third brush generators is effected by means of the reaction magnetic flux set up by the current flowing through the armature, it is necessary to introduce some protective device, such as a fuse in the field circuit, in order to prevent too great an increase in voltage across the field in case of an accidental loose or open battery connection. With the battery connected to the generator and all cable connections making good contact, the current flowing through the armature produces the necessary reaction and effects regulation holding down the voltage to a normal value.

When the generator is disconnected from the battery for any length of time, the reaction normally set up by the armature ap-

proaches a zero value, thereby causing a greatly increased e. m. f. to be developed by armature conductors between the main and third brush across which the field windings are connected. The net result under these conditions is an increased field exciting current approaching in value the normal output rating of the machine, and consequently a greatly increased terminal voltage developed. As the value of the current required for field excitation is quite small in comparison with the generator output, the field windings would not stand this overvoltage in case of an open battery connection for any length of time, and a fuse of 8 to 12 ampere capacity is therefore connected in the field circuit to protect the winding. This fuse is held in place by two phosphor-bronze clips, the entire assembly being protected by a nickel-plated cover, as shown on Diagram 164.

It is not feasible to supply lamps directly from a constant current generator with battery disconnected unless the lamps so connected consume the entire current output of the machine. If the current required to supply the lamps is less than the generator output the lamps will be burned out. For instance, if the generator output is 15 amperes and the current consumed by the lights is 7 amperes, the generator voltage will rise until the additional 8 amperes not required by the lamps will be forced through the lamp circuit. This will naturally overload the lamps and burn them out. No attempt should, therefore, be made to operate lamps direct from a constant current generator without using a storage battery in conjunction with them.

GENERATOR TEST

Start the engine, allow it to run at a speed sufficient to obtain a generator r. p. m. of 1,000 or more and with a test ammeter connected between the cable leading to generator and the terminal of generator, observe the output. This output should not be less than 12 or more than 16 amperes.

Before making any adjustment, test the battery with a hydrometer and carefully inspect the brushes to see that they are seated properly on the commutator and that they are free to move up and down in their respective holders. Also inspect the commutator to see that it is clean and that the mica insulation between bars is properly undercut, as high mica and dirt will prevent satisfactory operation of generator.

If the specific gravity of the battery is 1.25 or above, and the generator is delivering from 12 and 14 amperes at this speed, no adjustment is necessary.

The arrangement of the brushes and cut-out switch in the front head of the generator is shown on blue print 164 and all symbols used in the following instructions will be found on this blue print.

ADJUSTING THE GENERATOR SWITCH OR CUT-OUT

First, see that the main switch or cut-out connects the generator to the battery at the proper voltage. The speed of generator need not be considered in making this check, but with a test voltmeter connected across the two main brushes of machine measure the voltage at the instant the test ammeter, already connected in circuit, begins to show a charge. The correct voltage at which the main switch closes is 6.5 volts, and if the voltage is above or below this value switch should be adjusted by inserting a small fiber handle socket wrench in the adjusting hole at "A" and turning the tension-spring adjusting nut until the switch closes at the correct voltage.

ADJUSTING THE REGULATOR

The current output of the generator when driven at speeds of 1,400 to 1,600 r. p. m. should not be less than 12 or more than 15 amperes, and its output should be adjusted accordingly.

It is not necessary to remove the generator for adjusting. The third or regulating brush is so arranged that by inserting a special tooth-adjusting wrench (B–4 260–M) the adjusting hole at B and engaging the ratchet (6) the entire regulating brush assembly can be shifted in a direction required.

Before attempting to adjust, remove the cable from the generator terminal and connect a standard test ammeter between the generator and cable removed and note the value of current. If the current delivered by the generator is less than 12 or more than 16 amperes, then adjust.

Moving the regulating brush assembly in direction opposite to the rotation of the generator's armature decreases the current output and in the same direction of armature rotation increases the output.

To get the best results, the setting should be made when the generator is hot and connected to a battery having a specific gravity.

CARE AND MAINTENANCE

In order to maintain the following:

1. Lubricated bearings.
2. Clean brushes.
3. Clean commutator.
4. Free movement of the brushes in their holders.
5. Good contact of brushes with the commutator.
6. Brush springs bearing on brushes.

1. A few drops of thin neutral oil should be put into the oilers of the generator after every two weeks. This will insure proper lubrication of the bearings and prevent freezing to the armature shaft.

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2. After the generator has been run for a length of time, carbon dust will accumulate on the brushes and brush holders, which will tend to destroy their useful functions. Wear on the brushes is natural and the dust caused by same can not be avoided from collecting on the parts inside the generator. It is possible for oil from the bearings or other sources to reach the inside of the generator and mix with the carbon dust, forming a gummy paste which readily adheres to the brushes and holders. This paste can be removed by washing the brushes in gasoline and removing from the brush holders with a cloth soaked in gasoline.

3. The surface of the commutator should be free from oil and dirt. To clean the commutator, run the engine at a moderate speed, and with No. 00 sandpaper cut into thin strips remove any dirt or soil that may have collected. Do not use emery cloth or cloth. Never put lubricant of any kind on the commutator. After cleaning, be sure that all the sand particles from the sandpaper have been blown out of the machine.

4. The brushes, when replaced in their holders, should be free to move up and down.

5. Seating of the brushes can quickly be accomplished by placing a thin strip of No. 00 sandpaper under the brush with the sanded side of the paper against the commutator bearing surface of the brush and drawn from under brush against the rotation of the armature. Pressure of the brush springs is sufficient to cause the sandpaper to sear brushes and it is not necessary to apply extra pressure on the tops of brushes with the fingers.

6. See that the brush springs are away from the head casting or screws that would cause a ground, and that they bear upon tops of brushes at the center. This will insure proper pressure exerted on the brushes by the springs.

Chapter X

AMMUNITION AND ARMAMENT

OUTLINE SPECIFICATIONS

Number of six-pounder guns	2.
Number of Hotchkiss machine guns	7.
Six-pounder common shell	182 rounds.
Six-pounder smoke shells	26 rounds.
Quantity of machine-gun ammunition	21,000 rounds.
Number of machine-gun ammunition racks	42.

AMMUNITION AND ARMAMENT

GENERAL DESCRIPTION

The ammunition storage capacity of the Mark VIII machine is 21,000 rounds of machine-gun ammunition and 208 rounds of 6-pounder ammunition. Of the 208 rounds of 6-pounder ammunition, 26 rounds are smoke shells and the balance are common shells.

LOCATION OF 6-POUNDER SHELLS

There are five places for storing the 6-pounder ammunition, one in each sponson, one on each side of the driver, and one in the center of the fighting compartment. The top rows of 6-pounder shells in the sponsons are smoke shells. These shells go into cylindrical cases, designed to fit them, and from which they can be removed readily. The capacity of each of the sponson magazines or ammunition storage spaces are six smoke shells on each side of the sponson underneath the gun and seven smoke shells at rear of sponson, giving 13 smoke shells on each side, or 26 total.

There are 12 common shells in each sponson magazine. The magazines on each side of the driver are capable of holding 49 shells. These are common shells, giving a total of 98 for the two sides in these magazines. The munition storage in the center of the fighting compartment is capable of taking 30 shells on each side, giving a total of 60 in the center.

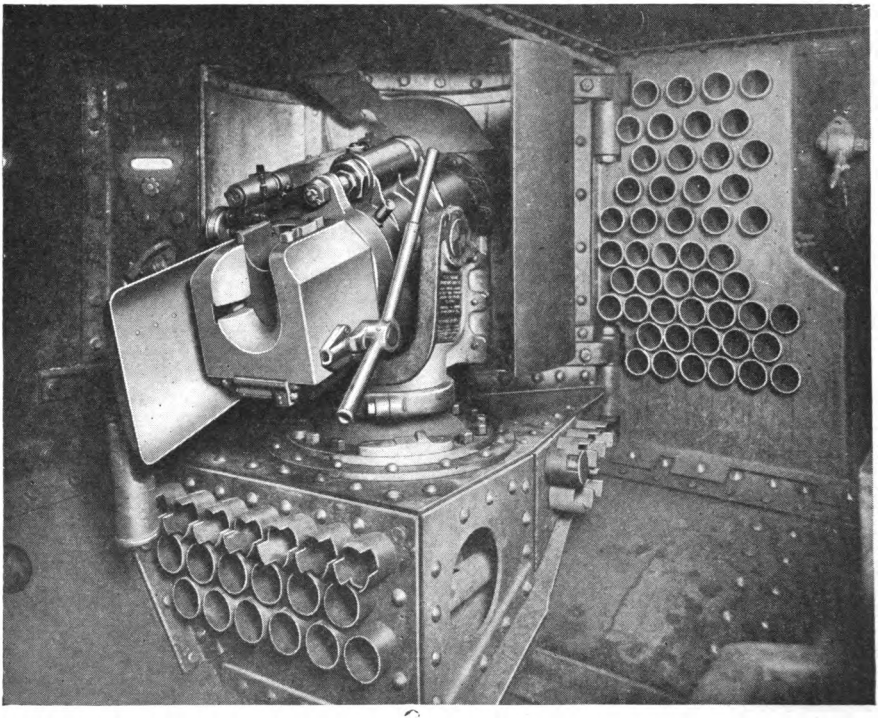
MACHINE-GUN AMMUNITION

The machine-gun ammunition is distributed between the ammunition storage space in the center and on the bulkhead between the engine room and the fighting compartment. The number of racks contained in the center consists of 21 on the starboard side and 17 on the port side. In the bulkhead between the engine room and the fighting compartment there are four ammunition racks.

SPARE MACHINE-GUN BARRELS

Seven spare machine-gun barrels are carried, one being mounted in each sponson just forward of the 6-pounder shield. Two are located in each sponson, forward of the side doors. The machine guns are dismounted, and carried inside the Mark VIII machine, and are stored in the following clips for use: One on each sponson, just forward of the 6-pounder shield; two on each sponson on the rear plate of same, and one on the port side just forward of the door.

PLATE No. 108



SIX-POUNDER GUN SHOWING ALSO AMMUNITION STORAGE

SMOKE BOMBS

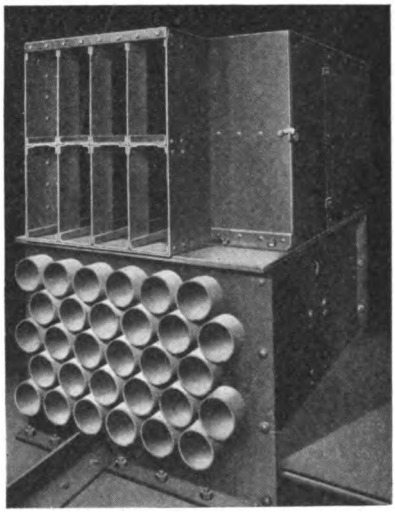
Two British .303 service rifles are stored, one on each side just aft of the doors and forward of the engine-compartment bulkhead, held by clips. Stored with these rifles are two smoke-bomb cups to be fitted to the ends of the rifles, and 80 rounds of .303 special rifle ammunition for the smoke bombs. There are also 44 rifle smoke bombs stored in a box under the port door.

HOTCHKISS SPARE PARTS

There are two boxes of Hotchkiss spare parts, tools, and appurtenances, and each box contains the following:

1 fore-sight cover.
1 ejector.
1 extractor.
2 firing pins.
2 locking screws.
2 fore sights.
1 cartridge stop spring.
1 ejector spring.
2 feed springs (No. 2).
1 recoil spring.
2 sear springs.

PLATE NO. 109



AMMUNITION STORAGE BOX

1 cleaning brush.
1 cylinder cleaner.
2 hand extractors.
1 ejector key.
1 bore-cleaning rod.
2 dismounting wrenches.
1 pin box for small parts M. G.
1 oil can.
1 hammer M. G.
1 No. 3 M. G. punch.
1 mirror reflector M. G.
1 large screw driver M. G.
2 double pull throughs .303.
4 pieces gauze wire, pull throughs.

SIX-POUNDER PARTS

The trays containing the 6-pounder spare parts are placed on the floor of the sponson just in the rear of the platform, one tray in each sponson. These boxes contain the following:

1 spare telescope (in leather case).
1 cleaning cloth for lenses.
1 cleaning rod and sponge brush.
1 spare sponge brush.

One set of spare parts and tools consisting of the following to be carried in two trays, one behind each gun:

1 spanner and screw driver, combined No. 143.
2 screw drivers.
1 oil can.
1 crank, complete.
1 crank roller.
2 extractors.
2 hand extractors.
2 firing hammers, complete.
4 firing pins, complete, with strikers.
1 rocking shaft.
2 trigger sears.
4 main springs.
4 trigger-retaining springs.
2 trigger sear springs.
1 tommy.

LOCATION OF 6-POUNDER GUNS

The two 6-pounder guns are carried, one in each sponson. These guns swing with the sponson, and have an angle of fire from 5° right of the longitudinal line to 5° aft of the transverse line, or, in other words, in a 90° arc, moving 5° back from true longitudinal transverse. The 6-pounder guns can be pulled back within the sponson so that when the sponsons are swung inboard the guns can be withdrawn sufficiently to allow the machine to be carried on the railway.

TO WITHDRAW THE 6-POUNDER GUNS

To pull back the 6-pounder guns for railway shipment, first unscrew the bolts fastening the sponson to the main hull, and push the sponson inboard from the outside as per directions on page 175. Unscrew the 12 bolts fastening the gun pivot plate, and the four screws fastening the training stops to the gun pedestal base plate. Draw the gun, pivot plate, and shield back as far as desired, and securely fasten to prevent sliding.

TO REMOVE AND REPLACE THE 6-POUNDER GUNS

In removing and replacing the 6-pounder guns, remove the "above platform shell store" to give more room to work. Unscrew the 12 bolts fastening the gun pivot plate and the four screws fastening the training stops to the gun pedestal base plate. Move the gun and shield back into the fighting compartment. Remove the shield by unscrewing the six bolts holding it to the gun mount. The gun and shield can then be removed separately through the side door. To replace the gun, put the shield in through one of the side doors, and then the gun and mounting. Bolt the two together, and place on top of the gun pedestal base plate and bolt into position.

LOCATION OF MACHINE GUNS

There are seven Hotchkiss machine guns on the Mark VIII machine, five of these being in the main turret, one front, one rear, two on each side, and one located in each of the side doors, in the hull of the machine.

TO MOUNT MACHINE GUN

To mount the Hotchkiss machine gun in any of the machine gun posts in the Mark VIII machine, the machine gun is placed in the mount and pushed forward until the mounting shoulder falls into the recesses. The gun is then pushed forward and down. This pushes the locking lug back and the gun falls into place, being held by the locking lugs.

To remove the machine gun, push forward and up, or turn upside down so weight will help, which pushes the locking lugs in and releases the shoulder. The gun can then be removed.

CHAPTER XI

MISCELLANEOUS FITTINGS AND EQUIPMENT

Ventilating system specifications

Fan capacity	0.900 cubic feet at 1,400 r. p. m.
Fan drive	Link belt from crank shaft.
Length of link belt	61 inches.
Pitch of link belt	½ inches.
Diameter of belt sprockets	5.101 inches.
Number of teeth in belt sprocket	32.
Center to center distance of pulleys	1 foot 9 5/16 inches.

DESCRIPTION OF VENTILATING SYSTEM

The air for ventilating the fighting compartment is drawn in through the inlet louver, above the engine, by means of a suction fan, driven from the crank shaft. The fan is a 7½-inch unit, driven by a link belt at crank-shaft speed.

The intake is drawn in through the front louver, and the air passes out through the duct to the fan, and thence through a discharge duct into the fighting compartment, through an opening beneath the starboard passageway. The fan is located under the side of the engine on the starboard side, just in the rear of the bulkhead, between the fighting compartment and the engine room. It is fastened to the floor by two angle irons.

CAPACITY OF FAN

The fan has a capacity of 900 cubic feet per minute at 1.400 r. p. m., against a pressure of 2 inches.

FAN DRIVE

The fan is driven by means of a link belt, ⅝ inch wide and ½ inch pitch. The diameters of the fan-driving sprockets are 5.101 inches, and there are 32 teeth on each, giving a 1 to 1 ratio, or, in other words, driving the fan at crank-shaft speed.

INLET LOUVER

The inlet louver is located in the rear of the towing post, the forward end being just where the rear end of the Mark VIII machine slopes downward. It is over the forward end of the engine compartment.

The inlet louver is made up of 34 armor-plate blades, angle-shaped, forming a 90° angle 16 mm. thick. Each of these plates is separated from the next one by a distance piece, and there are 122 of these distance pieces to the inlet louver. The total dimensions of the

louver opening are 3 feet 1¼ inches in width, and 2 feet 1.825 inches in length. The length and size of the louver opening are 6 feet 8¾ inches high, with a 2⅞-inch flange at the bottom and a ¾-inch flange at the top, these plates being made of $\frac{5}{16}$-inch material.

UNDITCHING DEVICE

The unditching device consists of two 12 by 12 skew logs, carried on the guards at the rear of the machine until they are required. When the machine is ditched the rods are chained to the tracks so that they move with the tracks. At the rear end of the turret the rods strike an angle plate, set so as to carry them by the turret at an angle. As they fall over the front of the machine they straighten themselves and lie under the track, giving additional traction to the machine, allowing it to go ahead. The logs are carried by the track back to their original position, and if the machine has become unditched they can be unjoined and stored in place.

EQUIPMENT OF MACHINE

The following list of equipment is tentative, and in the final edition of this handbook will probably be corrected. At the time of going to press with the preliminary edition the following items are to be carried by each Mark VIII machine. The parts marked "E." are supplied by England and the parts marked "A." are supplied by America:

EQUIPMENT CARRIED ON MARK VIII MACHINE

(E. Supplied by England. A. Supplied by America.)

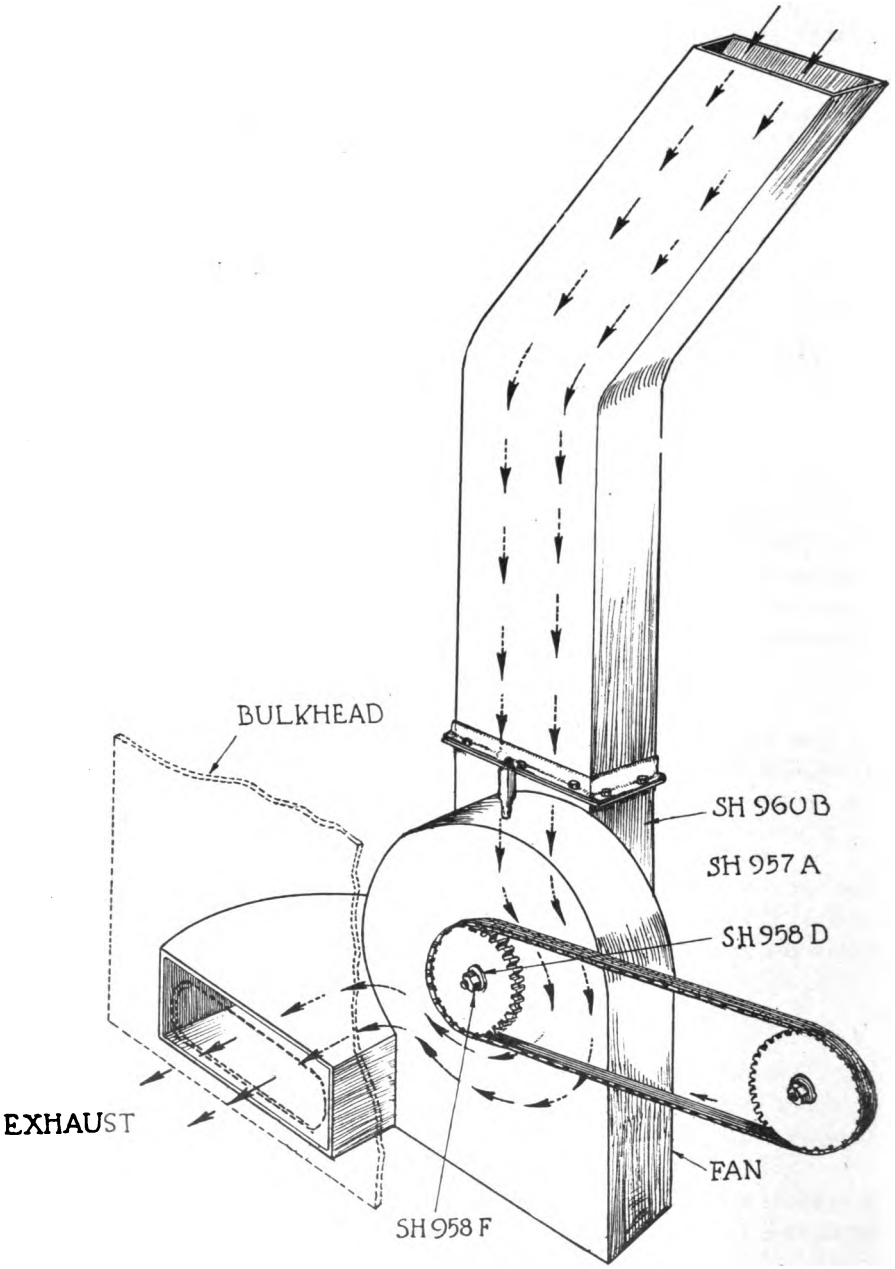
(As approved by the Tank Committee and the Anglo-American Commission, March 7, 1918.)

I. *Guns:*

6-pounder (E.)—

26-pounder Q. F. Hotchkiss 23-caliber.
2 recoil mountings casement, Mark II.
2 sighting telescopes 15, Mark I.
1 spare telescope (in leather case).
1 cleaning cloth for lenses.
1 cleaning rod and sponge brush.
1 spare sponge brush.
1 set spare parts and tools consisting of the following (to be carried in two trays, one behind each gun):
1 spanner and screw driver combined, No. 143.
2 screw drivers.
1 oil can.
1 crank, complete.
1 crank roller.
2 extractors.
2 hand extractors.
2 firing hammers, complete.

PLATE No. 110.



LAYOUT OF VENTILATING SYSTEM

I. *Guns*—Continued.

6-pounder (E.)—Continued.

4 firing pins, complete with strikers.
1 rocking shaft.
2 trigger sears.
4 main springs.
4 trigger-retaining springs.
2 trigger sear springs.
1 tommy.

Machine guns (E.)—

7 Hotchkiss .303-inch machine guns.
7 spare barrels.
7 tripod mountings.
7 shackles for tripod mountings.
7 shoulder pieces.
7 cradles for 50-round ammunition belts.
7 cartridge-case deflectors, Marks I or II.
7 deflector bags.
44 ammunition boxes (each box to hold six 50-round belts).
264 50-round ammunition belts.
2 boxes Hotchkiss spare parts, tools, and appurtenances (each box containing the following):

Machine—

1 fore-sight cover.
1 ejector.
1 extractor.
2 firing pins.
2 locking screws.
2 fore sights.
1 cartridge-stop spring.
1 ejector spring.
2 feed springs (No. 2).
1 recoil spring.
2 sear springs.
1 cleaning brush.
1 cylinder cleaner.
2 hand extractors.
1 ejector key.
1 bore-cleaning rod.
2 dismounting wrenches.
1 pin box for small parts, M. G.
1 oil can.
1 hammer, M. G.
1 No. 3 M. G. punch.
1 mirror reflector, M. G.

I. *Guns*—Continued.
Machine—Continued.
1 large screw driver, M. G.
2 double-pull throughs, .303.
4 pieces gauze wire-pull throughs.
Smoke-bomb rifles (E.)—
2 service rifles, .303.
2 smoke-bomb cups (fitted to end of barrel).
II. *Ammunition* (E.):
184 rounds of Q. F., 6-pounder.
24 rounds of Q. F., 6-pounder case shot.
13,200 rounds .303 M. G.
80 rounds .303 special rifle for smoke bombs.
44 rifle smoke bombs (to be stored in box below port door).
III. *Fittings:*
Internal—
(E.) 1 signaling semaphore.
(A.) 1 medical and surgical equip (carried in canvas bag and stored in bulkhead).
(E.) 1 yardometer and odometer calibrated to read in yards.
(E.) 1 compass (Aerial No. 259A, with electric bulb for night-work). 6 periscopes.
(A.) 8 Pyrene fire extinguishers (3 on each door and 2 in engine room).
(E.) 2 map boards (1 for commander and 1 for driver).
1 pigeon basket (to hold two birds).
1 broom.
2 electric torches.
1 Hellesen hand light.
1 inspection lamp (fitted with extension cord and plug).
1 hot-food container.
1 camp kettle.
2 canvas buckets.
1 signal gong (to be operated from outside tank).
1 speaking tube system.
4 2-gallon drinking-water cans (stored 2 above each door).
1 ration box (under starboard door and built into tank).
1 officer's locker (observation pedestal) to have folding door and lock).
External—
1 tarpaulin cover.
1 camouflage net (to be held up by detachable posts on hull).
1 unditching gear (two skew logs to be stored on sponson if carried).
1 towing cable, 30 feet (60 tons' strength).

III. *Fittings*—Continued.

External—Continued.

1 lock for top door (side doors to fasten from inside).
2 mud scrapers.
1 felling ax.
1 pickax.
2 shovels.
1 crowbar, 3 feet 6 inches.

IV. *Tools* (to be supplied in tool box with trays and place for each tool indicated in proper tray):

Mechanics'—

1 fitter's chisel.
1 drift, round, 7/8-inch.
1 file, half round, 6-inch.
1 file, round, 10-inch.
1 32-ounce fitter's hammer.
1 pair electrician's pliers.
2 dozen assorted split pins.
1 screw driver, 9-inch.
1 set box spanners, complete.
1 15-inch adjustable spanner.
1 small spanner.
1 spanner, double-ended, 1/8 by 3/16 inch.
1 spanner, double-ended, 1/4 by 5/16 inch.
1 spanner, double-ended, 3/8 by 7/16 inch.
1 spanner, double-ended, 1/2 by 5/8 inch.
1 spanner, double-ended, 5/8 by 3/4 inch.

Tools (E.):

Mechanics'—

6 spanner, double-ended, 3/4 by 7/8 inch.
1 spanner, double-ended, 3/4 by 1 inch.
1 single-ended spanner, 1-inch.
1 wrench pipe, 9-inch.
1 oil syringe.
4 grease guns.
1 roll insulating tape.
1 roll of 6 feet bare copper wire, No. 18, B. W. G.

Following supplied, but not in tool box:

1 wire cutter.
2 oil cans.

Engine (A.): Complete set of tools necessary for the general care and operation, to be shipped and carried in special tool box.

Transmission: Any special tools necessary for the adjustment and care of transmission units to be carried in a special tool box.

Track (A.): Any special tools necessary for the care and maintenance of the track units should include track pin drift, necessary punches and braces for removing grease plugs. To be carried in special tool box.

V. *Spares:*

Engine (A.)—

Spark plugs.
Generator parts.
Coil parts.
Breaker parts.
Distributor parts.
Wiring.
Fuses.
Carburetor parts.
Gaskets.

The above to be supplied in special box.

The following supplied, but not in box above.

Pump packing.
2 fan belts and spare links.
Copper tubing and connections for oiling system.

NOTE.—This list of engine spare parts is intended as a general outline. U. S. A. must advise exact spares to be furnished with engine.

Track. (from factory assembled): 1 complete road track shoe, links and pins, assembled.

Transmission (A.): Brake band linings.

Lighting system (E.):

2 spare bulbs and batteries for torches.
7 spare festoon bulbs.
2 inspection lamp bulbs.
1 Bulb and battery for Hellesen hand light.
1 Roll fuse wire.

The above to be supplied in a tin box. (Similar to ammunition box.)

LOCATION OF MACHINE GUNS

1 on each side in forward end on sponson.
2 on rear end of starboard sponson.
1 on rear end of port sponson.
1 on port side just forward of door.
1 on starboard side of central amm. storage opposite forward end of door.

SPARE BARRELS

1 on each side in forward end of sponson.
2 on starboard side just forward of side door.
2 on port side just forward of side door.
1 in main turret.

TOWING GEAR

The towing gear consists of five brackets, one on each side of the lower part of hull just forward of the rear mud chute, one on the front and one on the back end and one on the roof.

The brackets on the sides are riveted to the longitudinal butt strap with the shackle pins vertical. The front bracket is riveted to the front sloping plate and the front floor plate with the shackle pin horizontal. The back bracket is riveted to the back and rear floor plates with shackle pin horizontal.

The side, front, and rear towing brackets have a V shackle, 1½ inches in diameter and 2⅜ inches between jaws, and a shackle pin 1½ inches in diameter which is threaded for a nut.

The roof towing bracket is bolted to the roof plate abaft of the turret by means of six ¾-inch bolts. It has a post 2½ inches in diameter and 2½ inches high, over which fits a steel cap 5 inches in diameter and 1⅛ inches high. The post is taped and threaded for a 1-inch set screw, which passes through a hole in the cap and is screwed into the bracket post. To attach cable unscrew set screw and remove cap, place cable on post and replace cap.

Each machine is equipped with a steel wire cable 30 feet long by 1½ inches in diameter, each end of which has an eye 4½ inches in diameter.

NOMENCLATURE LIST

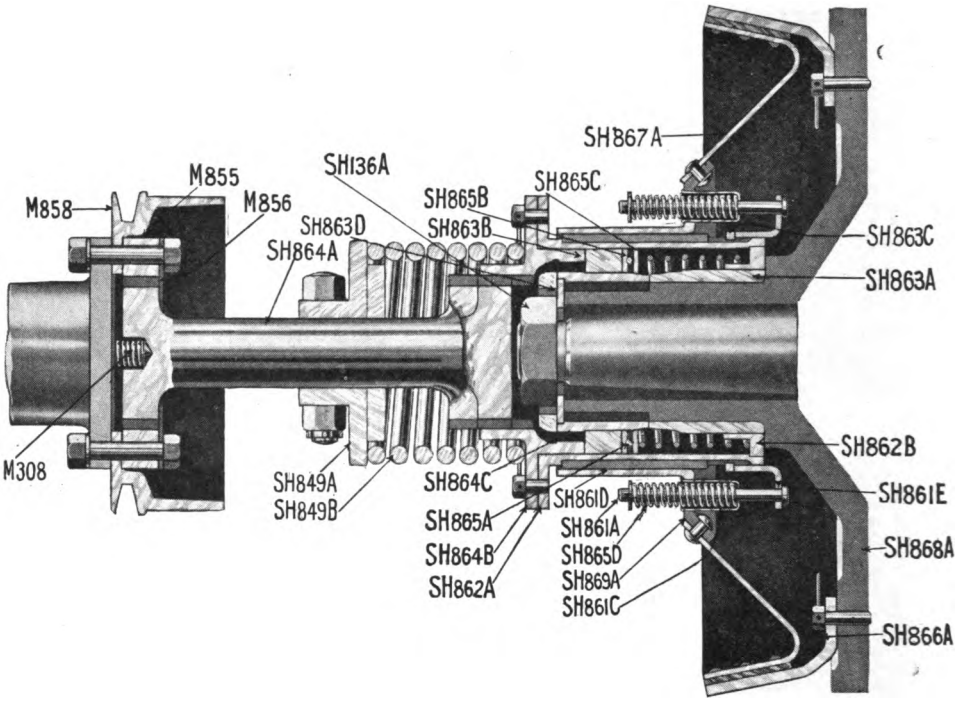
PROPERTY CLASSIFICATION, PART I, CLASS 4, SECTION II

Part No.	Number per machine	Description and location
		AMMUNITION STORAGE
		HOTCHKISS
M-3188	1	Arrangement and detail of platform storage.
M-3189	2	Fork, end for detail of platform storage
M-3190	2	Eyebolt for detail of platform storage.
M-3191	2	Adjusting nut detail of platform storage.
M-3193	1	Hotchkiss ammunition racks for above shell store.
M-3196	1	Hotchkiss ammunition racks—removable section.
M-3197	1	Wood batten for supporting racks on bulkhead.
M-3198	1	Wood packing piece for racks on bulkhead.
M-568	2	Pin for eyebolt.
		SHELL FORWARD
M-3063	2	Shell tube plate.
M-3064	2	Shell block (upper).
M-3065	2	Shell block (lower).
M-3066	10	Bracket.
M-3067	2	Bracket.
M-3068	2	Bracket.
M-3069	2	Shell stop shell holder.
M-3070	2	Shell stop shell holder.
M-3071	2	Shell stop shell holder.
M-3072	2	Shell stop shell holder.
M-3073	2	Shell stop shell holder.
M-3020	10	Spring case shell holder.
O-38—21192	10	Spring.
M-3023	10	Plunger.
M-3024	10	Bracket.
M-3025	10	Pin.
A-37—21191	98	Detail of shell tube.
B-37—21191	98	Expansion tube.
M-2437	4	Clip for periscope.
		SHELL REAR
M-3015	(L.H.) 2 (R.H.) 1	Side plate platform.
M-3016	1	End plate platform (rear).
M-3017	1	Cover plate platform (rear).
M-3018	1	End plate platform (forward).
M-3019	2	Bracket strip intermediate shaft.
M-3020	12	Spring case shell holder.
M-3022	2	Stop-bar case shell holder.
Q-38—21192	12	Spring case shell holder.
M-3023	12	Plunger shell holder.
M-3024	12	Bracket shell holder.
M-3025	12	Pin shell holder.
M-3026	4	Bracket platform.
A-37—21191	60	Detail of shell tube.
B-37—21191	60	Expansion tube.
M-3029	1	Starting handle front gearing plate.
M-3030	4	Stop-bar shell holder.
M-3031	1	Shell block.
M-3032	6	Bracket for shell block.
		CARBURETOR
P-1	1	Body.
P-2	1	Body gasket.
P-3	2	Body-gasket bushing.
P-4	2	Body spring pin.
P-5	2	Body dowel pin.
P-25	1	Float.
P-44	1	Float bolt.
P-45	1	Float-bolt nut.
P-26	1	Float chamber.
P-27	1	Float-chamber cover.
P-46	4	Float-chamber cover screws.
P-47	4	Float-chamber cover lock washer.
P-48	4	Float-chamber stud.
P-49	4	Float-chamber stud dowel pin.

NOMENCLATURE LIST—Continued

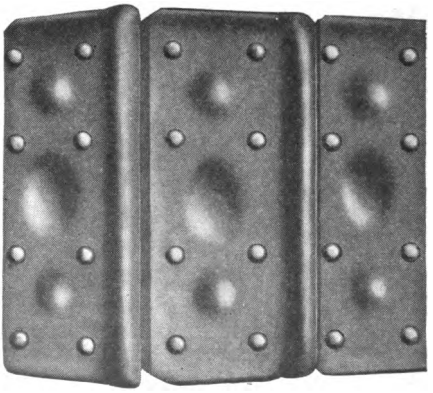
Part No.	Number per machine	Description and location
		CARBURETOR—Continued
P-50	4	Float-chamber nut.
P-51	4	Float-chamber lock washer.
P-52	1	Float-chamber equalizing tube.
P-53	1	Float rocker shaft.
P-54	2	Float rocker-shaft bearing.
P-55	2	Float rocker-shaft bearing washer.
P-35	1	Float valve.
P-36	1	Float-valve stem.
P-37	1	Float-valve collar.
P-38	1	Float-valve lever
P-39	2	Float-valve lever pins.
P-56	1	Float-valve guide.
P-28	1	Float-valve guide cap.
P-41	1	Float-valve seat.
P-57	1	Float-valve seat bushing.
P-42	1	Float-valve seat washer.
P-58	1	Float-valve stop collar.
P-250	2	Air valve.
P-251	2	Air-valve cage.
P-257	2	Air-valve stem.
P-255	2	Air-valve stem nuts.
P-256	2	Air-valve stem cotter.
P-252	2	Air-valve spring.
P-258	1	Air-valve locking wire.
P-150	1	Horn.
P-154	2	Horn spring.
P-600	2	By-pass screws.
P-602	2	By-pass plug screws.
P-300	2	Throttle stems.
P-302	2	Throttle blade.
P-303	6	Throttle-blade screw.
P-314	2	Throttle gear.
P-315	2	Throttle-gear dowel.
P-316	1	Throttle-gear stop screw.
P-317	1	Throttle-gear lock screw.
P-550	6	Gasoline-hole plug.
P-6	2	Body spring pin dowels.
P-403	2	Throat.
P-404	2	Throat-lock screw.
P-406	12	Throat tubes.
P-405	2	Throat washers.
P-407	2	Throat-lock washers.
P-650	2	Idling adjusting screw.
P-653	2	Idling adjusting-screw plug.
P-654	2	Idling adjusting-screw bushing.
P-700	2	Yoke end.
P-701	4	Yoke end set screw.
P-702	2	Yoke end set-screw wire.
P-703	2	Yoke end bolt.
P-704	2	Yoke end washer.
P-705	2	Yoke end nut.
		CHAIN CASING
M-1583	4	Angle cleats on sides.
M-1584	2	Packing strip under angle cleats.
M-1585	4	Beading for chain casing.
M-1586	4	Beading for removable cap.
M-1587	1	Supporting bracket (right hand).
M-1588	1	Supporting bracket (left hand).
M-1590	1	Chain casing.
M-1591	1	Chain-casing removable cap.
M-1592	1	Chain-casing angle fixing to hull back plate.
M-1593	2	Chain-casing angle cleat on top.
M-1594	2	Chain-casing register plate on removable cap.
M-1581	2	Register plate.
		CLUTCH ASSEMBLY COMPOUND
SH862A	1	Sliding collar.
SH861D	4	Keys.
SH862B	1	Sliding-collar cap.
SH866A	1	Outer clutch drum part.
SH861A	6	Spring plungers.
SH861B	6	Washers.
SH865D	6	Springs.
SH861C	6	Springs retainers.
SH861E	1	Spring stop ring.
SH867A	1	Inner clutch drum.
SH869A	1	Clutch-drum supporting collar.

PLATE No. 111



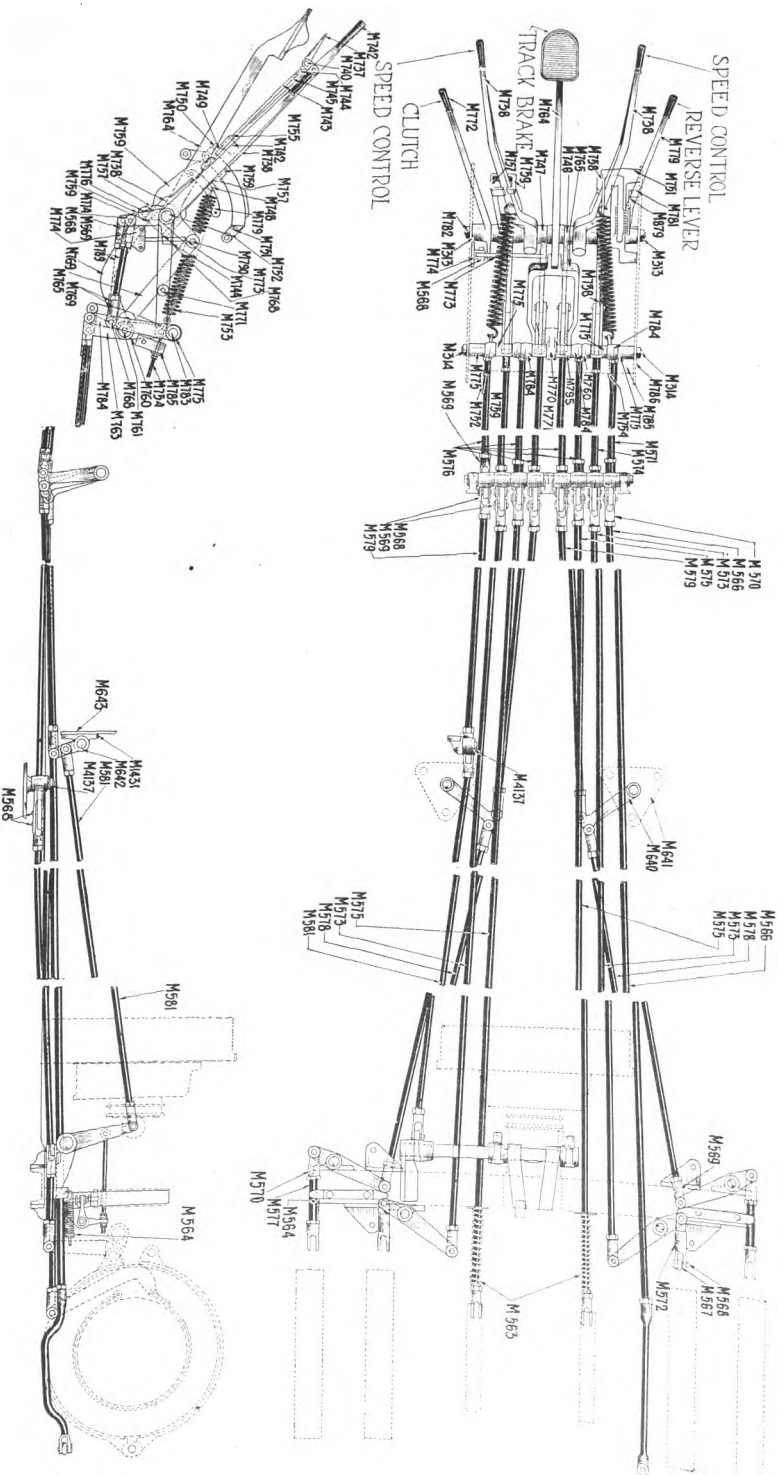
COMPOUND CLUTCH

PLATE No. 112



TOP OF ROAD TRACK

PLATE No. 113



CONTROL SYSTEM

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		CLUTCH ASSEMBLY COMPOUND—Continued
SH864B	1	Clutch coupling.
SH864C	1	Clutch sleeve.
SH864A	1	Cardon shaft.
SH863A	1	Clutch, front bearings.
SH863B	1	Clutch, rear bearings.
SH863D	1	Gear-lock washer.
SH863C	1	Snap ring.
SH855A	2	Bearing race.
M-855	1	Coupling box.
SH865B	1	Ball retainer.
SH865C	1	Large spring.
M-856	2	Coupling cover.
M-858	1	Clutch-stop drum.
M-308	1	Cardon shaft thrust spring.
SH136A	1	Crank-shaft nut.
SH849A	2	Spring flange.
SH849B	1	Clutch spring.
SH849C	1	Spring-retaining ring.
SH849D	1	Floating ring.
		CLUTCH SHAFT
SH953A	1	Clutch-shaft bracket (left).
SH953B	2	Clutch auxiliary operating lever.
	2	No. 6 taper pins 2¾ inches long.
SH953C	1	Clutch auxiliary operating shaft.
SH953D	1	Clutch auxiliary rod (rear).
	3	⅛-inch diameter cotter pins.
M-4163	1	Clutch lever (right).
M-4162	1	Clutch lever (left).
M-4161	2	Clutch-lever pin.
M-4155	4	Ball-bearing washer.
M-4164	1	Clutch-operating lever.
M-4160	1	Clutch-stop anchor plate.
M-4153	1	Ball-crank carrier plate.
M-4148	1	Clutch-shaft bracket.
M-4158	1	Clutch-stop band.
M-4159	1	Clutch-stop lining.
M-4150	1	Clutch shaft.
M-4156	1	Clutch-stop rod eyebolt.
M-4172	5	Clutch-lever feather key.
M-4152	1	Clutch-stop rod pin.
	1	⅛-inch split pin.
M-4165	1	Ball-crank pin.
	1	$\frac{3}{32}$-inch split pin.
M-4151	1	Clutch-stop rod.
S-673	1	Clutch-stop spring.
S-676	1	Clutch-stop eyebolt nut.
SH955A	2	Clutch-stop rod nut.
M-4175	2	Locking set screw for clutch-lever pin.
M-4157	1	Clutch-stop band pin.
	1	⅛-inch split pin.
M-4154	1	Clutch-stop bell crank.
		CONTROL RODS
M-563	2	High-speed brake-rod spring.
M-564	4	Foot and low-speed brake-rod spring.
M-565	1	Reversing rod (rear).
M-566	1	Reversing rod (center)
M-567	64	Spring washer (small) for brake gear.
M-568	64	Pin for fork ends.
M-569	42	Fork end for control rods.
M-570	12	Fork end for control tube.
M-571	1	Reversing rod (forward).
M-572	2	Low-speed brake connecting tube.
M-573	2	Low-speed brake rod (rear).
M-574	3	Low-speed brake rod (forward) and clutch rod (center).
M-575	2	High-speed brake (rear).
M-576	5	Clutch rod (forward), high-speed brake rod (center), foot-brake rod (forward).
M-577	2	Foot-brake connecting tube.
M-578	2	Foot-brake rod (rear).
M-579	2	Foot-brake rod (center).
M-581	1	Clutch rod (rear), Liberty.

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		CONTROL RODS
		ENGINE
SH964A	2	Engine-control lever bracket.
SH964B	2	Engine-control lever hub.
SH964C	2	Engine-control lever friction disc.
SH964D	2	Engine-control lever.
SH964E	2	Engine-control lever stud.
SH964F	4	Engine-control friction washer.
SH964G	2	Engine-control lever connection.
SH965A	1	Engine-control rocker arm bracket, long.
SH965B	2	Engine-control rocker shaft.
SH965C	2	Collar for rocker shaft.
SH965D	2	Engine-control rocker arm bracket shaft.
SH965E	4	Engine-control rocker arm.
SH965F	1	Fulcrum bracket for connecting lever.
SH965G	2	Fulcrum bracket pin.
SH965H	2	Engine-control rod connection lever.
SH966A	2	Rocker-shaft bracket for throttle control.
SH966B	1	Rocker arm—short—for throttle control.
SH966C	1	Rocker arm—long—for throttle control.
SH966D	1	Rocker shaft—for throttle control.
SH966E	1	Bell-crank lever bracket for throttle control.
SH966F	2	Bell-crank lever—spark and throttle control.
SH966G	2	Bell-crank lever stud.
SH967A	1	Bell-crank lever top—bracket spark control.
SH967B	1	Bell-crank lever for spark control.
		ENGINE
SH967C	1	Bell-crank lever stud for spark control.
SH967D	1	Bell-crank lever bracket bottom spark control.
SH967E	12	.5-engine control clevises.
SH967F	5	.375-engine control clevises.
SH967G	3	$\frac{5}{16}$-engine control clevises.
SH968A	1	Engine-control rod—for throttle.
SH968B	1	Engine-control rod—for throttle.
SH968C	1	Engine-control rod—for throttle.
SH968D	1	Engine-control rod—for sprak control.
SH968H	1	Engine-control rod—for spark control.
SH968E	5	.375 clevis pins.
SH968F	12	.5 clevis pins.
SH968G	5	$\frac{5}{16}$-clevis pins.
SH968K	1	.375 clevis pins.
SH969A	2	Engine-control rod—for spark and throttle.
SH969B	1	Engine-control rod—for throttle.
SH969C	1	Engine-control rod—for spark.
SH969D	2	Engine-control rod—vertical spark and throttle
SH970A	1	Governor spring.
SH970B	1	Throttle lever.
SH970D	1	Governor spring yoke.
SH970E	1	Spring—large end plate.
SH970F	1	Spring—small end plate.
		CONTROL UNIT
		CENTER
M-638	1	Intermediate shaft
M-639	3	Bracket for intermediate shaft.
M-640	10	Rocking lever for brakes.
M-641	2	Fulcrum bracket for foot brake lever.
M-642	1	Swing link for clutch.
M-4137	5	Spring washer (large) for brake gear.
M-4131	1	Fulcrum bracket for brake levers.
		CONTROL UNIT
		FRONT
M-764	1	Brake pedal.
M-765	1	Foot-brake bridle.
M-766	1	Foot-brake bridle distance.
M-767	1	Foot-brake bridle pin.
M-768	3	Foot-brake bridle pin nut.
M-769	2	Foot-brake link.
M-770	1	Foot-brake suspension link.
M-771	8	Brake connecting link.

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		CONTROL UNIT
		FRONT
M-738	2	Control lever.
M-739	3	Hand-lever trigger.
M-740	6	Control-lever trigger pin.
M-741	2	Control-lever pawl.
M-742	3	Control-lever pawl.
M-743	2	Control-lever trigger rod.
M-744	4	Control-lever trigger spring.
M-745	5	Control-lever trigger-spring pin.
M-746	1	Control-lever fulcrum, starboard.
M-747	1	Control-lever fulcrum, port.
M-748	2	Control-lever spring pin.
M-749	2	Control-lever lock.
M-750	2	Control-lever lock pin.
M-751	1	Control gate, starboard.
M-752	1	Control gate, port.
M-753	2	Control-lever spring.
M-754	2	Control-spring adjusting eye belt.
M-755	2	Control pawl stop.
M-756	1	Low-speed selector lever, starboard.
M-757	1	Low-speed selector lever, port.
M-758	1	High-speed selector lever, starboard.
M-759	1	High-speed selector lever, port.
M-760	2	Low-speed brake suspension link.
M-761	2	Low-speed brake suspension pin.
M-762	2	Low-speed connecting link.
M-763	2	Low-speed brake link.
M-798	1	Pedal stop.
M-799	1	Clutch-lever stop.
		CONTROL UNIT
		FRONT
M-772	1	Clutch-operating lever.
M-773	1	Clutch-locking bar.
M-774	1	Clutch-locking bar bracket.
M-775	4	Swing link distance piece.
M-776	2	Foot-brake bridle pin.
M-777	1	Reverse-operating lever.
M-778	1	Reverse-lever trigger rod.
M-779	1	Reverse-lever quadrant.
M-780	1	Reverse-lever pawl.
M-781	2	Reverse quadrant distance piece.
M-782	1	Fulcrum shaft.
M-783	1	Swing-link shaft.
M-784	4	Swing link.
M-785	1	Spring anchor angle.
M-786	1	Seat-support plate, starboard.
M-787	1	Seat-support plate, port.
M-788	2	Seat-support plate, angle.
M-789	4	Connecting rod.
M-790	3	Joint pin.
M-791	1	Seat.
M-792	1	Seat back.
M-793	1	Seat stay, forward.
M-794	1	Seat stay, aft.
M-795	1	Foot-brake suspension link sleeve.
No numbers	1	Seat cushion.
	1	Seat-back handle.
	2	Seat-back handle rivet.
M-810	4	Quadrant rack ferrule.
M-811	1	Packing for front seat stay.
M-812	1	Packing for rear seat stay.
		CONTROL UNIT
		REAR
M-4128	1	Control channel.
M-4129	2	Right-hand angle cleat for control channel.
M-4130	2	Left-hand angle cleat for control channel.
M-4131	5	Fulcrum bracket for brake levers.
M-4132	2	Horizontal lever for foot brake.
M-4133	1	Horizontal lever low-speed brake, port.
M-4134	1	Horizontal lever low-speed brake, starboard.
M-4135	2	High-speed brake rod spring bracket.
M-4136	2	Foot and low-speed brake-rod spring bracket.
M-4137	4	Spring washer (large) for brake gear.

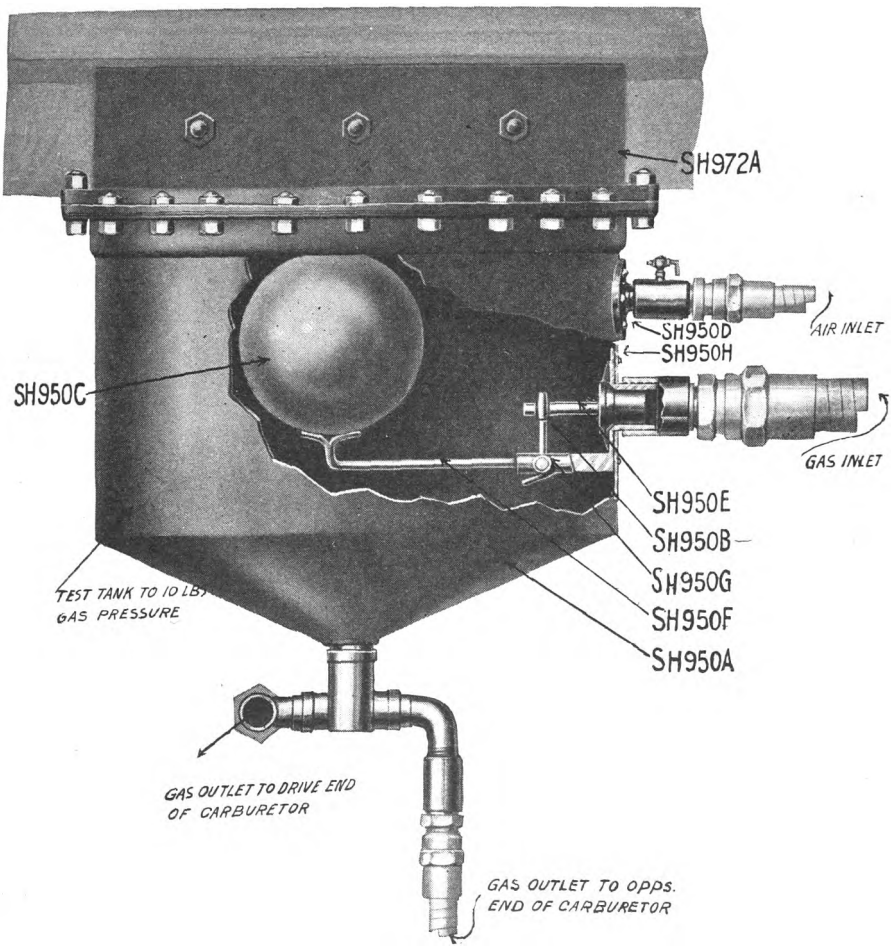
NOMECLATURE LIST—Continued

Part No.	Number per machine	Description and location
		COOLING SYSTEM
		AIR DUCTS
M-1032	1	Side plate.
M-1033	1	Bottom plate.
M-1034	1	Front bottom plate.
M-1035	1	Front plate.
		ENGINE COOLING SYSTEM
		ENGINE
12211	1	Water-pump assembly.
8079	1	Water-pump shaft with gear.
8056	1	Water-pump shaft ball bearing.
8069	1	Water-pump shaft bearing retainer.
8213	2	Water-pump packing.
8059	2	Water-pump shaft gland.
8058	1	Water-pump shaft gland engine.
12071	1	Water-pump body.
12075	2	Water-pump outlet connection (cast with body) (tube 1⅜ inches O. D. by 0.065 wall by 1⅞ inches).
8133	1	Water-pump body drain (plug ⅝ inch by 18 thd., hex. head).
158	1	Water-pump body drain plug gasket (⅝ inch annular).
131	8	Water-pump cover stud (¼ inch-28 by 1¼ inches, standard) (¼ inch between nut and surface).
159	1	Water-pump shaft key (3/16 inch by 1/8 by 5/8 inch)
12517	1	Water-pump impeller.
8214	1	Water-pump shaft nut.
212	1	Water-pump shaft cotter (rustproof).
8215	1	Water-pump cover gasket.
12435	1	Water-pump cover.
12081	1	Water-pump inlet connection (cast with cover) (tube 2 inches O. D. by 0.065 wall by 1⅞ inches).
111	8	Water-pump cover stud washer (¼ inch).
101	8	Water-pump cover stud nut (⅜ inch by 28 thd., standard).
8510	x	Water-pump shaft bearing retainer shim.
8345	1	Water-pump shaft bearing retainer gasket.
8077	1	Water-pump bevel driver.
8239	1	Water-pump bevel-driver bushing and housing assembly.
8062	2	Water-pump bevel-driver bushing.
8065	1	Water-pump bevel-driver bushing housing (front).
8064	1	Water-pump bevel-driver bushing housing (rear).
174	1	Water-pump bevel-driver bushing dowel (⅛ inch by ⅝ inch).
154	1	Water-pump bevel-driver bushing housing (rear) screw (⅜ inch-16 by 3¼ inches).
113	1	Water-pump bevel-driver bushing housing (rear) screw washer (⅜ inch).
177	1	Water-pump bevel-driver bushing housing (rear) screw lock wire (W. and M. Ga. No. 18 (0.0475) by 6).
12123	1	Cylinder water-inlet manifold.
12096	1	Cylinder water-inlet manifold extension (right).
12097	1	Cylinder water-inlet manifold extension (left).
12128	4	Cylinder water-inlet manifold extension hose (1⅜ inches I. D. by 1⅝ inches O. D. by 1¾ inches long).
8453	8	Cylinder water-inlet manifold extension hose clamp assembly.
8152	12	Cylinder-water hose (inlet); (see cylinder parts list also).
8450	24	Cylinder water-inlet hose clamp.
8426	1	Water-pump bevel-driver and housing assembly.
116	2	Water-pump bevel-driver housing clamp bolt.
174	1	Water-pump bevel-driver bushing dowel.
111	4	Water-pump bevel-driver housing clamp bolt washer.
8133	1	Water-pump body drain plug.
101	2	Water-pump bevel-driver housing clamp bolt nut.
106	2	Water-pump bevel-driver housing clamp bolt cotter.
		COOLING SYSTEM
		RADIATOR
M-878	1	Top header.
M-879	1	Bottom header.
M-880	1	Stiffening plate for drain-pipe connection.
M-881	2	Cover plate for tube plate.
SH607C	606	Radiator tubes.
M-886	1	Stiffening plate for water connections.
M-887	1	Stiffening plate for steam-pipe connection.
M-888	2	Gasket for header.
M-889	1	Swivel pin.
M-891	2	Front support bracket.
M-892	1	Rear support bracket.
M-897	1	Bottom stiffening plate for steam-pipe connection.
M-898	1	Front angle bracket for radiator support.
M-899	1	Rear angle bracket for radiator support.
SH606A	1	Tube plate (right).

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		COOLING SYSTEM—Continued
		RADIATOR—continued
SH606B	1	Tube plate (left).
SH606C	1	Reinforcing strip (right).
SH606D	1	Reinforcing strip (left).
SH607A	1	Middle tank gasket.
SH607B	2	Middle tank band iron.
SH611A	1	Middle tank plate (right).
SH611B	1	Middle tank plate (left).
SH612A	1	Side plate (left).
SH612B	1	Side plate (right).
		RADIATOR SUPPORTS
M-889	1	Swivel pin for radiator support (rear).
M-891	2	Radiator support bracket (front).
M-892	1	Radiator support bracket (rear).
		WATER TANK
M-1193	1	Water tank.
M-1194	1	Flange for filler pipe.
M-1195	1	Flange for radiator pipe.
M-1196	1	Stiffening plate for flow pipe.
M-1197	1	Filler pipe.
BA109—21149	1	Cap for filler pipe.
		WATER AND VAPOR PIPING
M-1228	1	Water-outlet pipe from engine.
M-1229	1	Radiator inlet pipe.
M-1230	1	Flanged socket for radiator inlet pipe.
M-1231	1	Water-tank outlet connection.
SH975C	3	Radiator outlet coupling.
M-1233	1	Radiator outlet band.
SH975B	1	Radiator outlet pipe.
SH975A	1	Radiator outlet tee.
M-1236	1	Pump suction band.
SH976C	2	Clip for water pipe.
M-1238	1	Radiator drain pipe.
M-1239	1	Plate bracket for radiator drain cock.
	1	½-inch bore cock inlet tapped ½-inch pipe thread outlet to take hose pipe.
	1	¾-inch by 2-inch bolt for plate bracket.
	1	½-inch bore copper pipe, 16-gage, 7 feet 8 inches long.
	2	Nipples for copper pipe, 16-gage, 7 feet 6 inches long.
	2	Union nuts for copper pipe, 16-gage, 7 feet 6 inches long.
	2	Union with one end screwed ¾-inch pipe thread.
	1	¾-inch W. I. knee with nipple.
M-1240	1	Pipe joint for water tank outlet.
M-1241	2	Pipe joint for radiator inlet and outlet.
M-1242	1	Water-outlet pipe from engine.
SH199C	1	Vapor pipe from engine-water outlet.
	2	Flexible coupling 2½ inches long (for 1-inch W. I. piping).
	4	Clips for coupling 2½ inches long (for 1-inch W. I. piping).
	1	1-inch Whit. Gas. plug (on M 1229).
	1	Vapor pipe connecting piece.
M-1244	1	Support bracket (for engine water outlet and vapor pipe).
M-1245	1	Clip for vapor pipe on engine.
	2	⅜-inch and ⅞-inch bolt (with Grover washer).
	1	½-inch by ½-inch set screw (with grover washer).
SH199B	2	Hose connection (short).
SH976B	1	Water pipe under engine.
SH975E	1	Water-pipe coupling.
SH976A	2	Water-pipe clip.
SH974A	1	Pipe connection to pump.
SH975D	1	Piping outlet coupling.
		DRIVING SPROCKET CHAIN
SH40AB	50	Outside side plate.
SH40AC	50	Inside side plate.
SH40AD	50	Collar busihng.
SH40AE	50	Collar-bushing pin.
		ENGINE
		CAM-SHAFT HOUSING
12104	1	Cam shaft, right.
12105	1	Cam shaft, left.
8100	2	Cam-shaft plug (machined in end of each cam shaft).
8400	2	Cam-shaft bearing, No. 1 assembly.
8111	2	Cam-shaft bearing, upper half, No. 1.
8112	2	Cam-shaft bearing, lower half No. 1.

PLATE NO. 114



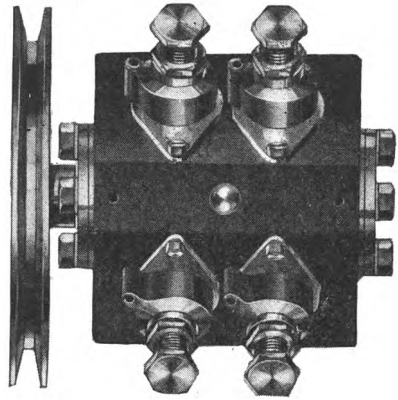
REGULATING TANK ASSEMBLY

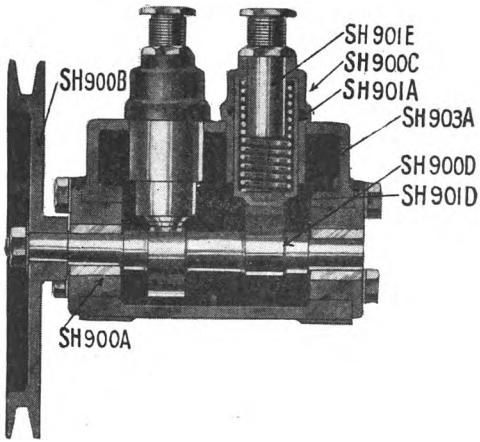
38285—25†——13

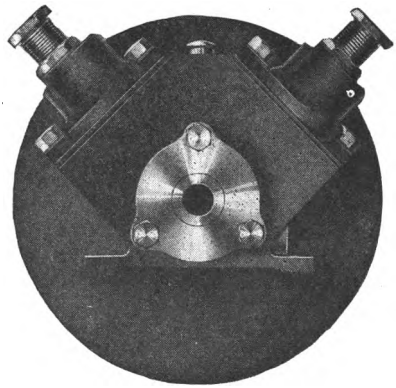
NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		ENGINE—Continued
		CAM-SHAFT HOUSING—continued
8481	2	Cam-shaft bearing, No. 2 assembly.
8113	2	Cam-shaft bearing, upper half, No. 2.
8114	2	Cam-shaft bearing, lower half, No. 2.
8482	2	Cam-shaft bearing, No. 3 assembly.
8115	2	Cam-shaft bearing, upper half, No. 3.
8116	2	Cam-shaft bearing, lower half, No. 3.
8483	2	Cam-shaft bearing No. 4 assembly.
8117	2	Cam-shaft bearing, upper half, No. 4.
8118	2	Cam-shaft bearing, lower half, No. 4.
8484	2	Cam-shaft bearing No. 5 assembly.
8119	2	Cam-shaft bearing (upper half), No. 5.
8120	2	Cam-shaft bearing (lower half), No. 5.
12485	2	Cam-shaft bearing No. 6 assembly.
12248	2	Cam-shaft bearing (upper half), No. 6.
12249	2	Cam-shaft bearing (lower half), No. 6.
8101	48	Cam-shaft bearing upper to lower half screw (screw No. 8—32 by ½-inch special.
		ENGINE
		CAM-SHAFT HOUSING
12250	2	Cam-shaft bearing (front).
8376	2	Cam-shaft bearing (front) end plate.
8219	8	Cam-shaft bearing (front) end plate screw (screw No. 10—thd. special head)
177	2	Cam-shaft bearing (front) end plate screw lock wire W. and M. Ga. No. 18 (0.0475) by 6.
8379	2	Cam-shaft bearing (front) end plate gasket.
8108	14	Cam-shaft bearing lock screw.
157	14	Cam-shaft bearing lock screw gasket (⅝-inch annular).
177	12	Cam-shaft bearing lock screw lock wire, W. and M. Ga., No. 18 (0.0475) by 6.
8093	2	Cam-shaft gear.
8059	x	Cam-shaft gear shim.
171	14	Cam-shaft gear bolt (¼-in.-28 by $\frac{11}{16}$-inch special) (1⅝ inches between head and nut).
200	14	Cam-shaft gear bolt nut (¼-inch-28.)
106	14	Cam-shaft gear bolt cotter ($\frac{1}{16}$ inch by ½).
13006	2	Cam-shaft distributor driving flange.
12486	2	Cam-shaft housing and cover assembly.
12124	2	Cam-shaft housing.
8095	10	Cam-shaft housiug cover.
8467	2	Cam-shaft housing cover (propeller end).
8133	2	Cam-shaft housing cover (propeller end plug).
		ENGINE
		CAM-SHAFT HOUSING
158	2	Cam-shaft housing cover (propeller end plug gasket) (⅝ inch annular).
178	36	Cam-shaft housing cover bolt ($\frac{1}{16}$-inch—24 by 2 $\frac{1}{16}$ inches special).
102	36	Cam-shaft housing cover bolt nut ($\frac{1}{16}$-inch—24 thd. standard).
112	72	Cam-shaft housing cover bolt washer ($\frac{1}{16}$-inch).
107	36	Cam-shaft housing cover bolt cotter ($\frac{1}{16}$ inch by $\frac{5}{16}$ inch).
8088	2	Cam-shaft housing front end cover.
169	2	Cam-shaft housing front cover gasket (1⅞-inch annular).
177	2	Cam-shaft housing front end cover lock wire W. and M. Ga. No. 18 (0.0475) by 6..
8462	2	Cam-shaft housing front end cover oil connection.
157	4	Cam-shaft housing front end cover oil connection gasket (⅜-inch annular).
8122	2	Cam-shaft housing front end cover oil connection nut.
8133	1	Cam-shaft housing cover (propeller end) plug.
8425	12	Cam-shaft rocker lever, right assembly.
8424	12	Cam-shaft rocker lever, left assembly.
8020	12	Cam-shaft rocker lever (right).
8019	12	Cam-shaft rocker lever (left).
8471	48	Cam-shaft rocker lever plug (machined with lever).
		ENGINE
		CAM-SHAFT HOUSING
8082	24	Cam-shaft rocker lever roller.
8083	24	Cam-shaft rocker lever roller pin.
8084	24	Cam-shaft rocker lever roller pin sleeve.
8085	24	Cam-shaft rocker lever tappet.
8086	24	Cam-shaft rocker lever tappet shim, medium.

PLATE No. 115

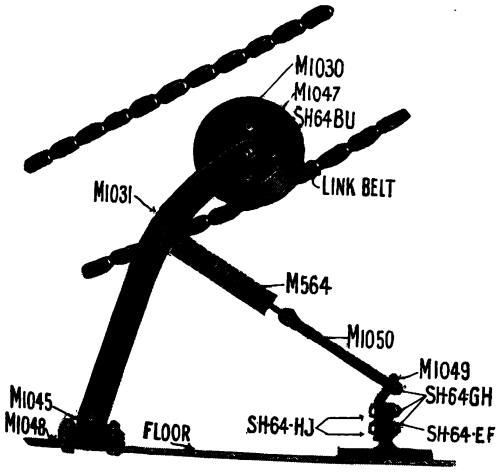


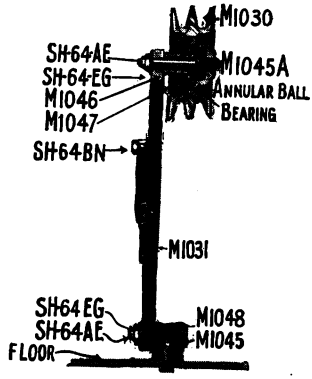




AIR-PRESSURE PUMP

PLATE No. 116



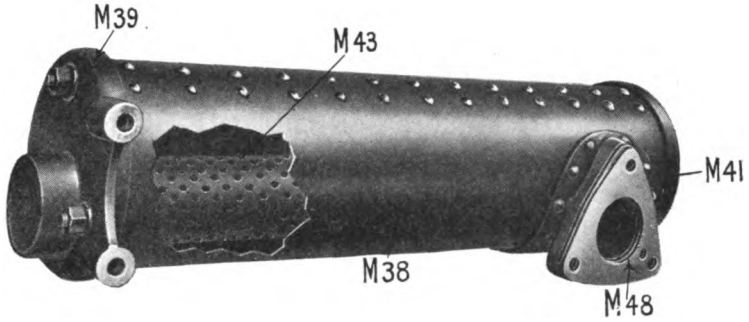


JOCKEY PULLEY

NOMENCLATURE LIST—Continued

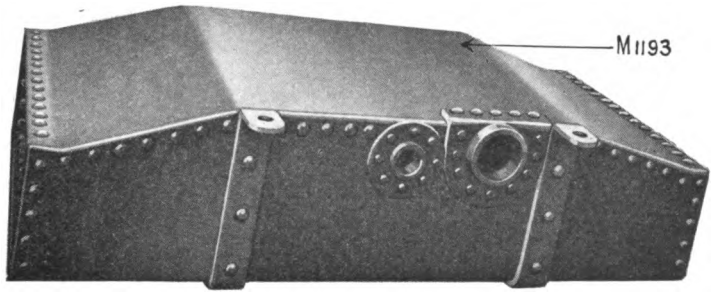
Part No.	Number per machine	Description and location
		ENGINE—Continued
		CAM-SHAFT HOUSING—continued
8087	24	Cam-shaft rocker lever tappet shim, thin.
8089	24	Cam-shaft rocker lever tappet shim, thick.
102	24	Cam-shaft rocker lever tappet nut.
107	24	Cam-shaft rocker lever tappet cotter.
8102	2	Cam-shaft driving shaft (upper).
8107	2	Cam-shaft driving shaft (upper), bushing small.
8092	2	Cam-shaft driving shaft (upper), bushing large.
8094	2	Cam-shaft driving shaft (upper) gear.
160	4	Cam-shaft driving shaft (upper) gear key ($\frac{1}{16}$ by $\frac{1}{8}$ by $1\frac{13}{16}$ inch).
156	2	Cam-shaft driving shaft (upper) gear pin ($\frac{1}{8}$ by $1\frac{7}{32}$ inches).
8109	2	Cam-shaft driving shaft (upper) housing and flange assem.
8103	2	Cam-shaft driving shaft (upper) housing.
8110	2	Cam-shaft driving shaft (upper) housing flange.
186	2	Cam-shaft driving shaft (upper) housing brazing pin; (8d. finishing nail).
		ENGINE
		CAM-SHAFT HOUSING
8139	2	Cam-shaft driving shaft (upper) housing flange gasket.
181	8	Cam-shaft driving shaft (upper) housing flange stud ($\frac{1}{4}$-inch—28 by $1\frac{1}{4}$ inches std.) ($\frac{1}{4}$ inch between nut and surface)
101	8	Cam-shaft driving shaft (upper) housing flange stud nut ($\frac{1}{4}$-inch—28 thd., standard).
106	8	Cam-shaft driving shaft (upper) housing flange stud nut ($\frac{1}{16}$ inch by $\frac{1}{2}$ inch).
8068	2	Cam-shaft driving shaft (upper) housing packing.
8066	2	Cam-shaft driving shaft (upper) housing packing nut.
		ENGINE
		CAM-SHAFT LOWER SHAFT
8208	2	Cam-shaft driving shaft (lower) assembly.
8141	2	Cam-shaft driving shaft (lower).
8063	4	Cam-shaft driving shaft (lower) ball bearing.
8070	2	Cam-shaft driving shaft (lower) ball bearing container.
8343	2	Cam-shaft driving shaft (lower) ball bearing container gasket.
8072	2	Cam-shaft driving shaft (lower) bearing container cover.
3144	2	Cam-shaft driving shaft (lower) bearing spacer.
3076	2	Cam-shaft driving shaft (lower) gear.
8142	2	Cam-shaft driving-shaft (lower) nut (nut $\frac{5}{8}$ inch—18 thd. special).
172	2	Cam-shaft driving-shaft, lower cotter ($\frac{1}{8}$ inch by 1 inch).
159	4	Cam-shaft driving-shaft, lower gear key ($\frac{1}{16}$ inch by $\frac{1}{8}$ inch by $\frac{5}{8}$ inch)
		ENGINE.
		CRANK CASE.
12243	1	Crank case, lower half assembly
12036	1	Crank case, lower half.
12038	1	Crank case, lower half oil manifold.
8518	1	Crank case, lower half oil-hole plug (plug $\frac{5}{8}$ inch—18 thd. Hex. head).
157	1	Crank case, lower half oil hold plug gasket ($\frac{5}{8}$-inch annular).
12135	1	Crank case, lower half oil tube (large).
12136	6	Crank case, lower half oil tube (small).
8174	2	Crank case, lower half oil pump to manifold tube.
12039	1	Crank case, lower half oil-pump suction tube.
8040	1	Crank case, lower half oil pump-suction tube extension.
158	1	Crank case, lower half oil-pump suction tube extension gasket ($\frac{5}{8}$-inch annular).
161	1	Crank case, lower half oil manifold plug ($\frac{1}{8}$-inch pipe).
161	2	Crank case, lower half oil-pump suction tube plug ($\frac{1}{8}$-inch pipe).
8033	14	Crank-shaft bearing bolt (long).
8034	2	Crank-shaft bearing bolt (short).
115	16	Crank-shaft bearing bolt washer $\frac{1}{2}$ (inch).
12548	16	Crank-shaft bearing bolt washer.
110	32	Crank-shaft bearing bolt cotter ($\frac{3}{32}$ inch by $\frac{7}{8}$ inch).
105	32	Crank-shaft bearing bolt nut ($\frac{1}{2}$ inch—20 thd. std).
8018	7	Crank-shaft bearing dowel.
		ENGINE.
		CRANK CASE
132	10	Oil pump to crank-case stud ($\frac{1}{4}$ inch—28 by $1\frac{1}{16}$ inch standard) ($\frac{1}{16}$ inch between nut and surface).
140	4	Water pump to crank-case stud ($\frac{3}{8}$ inch—24 by $1\frac{13}{16}$ inch standard).
8131	2	Crank case, lower half sump (front) cover lock bushing.
8130	11	Crank case, lower half sump (front) cover lock.
8129	1	Crank case, lower half sump (front) cover.

PLATE NO. 117



MUFFLER

PLATE NO. 118.



GASOLINE TANK

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and Location
		ENGINE—Continued
		CRANK CASE—continued
8530	1	Crank case, lower half sump (front) oil strainer assembly.
8527	1	Crank case, lower half sump (front) oil strainer housing.
8528	1	Crank case, lower half sump (front) oil strainer screen-side.
8529	1	Crank case, lower half sump (front) oil strainer screen-top.
12244	1	Crank case, upper half assembly.
12035	1	Crank case, upper half.
8216	1	Crank case, upper half drain tube assembly.
8217	1	Crank case, upper half drain tube.
8344	1	Crank case, upper half drain tube cup.
8218	1	Crank case, upper half drain tube flange.
117	2	Crank case, upper half drain tube bolt (¼ inch—28 by 1⅛ inch standard) (⅜ inch between head and nut).
101	2	Crank case, upper half drain tube bolt nut (¼ inch—28 thd. standard).
106	2	Crank case, upper half drain tube bolt nut ($\frac{1}{16}$ inch by ½ inch).
		ENGINE
		CRANK CASE
12137	1	Crank case, upper half oil tube.
8156	2	Crank case oil-filler assembly.
8155	2	Crank case oil-filler assembly.
8162	2	Crank case oil-filler cover assembly.
8151	2	Crank case oil-filler cover.
8157	2	Crank case oil-filler cover hinge.
8159	2	Crank case oil-filler cover hinge pin.
8163	2	Crank case oil-filler cover lock.
8160	2	Crank-case oil-filler cover spring.
261	4	Crank-case oil-filler cover spring escutcheon pin (No. 14 by ⅜ inch).
261	6	Crank-case oil-filler cover hinge escutcheon pin (No. 14 by ⅜ inch).
261	4	Crank-case oil-filler cover lock escutcheon pin (No. 14 by ⅜ inch).
8166	2	Crank-case oil-filler strainer (upper assembly).
8164	2	Crank-case oil-filler strainer (upper ring).
8165	2	Crank-case oil-filler strainer (upper screen).
8523	2	Crank-case oil-filler strainer (lower assembly).
8522	2	Crank-case oil-filler strainer (lower ring).
8521	2	Crank-case oil-filler strainer (lower screen).
8158	2	Crank-case oil-filler gasket.
132	4	Crank-case oil-filler stud (¼ inch—28 by $1\frac{7}{16}$ inches, standard) ($\frac{7}{16}$ inch between nut and surface).
111	4	Crank-case oil-filler stud washer (¼ inch.).
101	4	Crank-case oil-filler stud nut (¼ inch—28 thd., standard).
106	4	Crank-case oil-filler stud cotter ($\frac{1}{16}$ by ½ inch.).
12237	1	Crank-case oil-retaining washer front end.
8206	1	Crank-case (rear end) cover.
8205	1	Crank-case (rear end) cover gasket.
245	6	Crank-case (rear end) cover screw (⅜ inch—24 by 1 inch).
8365	1	Crank-case breather.
8366	1	Crank-case breather screen.
8172	1	Crank-case breather gasket (2-bolt gasket $\frac{11}{16}$-inch hole).
131	2	Crank-case breather stud (¼ inch—28 by 1¼ inches, standard) (¼ inch between nut and surface).
111	2	Crank-case breather stud washer (¼ inch).
101	2	Crank-case breather stud nut (¼ inch—28 thd., standard).
106	2	Crank-case breather stud cotter ($\frac{1}{16}$ inch by ½ inch).
13148	1	Crank-shaft bearing (lower half, long).
13418	1	Crank-shaft bearing (upper half, long).
13459	6	Crank-shaft bearing (lower half, short).
13435	6	Crank-shaft bearing (upper half, short).
8390	1	Propeller hub thrust bearing oil cup (brass).
116	50	Crank-case, upper to lower half bolt (small) (¼ inch—28 by $\frac{11}{16}$ inch) (½ inch between head and nut).
111	100	Crank case, upper to lower half bolt, small washer (¼ inch).
101	50	Crank case, upper to lower half bolt, small nut (¼ inch—28 thd., standard).
106	50	Crank case, upper to lower half bolt, small cotter ($\frac{1}{16}$ by ½ inch).
187	2	Crank case, upper to lower half bolt, short (⅜ inch—24 by 4⅜ inches, special) (3⅞ inches between head and nut).
165	2	Crank case, upper to lower half bolt, long (⅜ inch—24 by 5⅛ inches, special) (4⅝ inches between head and nut).
113	8	Crank case, upper to lower half bolt washer (⅜ inch).
103	4	Crank case, upper to lower half bolt nut (⅜ inch—24 thd., standard).
108	4	Crank case, upper to lower half bolt, cotter ($\frac{3}{32}$ inch by ⅝ inch).
151	100	Cylinder to crank-case stud (⅜ inch—24 by 1⅛ inches, special) (¼ inch between nut and surface).
108	100	Cylinder to crank-case stud cotter ($\frac{3}{32}$ inch by ⅝ inch).
103	72	Cylinder to crank-case stud nut (⅜ inch—24, standard).
108	4	Water pump to crank-case stud cotter ($\frac{3}{32}$ inch by ⅝ inch).
101	3	Generator to crank-case stud nut.

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		ENGINE—Continued
		CRANK CASE—continued
103	4	Water pump to crank-case stud nut (3/4 inch—24, standard).
113	4	Water pump to crank-case stud washer (3/8 inch).
111	10	Oil pump to crank-case stud washer (1/4 inch).
8348	1	Oil-pump body (lower half) gasket.
106	10	Oil pump to crank-case stud cotter (1/16 inch by 1/2 inch).
8389	1	Generator gasket.
177	3	Generator to crank-case stud lock wire.
101	8	Cam-shaft driving shaft, lower bearing connecting-stud nut (1/4 inch—28, standard).
106	8	Cam-shaft driving shaft, lower bearing connecting-stud cotter (1/16 inch by 1/2 inch).
12346	4	Cylinder to crank-case gasket.
8234	28	Cylinder to crank-case stud nut.
12353	1	Engine name plate.
197	4	Engine name-plate screw.
13157	1	Engine name plate (Navy).
101	10	Oil pump to crank-case stud nut.
13443		Crank-shaft bearing dowel (upper).
		ENGINE
		CRANK SHAFT
12514	1	Crank shaft, thrust bearing and gear assembly.
12546	1	Crank shaft.
8138	1	Crank-shaft propeller end plug.
13142	6	Crank-shaft oil-hole plug (small).
8067	1	Crank-shaft gear.
8502	x	Crank-shaft gear shim.
198	6	Crank-shaft gear bolt (1/16 inch—24 by 7/8 inch, special) (3/32 inch between head and nut).
102	6	Crank-shaft gear bolt (1/16 inch—24, standard).
107	6	Crank-shaft gear-bolt cotter nut (1/16 inch by 5/8 inch).
13481	1	Crank-shaft gear end plug.
13482	1	Crank-shaft gear end plug gasket.
13483	11	Crank-shaft main bearing plug.
13484	12	Crank-pin plug.
13485	12	Gasket (1 1/4 inches, annular).
13486	11	Gasket (1 5/8 inches, annular).
13487	1	Crank-shaft gear end plug stud.
13488	6	Crank-pin plug stud.
13489	5	Crank-shaft main bearing plug stud.
103	12	Crank-pin plug-stud nut.
157	24	Crank-shaft plug-stud gasket.
108	12	Crank-pin plug-stud cotter.
13490	12	Crank-pin plug-stud nut.
12048	1	Propeller hub thrust bearing assembly.
12252	1	Propeller hub thrust bearing sleeve (thick).
		ENGINE
		CONNECTING ROD
13442	6	Connecting-rod assembly.
13440	6	Connecting-rod (forked end) and bushings assembly.
12250	24	Connecting-rod (forked end) bolt.
13228	12	Connecting-rod (forked end) cap.
13220	24	Connecting-rod (forked end) bolt nut (1/16 inch—24 thd., standard).
107	24	Connecting-rod (forked end) bolt cotter (1/16 inch by 5/8 inch).
13460	6	Connecting-rod crank-shaft bearing (upper half).
13461	6	Connecting-rod crank-shaft bearing (lower half).
8028	12	Connecting-rod crank-shaft bearing dowel.
13441	6	Connecting rod (plain end) and piston pin bushing assembly.
13422	12	Connecting-rod (plain end) bolt.
13227	6	Connecting-rod (plain end) cap.
13251	12	Connecting-rod (plain end) bolt nut (1/16 inch—20 thd., special).
109	12	Connecting-rod (plain end) bolt cotter (3/32 inch by 3/4 inch).
8007	12	Connecting-rod piston-pin bushing.
		ENGINE
		CYLINDER
8385	12	Cylinder and valves assembly.
8106	12	Cylinder assembly.
8231	12	Cylinder barrel and elbows assembly
8098	12	Cylinder barrel.
8031	12	Cylinder-elbow exhaust.

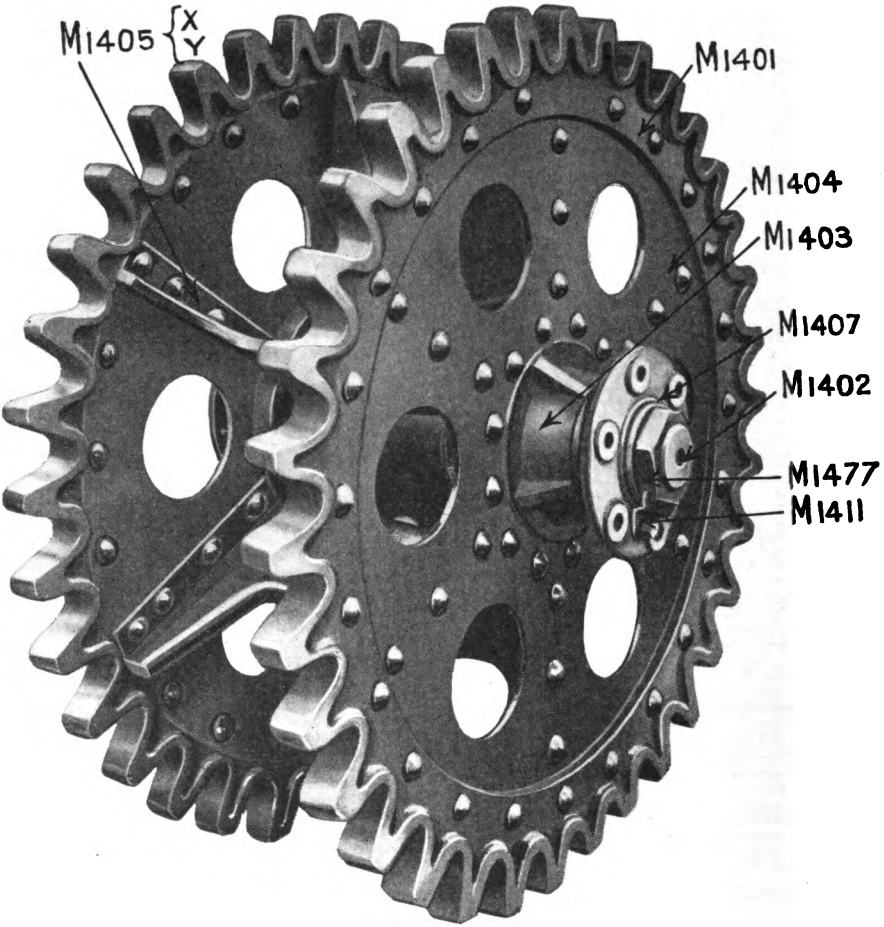
NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		ENGINE—Continued
		CYLINDER—continued
8032	12	Cylinder-elbow inlet.
8030	24	Cylinder-elbow flange.
8099	12	Cylinder water jacket (inlet half).
8359	12	Cylinder water jacket (outlet half).
8025	12	Valve-stem guide exhaust.
8026	12	Valve-stem guide inlet.
8126	12	Cylinder water-inlet pipe.
8127	12	Cylinder water-outlet pipe.
8021	24	Valve.
8253	24	Valve spring (inside).
8254	12	Valve-spring inlet (outside).
8357	12	Valve-spring exhaust (outside)
8090	24	Valve-spring collar (lower).
8023	24	Valve-spring collar (upper).
8524	48	Valve-spring collar key.
8591	24	Spark-plug assembly.
181	24	Spark-plug gasket (¾ inch, annular).
179	12	Cam-shaft housing to cylinder stud short ($\frac{5}{16}$ inch—24 by $2\frac{7}{16}$ inches, special) ($1\frac{7}{16}$ inches between nut and surface).
180	12	Cam-shaft housing to cylinder stud long ($\frac{5}{16}$ inch by $4\frac{3}{16}$ inches, special) ($3\frac{3}{16}$ inches, between nut and surface).
102	24	Cam-shaft housing to cylinder stud nut ($\frac{5}{16}$ inch—24 thd., standard).
107	24	Cam-shaft housing to cylinder stud cotter.
162	24	Exhaust header stud (⅜ inch—24 by 1¼ inches, special) ($\frac{5}{16}$ inch between nut and surface).
163	24	Intake header stud (⅜ inch—24 by 1½ inches, special) ($\frac{5}{16}$ inch between nut and surface.
103	24	Intake header stud nut.
108	24	Intake header stud cotter ($\frac{3}{32}$ inch by ⅝ inch).
167	24	Exhaust header stud nut (⅜ inch—24 thd., special).
112	24	Cam-shaft housing to cylinder stud washer ($\frac{5}{16}$ inch).
8176	12	Exhaust header gasket.
113	24	Exhaust header stud washer.
108	24	Exhaust header stud cotter ($\frac{3}{32}$ inch by ⅝ inch).
113	24	Intake header stud washer (⅜ inch).
8173	12	Intake header water inlet elbow assembly.
8170	12	Intake header water inlet elbow.
8171	12	Intake header water inlet elbow flange.
8539	12	Exhaust port cover DH4.
8538	12	Exhaust header flange DH4.
8152	12	Cylinder water hose (outlet), (see cooling system parts list).
		ENGINE
		ELECTRICAL EQUIPMENT
12229	2	Distributor assembly.
8358	2	Distributor to cam-shaft housing gasket.
116	10	Distributor bolt (¼ inch—28 by $\frac{13}{16}$ inches) (½ inch between head and nut).
111	20	Distributor-bolt washer (¼ inch).
101	10	Distributor-bolt nut (¼ inch—28 std.).
106	10	Distributor-bolt cotter ($\frac{1}{16}$ inch by ½ inch).
8333	1	Distributor-control connecting-rod, and clevis assembly.
8468	1	Distributor-control connecting-rod assembly.
8469	1	Distributor-control connecting rod.
8470	1	Distributor-control connecting-rod clevis (brazing) ($\frac{5}{16}$-inch clevis brazing).
210	2	Distributor-control connecting-rod brazing pin (2 D wire nail).
8472	1	Distributor-control connecting-rod end (¼-inch rod end).
8338	1	Distributor-control connecting-rod clevis (right hand) (¼ inch adj. clevis (right hand) thd.).
8340	1	Distributor-control connecting-rod clevis—RH check nut (¼ inch, 28 thd.).
196	2	Distributor-control connecting-rod clevis pin (¼-inch clevis).
106	2	Distributor-control connecting-rod clevis pin cotter ($\frac{1}{16}$ inch by ½ inch).
12490	1	High-tension cable and tube assembly.
12282	1	High-tension cable tube.
12283	6	High-tension cable-tube clip.
		ENGINE
		ELECTRICAL EQUIPMENT
12388	2	High-tension cable-tube end.
12387	2	High-tension cable separator.
8332	24	High-tension cable terminal (distributor end).
8397	24	High-tension cable-terminal assembly (spark plug end).
	24	High-tension cable rubber sleeve (distributor end).
8417	1	Ignition battery.
12987	1	Positive battery terminal.
12988	1	Negative battery terminal.

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		ENGINE—Continued
		ELECTRICAL EQUIPMENT—continued
8408	1	Ignition switch.
12868	1	Voltage regulator.
8245	1	Generator assembly.
	1	Tachometer elbow connection.
12945	1	Delco box.
12819	2	Contact-arm springs.
13181	2	Brush arms.
12999	1	Brush-arm spring.
12825	1	Clamp spring.
12935	2	Distributor wrenches.
12748	6	Rotor brushes.
12821	6	Rotor-brush springs.
12892	2	Contact-arm assemblies.
12890	1	Contact-arm assembly.
12826	1	Resistance-unit assembly.
12885	3	Screws.
		ENGINE
		ELECTRICAL EQUIPMENT
12701	3	Nuts.
12820	6	Breaker-arm spring.
12788	6	Terminal nuts.
12772	16	Lock washers.
12641	16	Cotter pins.
12790	8	Cotter pins.
12736	1	Resistance unit (right hand).
12737	1	Resistance unit (left hand).
		ENGINE
		FLYWHEEL
SH868A	1	Flywheel.
SH136B	1	Flywheel key.
SH64JH	2	Screw for flywheel key.
		ENGINE
		GENERATOR DRIVING SHAFT
8210	1	Generator driving-shaft assembly.
8146	1	Generator driving shaft.
8501	1	Generator driving-shaft plug.
8060	1	Generator driving-shaft ball-bearing (upper).
8524	1	Generator driving-shaft ball-bearing (upper) retainer.
8544	x	Generator driving-shaft ball-bearing (upper) shim.
8154	1	Generator driving-shaft ball-bearing (upper) container.
8149	1	Generator driving-shaft gear spacer (short).
8080	1	Generator driving-shaft gear (upper).
8150	1	Generator driving-shaft gear spacer (long).
8148	1	Generator driving-shaft ball-bearing (lower) and container assembly.
8060	1	Generator driving-shaft ball-bearing (lower).
8147	1	Generator driving-shaft ball-bearing (lower) container.
8209	1	Generator driving-shaft ball-bearing (lower) oil-retaining washer.
8074	1	Generator driving-shaft gear (lower).
8151	1	Generator driving-shaft gear nut.
173	1	Generator driving-shaft cotter (1/8 inch by 1 3/8 inches).
160	4	Generator driving-gear key (1/4 inch by 1/8 inch by 1 1/4 inches).
8511	x	Generator driving-shaft ball-bearing (upper) container shim.
8347	1	Generator driving-shaft ball-bearing (upper) container gasket.
214	1	Generator driving-shaft ball-bearing (upper) retainer screw (1/4 by 20 by 3/4-inch F. H. screw).
		ENGINE
		GOVERNOR
SH144B	1	Governor spindle.
SH141A	1	Governor housing.
SH145A	1	Governor housing.
SH143A	1	Governor thrust-bearing cup.
SH143B	1	Governor thrust-bearing mount.
SH143C	1	Governor-ball retainer.
SH143D	1	Governor-ball cup hub.
SH142A	1	Governor-arm bushing.
SH142B	1	Governor-arm bushing set screw.
SH142C	1	Check nut.
SH142D	1	Governor-spindle washer.
SH142E	1	Governor arm.
SH142F	1	Governor-bearing spacer.
SH142G	2	Felt-retaining washer.
SH142H	1	Oil-retaining washer.
SH44C	1	Governor-spindle key.
SH193A	1	Double-drive sprocket.
SH144A	1	Governor lever.

PLATE No. 119

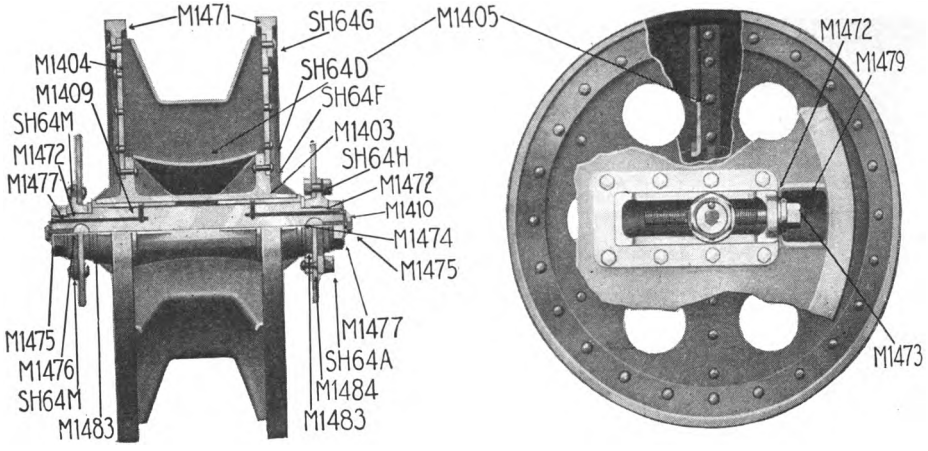


ROAD TRACK DRIVING WHEEL

NOMENCLATURE LIST—Continued

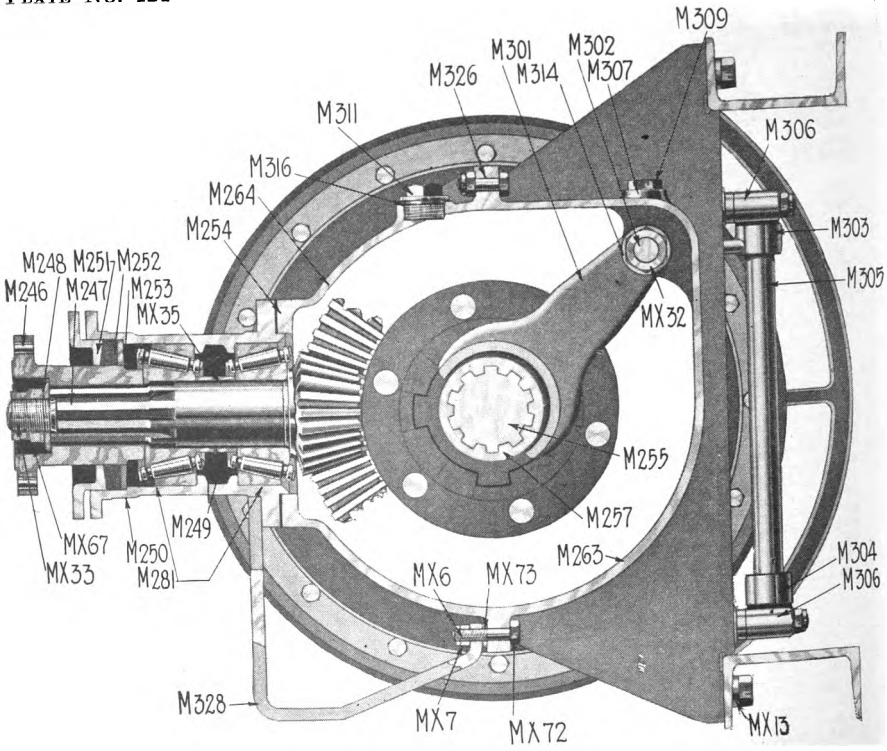
Part No.	Number per machine	Description and location
		ENGINE
		OIL PUMP
8200	1	Oil-pump assembly.
8190	1	Oil-pump body (lower half).
161	1	Oil-pump body (lower half) plug (⅛-inch pipe).
8420	2	Oil-pump connection.
207	2	Oil-pump tube connection gasket (⅞-inch annular).
8185	1	Oil-pump driving-shaft bushing (lower).
8186	1	Oil-pump (lower) driving gear.
8178	1	Oil-pump (lower) driven gear.
8138	1	Oil-pump separating plate.
8383	1	Oil-pump driven-gear pin (long).
8179	1	Oil-pump driven-gear pin (short).
8177	2	Oil-pump (upper) driven gear.
8187	1	Oil-pump (upper) driving gear.
8189	1	Oil pump body (upper half).
8221	2	Oil-pump body (upper half) plug (machined with body).
8201	1	Oil-pump driving-shaft bushing (upper).
118	4	Oil-pump body bolt (¼ inch—28 by 1 1/16 inches, standard) (⅞ inch between head and nut).
111	8	Oil-pump body bolt washer (¼ inch).
101	4	Oil-pump body bolt nut (¼ inch—28 std.).
106	4	Oil-pump body bolt cotter (1/16 by ½ inches).
8184	1	Oil-pump driving shaft.
8368	1	Oil-pump pressure relief valve seat.
		ENGINE
		OIL PUMP
8384	1	Oil-pump pressure relief valve guide.
8191	1	Oil-pump pressure relief valve spring.
8192	1	Oil-pump pressure relief valve.
177	1	Oil-pump pressure relief valve guide lock wire.
8220	1	Oil-pump screen and housing (lower) assembly.
8203	1	Oil-pump screen housing (lower).
8466	1	Oil-pump screen (lower) side.
8465	1	Oil-pump screen (lower) top.
8381	1	Oil-pump body (lower) lower half cover.
8133	1	Oil-pump body (lower half) cover drain plug (plug ⅝ inch—18 thd., hex. hd.).
158	1	Oil-pump body (lower) half cover drain plug gasket (⅝ inch annular).
8382	1	Oil-pump body (lower) half cover gasket.
116	10	Oil-pump body (lower) half cover bolt (¼ inch—28 by 1 1/16 inch) (½ inch between head and nut).
111	20	Oil-pump body (lower) half cover bolt washer (¼ inch).
101	10	Oil-pump body (lower) half cover bolt nut (¼ inch—28 thd. std.).
106	10	Oil-pump body (lower) half cover bolt cotter (1/16 inch by ½ inch).
8531	1	Oil-pump screen and housing (upper) assembly.
8534	1	Oil-pump screen housing (upper).
		ENGINE
		OIL PUMP
8533	1	Oil-pump screen (upper) side.
8532	1	Oil-pump screen (upper) top.
8535	1	Oil-pump screen (upper) nut.
8536	1	Oil-pump screen (upper) nut lock.
174	1	Oil-pump screen (upper) dowel.
8461	2	Crank case to cam-shaft oil-tube assembly (1/16 inch by ⅜ inch).
8463	1	Crank case to cam-shaft oil-tube connection.
8236	1	Crank case oil-tube union connection gasket.
131	2	Stud (¼ inch—28 by 1¼ inches std.).
101	2	Nut (¼ inch—28 std.).
106	2	Cotter (1/16 inch by ½ inch).
		ENGINE
		PISTON
13149	12	Piston (20.5 per cent low compression).
13138	12	Piston ring.
8057	12	Piston ring (intermediate).
8055	24	Piston ring (top and bottom).
12547	24	Piston-ring retainer.

PLATE No. 120



ROAD TRACK ADJUSTING WHEEL

PLATE No. 121

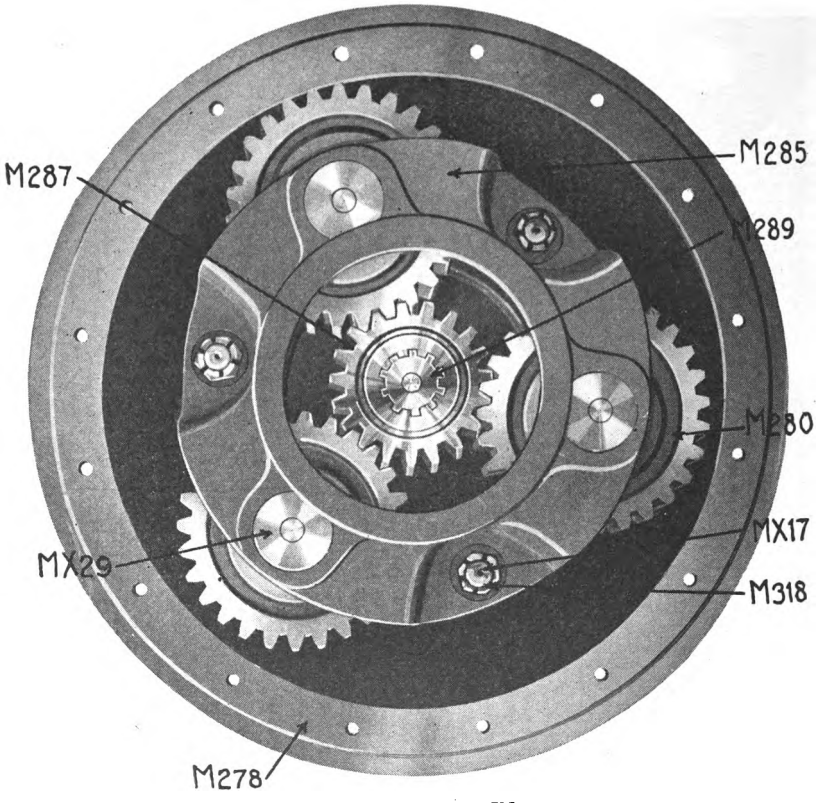


ARRANGEMENT OF EPICYCLIC BEVEL DRIVE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		ENGINE
		SUPPORTS
M-178	1	Longitudinal channel (port).
M-179	1	Longitudinal channel (starboard).
M-180	1	Transverse channel (back).
M-181	1	Transverse channel (front).
M-182	1	Double-point suspension bracket (port).
M-183	1	Double-point suspension bracket (starboard).
M-184	1	Single-point suspension bracket.
M-185	1	Gusset plates for engine bearer (starboard).
M-186	1	Gusset plates for engine bearer (port).
M-187	1	Packing under front bracket.
M-188	2	Packing under back brackets.
M-189	1	Cleat for front engine bearer.
		ENGINE
		STARTER, HAND
988A	1	Hand-starter ratchet.
988B	1	Collar for starter shaft.
988C	1	Key for ratchet.
988D	1	Starter sleeve.
	1	$\frac{1}{2}$ by $\frac{5}{8}$ headless set screw for ratchet.
	1	$\frac{1}{16}$ by $3\frac{3}{8}$ pin for collar.
989A	1	Hand-starter lever.
990A	1	Supporting flange.
990B	1	Starter shaft.
990C	1	Starter spring.
990C	1	Starter spring.
	4	$\frac{1}{2}$ by $1\frac{1}{2}$ bolt with nuts for flange.
	4	$\frac{1}{2}$ lock washers.
		EPICYCLIC GEAR
M-246	1	Flange coupling for bevel-pinion shaft.
M-247	1	Bevel pinion and shaft.
M-248	1	Washer for bevel-pinion shaft.
M-249	2	Distance piece for bevel-pinion shaft.
M-250	1	Stuffing box and Timken bearing case.
M-251	1	Stuffing-box gland.
M-252	1	Stuffing-box disk.
M-253	1	Oil-retaining washer for stuffing box.
M-254	1	Packing washers for bevel-pinion adjustment.
M-255	1	Bevel and epicyclic cross shaft.
M-256	2	Retaining rings for cross shaft.
M-257	1	Clutch for bevel-gear cross shaft.
M-258	2	Bevel wheel for cross shaft.
M-259	2	Flanged sleeve for bevel wheel.
M-260	2	Packing washers for bevel-wheel adjustment.
M-261	2	Bushing for flanged sleeve (internal).
M-262	2	Bushing for flanged sleeve bearing (external).
M-263	1	Bevel-gear case.
M-264	1	Bevel-gear case cover.
M-265	2	Bushing for brake bearing.
M-266	2	Cap for brake bearing.
M-267	2	Epicyclic sun pinion and sleeve (small).
M-268	2	Bushing for sun pinion.
M-269	2	Brake wheel for sun pinion.
M-270	6	Epicyclic planet pinions (small).
M-271	6	Bushings for planet pinion (small).
M-272	6	Bushings for planet pinion (small).
M-273	2	Rings for planet pinion (small).
M-274	6	Pins for planet pinion (small).
M-275	2	Epicyclic spur rings (small).
M-276	2	Disks for epicyclic spur ring (small).
M-277	2	Epicyclic gear case.
M-278	2	Epicyclic gear case and brake.
M-279	2	Epicyclic spur rings (large).
M-280	6	Epicyclic planet pinion (large).
M-281	2	Timken bearing.
M-282	6	Bushings for planet pinion (large).
M-283	6	Bushings for planet pinion (large).
M-284	6	Pins for planet pinion (large).
M-285	2	Rings for planet pinion (large).
M-286	2	Disks for planet pinion (large).
M-287	2	Sun pinions (large).
M-288	2	Washers for planet disk.
M-289	2	Sprocket shaft.
M-290	6	Retaining rings for shaft.
M-291	2	Chain sprocket pinions.

PLATE No. 122

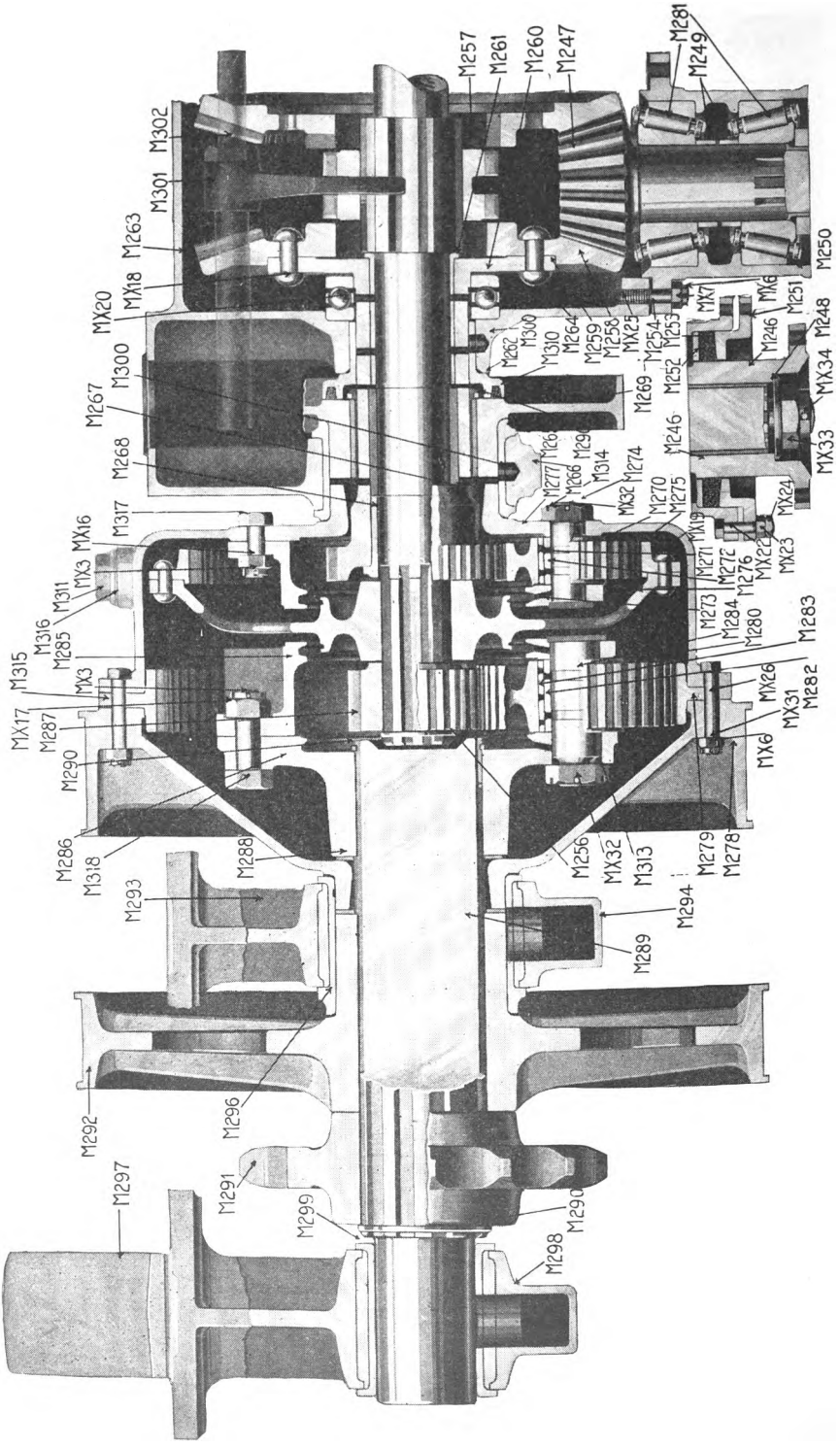


EPICYCLIC TRAIN

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		EPICYCLIC GEAR—Continued
M-292	2	Brake wheels for sprocket shaft.
M-293	2	Sprocket-bearing brackets (inside).
M-294	2	Sprocket-bearing caps (inside).
M-295	4	Oil box cover for (outside and inside).
M-296	2	Sprocket-bearing bushes (outside).
M-297	2	Sprocket-bearing brackets (outside).
M-298	2	Sprocket-bearing caps (outside).
M-299	2	Sprocket-bearing bushing (outside).
M-300	8	Dowels for bearing.
M-301	1	Clutch fork for reversing gear.
M-302	1	Striking rod for reversing gear.
M-303	1	Top lever for reversing gear.
M-304	1	Bottom lever for reversing gear.
M-305	1	Vertical shaft for reversing gear.
M-306	2	Vertical shaft bearings for reversing gear.
M-307	1	Dodent plunger.
M-308	1	Plunger spring.
M-309	1	Plunger cap.
M-310	2	Oil-retaining washer for bushing.
M-311	3	Oil-filling cap for gear case.
M-313	6	Nuts for planet pinion (large).
M-314	7	Nuts for planet pinion (small).
M-315	4	Joint for epicyclic gear case.
M-316	3	Joint ring for oil-filling cup.
M-317	6	Bolts for planet pinion ring (small).
M-318	6	Bolts for planet pinion ring (large).
M-326	2	Gasket for bevel-gear case to cover.
M-328	1	Support foot for epicyclic.
M-330	4	Lever handle.
M-331	4	Brake-adjusting swivel pin.
M-332	4	Brake-adjusting nut.
M-335	4	Brake-adjusting screw.
M-335	4	Brake-adjusting spring.
M-336	8	Brake pin, free end.
M-337	4	Brake-suspension link.
MX		No MX numbers shown.
M-338	4	Brake-suspension bracket.
M-339	2	Low-gear and track brake-suspension pin.
M-340	2	Locking belt for pin.
M-341	2	Brake-stop bracket.
M-342	2	Brake-stop bar.
M-343	4	Low-gear and brake-stop screw.
M-344	4	Low-gear brake band.
M-346	12	Low-gear brake band lining.
M-348	2	Low-gear brake anchor pin.
M-349	4	Track brake band.
M-351	12	Track brake band lining.
M-352	1	Track brake strap complete.
M-353	2	Track brake anchor pin.
M-355	2	High-speed brake lever.
M-356	4	Free end pin—high-speed brake.
M-357	2	Adjusting nut, high-speed brake.
M-358	2	Adjusting screw, high-speed brake.
M-359	2	High-speed brake band, long end.
M-360	2	High-speed brake band, short end.
M-361	2	Anchor end high-speed brake band.
M-362	2	Anchor bracket high-speed brake.
M-363	2	Anchor pin high-speed brake.
M-364	6	High-speed brake lining.
M-365	2	High-speed brake band clip.
M-366	2	High-speed brake bottom band stop.
M-367	2	High-speed brake strap complete.
M-369	2	High-speed brake suspension spring.
M-372	1	Epicyclic gear frame.
M-373	1	Top channel—epicyclic gear frame.
M-374	1	Bottom channel—epicyclic gear frame.
M-375	1	Middle diaphragm—epicyclic gear frame.
M-376	1	R. H. inner angle—epicyclic gear frame.
M-377	1	L. H. inner angle—epicyclic gear frame.
M-378	2	Outside angle—epicyclic gear frame.
M-380	2	Top gusset left inner diaphragm. Bottom guset right inner diaphragm.
M-382	2	Top gusset right inner diaphragm. Bottom gusset left inner diaphragm.
M-383	2	Corner gussets outside diaphragm epicyclic gear frame.
M-384	2	Corner gussets outside diaphragm epicyclic gear frame.
M-385	2	Suspension link stop epicyclic gear frame.

PLATE No. 123

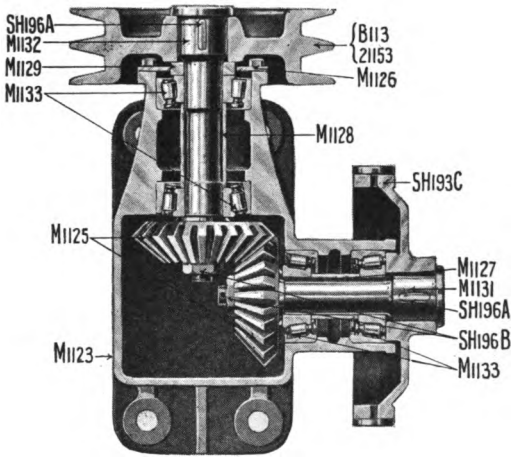


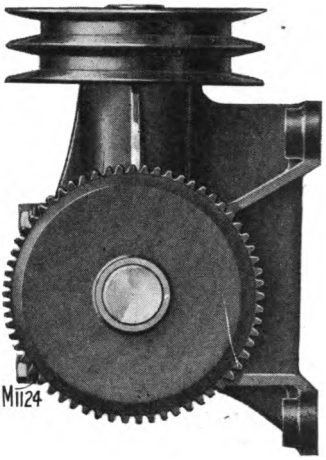
EPICYCLIC DRIVE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		EPICYCLIC GEAR—Continued
M-386	8	Main packing pieces epicyclic gear frame.
M-387	4	Additional piece epicyclic gear frame.
M-388	2	Holding bolts "A" epicyclic gear frame.
M-389	2	Screws "B" epicyclic gear frame.
M-390	2	Screws "C" epicyclic gear frame.
M-391	2	Epicyclic gear support foot.
M-392	2	Sprocket bearing brass (insdie).
M-393	2	Sprocket bearing brass (inside).
M-394	4	Sprocket bearing shims (inside).
M-395	2	Sprocket bearing brass (outside).
M-396	2	Sprocket bearing brass (outside).
M-397	4	Sprocket bearing shims (outside).
M-398	2	Back band stop—high-speed brake.
M-399	2	Top band stop—high-speed brake.
M-400	6	Set screw stop—high-speed brake.
M-401	2	Hoffman B thrust washer W4.
MX		MX numbers not noted.
		EXHAUST SYSTEM
SH140C	1	Top exhaust elbow, right.
SH140E	1	Top exhaust elbow, left.
SH140D	1	Bottom exhaust elbow, right.
SH140F	1	Bottom exhaust elbow, left.
SH158D	4	Exhaust-pipe gasket.
SH139D	6	¼ by 1⅛ inch taper pin.
M-3713	2	Exhaust pipe to silencer.
M-3716	2	Exhaust tail pipe from silencer.
M-3714	2	Silencer tail pipe elbow.
SH158D	12	Exhaust manifold gasket.
SH403C	2	Exhaust tube support.
SH402F	2	Manifold tee.
SH402Q	4	Manifold tee thimble.
SH403A	2	Exhaust pipe.
SH403B	2	Exhaust pipe.
SH401A	2	Cut-out body.
SH402A	2	Cut-out valve.
SH403B	2	Cut-out lever.
SH402C	2	Cut-out shaft.
SH402D	2	Cut-out spring anchor pin.
SH402E	2	Cut-out spring.
M-48	2	Silencer washer.
SH402G	2	Cut-out.
SH402H	2	Manifold tee deflector.
SH403A	2	Exhaust pipe.
SH403B	2	Exhaust pipe.
SH403C	2	Exhaust-pipe support.
SH599A	2	Exhaust manifold.
SH158A	2	Filler plate for exhaust hole in floor plate.
SH158B	12	Exhaust manifold gasket.
		FAN
		BEVEL BOX
M-1123	1	Detail of bevel box.
M-1124	1	Cover for bevel gear box.
M-1125	2	Bevel wheel.
M-1126	1	Bearing cover plate.
M-1127	1	Short-distance tube.
M-1128	1	Long-distance tube.
M-1129	1	Pulley-distance piece.
SH193C	1	Chain wheel.
M-1131	1	Chain-wheel spindle.
M-1132	1	Pulley spindle.
B-113—21153	1	Driving pulley.
M-1133	4	Timken roller bearing 316-312.
M-1134	1	Coventry N. L. chain L 2 A, 2 by 3.
M-1135	2	Whittle belt.
SH146A	1	Bearing cover plate gasket.
SH146B	2	Bevel gear box side cover.
SH194A	1	Bevel gear housing upper gasket cover.
SH194B	2	Bevel gear box side cover gasket.
SH196A	2	Key for spindle.
SH196B	2	⅝-inch nut.
SH196C	2	Plain washer for bevel gear.

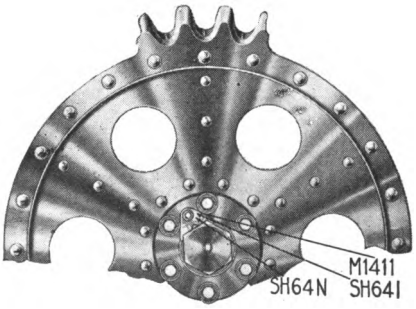
PLATE No. 124

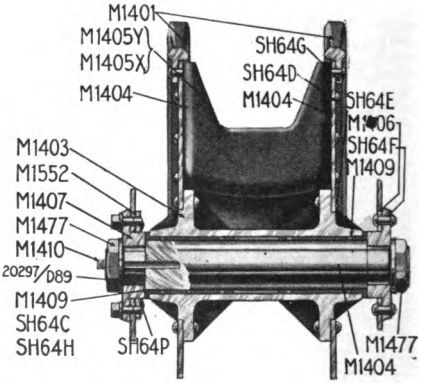




FAN BEVEL BOX

PLATE No. 125

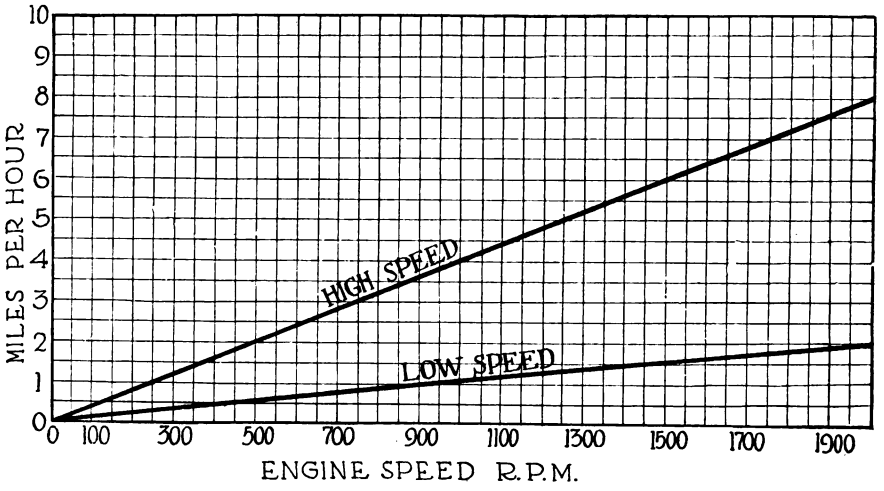


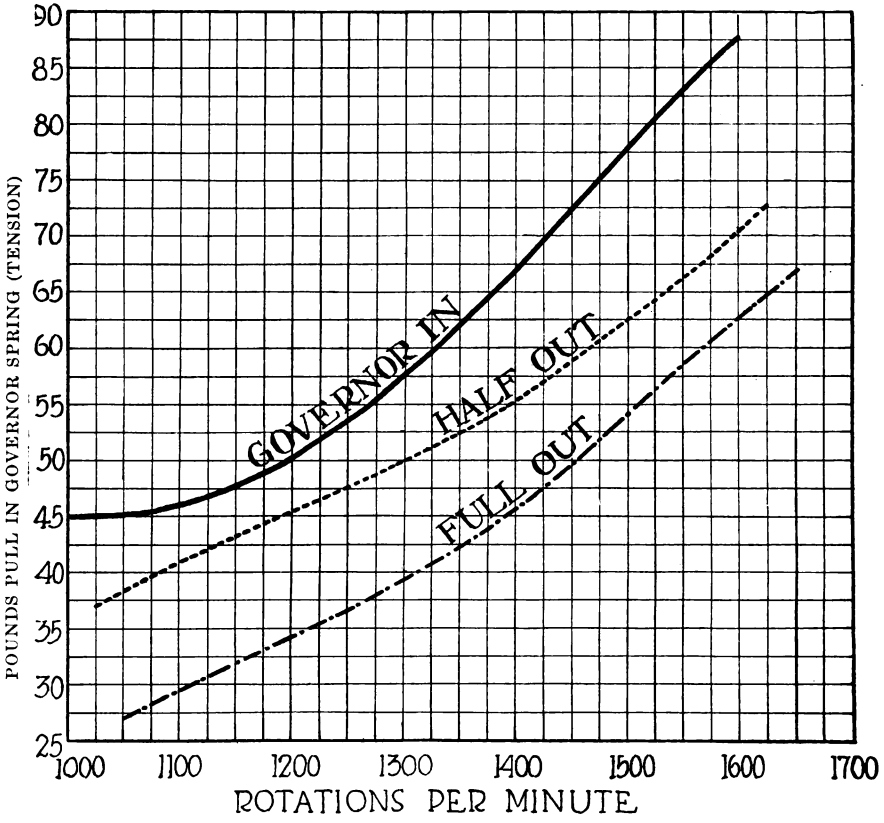


ROAD TRACK DRIVING WHEEL SECTION

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		FAN
		LARGE AIR DUCTS
M-1030	1	Jockey pulley.
M-1031	1	Arm for jockey pulley.
M-1032	1	Removable side plate for air duct (between rad. and fan).
M-1033	1	Removable bottom plate (between rad. and fan).
M-1034	1	Front bottom plate.
M-1035	1	Top and corner plates for air duct (between rad. and fan).
M-1036	1	Air duct (between radiator and roof).
M-1037	1	Plate for air duct (on top of radiator)
M-1038	1	Cover for air-duct mud hole.
M-1039	1	Cover joint for air-duct mud hole.
M-1040	1	Air-duct seal for corner.
M-1041	1	Air-duct seal for radiator tank.
M-1042	1	Air-duct seal for radiator port side plate.
M-1045	2	Pin for jockey pulley.
M-1046	1	Distance tube for jockey pulley.
M-1047	1	Cover plate for jockey pulley.
M-1048	1	Bracket for jockey pulley.
M-1049	1	Adjusting plate for jockey pulley.
M-1050	1	Adjusting rod for jockey pulley.
M-1062	1	Journal bearing ¾-inch bore, 2-inch O. D., 11/16 inch wide.
A-113—21153	1	Driving pulley.
M-564	1	Spring for jockey pulley.
		FAN
		VENTILATING
SH957A	1	Housing for 7.5 fan.
SH958A	1	Fan spindle.
SH958B	1	Coupling sleeve.
SH958C	1	Gear sleeve.
SH958D	1	Gear washer.
SH958E	2	Coupling nut.
SH958F	2	Gear nut.
SH958G	1	Inlet stud.
SH958H	4	Bearing holder stud.
SH959A	1	Inlet cone.
SH959B	1	Ball-bearing holder.
SH959C	1	Adapter piece.
SH959D	1	Bearing cap.
SH959E	3	Bearing cap.
SH960A	1	20-inch conoidal wheel.
SH960B	1	Intake box.
SH961A	1	Fan discharge box.
M-1054	1	Inlet duct assembly.
		GASOLINE (PETROL)
		AIR-PRESSURE PUMP
SH900A	2	Air-pressure pump bushing.
SH900B	1	Air-pressure pump pulley.
SH900C	4	Air-pressure pump cylinder.
SH900D	1	Air-pressure pump shaft.
SH901A	4	Air-pressure pump spring.
SH901B	4	Air-pressure pump check nut.
SH901C	2	Air-pressure pump bushing.
SH901D	4	Air-pressure pump piston.
SH901E	4	Air-pressure pump displacement plug.
SH901F	1	Air-pressure pump airhole cover.
SH903A	1	Air-pressure pump base.
		AIR-PRESSURE SYSTEM
SH981A	1	Air tube 33¼ long—Armored flexible brass tubing—½ inside diameter Union and ½ male pipe adapter each end.
SH981B	1	Air tube 25 long—Armored flexible brass tubing ¼ inch inside diam.—Union and ¼ male pipe adapter one end and Union and ⅛-inch male pipe adapter other end.
SH981C	1	Air tube 10⅜ inches long—Armored flexible brass tubing ¼ inch inside diam.—Union and ¼ male pipe adapter one end and Union and ⅛-inch male pipe adapter other end.
SH981D	1	Air tube 26 inches long—Armored flexible brass tubing ¼ inch inside diam.—Union and ¼ male pipe adapter one end and Union and ⅛-inch male pipe adapter other end.
SH981E	1	Air tube 25 inches long—Armored flexible brass tubing ¼ inch inside diam.—Union and ¼ male pipe adapter one end and Union and ⅛-inch male pipe adapter other end.
SH981F	1	Air tube 29¾ long—armored flexible brass tubing—¼ inside diameter—Union and ¼-inch male pipe adapter one end—Union—elbow and ⅛-inch male pipe adapter other end.
SH981G	2	Air tube 26 long—Armored flexible brass tubing—¼ inside diameter. Union and ¼ male pipe adapters both ends.
SH981H		Air tube 31¼ long—Armored flexible brass tubing—¼ inside diameter. Union and ¼ male pipe adapters both ends.
SH982A	1	Air tube 88 long—armored flexible brass tubing ¼ inside diameter—Union and ¼ male pipe adapter one end—Union—elbow and ⅛-inch male pipe adapter on other.



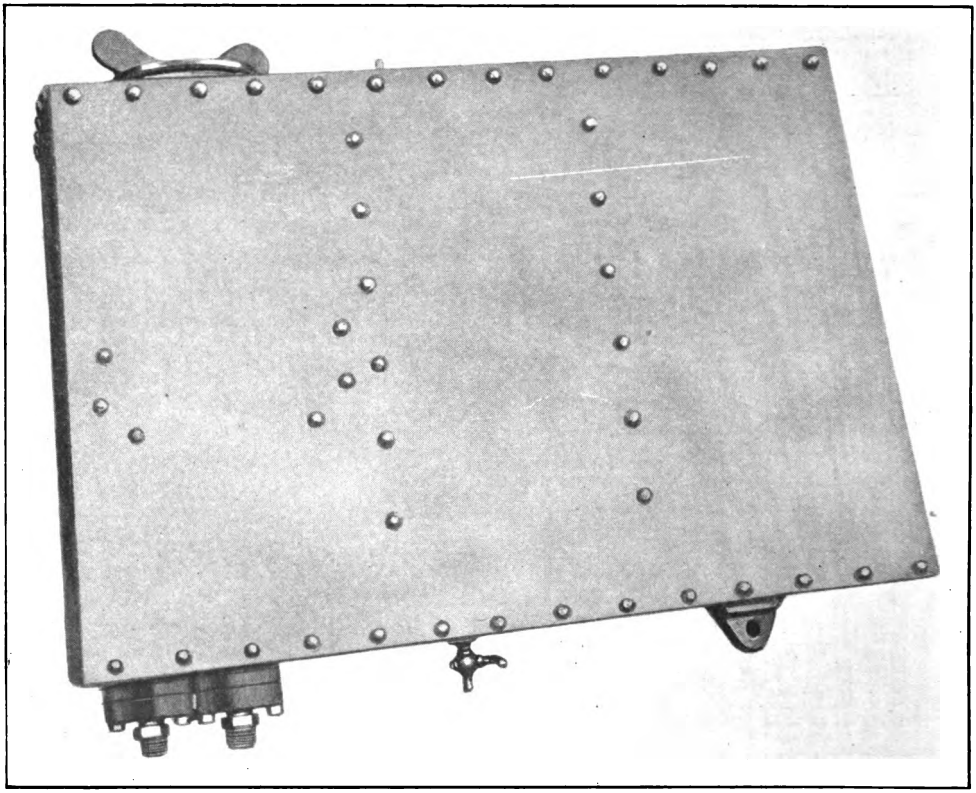


CHARACTERISTIC SPEED AND GOVERNOR CURVES OF ENGINE IN 35-TON TANK MARK VIII

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		GASOLINE (PETROL)—Continued
		AIR-PRESSURE SYSTEM—continued
SH982B	3	Air tube, copper tubing ¼ outside diameter. Following parts fastened to each tube: 1, ¼ brazing union, brazing both ends. 1, ¼ brazing union, ⅛ male pipe thread one end. 1, ¼ by ⅛ pipe bushing mall iron. 1, ¼ mall iron tee. 1, ¼ W. I. pipe nipple 1¼ long. 1, ¼ brass vertical ball check valve.
SH982C	3	Air tube A=12½ Copper tubing.
SH982D	1	Air tube A=16 ¼ outside diameter.
SH982E		Air tube A=19½ Fastened to each tube are: 1 brazing union tee, ⅛ male pipe thread each side. 1, ¼ by ⅛ reducing elbow.
982F	1	Air tube, copper tubing ¼ inch outside diameter. Following parts fastened to each tube: 1 brazing union brazing both ends. 1 brazing union, male pipe thd. one side. 1, ⅛ by ¼ bushing mall iron. 1, ¼ cross. 1, ¼ air cock brass. 1, ¼ close nipple. 1, ¼ brass horizontal check valve.
982G	1	Air tube—copper tubing ¼ in. outside dia. Fastened in tube are following parts: 3 brass lever handled cocks. 2 brass brazing tees. 1 brazing union, ⅛-inch male pipe thd. one end. 1 ¼ by ⅛ reducer.
982H	1	Air tube—copper tubing ¼ in. outside dia. Fastened to tube are: 1 brazing union—⅛-inch male pipe thd. one end. 1 ¼ by ⅛ reducing elbow.
SH980A	1	Air gauge board, oak.
SH980B	1	Hand-pressure air pump, complete.
SH980C	3	Air-pressure gauge.
	9	No. 4 by ¾ round head brass wood screws.
SH980C	2	Bracket for air-gauge board.
	4	⅜ by 1 bolts gauge boards with nuts.
		¼ by ⅝ bolts gauge pump.
SH985C	2	½ mal. iron elbows.
SH985D	1	½-inch w. i. pipe nipple, 2 inches long.
SH985E	1	½-inch w. i. pipe nipple, 3¼ inches long.
SH985B	1	½ street elbow.
		GASOLINE (PETROL) SYSTEM
		PRESSURE-REGULATING TANK
SH950A	1	Tank.
SH950B	1	Valve bracket.
SH950C	1	Float.
SH950D	1	Air-pipe connection.
SH950E	1	Valve.
SH950F	1	Float rod.
SH950G	1	Pin for valve bracket.
SH972A	2	Regulating tank support.
SH950H	1	Valve bracket holder and gas inlet.
		SYSTEM
SH984A	1	Flexible petrol tube 12.25 long.
SH984B	1	Flexible petrol tube 14.5 long.
SH984C	1	Flexible petrol tube 26.75 long.
SH984D	1	Flexible petrol tube 81 long.
SH894E	1	Flexible petrol tube 20 long.
SH985B	2	5 Street elbow m. i.
SH985C	2	5 m. i. elbow.
SH985D	1	5 by 2 w. i. pipe nipple.
SH985G	1	5 m. i. pipe coupling.
SH985A	1	Subassembly-connection-comb. tap to flexible tubing.
SH985F		Subassembly-connecting-req. tank to flexible tubing.
		TANKS
M-1755	3	Petrol tank.
M-1757	3	Flange for drain plug.
M-1758	3	Washer for drain plug.
SH951B	3	Filler-cap flange.
M-1761	3	Filler-cap flange stiffening ring.
SH951C	1	Combination tap body.

PLATE NO. 127

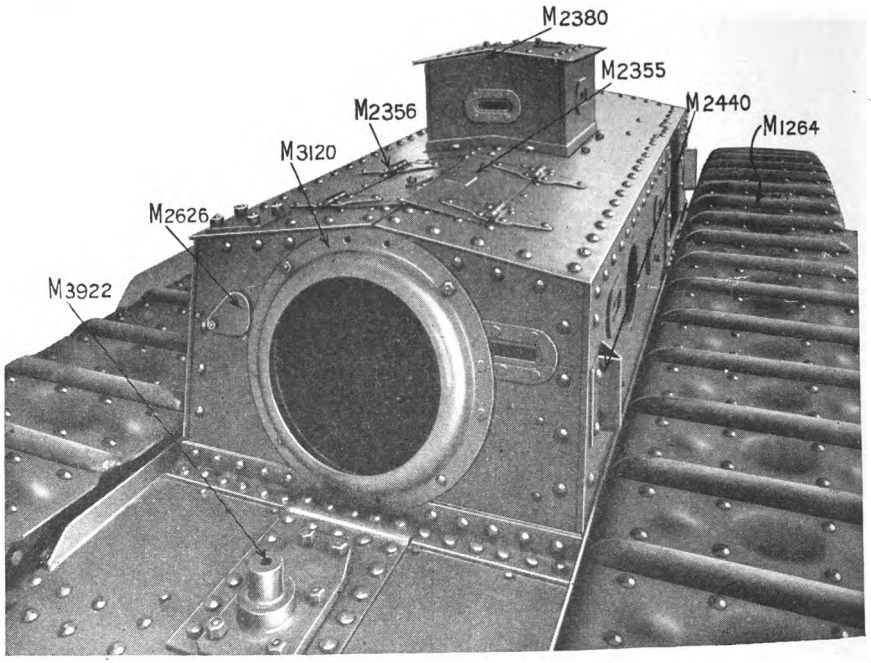


OIL TANK

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		GASOLINE (PETROL) SYSTEM—Continued
		TANKS—continued
SH951E	1	Combination tap plug.
M-1765	3	Petrol tank suction pipe.
C-153—21256	3	Petrol tank strainer.
B-153—21256	3	Petrol tank filler cap.
D-153—21256	3	Washer for filler cap.
E-152—21256	3	Drain plug.
M-1785	1	Port cover for petrol tank.
M-1786	1	Starboard cover for petrol tank.
M-1787	1	Strip on port cover.
M-1788	1	Strip on cover plate.
M-1789	4	Half hinge for cover.
M-1790	4	Half hinge for cover.
M-1791	4	Pin for hinge.
J-206—21067	2	Handle for cover.
M-1794	2	Arrangement of lock on cover.
M-716	2	Bracket for lock.
M-1756	3	Filler cap stiffening ring inside tank.
M-1766	3	Filler flange joint.
SH951F	3	Washer for tap plug.
SH951G	3	Washer for tap plug.
SH951A	3	Thackeray "washer" for tap plugs.
M-718	2	Packing piece for lock.
M-720	2	Catch for lock.
M-722	2	Spring for lock.
M-1793	2	Spindle for lock.
H-20—21195	3	Washer for lock.
M-1756	3	Filler cap stiffening ring inside tank.
M-1766	3	Filler flange joint.
		GUN PEDESTAL, 6-POUND
M-3777	1	6-pdr. gun pedestal top plate, starboard side.
M-3778	1	6-pdr. gun pedestal top plate, port side.
M-3779	2	6-pdr. gun pedestal base plate.
M-3780	2	6-pdr. gun pedestal back plate.
M-3781	2	6-pdr. gun pedestal front plate.
M-3782	2	6-pdr. gun pedestal side plate.
M-3783	2	6-pdr. gun pedestal shell plate.
M-3784	2	6-pdr. gun pedestal shell plate.
M-3785	2	Hotchkiss gun support blank.
M-3786	2	Stiffener for Hotchkiss gun block.
M-3789	2	6-pdr. gun pedestal angle for back plate.
M-3788	2	6-pdr. gun pedestal angle for top plate, starboard.
M-3790	2	6-pdr. gun pedestal angle for back plate.
M-3791	2	6-pdr. gun pedestal angle at corner.
M-3792	1	6-pdr. gun pedestal angle for front plate.
M-3793	1	6-pdr. gun pedestal angle for front plate.
M-3794	2	6-pdr. gun pedestal angle for front plate.
M-3795	2	6-pdr. gun pedestal angle for front plate.
M-3796	2	6-pdr. gun pedestal angle for side plate.
M-3797	2	6-pdr. gun pedestal angle for side plate.
M-3798	4	6-pdr. pedestal for stop bracket.
M-3799	2	6-pdr. gun pedestal angle for front side plate.
		GUN PEDESTAL, 6-POUND
M-3800	1	6-pdr. pedestal angle for top plate port-side gun.
M-3803	2	6-pdr. pedestal, stop bar for shell holder.
M-3804	2	6-pdr. pedestal, stop bar for shell holder.
M-3805	2	6-pdr. pedestal, stop bar for shell holder.
M-3806	2	6-pdr. pedestal shell block.
M-3024	6	Shell holder bracket.
M-3025	6	Shell holder bracket pin.
M-3023	6	Shell holder plunger.
Q-38—21192	6	Shell holder spring.
M-3020	6	Shell holder spring case.
C-37—21191	26	6-pdr. case shell tube.
M-3817	26	6-pdr. case shell expansion tube.
A-37—21192	24	6-pdr. common shell tube.
B-37—21191	24	Expansion tube.
		HULL
		DOOR—SIDE
M-702	1	Side door (upper part), port side.
M-703	1	Side door (upper part) starboard side.
M-704	1	Side door (lower part), port side.

PLATE NO. 128

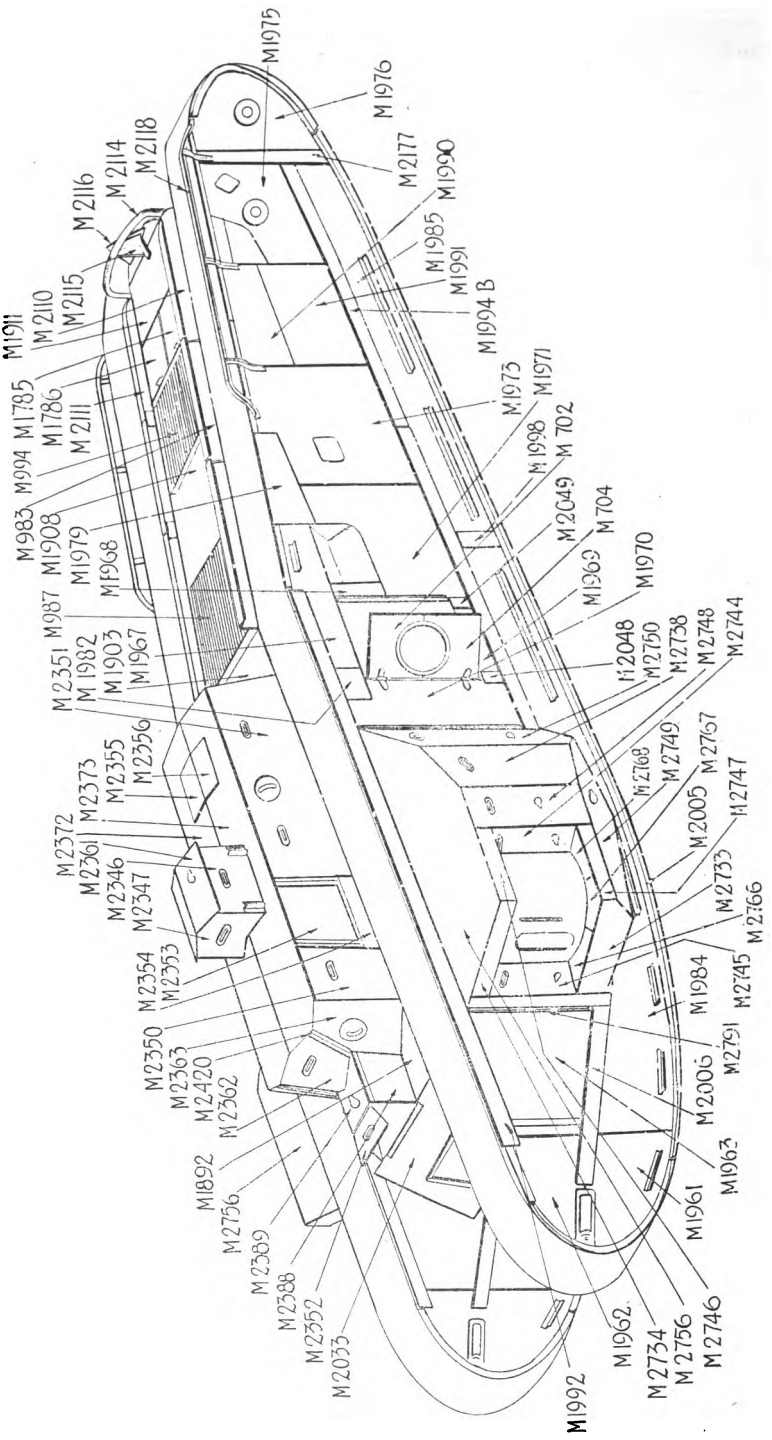


UPPER PART OF HULL

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
		DOOR—SIDE—continued
M-705	1	Side door (lower part) starboard side.
M-706	8	Hinge for side door.
M-707	4	Hinge pin and nut.
M-708	4	Clip for side door.
M-709	4	Butt strap for side door.
M-710	2	Splash plate for side door (bottom).
M-711	2	Splash plate for side door (top).
M-712	2	Splash plate for side door (rear).
M-713	1	Splash plate for side door (front) port.
M-714	1	Splash plate for side door (front) starboard.
M-715	2	Bracket for side door lock (port).
M-716	2	Bracket for side door lock (starboard).
M-717	2	Packing piece for side door lock (port).
M-718	2	Packing piece for side door lock (starboard).
M-719	2	Catch for side door lock (port).
M-720	2	Catch for side door lock (starboard).
M-721	4	Spindle for side door lock.
M-722	4	Spring for side door lock.
M-20—21195	4	Handle for side door lock.
M-3120	2	Cover plate for hemispherical turret.
M-2431	4	Arrangement of side door lock.
		FLOOR
M-1927	1	Floor beam between floor plates 3 and 4.
M-1928	1	Floor beam between floor plates 4 and 5.
M-1929	1	Floor beam between floor plates 6 and 7.
M-1930	1	Floor beam between floor plates 7 and 8.
M-1931	1	Floor plate No. 1.
M-1932	1	Floor plate No. 2.
M-1933	1	Floor plate No. 3.
M-1934	1	Floor plate No. 4.
M-1935	1	Floor plate No. 5.
M-1936	1	Floor plate No. 6.
M-1937	1	Floor plate No. 7.
M-1938	1	Floor plate No. 8.
M-1939	1	Floor plate under petrol tank.
M-1940	1	Butt strap between floor plates 1 and 2.
M-1941	1	Floor beams between floor plates 2 and 3.
M-1942	2	Floor angle at bulkhead.
M-1943	1	Connecting angle (backplate to floor).
M-1944	2	Roller track for sponsons.
M-1945	2	Inside cleat for sponsons.
M-1946	2	Center cleat for sponsons.
M-1947	2	Outside cleat for sponsons.
M-1948	1	Commode cover for engine-room floor.
M-1949	1	Cover plate to hole in No. 2 floor plate.
		MAIN
M-1961	2	Front wing (lower plate outside).
M-1962	2	Front wing (upper plate outside)
M-1963	2	Outside plate in front of sponson.
M-1964	2	Front inside upper plate.
M-1965	2	Front plate under sponson.
M-1966	2	Back plate under sponson.
M-1967	2	Side plate at top of door.
M-1968	2	Side plate at side door.
M-1969	2	Plate at bottom of door.
M-1970	2	Side plate rear of sponson.
M-1971	2	Side plate No. 1 engine room.
M-1972	2	Vertical angle side to engine-room backplate
M-1973	1	Side plate No. 2 engine room.
M-1974	1	Gusset stay side plate to roof (engine room).
M-1975	2	Back outside wing plate.
M-1976	2	Rear outside wing plate.
M-1977	2	Inside plate in way of petrol tank.
M-1978	2	Rear inside wing plate.
M-1979	2	Cover plate shaft mud chute.
M-1980	2	Butt strap under sponson (front)
M-1981	2	Butt strap under sponson (rear).
M-1982	2	Butt strap at top of door.
M-1983	2	Inside skirting plate.
M-1984	2	Outside skirting plate (front half).
M-1985	2	Outside skirting plate (rear half).
M-1986	2	Front mud chute (side plate).
M-1987	2	Front mud chute (side plate).
M-1988	2	Front mud chute (bottom plate).

PLATE No. 129

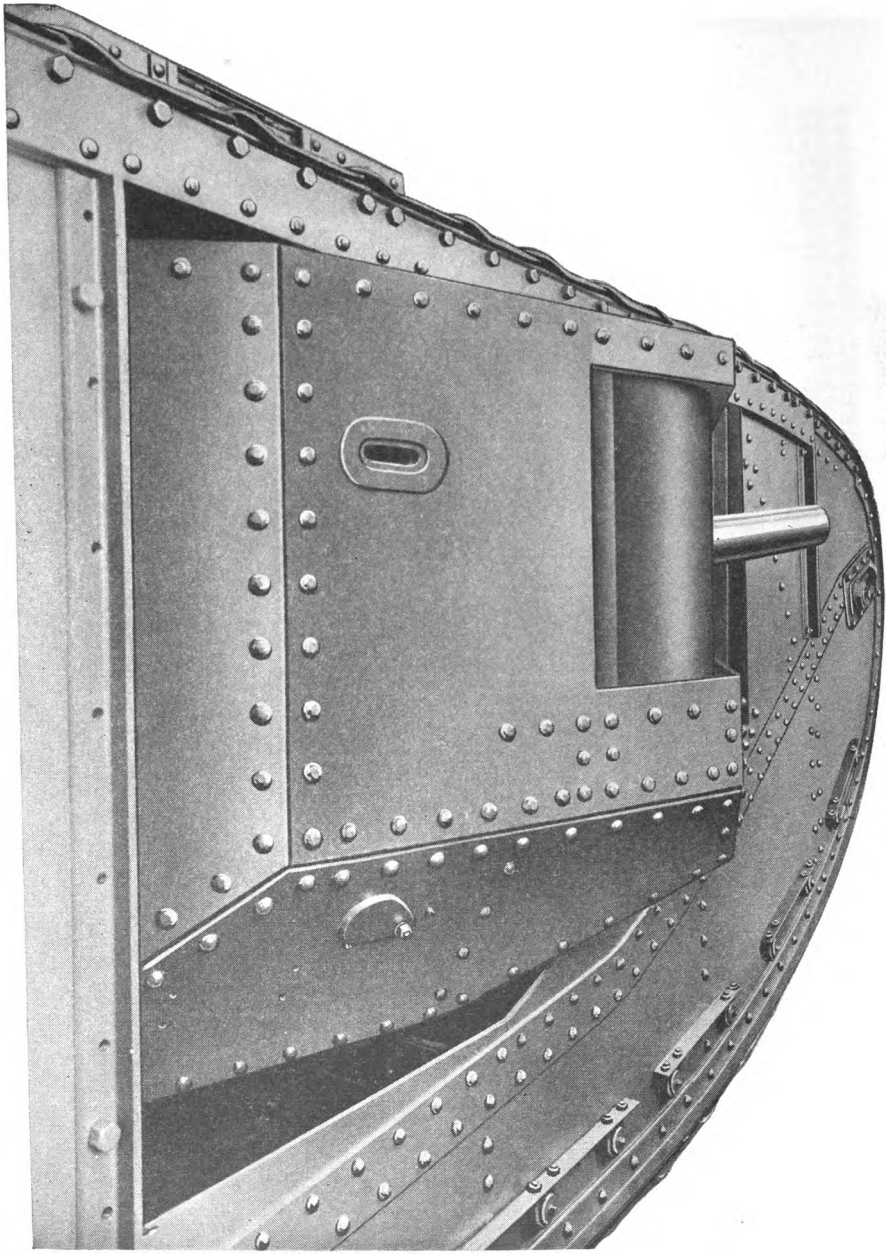


HULL PLATING

NOMENCLATURE LIST—Continued

Part No.	Number per Machine	Description and Location
		HULL—Continued
		MAIN—continued
M-1989	2	Front mud chute (back plate).
M-1990	2	Side plate (No. 3 engine room).
M-1991	1	Removable plate for engine room.
M-1992	2	Side plates, top of sponson.
M-1993	2	Rear connecting strap.
M-1994	2	Exterior longitudinal butt strap.
M-1995	2	Front interior butt strap.
M-1998	4	Connecting strap for outside skirting plate.
M-1999	4	Angle for front wings (inside and outside).
M-2000	2	Front outside longitudinal butt strap.
M-2001	2	Butt strap for removable plate (engine room).
M-2002	2	Bottom packing strip for removable plate.
M-2003	1	Engine room back plate.
M-2004	4	Rear angle track.
M-2005	4	Bottom track angle.
M-2006	2	Exterior longitudinal butt strap.
M-2007	2	Longitudinal side angle outside.
M-2008	2	Longitudinal side angle outside.
M-2009	4	Track bulb rail.
M-2010	4	Track bulb rail.
M-2011	4	Track bulb rail.
M-2012	4	Track bulb rail.
M-2013	4	Track bulb rail.
M-2014	1	Front sloping plate.
M-2015	2	Sloping plate connecting angle (inside).
M-2016	2	Sloping plate connecting angle (outside).
M-2017	2	Angle inside skirting plate to floor.
M-2018	2	Angle inside skirting plate to floor.
M-2019	2	Connecting angle side to roof.
M-2020	2	Track angle top.
M-2021	1	Backplate petrol tank.
M-2022	2	Connecting angle backplate.
M-2023	2	Connecting angle backplate.
M-2024	1	Connecting angle backplate to cover.
M-2025	1	Connecting angle backplate to floor.
M-2026	2	Connecting angle floor plate to hull (petrol tank casing).
M-2027	2	Connecting angle top to hull (petrol tank casing).
M-2028	2	Side plate above rear mud chute.
M-2029	1	Vertical beam shaft sponson (port).
M-2030	2	Connecting angle side to roof (forward).
M-2031	2	Angle for chain casing (left hand).
M-2032	2	Angle for chain casing (right hand).
M-2033	1	Front sloping plate.
M-2034	3	Fan-hole cover plate.
M-2035	2	Sponson stiffener.
M-2036	2	Packing piece for sponson stiffener.
M-2037	4	Bottom guide strip.
M-2038	2	Front diaphragm plate.
M-2039	4	Side beam for front diaphragm.
M-2040	2	Angle for front diaphragm engine (starboard).
M-2041	1	Vertical beam between No. 1 and 2 room side plates (starboard.)
M-2042	1	Vertical beam between No. 2 and 3 engine-room side plates (port).
M-2043	1	Vertical butt strap between No. 2 and 3 engine-room side plates (port).
M-2044	2	Vertical angle connecting removable plate to engine-room bulkhead.
M-2045	2	Vertical angle connecting rear outside wing plate to rear.
M-2046	1	Vertical butt strap between No. 1 and 2 engine-room side plates (port).
M-2047	1	Vertical beam shaft sponson (starboard).
M-2048	2	Butt strap under door (front).
M-2049	2	Butt strap under door (rear).
M-2055	2	No. 2 diaphragm.
M-2056	2	No. 3 diaphragm.
M-2057	4	Nos. 4, 5, and 6 diaphragm.
M-2058	2	No. 7.
M-2059	2	No. 8.
M-2060	2	Angle front mud chute (back plate).
M-2061	4	Angle front mud chute (side plate).
M-2062	2	Angle front mud chute (side plate).
M-2063	2	Angle front mud chute (bottom plate).
M-2064	2	Packing strip (back floor plate).
M-2065	2	Detachable plate above roller pinion.
M-2066	4	Gusset stay between floor and side plates.
M-2067	2	Gusset stay side plate to roof.
M-2068	1	Gusset at roof channel to side (starboard).
M-2069	2	Gusset stay to roof shaft sponson.
M-2070	1	Side plate No. 2 engine room star.
M-2071	2	No. 9 diaphragm.
M-2072	3	Splash angle on front sloping plate.
M-2073	1	Plate under driver's turret.

PLATE No. 130

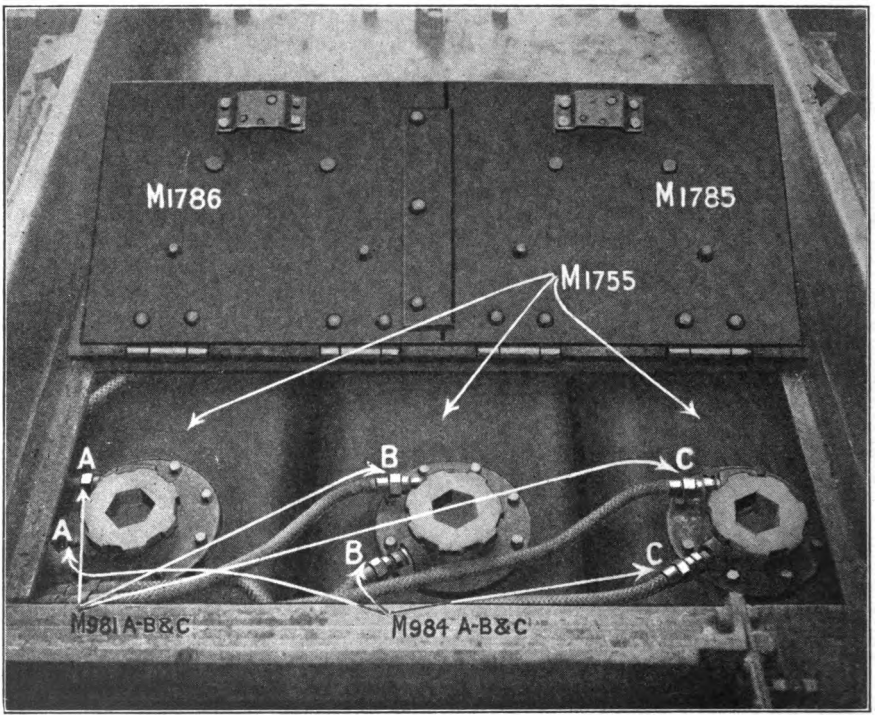


SPONSON ROLLED BACK FOR SHIPPING PURPOSES

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
		MAIN—continued
M-2074	1	Splash strip on plate under driver's turret.
M-2075	1	Angle bracket under driver's turret.
M-2076	2	Packing piece on plate.
M-2077	1	Removable plate for engine room star.
M-2078	4	Roller support angle No. 1.
M-2079	4	Roller support angle No. 2.
M-2080	4	Roller support angle No. 3.
M-2081	4	Roller support angle No. 4.
M-2082	2	Roller support angle No. 5.
M-2083	4	Roller support angle No. 6.
M-2084	4	Roller support angle No. 7.
M-2085	4	Roller support angle No. 8.
M-2086	1	Packing piece between floor beam and plate No. 3.
M-2087	2	Splash angle on side plate.
M-2088	2	Splash angle in front of sponson.
M-2089	2	Splash angle in rear of sponson.
M-2090	2	Splash angle in front of side door
M-2091	2	Splash angle in rear of side door.
M-2092	4	Roller support angle top.
M-2093	2	Front wing upper plate (inside).
M-2094	2	Front wing lower plate (inside).
M-2095	2	Vertical side plate for rear mud chute.
M-2096	2	Side sloping plate for rear mud chute.
M-2097	2	Top sloping plate for rear mud chute.
M-2098	2	Bottom sloping plate for rear mud chute.
M-2099	2	Butt strap for rear mud chute.
M-2100	2	Angle for top and side sloping plates.
M-2101	2	Angle for bottom and side sloping plates.
M-2102	2	Top angle for side sloping plate.
M-2103	2	Angle for side sloping plate to hull.
M-2104	2	Angle for top sloping and side vertical plates.
M-2105	2	Angle for bottom sloping and side vertical plates.
M 2106	2	Top angle for top sloping plate.
M-2107	2	Bottom angle for bottom sloping plate.
M-2108	1	Port side deflector channel.
M-2109	1	Packing under deflector channel.
M-2110	1	Rear deflector channel (port).
M-2111	1	Rear deflector channel (starboard).
M-2112	2	Packing under rear deflector channels.
M-2113	2	Petrol tank case door ledge.
M-2114	1	Stern guide for haulage rope.
M-2115	1	Bracket for deflector plate.
M-2116	1	Deflector plate.
M-2118	1	Side angle (port).
M-2119	1	Side angle (starboard)
M-2120	1	Front strut, starboard.
M-2121	1	Front strut (port).
M-2122	1	Rear strut (starboard).
M-2123	1	Rear strut (port).
M-2124	1	Intermediate strut (starboard).
M-2125	1	Intermediate strut (port).
M-2126	1	Camouflage brackets (port sponson)
M-2127	1	Camouflage brackets (starboard sponson).
		HULL
M-2128	1	Camouflage brackets, rear port.
M-2129	1	Camouflage brackets, rear starboard.
M-2130	1	Camouflage brackets, mud chute, port.
M-2131	1	Camouflage brackets, mud chute, starboard.
M-2132	1	Camouflage brackets, front, port.
M-2133	1	Camouflage brackets, front, starboard.
M-2134	2	Division plate. Tin hat compartment.
M-2135	1	Rear lamp bracket.
M-2137	1	Top plate for bulkhead.
M-2138	1	Center plate for bulkhead.
M-2139	1	Bottom plate for bulkhead.
M-2140	2	Side plate for bulkhead.
M-2141	2	Side angle for bulkhead plates.
M-2142	2	Vertical stiffening angle for bulkhead.
M-2143	1	Channel cross stiffener for bulkhead.
M-2144	1	Butt strap for bulkhead plates (long).
M-2145	2	Butt strap for bulkhead plates (short).
M-2146	2	Sliding door for bulkhead (access to engine room).
M-2147	4	Roller bracket for sliding door.
M-2148	4	Rollers for sliding door.
M-2149	4	Pin for rollers.

PLATE No. 131

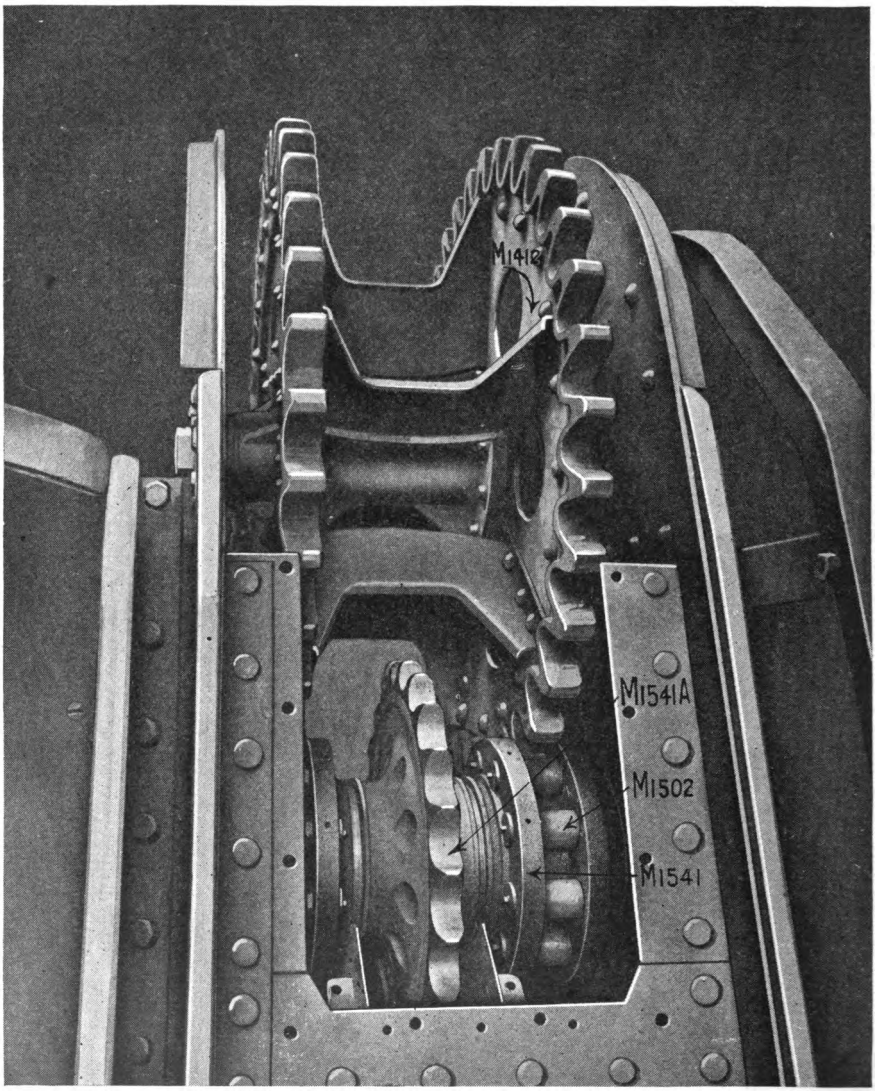


GASOLINE TANK INSTALLATION

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
M-2150	2	Wedging strip for sliding door.
M-2151	3	Handle for moving door.
M-2152	2	Handle for locking door.
M-2153	2	Catch for locking door.
M-2154	2	Bearing for catch.
M-2155	2	Bottom guide for sliding door.
M-2156	1	Top guide for sliding door.
M-2157	2	Plate for machine gunner's seat.
M-2158	4	Hinge for machine gunner's seat.
M-2159	2	Strut for machine gunner's seat.
M-2160	4	Packing for hinge for machine gunner's seat.
M-2161	2	Pin for strut of machine gunner's seat.
M-2162	2	Support for strut of machine gunner's seat.
M-2163	4	Fulcrum bracket for strut of machine gunner's seat.
M-2164	2	Catch for holding up machine gunner's seat.
M-2165	2	Side guides for magnetos inspection door.
M-2166	1	Bottom guides for magnetos inspection door.
M-2167	1	Magnetos inspection door.
M-2168	1	Hook for holding up magnetos inspection door.
M-2169	2	Bracket for hook of magnetos inspection door.
M-2170	1	Pocket for medical outfit.
M-2171	1	Strap for medical outfit
M-2172	2	Spring for catch on main sliding doors.
M-2173	2	No. 5 diaphragm.
M-2174	2	Vertical beam inner skirting plate.
M-2175	2	Roller angle inner skirting plate.
M-2176	2	Roller angle inner skirting plate.
M-2177	2	Vertical butt strap rear.
M-2178	1	Driver's mapboard buckle catch.
M-2179	1	Bracket-supporting voltmeter.
M-2181	1	Bracket for driver's mapboard.
M-2185	2	Control-rod casing.
M-2186	6	Control-rod casing cleat.
M-2187	1	Hook for pigeon basket.
M-2188	----------	
M-2189	2	Lamp clips (engine room).
M-2190	1	Lamp clips (engine room).
M-2191	2	Studs for holding pick.
M-2192	1	Rack for scraper and pinch bars.
M-2193	1	Rack for scraper and pinch bars.
M-2194	1	Stay for axe and bar rack.
M-2195	4	Clips for shovels.
		HULL
		REVOLVER HOLE
M-2627	11	Swivel pin and nut for revolver hole cover L. H.
C138/20384	10	Cover plate for revolver hole.
A42/21221	12	Operating handle.
C42/21221	12	Thackray washer.
D42/21221	12	Spring for handle.
E42/21221	12	Grover washer.
F42/21221	24	Stop pin for cover.
M-2628	2	Cover for hole in bottom of sponson.
M-2629	2	Arrgt. of hole in bottom of sponson.
M-2630	11	Arrgt. of revolver hole.
B42/21221	1	Swivel pin and nut right hand for rear of turret.
		HULL
		REVOLVING PEEPHOLE
1 by 90	22	Cover plate.
2 by 90	22	Revolving plate.
3 by 90	22	Packing plate.
4 by 90	22	Operating knob.
5 by 90	22	Padded head rest.
6 by 90	22	Operating belt.
7 by 90	22	Peg for operating belt.
8 by 90	22	Sheath for spring.
9 by 90	22	Spring.
10 by 90	44	½-inch bolts, 1¼ inches long, heads $\frac{1}{16}$ inch thick
11 by 90	44	⅜-inch screws, ¾ inch long.
12 by 90	44	⅜-inch rivets.
14 by 90	22	Poaking piece for cover plate.

PLATE NO. 132.

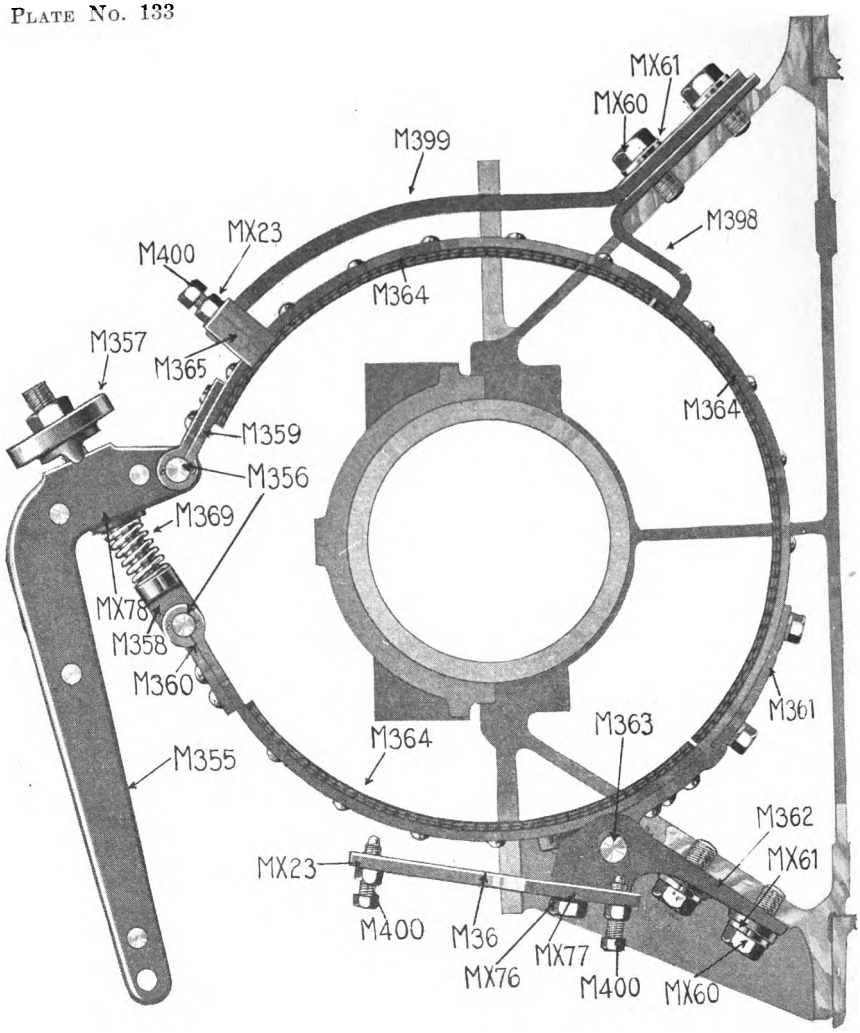


ROLLER SPROCKET AND ROAD TRACK DRIVING WHEEL

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL
		ROOF
M-1892	2	Butt strap in roof, forward.
M-1893	2	Connecting angle, front sloping plate to roof.
M-1894	2	Butt strap shaft turret.
M-1895	1	Connecting angle bulkhead to roof.
M-1896	1	Connecting angle bulkhead to roof shaft bulkhead
M-1897	2	Roof angle shaft front mud chute.
M-1898	1	Removable roof beam over engine.
M-1899	1	Roof beambat side of removable beam.
M-1900	1	Channel roof beam, front of rear louver.
M-1901	2	Roof plates over wings, front.
M-1902	2	Roof plates over driver.
M-1903	1	Roof plates over shaft turret.
M-1904	1	Roof plates under track, back starboard side.
M-1905	1	Roof plates in front of front louver.
M-1906	2	Roof plates packing in way of front mud chute.
M-1908	1	Roof plates detachable over engine.
M-1909	1	Roof plates in front of back louver.
M-1910	1	Roof plates packing piece shaft rear louver.
M-1911	1	Roof plates top of petrol tank.
M-1912	1	Roof plates side of back louver.
M-1913	1	Roof angle at back plate.
M-1914	2	Roof plate at rear mud chute.
M-1915	1	Roof plate under track, back, port side.
M-1916	2	Packing strap above roller pinion.
M-1917	2	Rear roof plate under track.
M-1918	2	Roof plate at rear of rear mud chute.
M-1919	1	Butt strap port side rear louver.
M-1920	1	Packing strip at rear of petrol tank roof.
M-1921	1	Angle at side of front mud chute.
M-1922	2	Stiffener at side of front mud chute.
		HULL
		SPHERICAL MOUNTING
A-20793	4	Ball pivot ring (outer).
B-20793	4	Ball pivot ring (inner).
C-20793	7	Gun pivot ball.
D-20793	4	Fastening ring.
E-20793	7	Trunnion bracket and handle.
F-20793	7	Trunnion bracket.
G-20793	14	Spring for rifle clip.
H-20793	4	Screw for fastening ring.
J-20793	14	Rifle clip.
K-20793	4	Darlston washer.
K1-20793	14	Stop pin.
K2-20793	14	⅛-inch jack chain.
L-20793	4	Handle.
G-20793	28	Set screw (long).
P-20793	14	Set screw (short).
		SPONSONS
M-2732	2	Sponson plate (front vertical).
M-2733	2	Sponson plate (front lower).
M-2734	2	Sponson plate (front upper).
M-2735	1	Sponson plate side (upper starboard side).
M-2736	1	Sponson plate side (lower starboard side).
M-2737	1	Sponson plate side (starboard side).
M-2738	2	Sponson plate (back).
M-2739	1	Sponson plate (back starboard side).
M-2740	2	Sponson plate (sloping bottom).
M-2741	1	Sponson plate (side sloping starboard side).
M-2742	1	Sponson wing plate (back, starboard side).
M-2743	1	Sponson wing plate (front, starboard side).
M-2744	1	Sponson wing plate (back, port side).
M-2745	1	Sponson wing plate (front port side).
M-2746	1	Sponson plate side (upper port side).
M-2747	1	Sponson plate side (lower port side).
M-2748	1	Sponson plate side (port side).
M-2749	1	Sponson plate side, sloping (port side).
M-2750	1	Sponson plate (back port side).
H-172/21579	5	Hotchkiss gun clip.
J-172/21579	3	Hotchkiss gun clip support.
C-45/21237	2	Clip for Hotchkiss gun barrel.

PLATE NO. 133

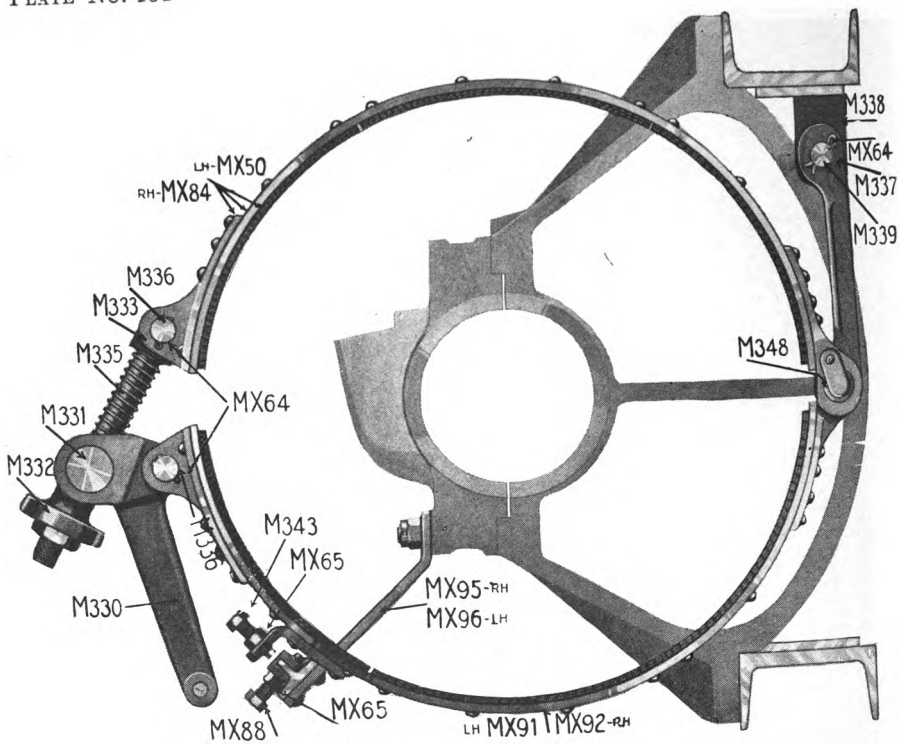


HIGH-SPEED BRAKE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
		SPONSONS—continued
B-45/21237	2	Carrier for Hotchkiss gun barrel.
M-2437	4	Spring clip for periscope.
M-2756	2	Sponson roof plate.
M-2757	2	Sponson floor plate.
M-2758	1	Sponson shield plate (starboard side).
M-2759	1	Ditto.
M-2760	1	Ditto.
M-2761	1	Ditto.
M-2762	1	Ditto.
M-2763	1	Sponson shield plate (port side).
M-2764	1	Ditto.
M-2765	1	Ditto.
M-2766	1	Ditto.
M-2767	1	Ditto.
M-2768	1	Ditto.
M-2769	2	Sponson periscope hole cover.
M-2770	2	Sponson periscope hole cover pin.
M-2626	5	Sponson revolver hole complete.
M-2626	2	Sponson revolver hole complete special.
M-2661	7	Sponson revolving peep hole complete.
M-2775	1	Sponson pressing for roof plate (starboard side).
M-2776	1	Sponson pressing for roof plate (port side).
M-2777	1	Sponson angle below gun shield (starboard side)
M-2778	1	Sponson angle below gun shield (port side)
M-2779	1	Sponson butt strap (starboard side).
M-2780	2	Sponson butt strap.
M-2781	2	Ditto.
M-2782	2	Ditto.
M-2783	2	Ditto.
M-2784	2	Ditto.
M-2785	2	Ditto.
M-2786	2	Ditto.
M-2787	1	Sponson butt strap (starboard side)
M-2788	1	Sponson butt strap (port side).
M-2789	1	Ditto.
M-2790	2	Sponson splash angle at hinge.
M-2791	2	Sponson splash angle at front.
M-2792	2	Sponson splash angle at back.
M-2793	2	Sponson splash angle on roof plate.
M-2794	2	Sponson splash angle on bottom plate.
M-2795	1	Sponson splash strip on front wing plate (starboard side)
C-42/21221	2	Thackray washer.
M-2791	1	Sponson splash strip for wing (port side).
M-2798	2	Sponson splash strip (at back).
M-2799	1	Sponson splash plate for back wing (starboard side).
M-2800	1	Sponson splash plate for front wing (starboard side).
M-2801	1	Sponson splash plate for back wing (port side).
M-2802	1	Sponson splash plate for front wing (port side).
M-2803	1	Sponson cleat angle for wing plate (starboard).
M-2804	1	Ditto.
M-2805	1	Sponson cleat angle for wing plate (port side).
M-2806	1	Sponson cleat angle for (port side).
M-2807	1	Ditto.
M-2808	1	Sponson cleat angle for wing plate (port side)
M-2809	2	Sponson packing strip under hinge.
M-2810	2	Ditto.
M-2811	2	Sponson strip on M-2740.
M-3812	2	Ditto.
M-2813	1	Sponson butt strap port side.
M-2814	4	Hinge for sponson seat.
M-2815	4	Ditto.
M-2816	4	Pin for seat hinge.
M-2817	4	Packing under hinge.
M-2818	2	Seat.
M-2819	2	Seat support.
M-2820	4	Support for periscope spring clip.
M-2821	2	Sponson top bracket for Hotchkiss spare barrel.
M-2822	2	Sponson bottom bracket for Hotchkiss spare barrel.
M-2823	4	Packing for Hotchkiss gun bracket.
M-2824	2	Sponson clip bracket for Hotchkiss gun.
M-2826	4	Sponson hinge.
M-2827	2	Sponson hinge on hull.
M-2828	2	Do.
M-2829	4	Sponson pin for hinge.
M-2830	4	Spsonson washer for hinge.
M-2831	4	Sponson nut for pin.
M-2832	2	Sponson roller bracket.
M-2833	2	Sponson shaft for roller.

PLATE No. 134

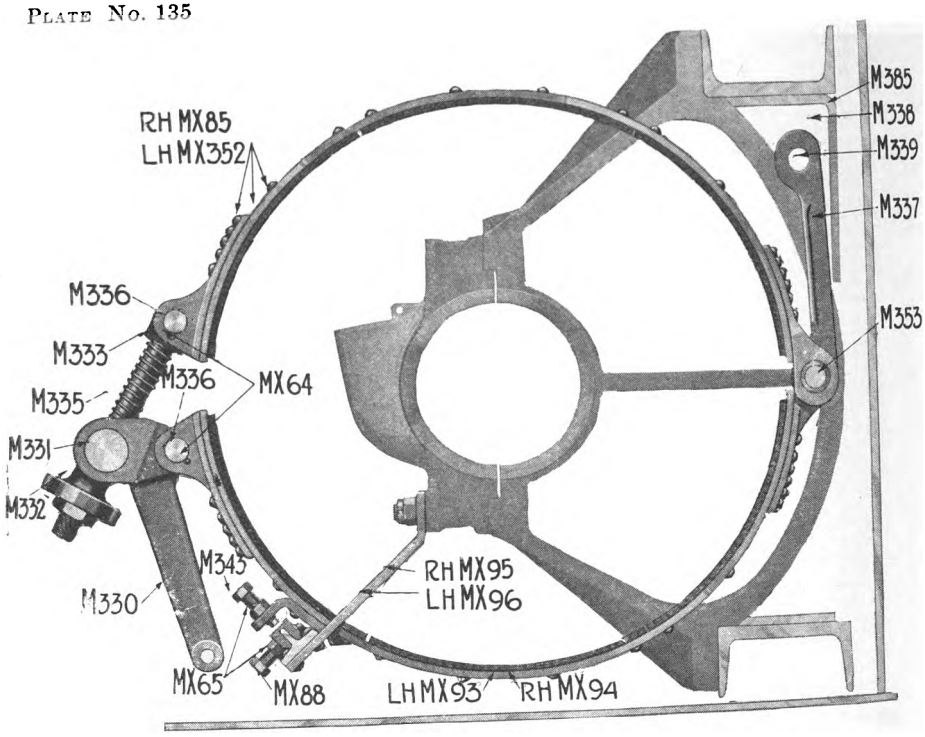


LOW-SPEED BRAKE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
		SPONSONS—continued
M-2834	4	Sponson bracket for ramrod spring clip.
M-2835	4	Sponson spring clip for ramrod.
M-2836	1	Telescope bracket.
M-2837	1	Telescope bracket cup.
M-2838	1	Catch for telescope strap.
M-2839	2	Lug holding sponson in position.
M-2840	1	Sponson clip for lug.
M-2841	1	Support block for Hotchkiss gun (port side).
M-2842	2	Sponson footrest on floor plate.
M-2843	1	Support block for Hotchkiss gun (starboard).
M-2844	1	Peephole splash plate (special).
M-2845	20	Peephole splash plate.
M-2126	1	Camouflage bracket (port side).
M-2127	1	Camouflage bracket (starboard side).
M-2848	2	Ball bearing 40 m. m.; bore, 110 m. m.; O. D., 27 m. m wide.
		TURRET—HEMISPHERICAL
M-3117	3	Hemispherical turret.
M-3118	3	Mounting for Hotchkiss machine gun (front plate).
M-3119	3	Mounting for Hotchkiss machine gun (rear plate).
M-3120	1	Cover plate for hemispherical turret.
M-3121	6	Bracket supporting hemispherical turret.
M-3122	6	Trunnion for hemispherical turret.
M-3123	6	Bolt and nut securing trunnion.
M-3124	24	Packing for bracket.
M-3125	24	Packing for trunnion.
M-3126	6	Bush for bracket.
M-3127	9	Pin for bracket and ring.
M-3128	3	Fastening ring for Hotchkiss M. G. hemispherical turret.
M-3130	3	Darlston washer for hemispherical turret.
M-3131	3	Handle for hemispherical turret.
M-3132	2	Felt strip for antisplash.
M-3133	2	Steel strip for anitsplash.
M-3134	10	Spring for anitsplash.
M-3135	2	Channel for antisplash.
M-2348	1	Main turret starboard side plate (front part).
M-2349	1	Main turret starboard side (rear part).
M-2350	1	Main turret port side (front part).
M-2351	1	Main turret port side (rear part).
M-2352	1	Drivers turret front flap plate.
M-2353	2	Main turret side flaps.
M-2354	2	Main turret side plate junction piece.
M-2355	1	Main turret roof doorplate (starboard).
M-2356	1	Main turret roof doorplate (port).
M-2357	1	Main turret roof door apron plate.
M-2358	2	Main turret roof door (side battons).
M-2359	4	Main turret roof door (end battons).
M-2360	1	Main turret bracket for machine-gun clip.
M-2362	1	Main turret front center plate.
M-2363	2	Main turret front wing plates.
M-2364	1	Main turret rear peephole splash plate.
M-2366	2	Main turret pin for fastener arrangement.
M-2372	1	Main turret roof plate (starboard).
M-2 73	1	Main turret roof plate (port).
M-2374	4	Main turret flaps (side splash plates).
M-2375	2	Main turret flaps (bottom splash plates).
M-2376	2	Main turret flaps suspension chains.
M-2377	2	Main turret flaps catch plate.
M-2378	1	Main turret rear top angle (starboard).
M-2379	1	Main turret rear top angle (port).
M-2381	1	Main turret rear bottom angle.
M-2383	2	Main turret side top angle (front part).
M-2384	1	Main turret side top angle (rear starboard).
M-2385	4	Main turret flaps (side battons).
M-2386	2	Main turret flaps (bottom battons).
M-2387	1	Driver's turret starboard side plate.
M-2388	1	Driver's turret port side plate.
M-2389	1	Driver's turret roof plate.
M-2390	2	Main turret side bottom angles.
M-2391	2	Main turret flap ring.
M-2392	2	Main turret flap ring bolt.
M-2393	1	Main turret flap suspension bkt.
M-2394	2	Main turret flap top splash plate.
M-2395	2	Main turret front vertical angles.
M-2396	1	Main turret rear vertical angles (starboard).
M-2397	1	Main turret rear vertical angle (port).
M-2398	1	Main turret roof butt strap (front part).

PLATE No. 135



TRACK BRAKE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		HULL—Continued
		TURRET—HEMISPHERICAL—continued
M-2399	1	Main turret roof butt strap (center part).
M-2400	1	Main turret roof butt strap (rear part).
M-2401	1	Driver's turret flap top splash plate.
M-2402	1	Driver's turret flap starboard side splash plate.
M-2403	4	Driver's turret flap hinge.
M-2404	1	Driver's turret flap (port side) splash plate.
M-2405	1	Driver's turret flap hinge pin.
M-2406	1	Main turret backplate (starboard).
M-2407	1	Main turret backplate (port).
M-2408	1	Main turret port side top angle (rear port).
M-2409	2	Periscope hole cover.
M-2410	2	Periscope hole cover lever.
M-2411	1	Periscope hole cover pin.
M-2414	1	Main turret roof door lock plate.
M-2415	2	Driver's turret side bottom angles.
M-2416	2	Main turret front wing plate bottom angles.
M-2417	1	Main turret front center plate top angle.
M-2418	2	Main turret front wing plate top angle.
M-2419	2	Driver's turret vertical angles.
M-2420	2	Main turret front butt straps.
M-2422	4	Main turret side plate butt straps.
M-2423	1	Driver's turret plate for cover arrgt.
M-2425	1	Driver's turret pin for cover arrgt.
H172—21579	1	Clip for Hotchkiss machine gun.
		HULL TURRET
M-2426	1	Driver's turret flap raising lever.
M-2427	2	Driver's turret flap eyebolts.
M-2428	1	Driver's turret flap raising lever guide.
M-2429	1	Driver's turret flap locking lever.
M-2430	1	Driver's turret flap locking lever pin.
M-716	2	Bracket for lock.
M-718	2	Packing piece for lock.
M-720	2	Catch for lock.
M-721	2	Spindle for lock.
M-722	2	Spring for lock.
F20—21195	2	Handle for lock.
M-3117	----------	Hemispherical turret.
M-3118	1	Hotchkiss gun mounting for De. (front plate).
M-3119	1	Hotchkiss gun mounting for De. (rear plate).
M-3120	1	Cover plate for De.
M-3121	1	Supporting bracket.
M-3122	2	Trunnion.
M-3123	2	Trunnion bolt and nut.
M-3124	8	Bracket packing.
M-3125	8	Trunnion.
M-3126	2	Bracket bush.
M-3127	3	Ring pin.
M-3128	1	Gun mounting ring.
M-3130	1	Darlston washer for hemispherical turret.
M-3131	1	Handle for hemispherical turret.
A-20793	4	Ball pivot ring (outer) for Hotchkiss gun mounting.
B-20793	4	Ball pivot ring (inner) for Hotchkiss gun mounting.
C-20793	5	Gun pivot ball for Hotchkiss gun mounting.
D-20793	4	Fastening ring for Hotchkiss gun mounting.
E-20793	5	Trunnion bracket and handle for Hotchkiss gun mounting.
F-20793	5	Trunnion bracket and handle for Hotchkiss gun mounting.
G-20793	10	Spring for rifle clip for Hotchkiss gun mounting.
H-20793	4	Screw or fastening ring for Hotchkiss gun mounting.
J-20793	10	Rifle clip for Hotchkiss gun mounting.
K-20793	4	Darlaston washer for Hotchkiss gun mounting.
K1-20793	10	Stop pin for Hotchkiss gun mounting.
K2-20793	5	⅛-inch jack chain, 4 inches long each, for Hotchkiss gun mounting. 8 inches long each, for Hotchkiss gun mounting.
L-20793	4	Handle for Hotchkiss gun mounting.
O-20793	20	Set screw (long) for Hotchkiss gun mounting.
P-20793	10	Set screw (short) for Hotchkiss gun mounting.
E43—21220	1	Driver's turret rubber washer for periscope.
F19—21210	2	Main turret roof door fastener.
M45—21421	1	Main turret roof door Chubb lock (3 keys).
M-2627	2	Revolver hole cover swivel, pin and nut (left hand).
C138—20384	3	Revolver hole cover plate.
A42—21221	3	Revolver port cover handle.
C42—21221	3	Revolver port cover Thackery washers.
D42—21221	3	Revolver port cover handle spring.
E42—21221	3	Revolver port cover Grover washer
F42—21221	6	Revolver port cover stop pins.

PLATE NO. 136

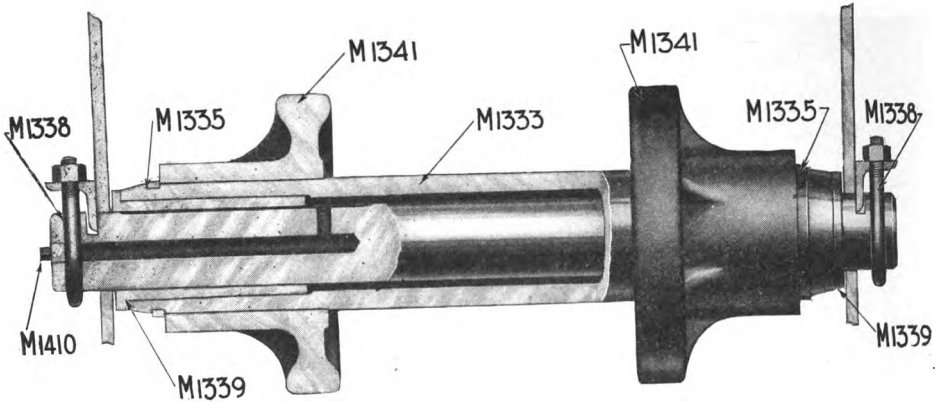


PLATE NO. 137

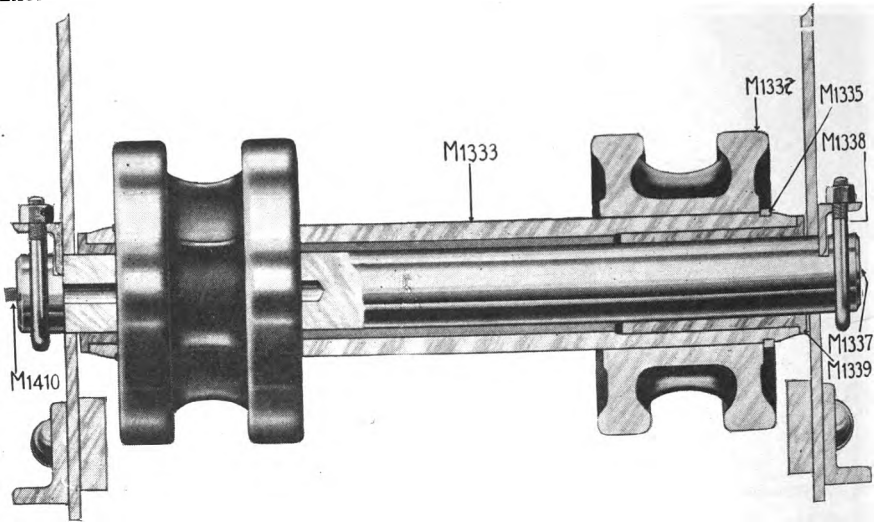
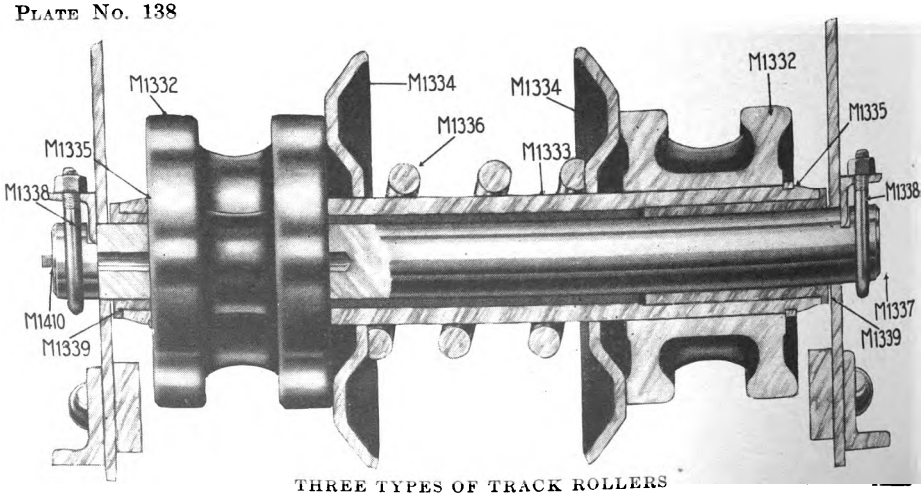


PLATE NO. 138

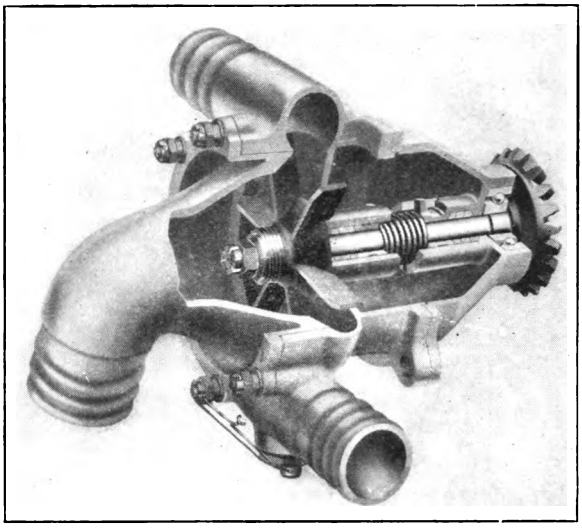


THREE TYPES OF TRACK ROLLERS

NOMENCLATURE LIST—Continued

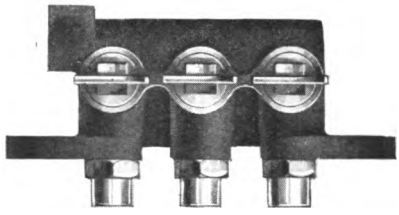
Part No.	Number per machine	Description and location
		HULL TURRET—Continued
B42—21221	1	Revolver port cover swivel pin and nut (right hand).
J206—21067	3	Handle for holding-on.
M-2845	10	Peep hole splash plate.
1 by 90	11	Cover plate for revolving peephole cover.
2 by 90	11	Revolving plate for revolving peephole cover.
3 by 90	11	Packing plate for revolving peephole cover.
4 by 90	11	Operating knob for revolving peephole cover.
5 by 90	11	Padded head rest for revolving peephole cover.
6 by 90	11	Operating bolt for revolving peephole cover.
7 by 90	11	Operating peg for revolving peephole cover.
8 by 90	11	Spring shield for revolving peephole cover.
9 by 90	11	Spring for revolving peephole cover.
M-1789	8	Half hinge for roof and side flaps.
M-1790	8	Half hinge for roof and side flaps.
M-1791	8	Pin for hinge for roof and side flaps.
M-2432	1	Outlook turret, compass bracket.
		HULL
		TURRET OUTLOOK
M-2346	2	Outlook turret side plate.
M-2347	2	Outlook turret front and rear plates.
M-2361	1	Outlook turret roof plate.
M-2367	2	Outlook turret top angles (front and rear).
M-2368	2	Outlook turret top angles (sides).
M-2369	4	Outlook turret vertical angles.
M-2370	2	Ootlook turret bottom angles (front and rear).
M-2371	2	Outlook turret bottom angles (sides).
M-2409	2	Periscope hole cover.
M-2410	2	Periscope hole cover lever.
M-2411	2	Periscope hole cover pin.
M-2845	4	Peephole splash plates.
X-90	4	Peephole covers
		JOCKEY PULLEY
M-1030	1	Jockey pulley for large fan.
M-1050	1	Adjusting rod for jockey pulley.
M-564	1	Tension spring for jockey pulley.
M-1047	1	Cover plate for jockey pulley.
M-1031	1	Arm for jockey pulley.
M-1045	1	Pin for jockey pulley.
M-1048	1	Bracket for jockey pulley.
M-1049	1	Adjusting plate for jockey pulley.
M-1045A	1	Pin for jockey pulley.
M-1046	1	Distance tube for jockey pulley.
		LIGHTING DYNAMO
M-1613	1	Dynamo.
M-1614	1	Diagram of belt drive.
M-858	----------	Pulley on Liberty engine.
M-874	----------	Pulley on Ricardo engine.
M-1615	2	Lighting dynamo brackets.
		LOUVRE
		INLET
M-982	1	Starboard side frame.
M-983	1	Port side frame.
M-984	1	Front end frame.
M-985	1	Back end frame.
M-986	1	Cover plate.
M-987	39	Louver blade.
M-995	2	Retaining plate.
M-996	2	Saddle.
M-998	2	End packing piece.
M-997	66	Distance piece.
M-999	4	Corner cleat.
M-1000	2	Thickening plate at adj. screw.
M-1005	1	Packing strip, port side.
		LOUVRE
		OUTLET
M-988	2	Retaining plate.
M-989	1	Port side frame.
M-990	1	Starboard side frame.

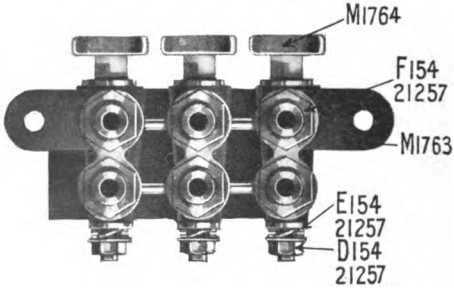
PLATE No. 139



WATER PUMP

PLATE No. 140



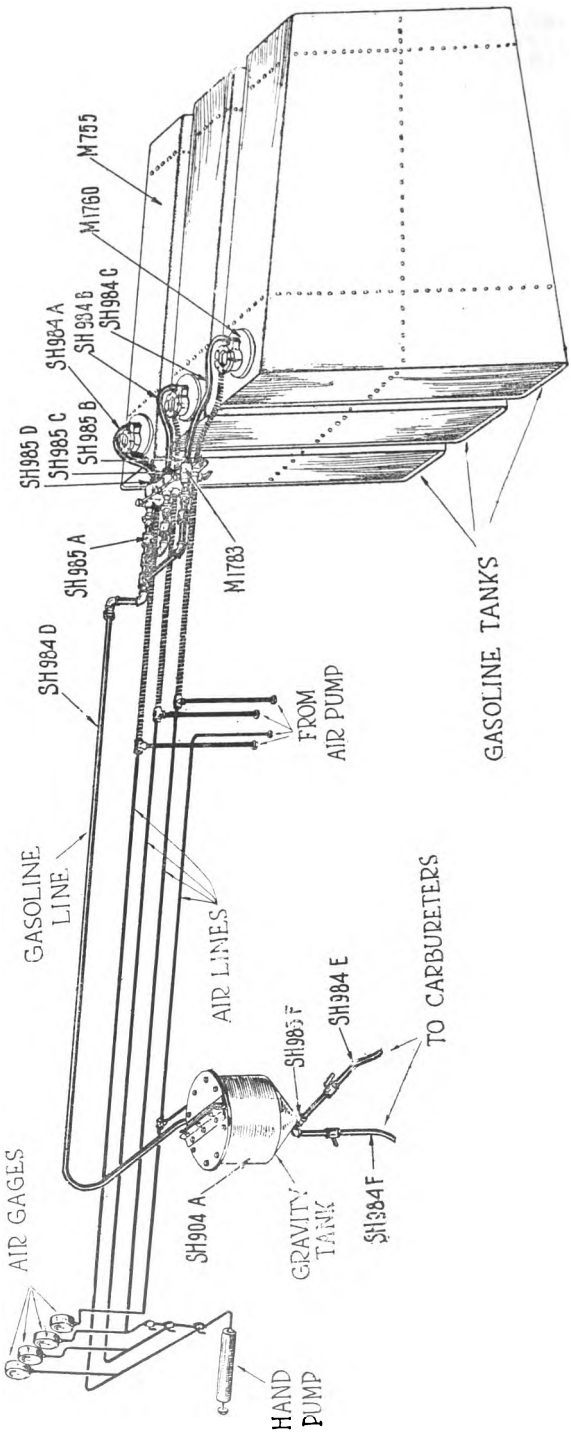


COMBINATION TAP

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		LOUVRE—Continued
		OUTLET—continued
M-991	1	Rear end frame.
M-992	1	Front end frame.
M-993	1	Cover plate.
M-994	29	Louver blade.
M-996	2	Saddle.
M-997	56	Distance piece.
M-998	2	End packing piece.
M-999	4	Corner cleat.
M-1000	2	Thickening plate at adj. screw.
M-1004	2	Fishplate on starboard side frame.
		OIL TANKS
M-3292	1	Oil tank (engine).
M-3293	1	Filler flange.
M-3294	1	Filler-flange cap.
M-3295	1	Filler-cap gasket.
M-3296	1	Top ring for filter.
M-3297	1	Bottom ring for filter.
M-3298	1	Cone for delivery pipe.
M-3299	1	Filter body.
M-3300	1	Filter gauze.
M-3301	1	Oil-delivery pipe.
M-3304	2	Indicator flange.
M-3305	2	Indicator-flange cap.
M-3307	1	Indicator-float tube.
M-3308	1	Indicator rod.
M-3309	1	Indicator float.
M-3310	4	Oil-tank support cleat.
M-3311	2	Drain-cock flange.
	1	Drain cock.
M-3312	1	Oil tank for sprockets and epicyclic brgs.
SH971B SH971A	2	Sprocket oil-tank support.
M-3314	1	Sprocket oil-tank lubricator.
M-3315	2	Engine oil-tank suction and delivery flange.
M-3311	1	Oil-tank flange for drain cock.
		OIL TANK
SH207A	1	Suction oil tube
SH207B	1	Overflow oil tube.
SH207C	2	Suction oil-tube flange.
SH207D	2	Suction oil-tube nipple nut.
SH207E	1	Suction oil-tube nipple.
SH207F	1	Suction oil-tube elbow.
SH207G	2	Oil-pipe flange gasket.
		ROAD TRACK
		ADJUSTING GEAR AND WHEEL
M-1472	2	Bracket for tension adjusting screw.
M-1474	1	Shaft for tension adjusting screw.
M-1479	2	Guard in hull plate for adjusting screw.
M-1475	2	Locking screw for adjusting screw.
M-1476	2	Plug for locking screw-adjusting screw.
M-1473	2	Tension adjusting screw.
M-1477	2	Nut for shaft for track adj. wheel.
M-1410	2	Plug $\frac{3}{8}$ inch
M-1471	2	Rim for road track adj. wheel.
M-1404	2	Disk for road track adj. wheel.
M-1405X M-1405Y	6	Diaphragm for road track adj. wheel.
M-1409	2	Bushing for road track adj. wheel.
M-1483	2	Washer for track adjusting shaft.
M-1484	2	Plate for track adjusting bracket.
M-1403	1	Boss for road track adjusting wheel.
		ROAD TRACK
		DRIVING WHEEL
M-1401	2	Teeth for road track wheel.
M-1402	1	Shaft for road track wheel.
M-1403	1	Boss for road track wheel.
M-1404	2	Disk for road track wheel.

PLATE No. 141

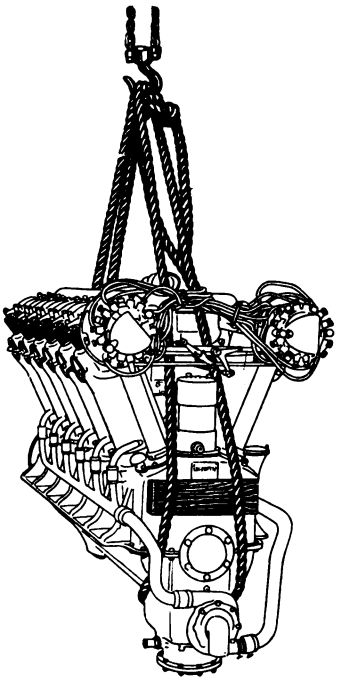


FUEL-SUPPLY SYSTEM

NOMENCLATURE LIST—Continued

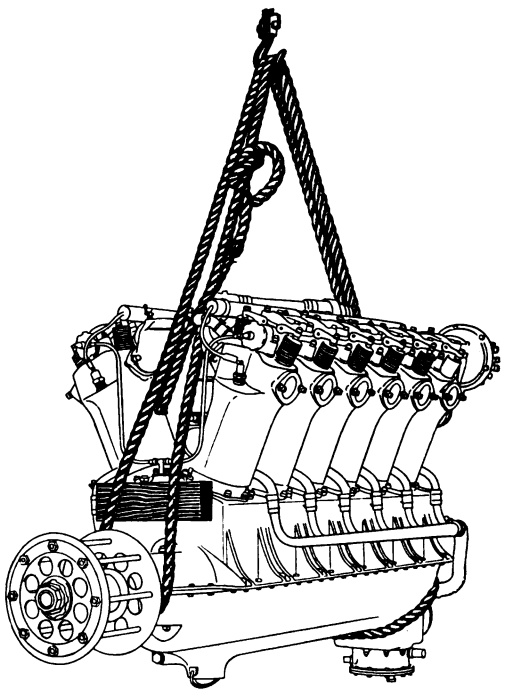
Part No.	Number per machine	Description and location
		ROAD TRACK—Continued
		DRIVING WHEEL—continued
M-1405	4	Diaphragm for road track wheel.
M-1406	1	Shaft bearing inner end.
M-1407	1	Shaft bearing outer end.
M-1409	2	Bushing for road track driving wheel.
M-1410	1	Plug in end of shaft.
M-1411	2	Locking plate for shaft nut.
M-1552	1	Stud plate for shaft bearing.
20297-D89	1	Key for road track driving wheel shaft .
M-1477	2	Nut for shaft.
		ROAD TRACK
		LINK AND SHOES
M-1261	312	Road track link (right hand).
M-1262	312	Pin for road track link.
M-1263	312	Bushing for road track link.
M-1264	156	Road track shoe.
M-1265	312	Road track link (left half).
		ROAD TRACK
		ROLLER LOWER WITH SPRING PLATES
M-1333	1	Road track roller tube.
M-1335	2	Spring steel split rings.
M-1332	2	Road track roller.
M-1336	1	Road track roller spring.
M-1334	2	Road track roller spring plates.
M-1337	1	Road track roller pin.
M-1339	2	Road track roller tube bushing.
M-1410	1	.375 plug.
M-1338	2	Road track roller pin staple and nut.
		ROAD TRACK
		ROLLERS LOWER WITHOUT SPRING PLATES
M-1333	1	Road track roller tube.
M-1335	2	Spring steel split ring.
M-1332	2	Road track rollers.
M-1337	1	Road track roller pin.
M-1339	2	Road track roller tube bushing.
M-1410	1	.375 plug.
M-1338	2	Road track roller pin staples and nut.
		ROAD TRACK
		ROLLER PINION
M-1541B	1	Chain sprocket and roller pinion.
M-1542	18	Roller.
M-1543	18	Pin for roller pinion rollers.
M-1550	18	⅛-inch taper plug for roller pin.
M-1409	2	Driving wheel.
M-1544	1	Shaft for roller pinion.
M-1407	1	Outer shaft bearing.
M-1546	1	Inner shaft bearing.
M-1552	1	Plate for shaft bearing.
20297-D89	1	Wheel shaft.
M-1549	2	¼-inch taper plug in shaft.
M-1541A	1	Roller pinion sprocket.
		ROAD TRACK
		TOP ROLLERS
M-1333	1	Road track roller tube.
M-1335	2	Spring steel split rings.
M-1341	2	Top road track roller.
M-1337	1	Road track roller pin.
M-1339	2	Road track roller tube bushing.
M-1410	1	.375 plug.
M-1338	2	Road track roller pin staple and nut.

PLATE No. 142



PROPER WAY TO LIFT ENGINE

PLATE No. 143

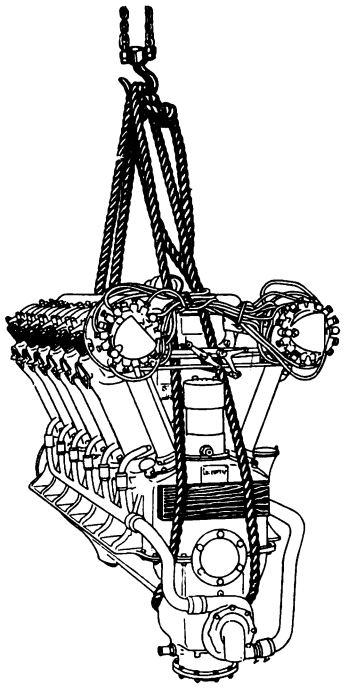


PROPER WAY TO LIFT ENGINE

NOMENCLATURE LIST—Continued

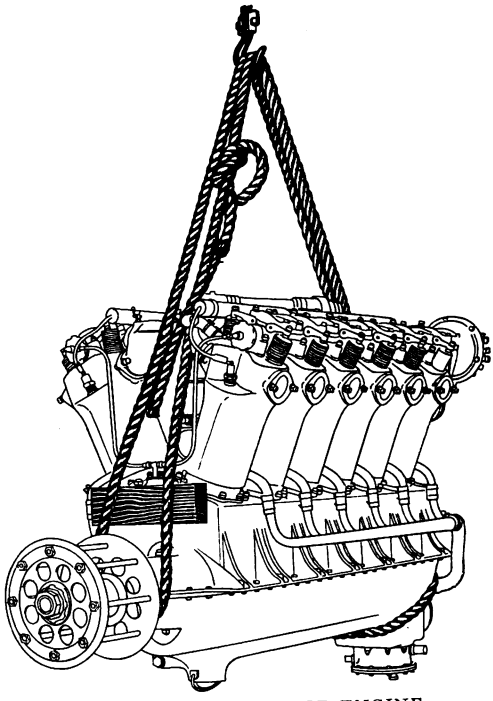
Part No.	Number per machine	Description and location
		SILENCER PARTS
M-37	1	Silencer body (port).
M-38	1	Silencer body (starboard).
M-39	1	Silencer end (port).
M-40	1	Silencer end (starboard)
M-41	2	Silencer end (rear).
M-42	6	Silencer tie rods.
M-43	2	Silencer inlet pipe.
M-44	2	End for silencer inlet pipe.
M-45	2	Silencer outlet flange.
M-48	2	Washer for silencer outlet flange.
		SPEEDOMETER
SH586A	1	Distance recorder head assembly—model 26 DLh calibrated 2,500 revs.; 10 revs. to register 1 meter.
B-5	1	Cup.
B-94	1	Frame.
K-67L	1	Governor.
L-255L	1	Pinion.
L-256	1	Odometer.
D-60N	1	Dial.
F-3WN	1	Hand.
B-17-BKN	1	Ring.
J-3	3	Screws.
J-4	2	Screws.
SH386D	1	Assembly of cable.
P-199	1	Coupling end.
P-303	1	Coupling end.
P-30	1	5 Casing.
P-390	2	Coupling nut.
P-59	1	Coupling end.
P-27	1	Coupling end.
P-55	1	Coupling collar.
P-29	1	Coupling collar.
S-374	1	Housing.
S-372A	1	Pinion shaft and gear.
S-373	1	Pinion shaft bearing.
S-35	2	Washers.
S-34	1	Cap.
		STARTING MOTOR AND GENERATOR
SH80A	1	Generator assembly.
SH137A	1	Bracket.
SH81A	1	Starting-switch assembly.
SH137B	1	Starting-motor bracket cap.
		TOWING GEAR
M-3917	1	Front towing bracket.
M-3918	1	Back towing bracket.
M-3919	2	Side towing bracket.
M-3920	4	Towing shackle pin.
M-3921	8	Nut for shackle pin.
D14/21202	4	Towing shackle (standard).
M-3922	1	Roof towing bracket.
M-3923	1	Roof towing bracket cap.
		YARDOMETER DRIVE
M-3883	1	Gear-wheel supporting bracket.
M-3884	1	Gear-wheel journal bolt.
M-3885	1	Gear wheel.
M-3886	1	Gear pinion.
M-3887	1	Crank pin.
M-3888	1	Coupling rod end.
M-3889	1	Dowel for gear pinion.
M-3890	1	Fixing pin for gear pinion.
M-3891	1	Packing piece for gear wheel—supporting bracket.
M-3892	1	Yardometer supporting bracket.
M-3893	1	Yardometer connecting rod.

PLATE No. 142



PROPER WAY TO LIFT ENGINE

PLATE No. 143



PROPER WAY TO LIFT ENGINE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
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F-3WN	1	Hand.
B-17-BKN	1	Ring.
J-3	3	Screws.
J-4	2	Screws.
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P-303	1	Coupling end.
P-30	1	5 Casing.
P-390	2	Coupling nut.
P-59	1	Coupling end.
P-27	1	Coupling end.
P-55	1	Coupling collar.
P-29	1	Coupling collar.
S-374	1	Housing.
S-372A	1	Pinion shaft and gear.
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S-35	2	Washers.
S-34	1	Cap.
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M-3888	1	Coupling rod end.
M-3889	1	Dowel for gear pinion.
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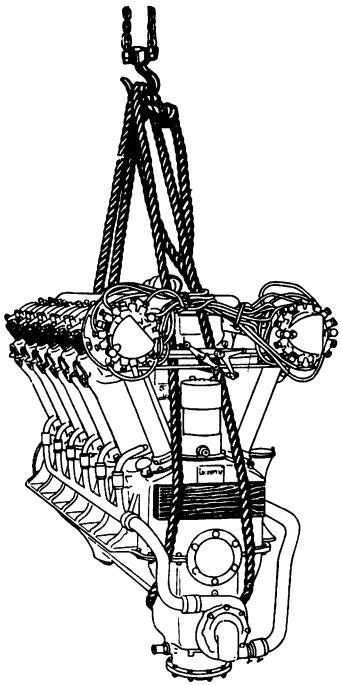
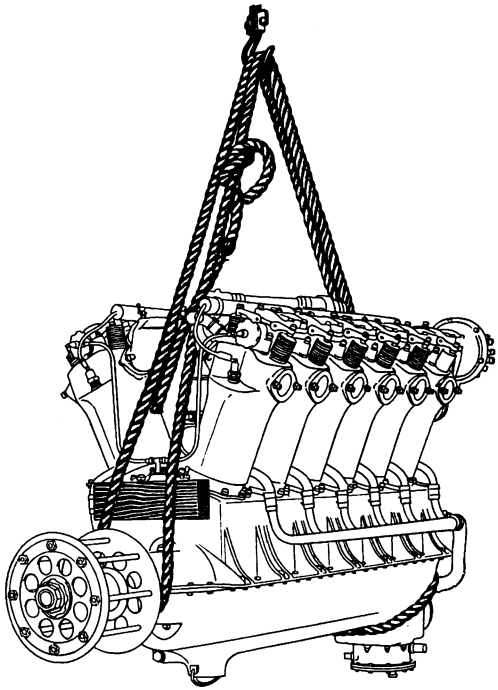
M-3892	1	Yardometer supporting bracket.
M-3893	1	Yardometer connecting rod.

PLATE No. 142



PROPER WAY TO LIFT ENGINE

PLATE No. 143



PROPER WAY TO LIFT ENGINE

NOMENCLATURE LIST—Continued

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M-3884	1	Gear-wheel journal bolt.
M-3885	1	Gear wheel.
M-3886	1	Gear pinion.
M-3887	1	Crank pin.
M-3888	1	Coupling rod end.
M-3889	1	Dowel for gear pinion.
M-3890	1	Fixing pin for gear pinion.
M-3891	1	Packing piece for gear wheel—supporting bracket.
M-3892	1	Yardometer supporting bracket.
M-3893	1	Yardometer connecting rod.

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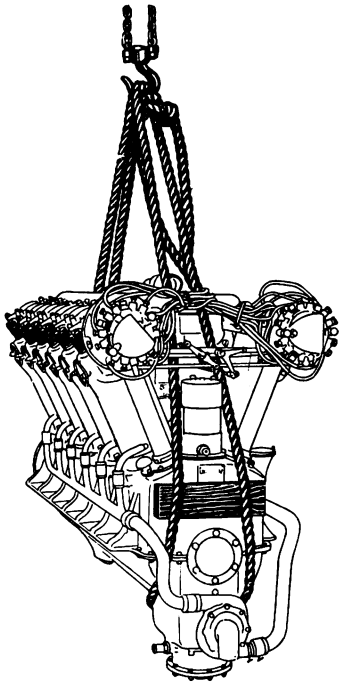
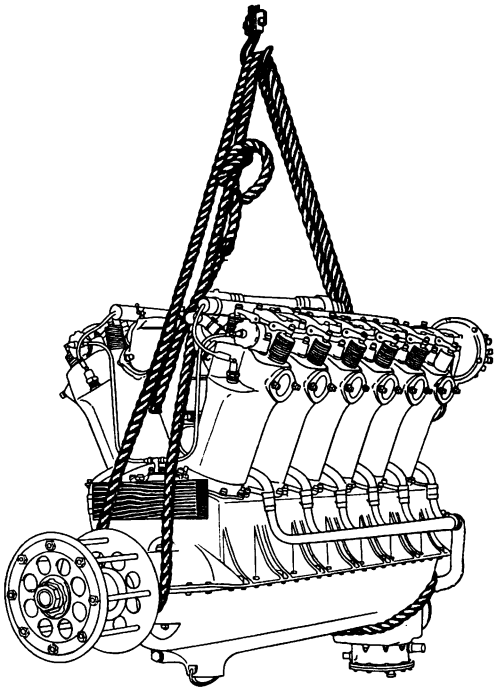


PROPER WAY TO LIFT ENGINE

PLATE No. 143



PROPER WAY TO LIFT ENGINE

NOMENCLATURE LIST—Continued

Part No.	Number per machine	Description and location
		SILENCER PARTS
M-37	1	Silencer body (port).
M-38	1	Silencer body (starboard).
M-39	1	Silencer end (port).
M-40	1	Silencer end (starboard)
M-41	2	Silencer end (rear).
M-42	6	Silencer tie rods.
M-43	2	Silencer inlet pipe.
M-44	2	End for silencer inlet pipe.
M-45	2	Silencer outlet flange.
M-48	2	Washer for silencer outlet flange.
		SPEEDOMETER
SH586A	1	Distance recorder head assembly—model 26 DLh calibrated 2,500 revs.; 10 revs. to register 1 meter.
B-5	1	Cup.
B-94	1	Frame.
K-67L	1	Governor.
L-255L	1	Pinion.
L-256	1	Odometer.
D-60N	1	Dial.
F-3WN	1	Hand.
B-17-BKN	1	Ring.
J-3	3	Screws.
J-4	2	Screws.
SH386D	1	Assembly of cable.
P-199	1	Coupling end.
P-303	1	Coupling end.
P-30	1	5 Casing.
P-390	2	Coupling nut.
P-59	1	Coupling end.
P-27	1	Coupling end.
P-55	1	Coupling collar.
P-29	1	Coupling collar.
S-374	1	Housing.
S-372A	1	Pinion shaft and gear.
S-373	1	Pinion shaft bearing.
S-35	2	Washers.
S-34	1	Cap.
		STARTING MOTOR AND GENERATOR
SH80A	1	Generator assembly.
SH137A	1	Bracket.
SH81A	1	Starting-switch assembly.
SH137B	1	Starting-motor bracket cap.
		TOWING GEAR
M-3917	1	Front towing bracket.
M-3918	1	Back towing bracket.
M-3919	2	Side towing bracket.
M-3920	4	Towing shackle pin.
M-3921	8	Nut for shackle pin.
D14/21202	4	Towing shackle (standard).
M-3922	1	Roof towing bracket.
M-3923	1	Roof towing bracket cap.
		YARDOMETER DRIVE
M-3883	1	Gear-wheel supporting bracket.
M-3884	1	Gear-wheel journal bolt.
M-3885	1	Gear wheel.
M-3886	1	Gear pinion.
M-3887	1	Crank pin.
M-3888	1	Coupling rod end.
M-3889	1	Dowel for gear pinion.
M-3890	1	Fixing pin for gear pinion.
M-3891	1	Packing piece for gear wheel—supporting bracket.
M-3892	1	Yardometer supporting bracket.
M-3893	1	Yardometer connecting rod.

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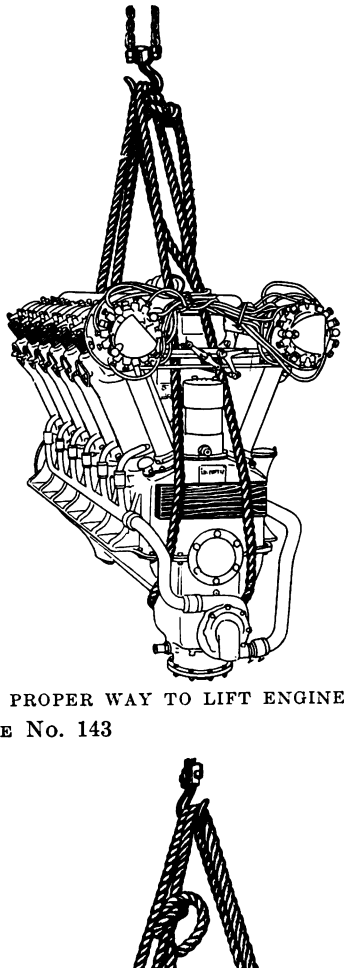

PROPER WAY TO LIFT ENGINE

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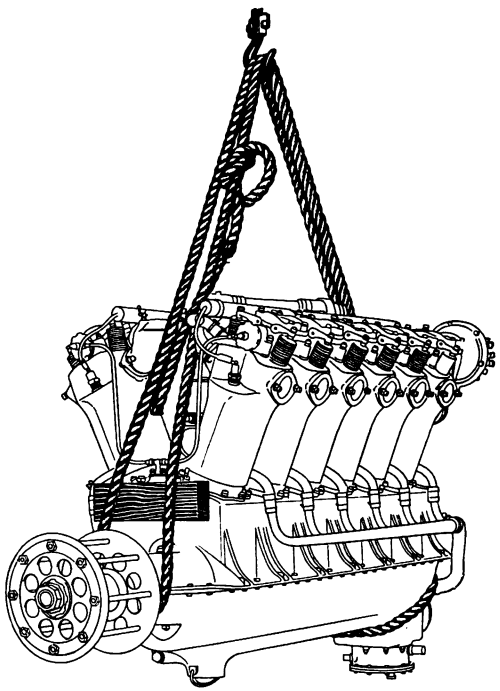

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