ATTACHMENT 11.

NOT TO BE PUBLISHED (A.M.R.&O. 1588B)

TANKS
AUSTRALIAN CRUISER
MARK-1

INSTRUCTION BOOK

(PROVISIONAL)

Prepared and Issued by:
THE DIRECTORATE OF ARMOURED FIGHTING VEHICLES PRODUCTION
MINISTRY OF MUNITIONS
In collaboration with
HEADQUARTERS, ALLIED LAND FORCES,
SOUTH WEST PACIFIC AREA

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SCOPE AND PURPOSE OF THIS BOOK.

This provisional handbook has been written, primarily, for the A.C.Mk. 1 Tank driver, and is not intended to be a guide to the undertaking of major mechanical repairs and replacements which are the duties of workshop personnel only. Information, therefore, has been reduced to the simplest possible terms, commensurate with accurate explanation of mechanical principles.

Although a high degree of technical knowledge may not be necessary to drive the Australian Cruiser Tank, the underlying principles have been explained so that the crew may detect small mechanical faults before they develop into major repair undertakings. If faults can be discovered and reported at this stage, repairs can be undertaken by Light Aid Detachments or Brigade Workshops thus ensuring that the vehicle is where it is most needed - in action.

A tremendous responsibility also rests with the crew to carry out lubrication and maintenance in accordance with the schedule and instructions contained in this manual.

From time to time it is probable that modifications will be made to increase the efficiency of the A.C. Mk. 1 Tank and the accuracy of this preliminary manual will be affected thereby. Any such modifications will be fully described in the standard printed edition of this manual to be published shortly, and in regular supplements.

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C O N T E N T S

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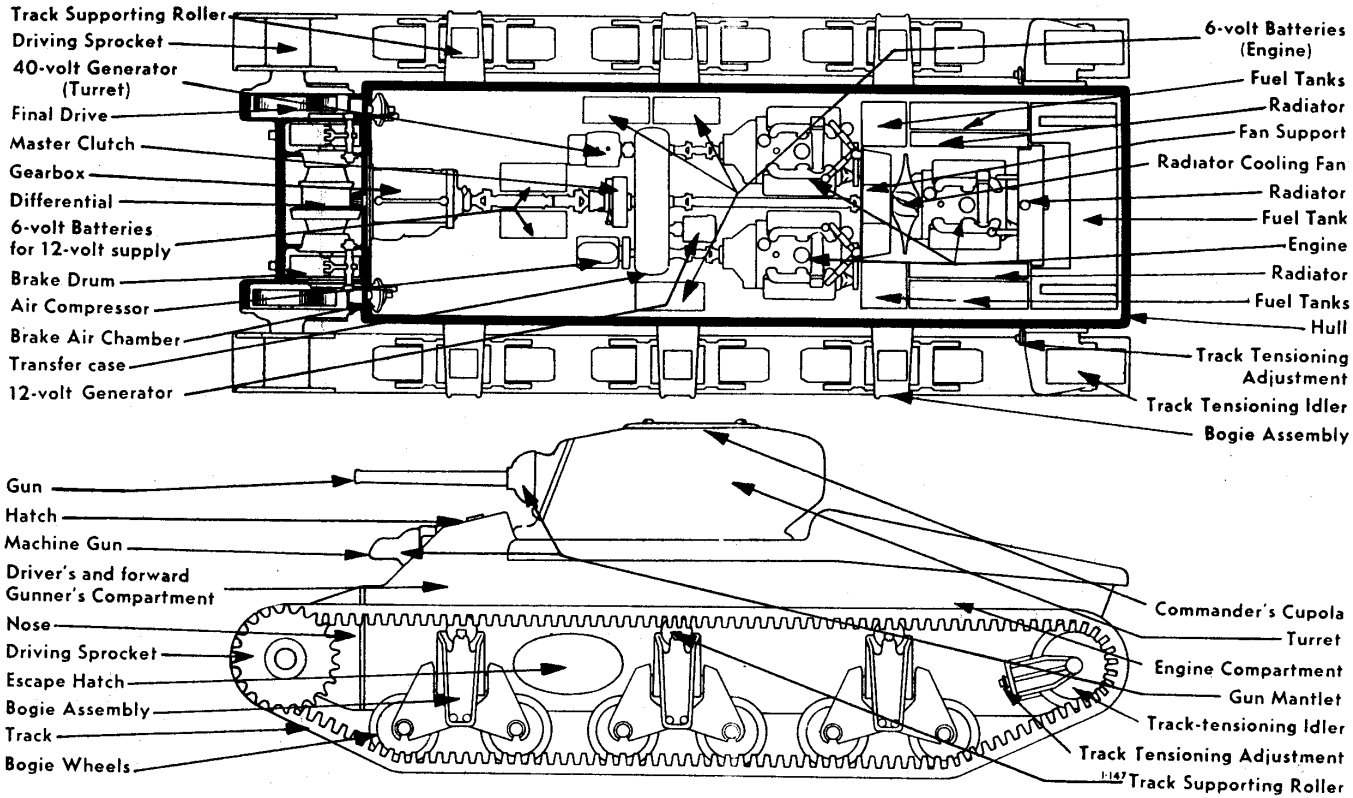


Fig. 1. General arrangement of principal components

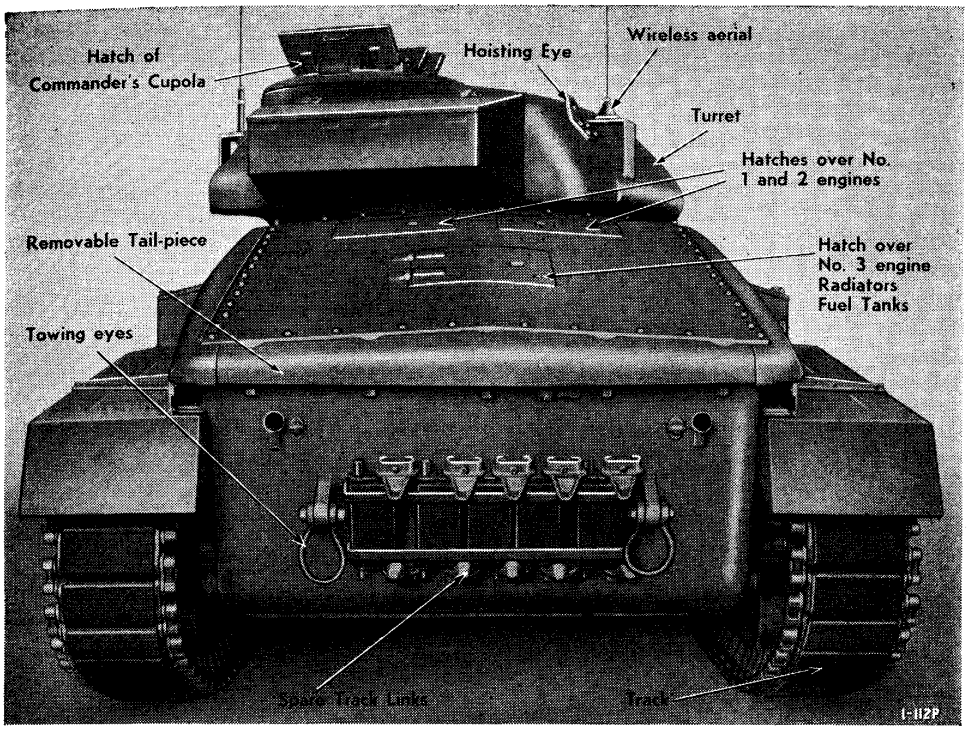


Fig. 3. Rear view of the A.C. Mk. 1 Tank

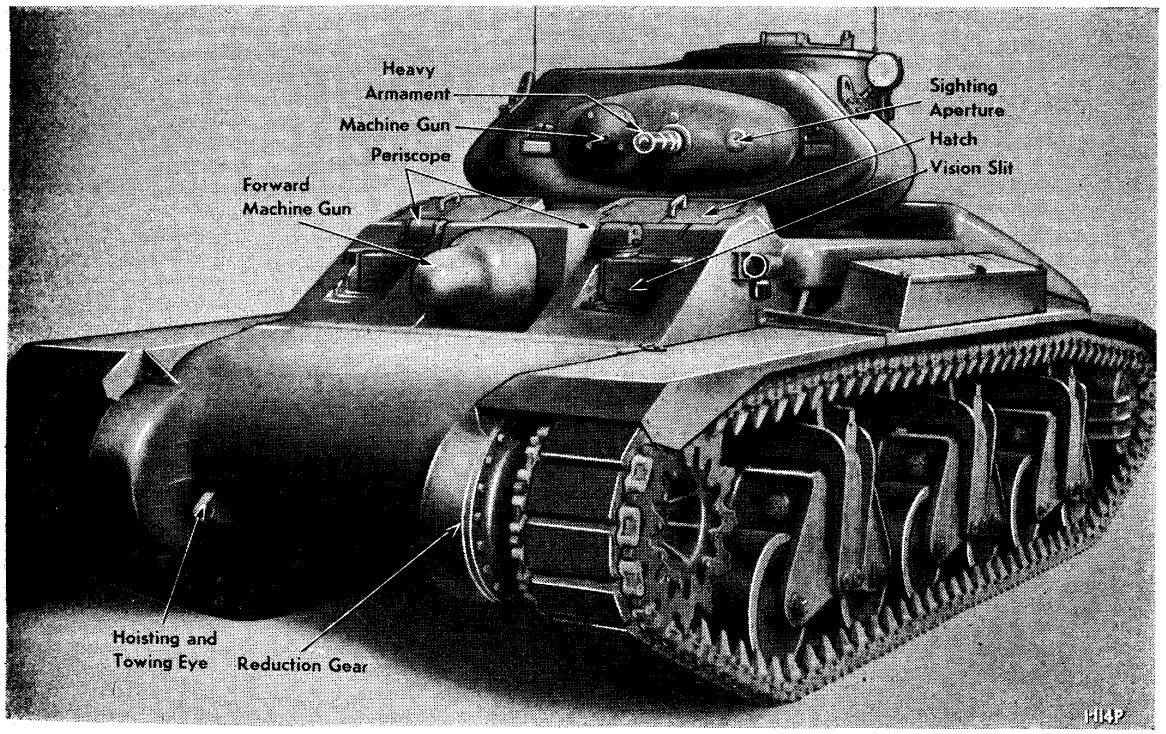
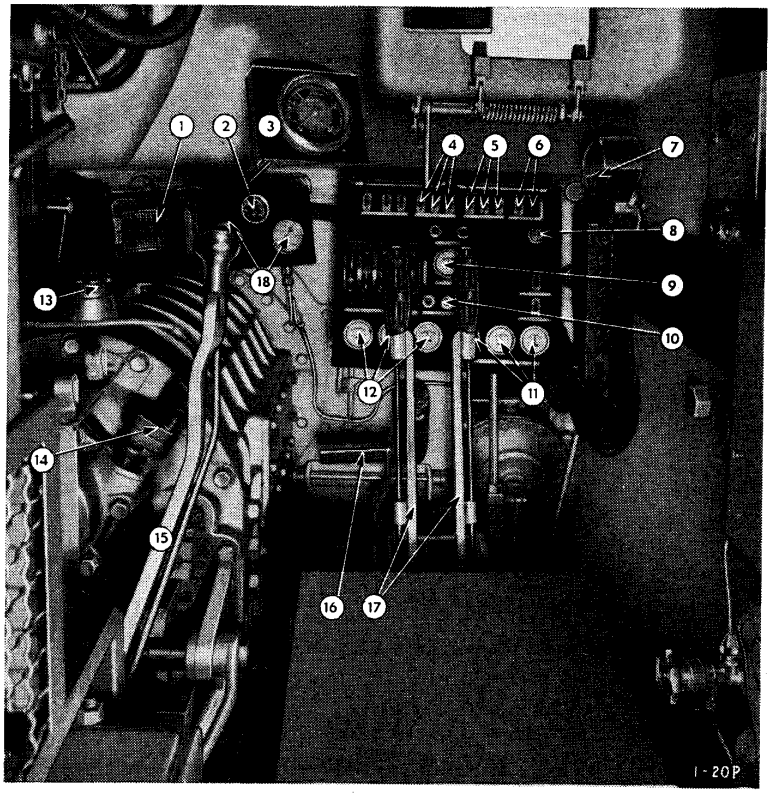


Fig. 4. Front and L.H. side view

Fig. 5.

Driver's Compartment

1. Tachometer.
2. Oil pressure gauge gear box pump.
3. Speedometer.
4. Ignition switches.
5. Starter switches.
6. Emergency starter switches.
7. Fire extinguisher push button.
8. Starter push button.
9. 12-volt ammeter.
10. Red tell-tale lights oil circulation.
11. Engine temperature.
12. 6-volt ammeter.
13. Gear box filler.
14. Speedometer drive.
15. Gear shift lever.
16. Clutch pedal.
17. Steering levers.
18. Air pressure gauges.



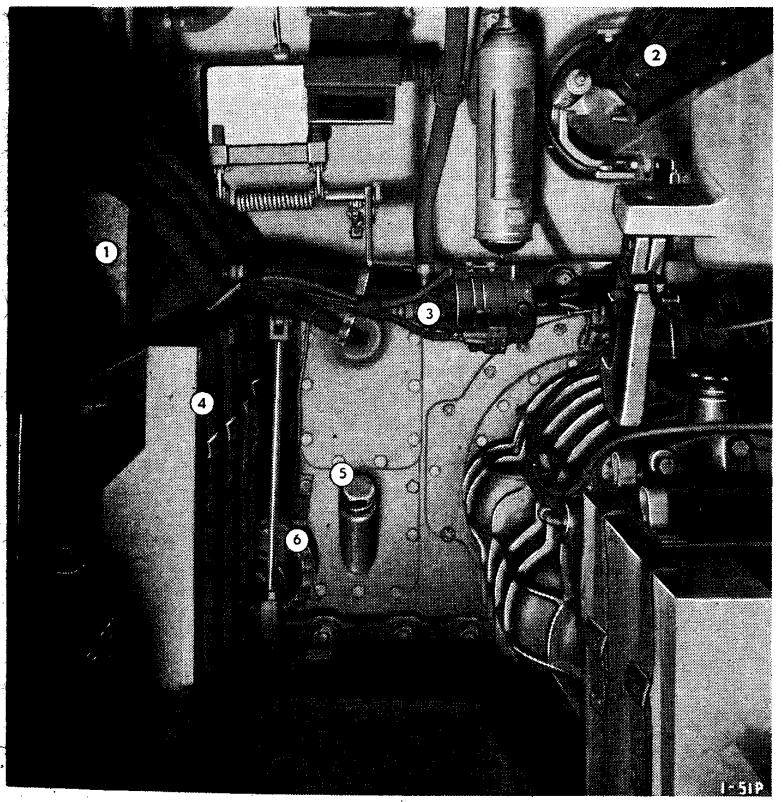


Fig. 6.

Gunner's Compartment

1. M.G. water tank.
2. Machine gun.
3. M.G. water pump.
4. .303 ammunition box.
5. Differential filler.
6. Diaphragm air brake.

HULL AND FITTINGS

The hull (see Figs. 2, 3 and 4) consists principally of four main castings of armour plate; these include the nose, main body, turret and power unit cover plate.

Nose:

The nose is a separate casting which is bolted to the machined face of the main body. It houses the front axle drive assembly, braking components, final drive and gearbox pinion.

Main Body:

The main body is a large one-piece casting to which all the above mentioned smaller castings are fitted. For purposes of description it can be divided into three sections - front, middle and rear.

The front compartment, (see Figs. 5 and 6) accommodates the driver and forward gunner for whom individual seats are provided. These seats slide forward and backward and are adjustable for tilt. On the right hand side is the driver's compartment containing the various controls and their accessories. On the left is the forward gunner's seat, adjacent to which a Vickers machine gun is installed. A small electric motor, with a centrifugal pump, is bolted to the hull above and to the left of the gear box; its function is to circulate cooling water through the jacket surrounding the barrel of the gun. The motor is described in the section of this manual entitled "Electrical System". The gun is held in position by clamps (friction plates). Hatches are provided above the driver's and the gunner's seats and near each of these hatches is a periscope. In the front of the compartment, and between the driver's and gunner's positions is the gearbox.

The gearbox oil cooler is mounted between the driver's and the gunner's seats; it consists of a radiator through which the oil circulates and a cooling fan driven from the main cardan shaft.

In the middle compartment, just above the floor, are the universal joints, shafts, transfer box, and master clutch. Various electrical components and accessories are also located in this section as well as ammunition for the main armament and machine guns. See

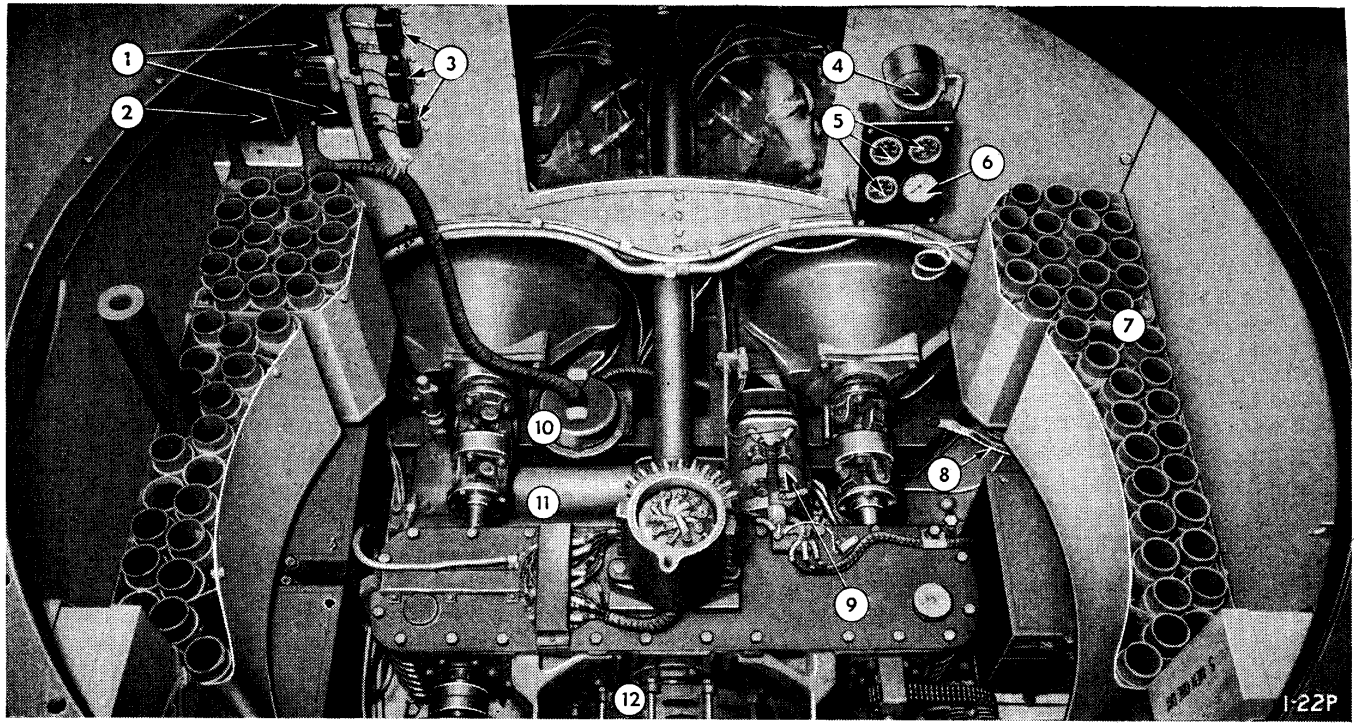


Fig. 7. Central Compartment, looking backward

1. Voltage Regulators.
2. Commander's Ignition Control Solenoid.
3. Ignition Relays.
4. Fire Extinguisher Push Button.
5. Oil Gauges for Nos. 1, 2, and 3 Engines.
6. Air Pressure Gauge.
7. Heavy Ammunition Rack.
8. Earth Strap.
9. 12-volt Generator.
10. Junction Box.
11. Air Reservoir.
12. Master Clutch.

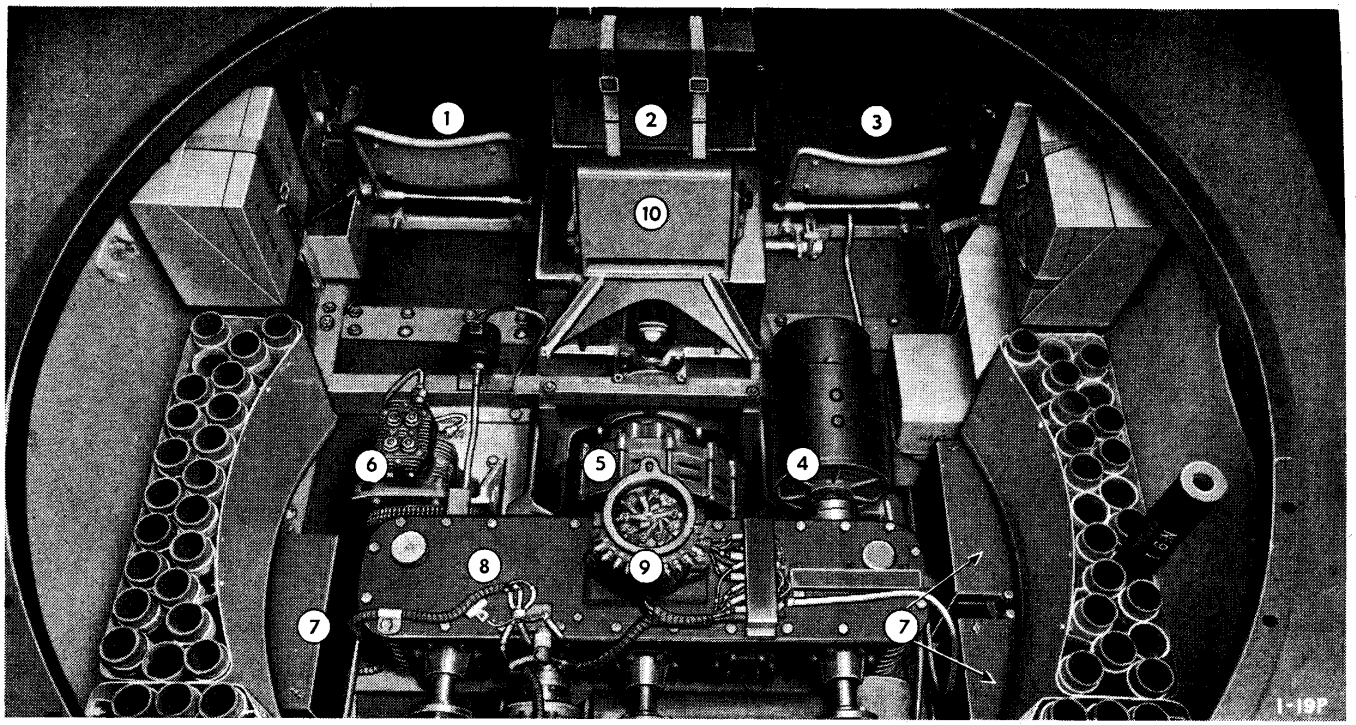


Fig. 8. Central Compartment, looking forward

1. Gunner's Seat.
2. .303 Ammunition Boxes.
3. Driver's Seat.
4. 40-volt Generator.
5. Master Clutch.
6. Air Compressor.
7. Batteries for Nos. 1, 2, and 3 Engines.
8. Transfer Box.
9. Turret Base Junction Connector.
10. Oil Radiator.

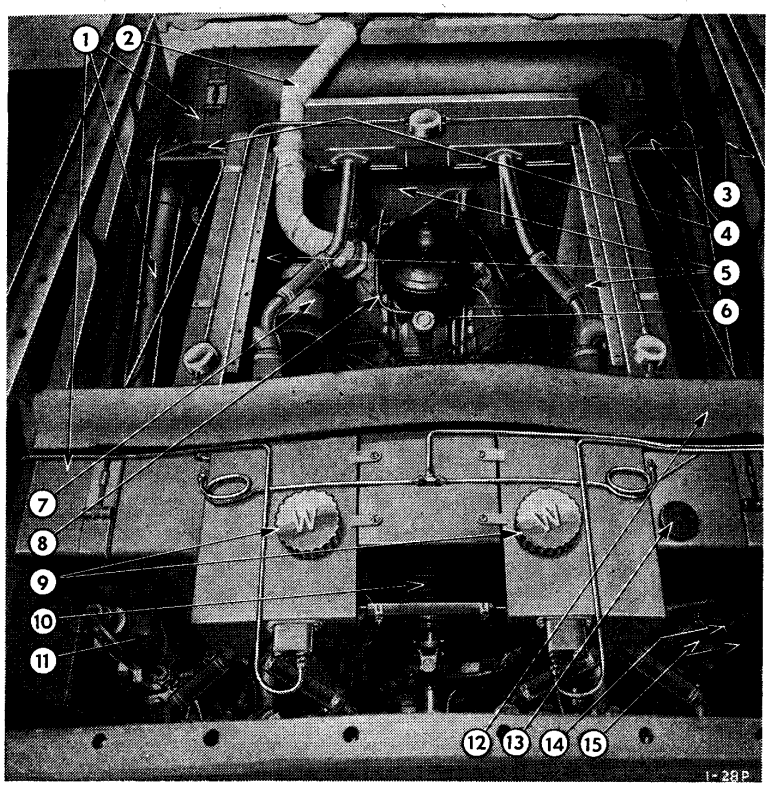


Fig. 9. Rear engine compartment

1. Fuel tank.
2. Rear exhaust pipe.
3. Air vent.
4. Engine unit lifting eyes.
5. Radiators.
6. Oil filler cap.
7. Oil cleaner.
8. Fire extinguisher pipe.
9. Radiator filler caps.
10. Fan driving pulley.
11. Fire extinguisher bottles.
12. Felt seal.
13. Fuel filler cap.
14. Fire extinguisher bottle.
15. Fire extinguisher bottle.

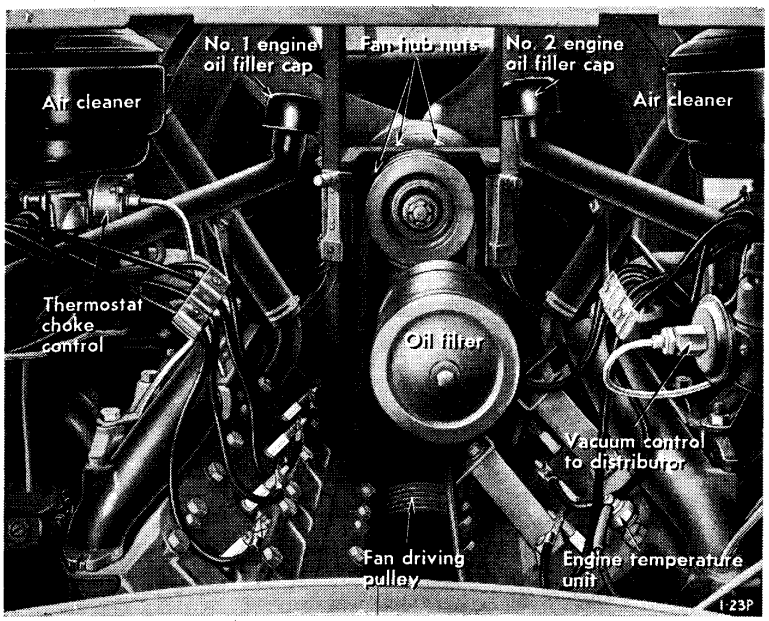


Fig. 10. Close up of Nos. 1 and 2 engines through bulkhead aperture

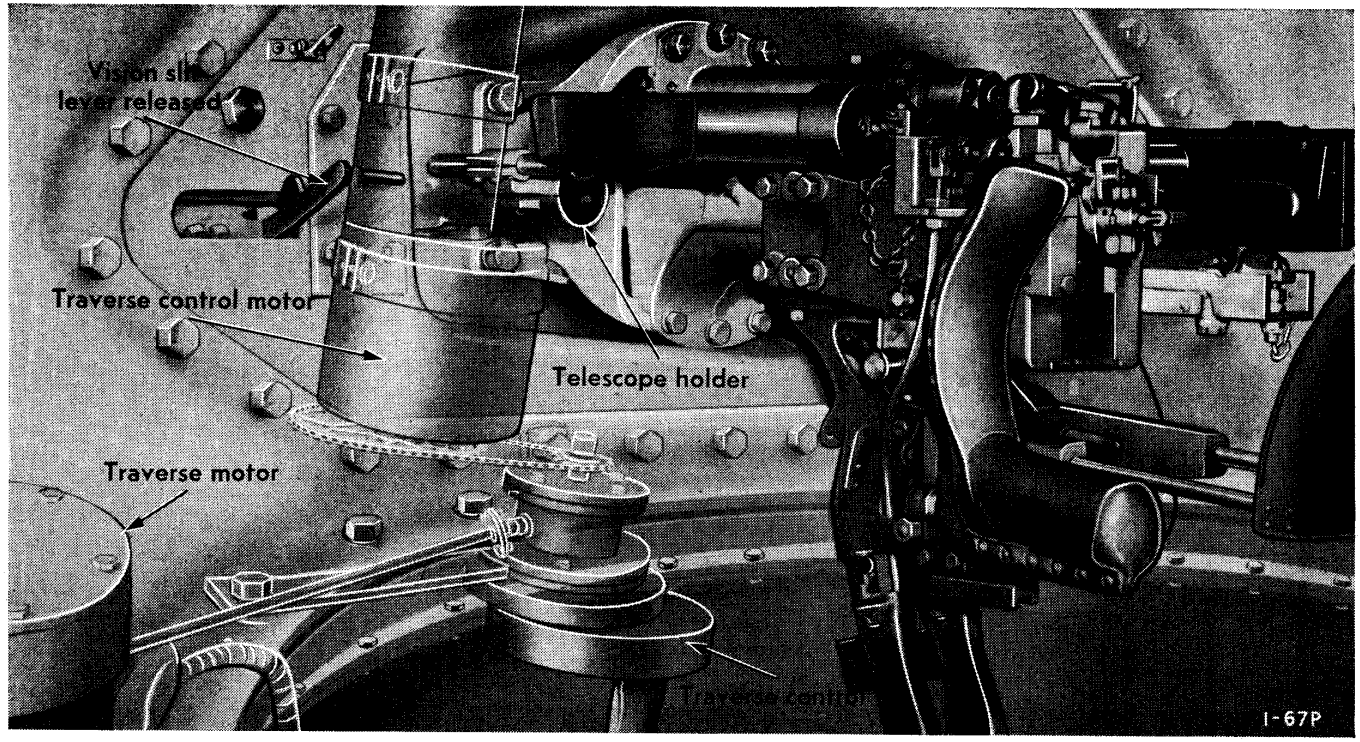


Fig. 11. R.H. view turret interior

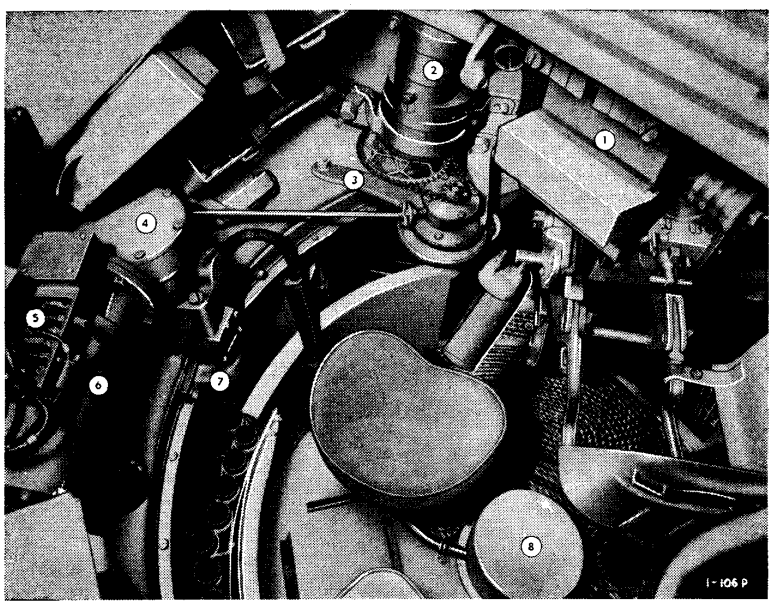


Fig. 12. L.H. view Turret interior

1. Periscope.
2. Control Motor.
3. Operator's Control of Motor.
4. Bevel Gears.
5. Terminal Box.
6. Traverse Motor.
7. Gear Engaging Turret Internal Ring Gear.
8. Base Junction Connector.

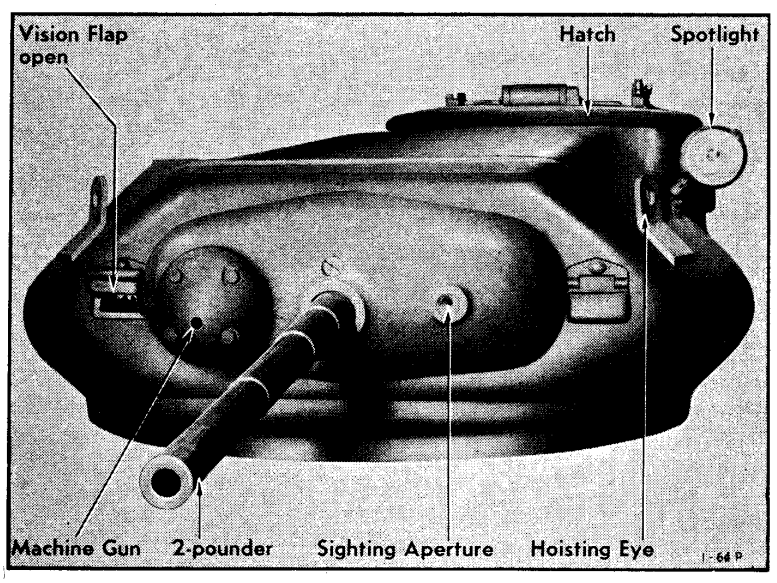


Fig. 13. Turret detached.

Figs. 7 and 8). A wheel operated escape hatch is provided on each side of the Tank. See Fig. 1 for location.

The rear compartment houses the power unit, radiators, petrol tanks and fan. See Figs. 9 and 10. The engines cover plate forms the roof of this compartment and is bolted to the main body. The removal of this plate permits the lifting of the engines, as a unit, out of the hull. Three hatches are located one above each engine to provide for refilling radiators and petrol tanks and for adding engine oil. See Fig. 3.

A track cover plate extends along the full length of the Tank on each side. On top of each of these plates, parallel with the centre of the hull, is a tool box. For contents of these tool boxes and other equipment attached to the hull, see "Packing List" at the back of this manual.

Turret:

The turret is supported, centrally, on top of the main body and in it is mounted the main armament. Suspended from the turret is the fighting basket which accomodates the commander, gunner and loader. The turret is supported on ball bearings and can be rotated either electrically or manually. The commander's cupola forms the near-side half of the turret roof. It is divided into two segments which work on hinges and are pushed open from inside the turret.

A detailed description of the electrical arrangements for rotating the turret will be found in this manual under the heading "Turret Traverse Operating Mechanism" in the "Electrical System" section.

The turret has a full circle traverse and contains a two pounder gun, a machine gun and a wireless set. See detailed description under "Electrical System" for particulars regarding machine gun water cooling motor and wireless circuits. Figs 11, 12 and 13 provide interior and exterior views, together with the various components and accessories attached to and contained in the turret.

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CONDENSED SPECIFICATIONS

GENERAL DIMENSIONS

Length (overall)	- 20 ft. 9 ins.
Height "	- 8 ft. 4¾ ins.
Width "	- 9 ft. ⅛ ins.
Width of track centre to centre	- 7 ft. 6½ ins.
Ground clearance	- 15½ ins.
Minimum turning circle	- 58 ft. diameter.
Width of trench spanned	- 8 ft.
Weight (unladen)	- Approx. 26 tons.
Total area of track (steel) in contact with the ground	- 32 square ft.
Bogie wheel loading	- 43-1/3 cwt. each.
Ground pressure	- 13.4 lbs. per sq.in.

MAXIMUM PERMISSIBLE SPEEDS AT 3,600 R.P.M.

Fifth gear	29.5 m.p.h.
Fourth "	22.0 m.p.h.
Third "	12.5 m.p.h.
Second "	6.0 m.p.h.
First "	3.0 m.p.h.
Reverse "	3.5 m.p.h.

MAXIMUM TRAINING SPEEDS AT 3,000 R.P.M.

Fifth gear	24.0 m.p.h.
Fourth "	18.5 m.p.h.
Third "	10.5 m.p.h.
Second "	5.0 m.p.h.
First "	2.5 m.p.h.
Reverse "	3.0 m.p.h.

ENGINE

Make	- Cadillac "75"
Total number of engines	- Three
Arrangement	- Clover leaf
No. of cylinders per engine	- Eight
Firing order	- 1,8,7,3,6,5,4,2.
Compression ratio	- 6.25 to 1
Compression pressure at cranking speed	- 110 lbs. per sq. in.
Total combined B.H.P.	- 330 at 3.050 r.p.m.
Normal oil pressure	- 25 lbs. per sq. in.
Idle oil pressure	- 15 lbs. per. sq. in.
Carburettor:	
Make	- Stromberg A.A.V. 26
Type	- Downdraft.

TRANSMISSION & DRIVE

Transfer case ratio	- 1 to 1
Differential pinion	- 17 teeth
Differential crown wheel	- 60 teeth
Final Drive pinion	- 23 teeth
Final Drive spur wheel	- 73 teeth

Drive Sprockets:		Rubber Track	Steel Track
No. of teeth	-	13	20
Pitch	-	6 ins.	4 ins.
Tracks:			
No. of links	-	86	129

Gear	Overall Ratio	Engine r.p.m.	Road Speed
First	62.04 : 1	3,000	2.5
Second	26.81 : 1	"	5.0
Third	10.75 : 1	"	10.5
Fourth	8.4 : 1	"	18.5
Fifth	6.35 : 1	"	24.0

ELECTRICAL

Ignition:

System	-	Delco Remy
Distributor	-	Delco Remy
Ignition coils	-	6 volt
Distributor rotation	-	Clockwise
Distributor points gap	-	0.0125 in. to 0.0175 in.
Spark plugs	-	10 m.m.
Spark plug gap	-	0.025 in.
Spark advance	-	Automatic
Timing	-	5 degrees before t.d.c.

Generator:

Make	-	Delco Remy
Drive	-	V Belt
Rotation	-	Clockwise

Batteries:

Type	-	6 volt 17 plate
Total number of batteries:	-	Five
Automotive	-	Three: positive earthed
Wireless	-	Two in series

CAPACITIES

Combined radiators	-	23 Imp. gals.
Combined fuel tanks	-	140 Imp. gals.
Transfer case	-	4 Imp. gals.
Gearbox, differential and final drive combined	-	17 Imp. gals.
Crankcase (each)	-	2¾ Imp. gals.

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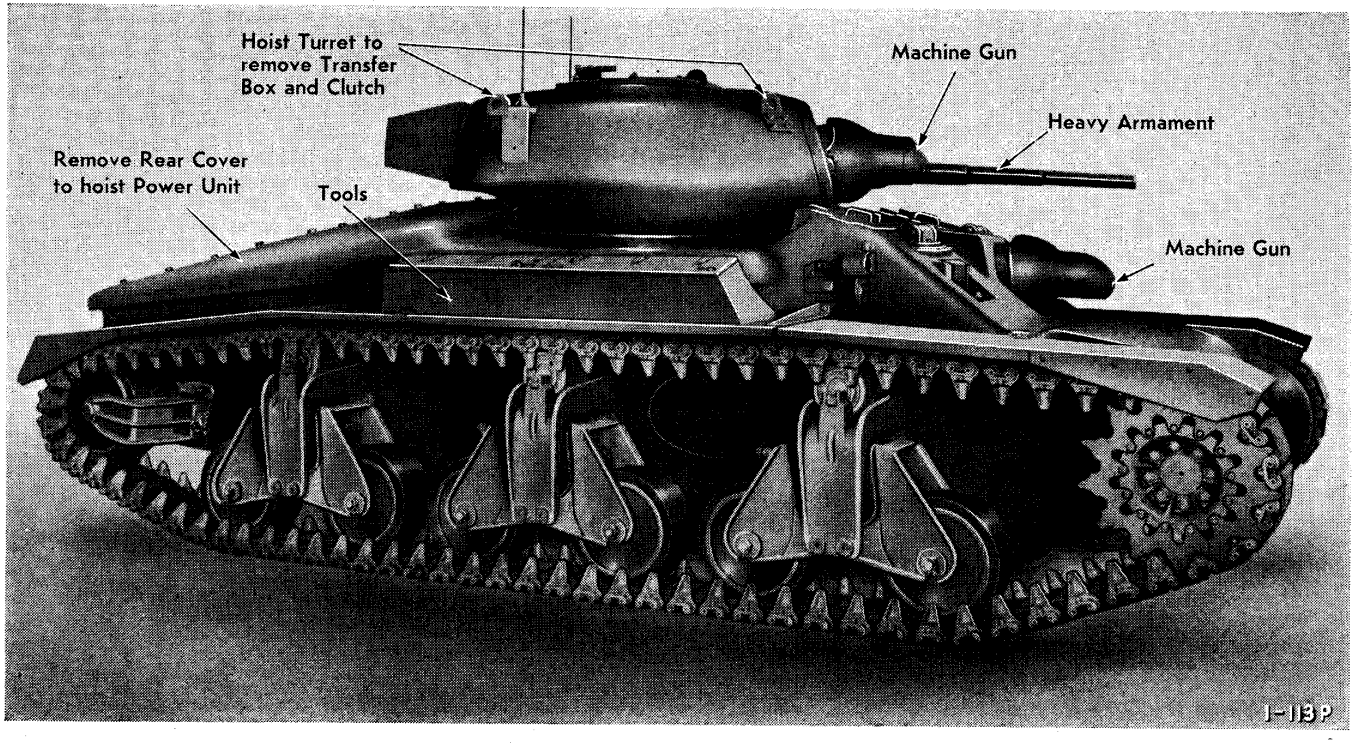

Fig. 2. R.H. side view of A.C. Mk. 1 Tank

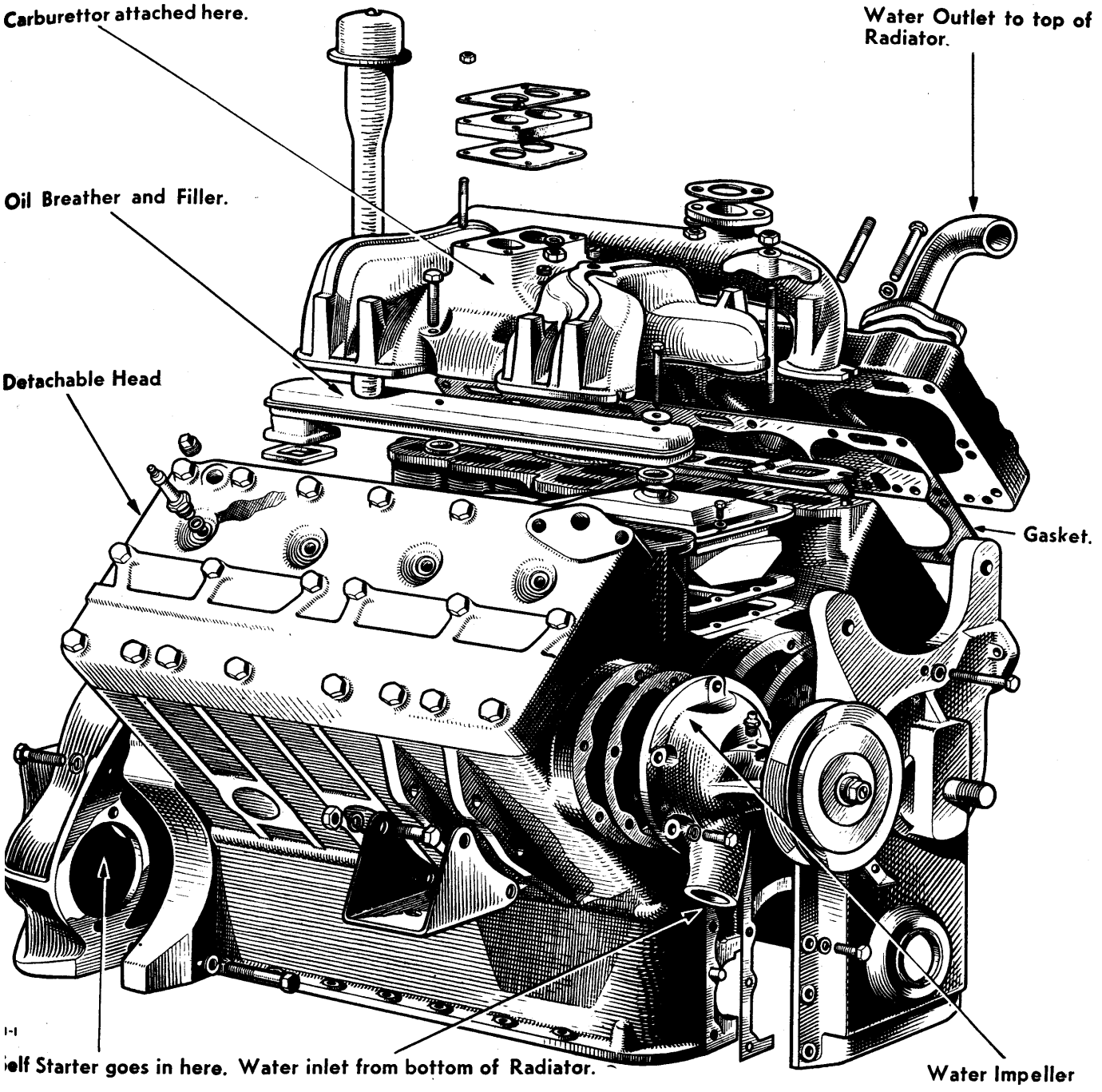

Fig. 14. Cylinder block arrangement

POWER UNIT

Engines:

The power unit is composed of three Cadillac "75" engines which are arranged in "clover leaf" formation. They, together with fuel tanks, radiators and fan assembly, are mounted on a sub-frame and their combined power is transmitted through clutch drives to the transfer box. For descriptive purposes, a single engine is taken in detail and divided into five sections:- Mechanical, Fuel, Electrical, Cooling and Lubrication. The description of the electrical section will be found under "Electrical System" elsewhere in this manual.

Mechanical:

The cylinders are set at 90 degrees and the blocks are staggered approximately 1½ ins. to allow the connecting rods to work side by side on the same crank pin. See Fig. 14 for cylinder head arrangement. The cylinders and heads are of cast iron and the sump is of sheet steel. The crankshaft is four throw, with two rods per throw. The connecting rods are H section and are rifle drilled for pressure lubrication to the gudgeon pins. The pistons are T slot aluminium alloy with four rings per piston, all are above the gudgeon pin. The gudgeons, which are secured by circlips in the piston boss, are hollow and full floating both in the rod and in the piston. There are two compression and two oil rings. The valves are lifted by hydraulic valve lifters, thus the clearance is automatically adjusted and no maintenance is necessary excepting at overhaul periods. The valve seat angle is 45 degrees. Sectional and cross-sectional views of the Cadillac engine are supplied in Figs. 15 and 16.

Fuel System:

Each engine is fitted with a Stromberg dual downdraft carburettor, model A.A.V. 26. The carburettor has the following features: accelerator pump, slow and fast idle, thermostatic choke control. An air cleaner of the oil bath type is fitted to each carburettor. Fig. 17 provides an exploded view of the carburettor.

Mechanical Fuel Pump:

A standard Cadillac mechanically operated fuel pump is fitted to each engine.

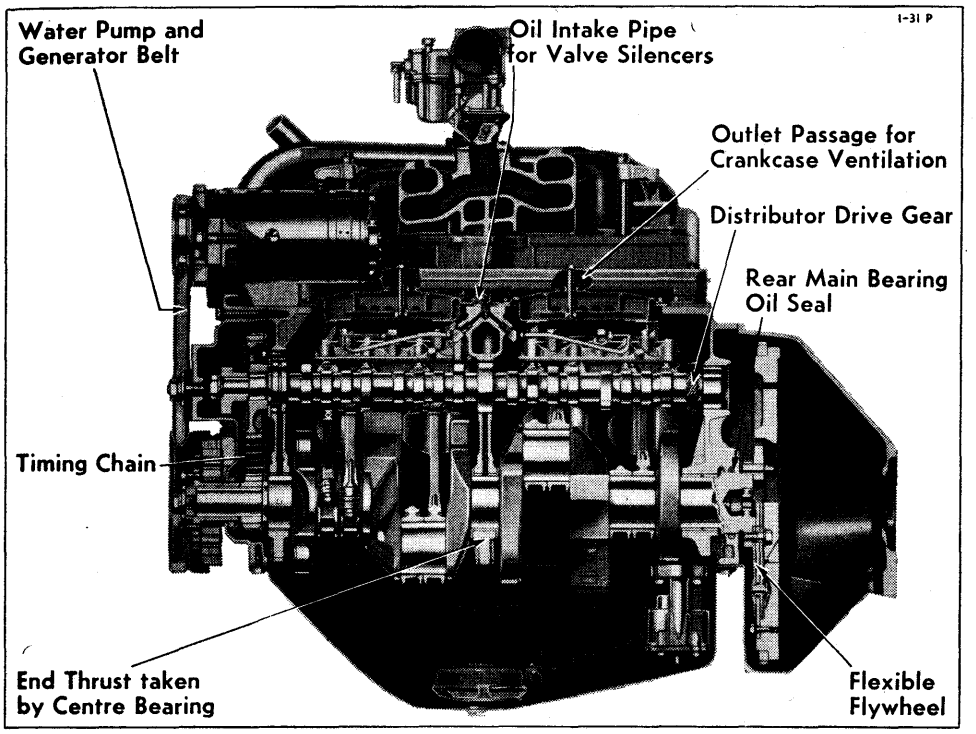

Fig. 15. Sectional view of Cadillac engine

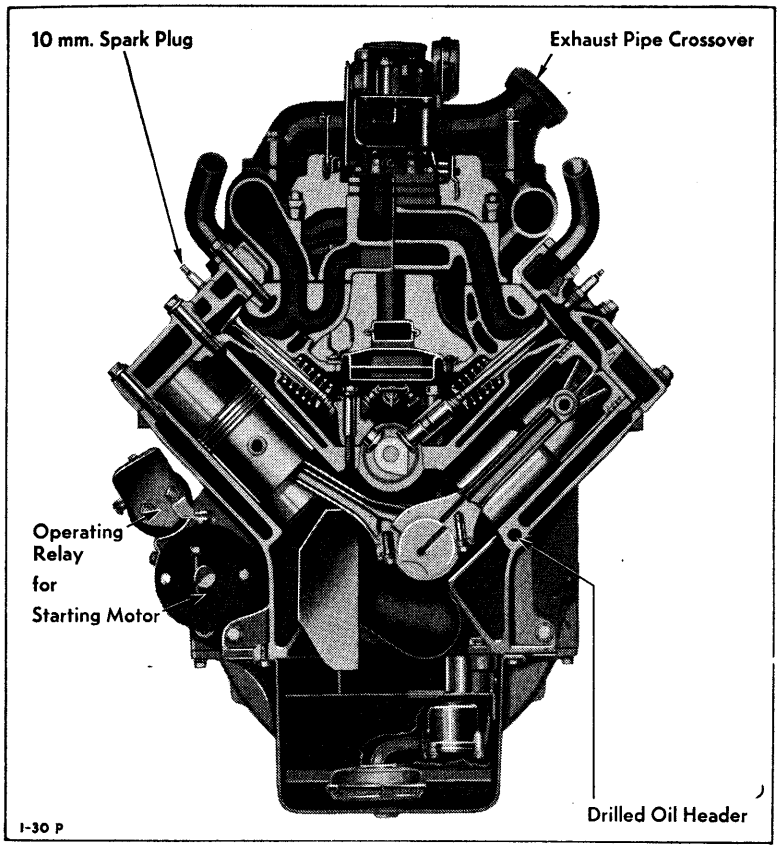

Fig. 16. Cross sectional view of Cadillac engine

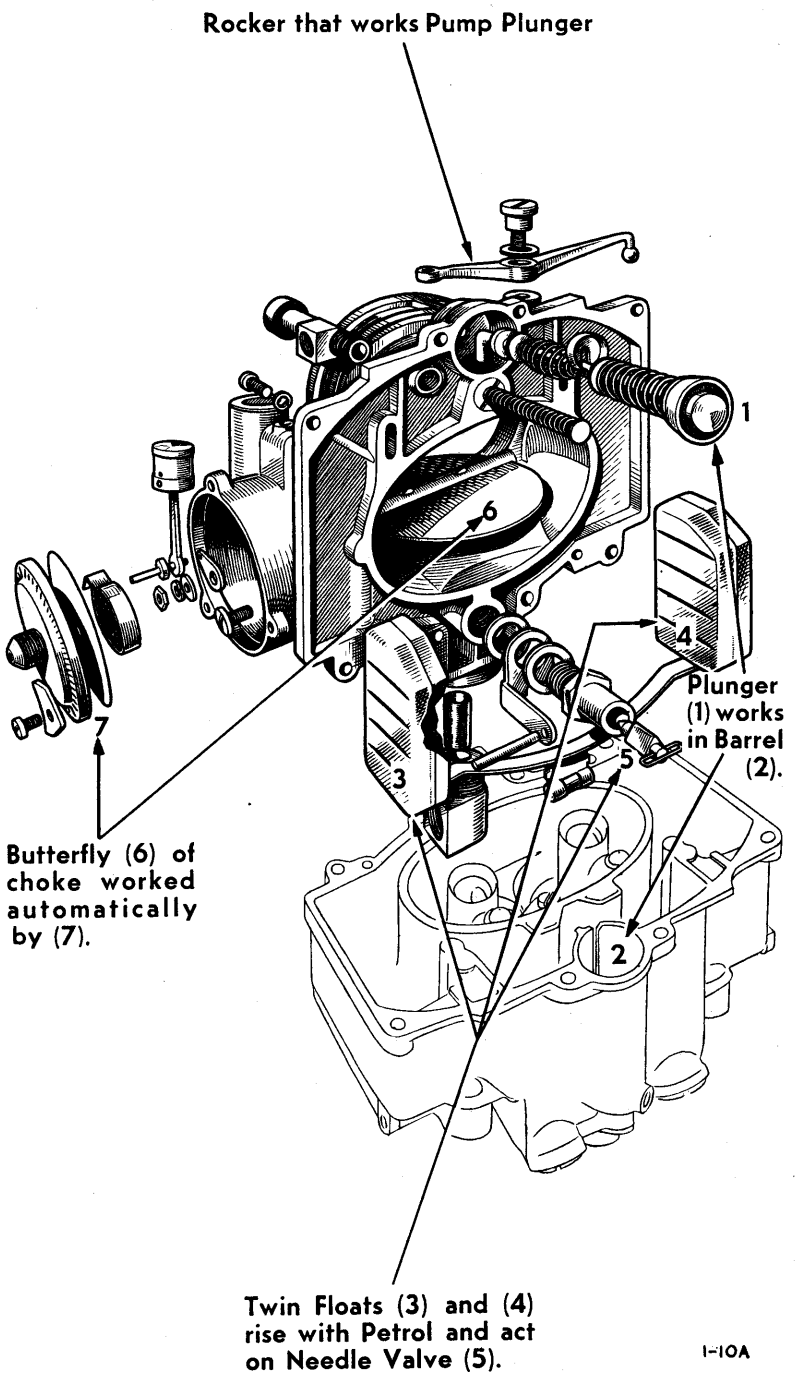

Fig. 17. Dismantled view of Carburettor

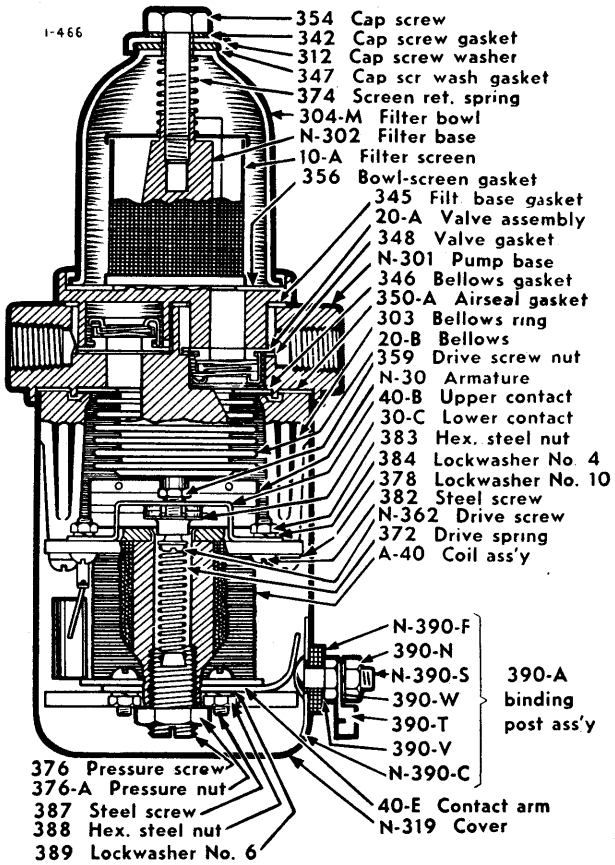

Fig. 18. Sectional view of autopulse pump. Filter bowl and screen only to be adjusted by crew. Other components *not* to be dismantled by crew

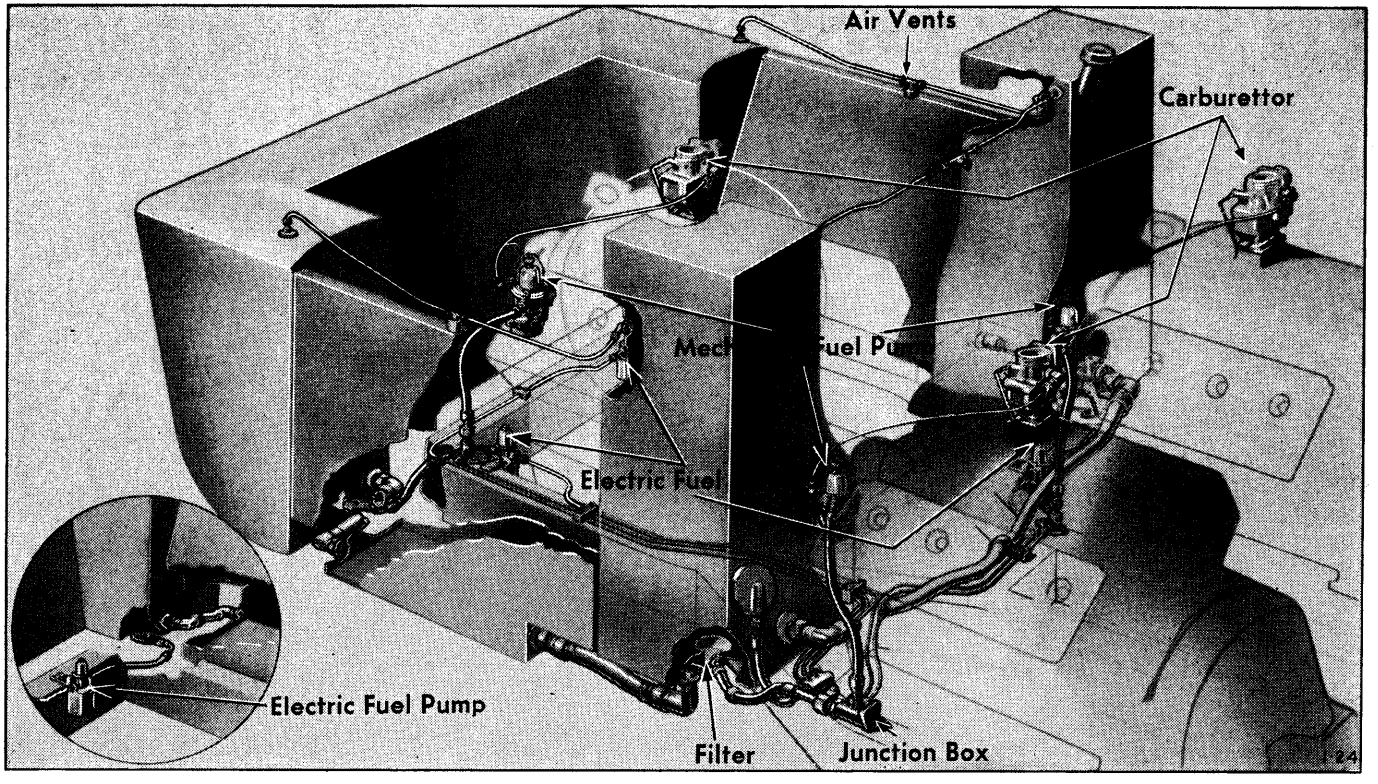

Fig. 19. Fuel system showing tanks, line and controls

Electric Fuel Pump:

To ensure that a sufficient supply of fuel will be available for the continuous functioning of each engine even over undulating country with steep inclines, an additional pump - namely an Autopulse electric pump - is fitted to each of the three fuel lines. The operation of these electric pumps is controlled by a float valve in the near-side front fuel tank. This tank acts as a header. Fig. 18 shows sectional view of Autopulse pump.

Fuel Tanks:

There are five fuel tanks, all inter-connected. A study of Fig. 19 shows how they are situated around the radiators.

Ignition:

The ignition is described in detail in the section of this manual entitled "Electrical System".

Cylinder Numbering:

The left front cylinder is numbered 1. All odd numbered cylinders are in the left bank and even numbered in the right bank.

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COOLING SYSTEM

Three radiators, one serving each engine, are arranged around the sides and rear of the single rear engine, forming three sides of a box. A cover plate of sheet metal becomes, in effect, the top of the box and the bottom is represented by a plate attached to the lower surface of the sub-frame. The sixth and forward side is open and occupied by the single cooling fan and its shroud. Thus an air duct is formed which ensures that the draught created by the rotation of the fan is conducted over the cooling surfaces of the radiators.

The space between the fan shroud and fuel tanks is sealed on both sides by the provision of sheet steel baffles with sponge rubber sealing strips, arranged so that the fan shroud has some degree of freedom.

Radiators:

The radiators are of fin and tube core construction, the core area of each radiator is approximately 6¼ square feet. Each radiator is fitted with a screw type filler cap, and pressure relief valve set to blow off at 6 lb/sq. in. During operation, the effect of this pressure is to raise the boiling point of the water to 228 degrees F. and thus prevent water losses which would otherwise occur.

The radiators are cushioned by rubber pads and are secured by straps to the sub-frame which supports the power unit, petrol tanks etc.

Impeller:

The water is circulated under light pressure, through the blocks of both cylinders, by a standard Cadillac impeller (pump). This impeller is situated in the front of the right hand block looking from the clutch towards the generator.

Access Hatch in Radiator Cover Plate:

A hatchway in the cover plate provides access to the three radiator fillers and to the oil filler for the rear engine. The hatchway cover is held in position by four spring-loaded latches - one at each corner.

Fan:

The fan is a four-bladed propeller of laminated wood, 27 inches in diameter. It is bolted to a centre hub which is keyed to a shaft. The shaft runs in two ball bearings which are housed in a mechanite casting; this casting is bolted to the fan support structure. The fan is driven by six "V" belts which run in a multiple-grooved pulley from the clutch shaft of the rear engine. Constant tension of the fan belts is maintained by a spring-loaded jockey pulley.

Fan Support Structure:

The fan shaft bearing housing is supported by two pressed steel channels which are bolted either side of the rear engine support casting.

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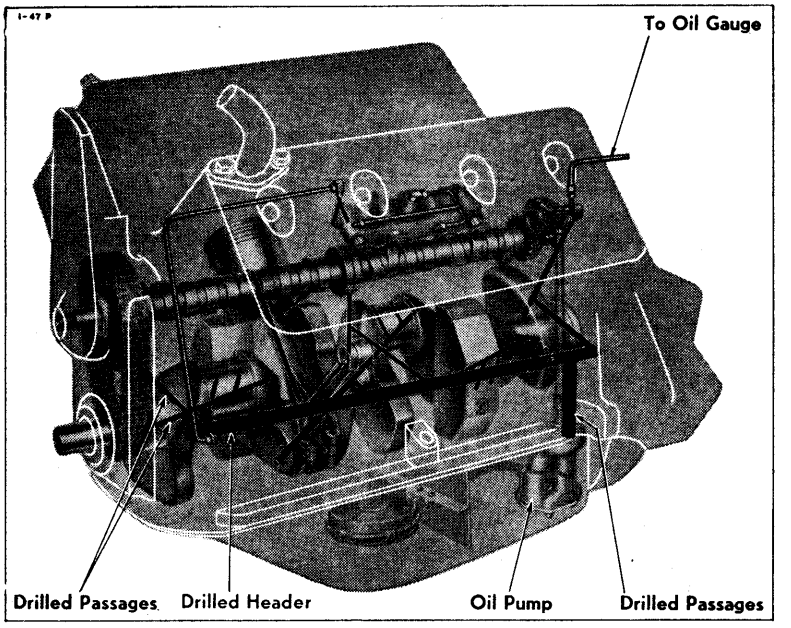

Fig. 20. Engine Oiling System

LUBRICATION SYSTEM

Each of the three engines has its own lubrication system which is on the full forced feed principle. The oil is carried in the sump and is delivered under pressure by a gear-type pump to the oil header which is drilled lengthwise along the left side of the crankcase. See Fig. 20.

Other drilled passages branch through the support webs to the main and camshaft bearings. One from the main bearings passes through the drilled passages to the crank pins, where part lubricates the connecting rod bearings; a portion flows up from these bearings to the piston pins. The lubricant is squirted out on to the cylinder bores from small holes in the connecting rod big ends.

Oil is carried from the rear camshaft bearing to the distributor, oil pump drive shafts and gears, and from the front bearing to the timing chain and is piped to the hydraulic valve lifters.

Sump:

A special large capacity sump has been provided for each engine in order to compensate partly for the wide variations in speeds over which the engines operate and the difficulty of keeping the engine sumps cool.

Oil Circulation Indicator:

Oil circulation is indicated by a red tell-tale light on the instrument panel and by a Bourdon type pressure gauge calibrated in lb. per sq. in., mounted on the engine compartment bulkhead.

Oil Filters:

These units are A.C. military pattern, detachable type and are mounted in a horizontal position on brackets on the cylinder head of each engine.

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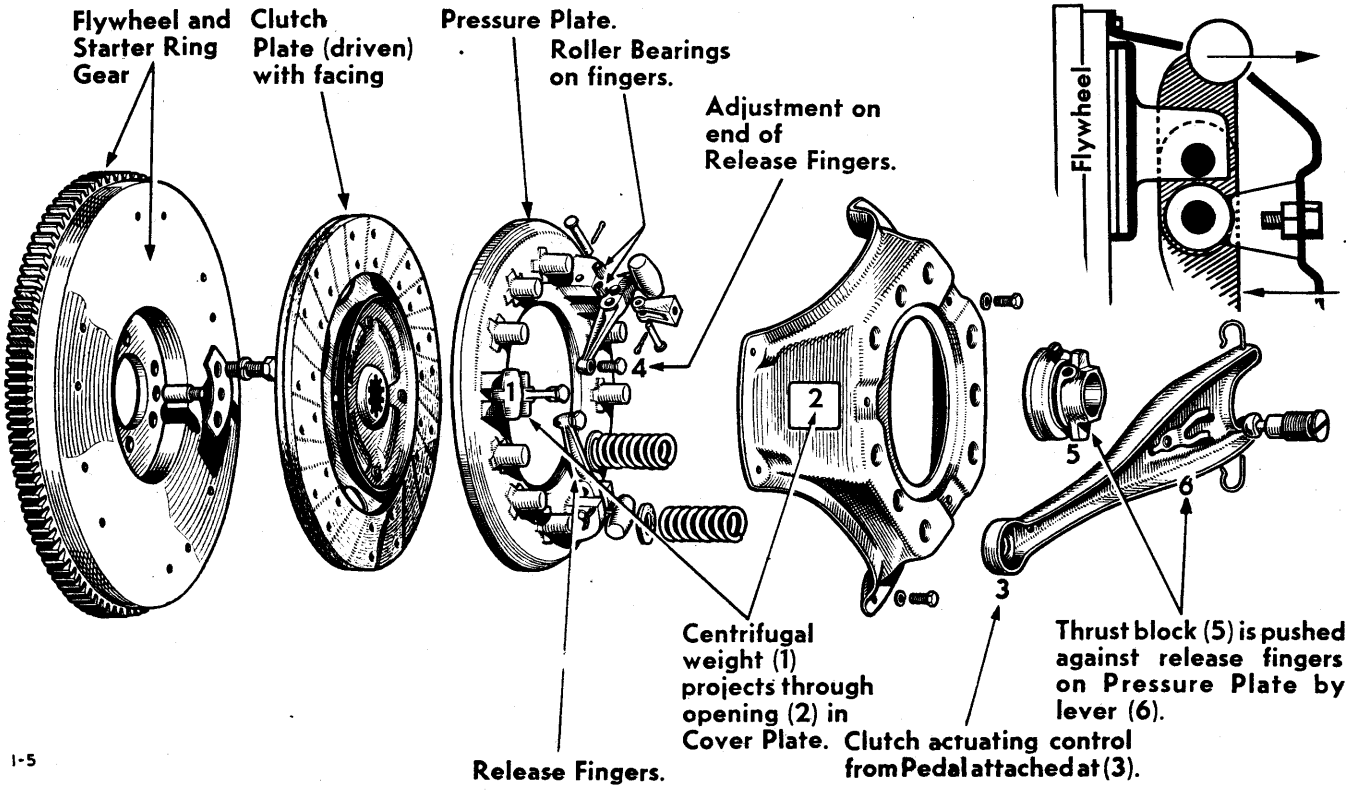

Fig. 21. Individual engine clutch

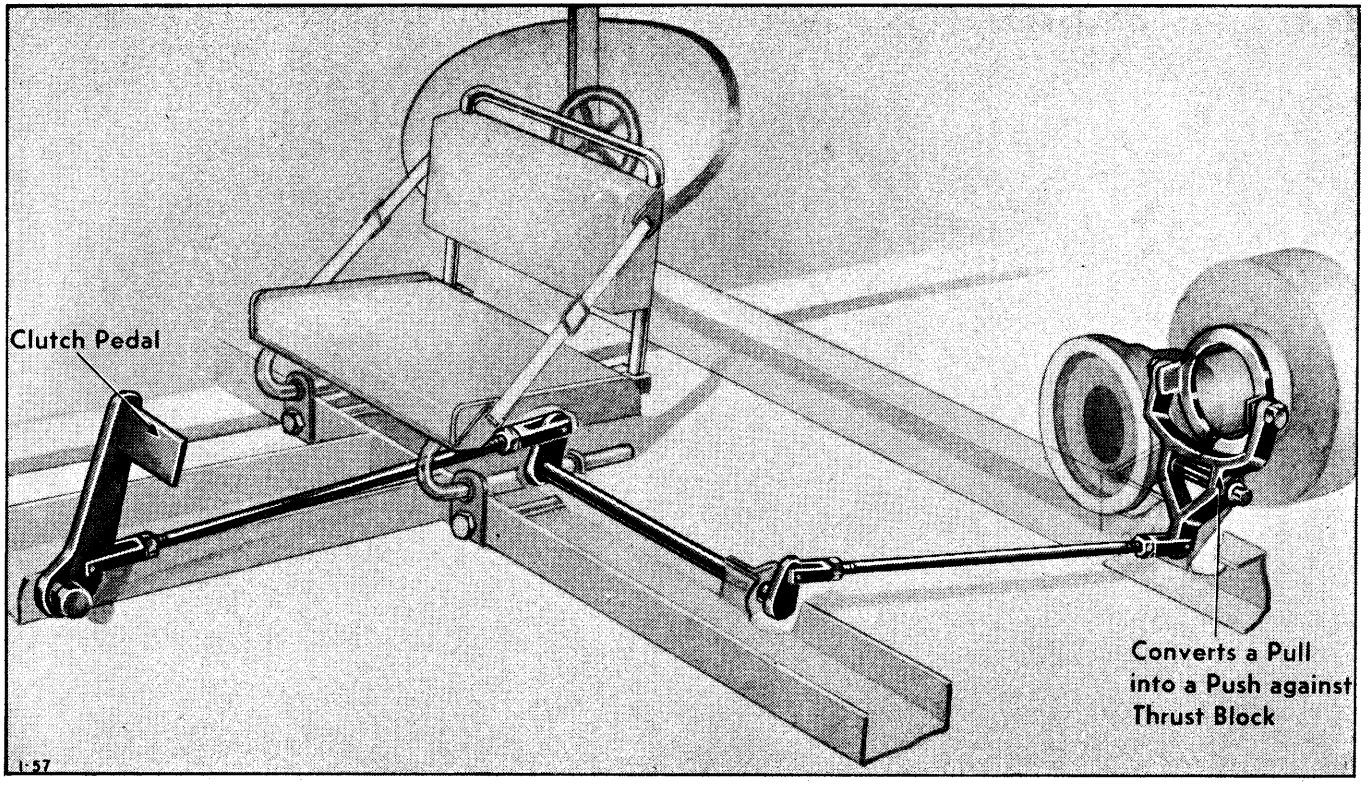

Fig. 22. Master clutch operating mechanism

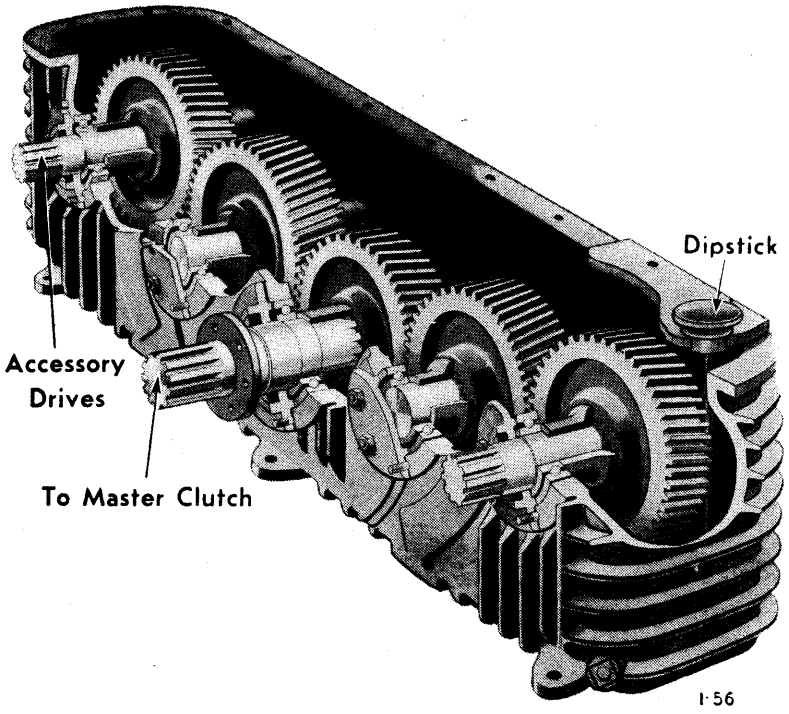

Fig. 23. Transfer box

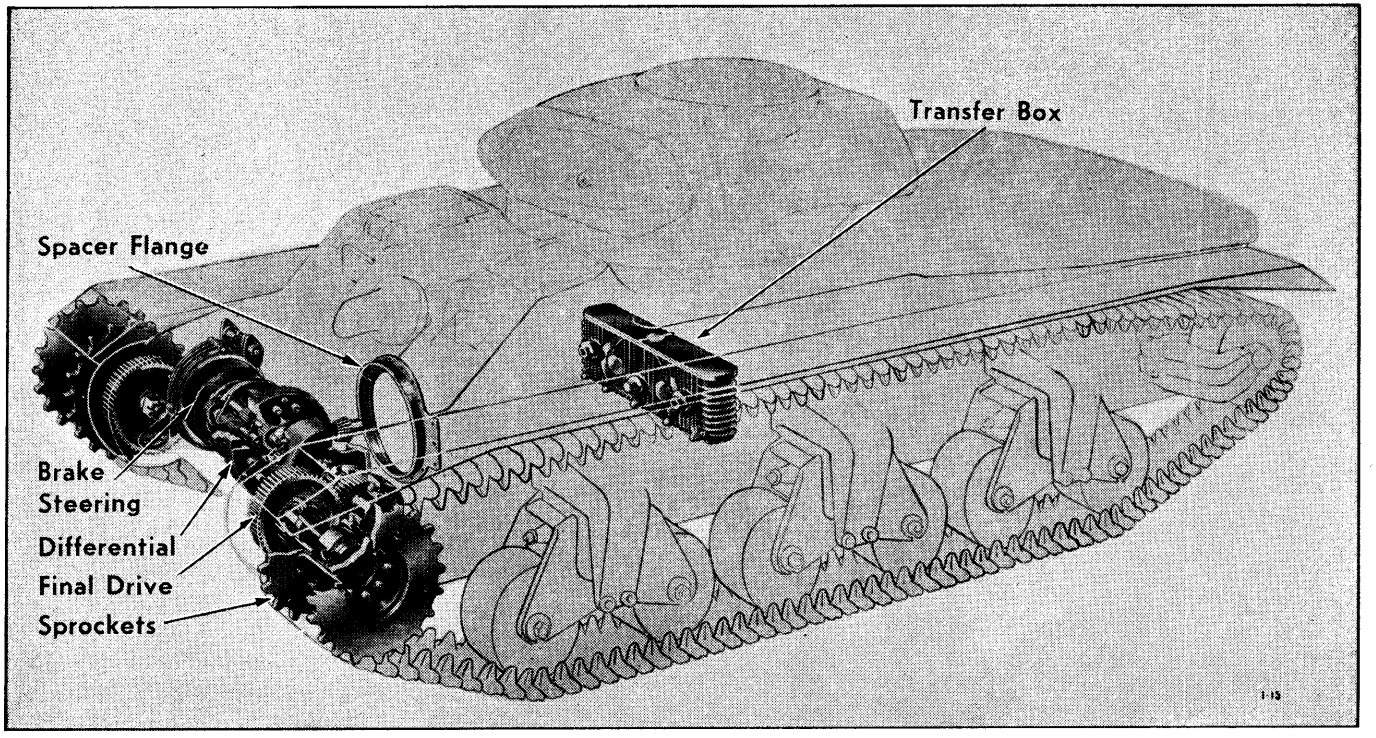

Fig. 24. Front axle assembly

TRANSMISSION

Each engine has its own drive shaft which is coupled to a transfer box. From this transfer box the combined power of the three engines is transmitted to a master clutch through a single drive shaft to the gear box, then to the controlled differential and lastly to the final drive gears and to the tracks.

The drive shafts from the two front engines to the transfer box are identical. The shafts are splined at each end, one end fitting the clutch plate and the other end supporting the universal joint coupling. Each shaft fits through the clutch plate into a pilot bearing in the flywheel and is supported by a ball race mounted at the rear end of the clutch housing.

The drive shaft from the rear engine is much longer than the others and carries the fan drive pulley.

The universal joints used on these shafts are of the noodle bearing type and each shaft is free to move on the splines at the transfer case end.

Engine Clutches and Master Clutch:

The engine clutches are standard Cadillac equipment of the single dry-plate type. These three clutches are permanently engaged, thereby eliminating the necessity for maintenance. In the event of a break down, any engine can be isolated by releasing its clutch or by removing the drive shaft assembly between the engine and the transfer box. One of these clutches is shown (dismantled) in Fig. 21.

The master clutch is of the dry multi-plate type and consists of two driving, three driven plates and a spring loaded pressure plate. This clutch is operated by rod linkage as shown in Fig. 22 and is controlled by the clutch pedal in the driving compartment.

Transfer Box:

The transfer box contains five helical cut gears in constant mesh, see Fig. 23. It is mounted on a sub-frame clear of the hull floor directly below the turret. Fig. 24 shows position of transfer box in hull.

As the transfer box is simply a train of gears arranged to transfer the combined power of the three engines

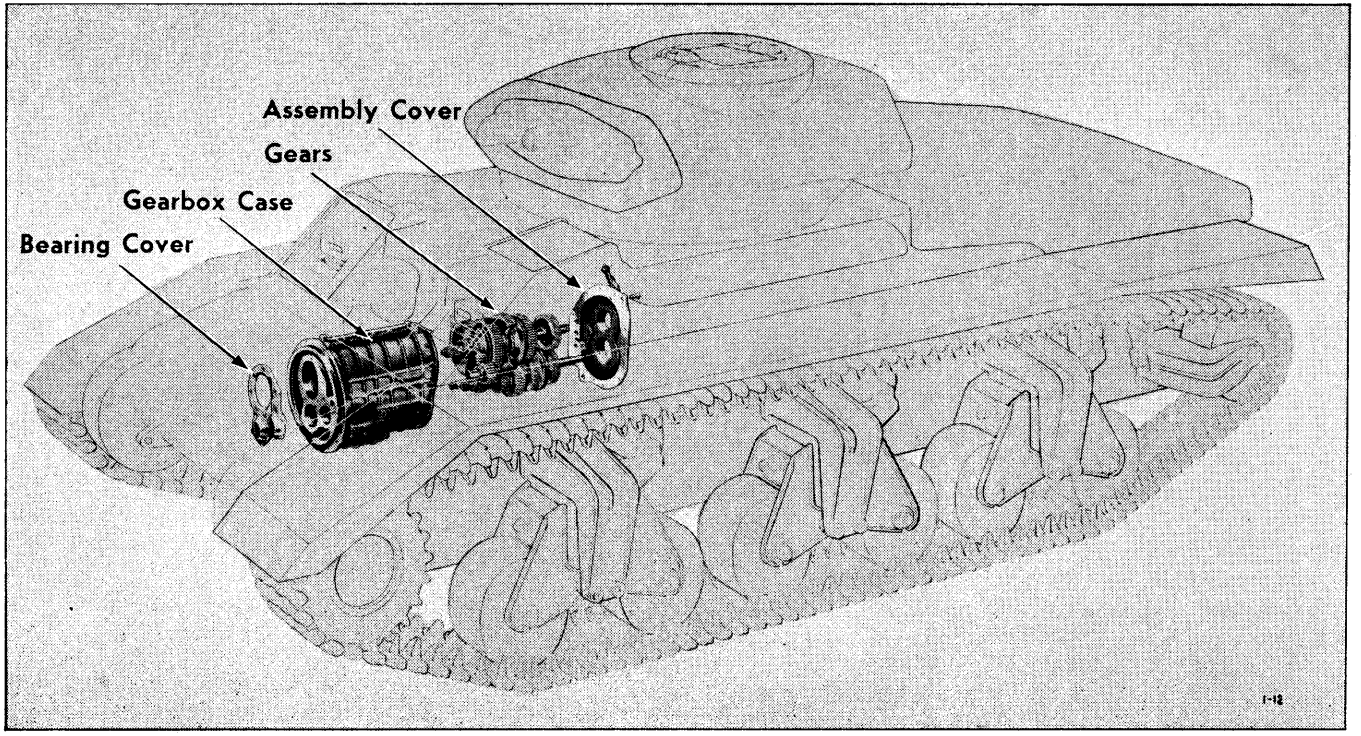

Fig. 25. Position of gearbox

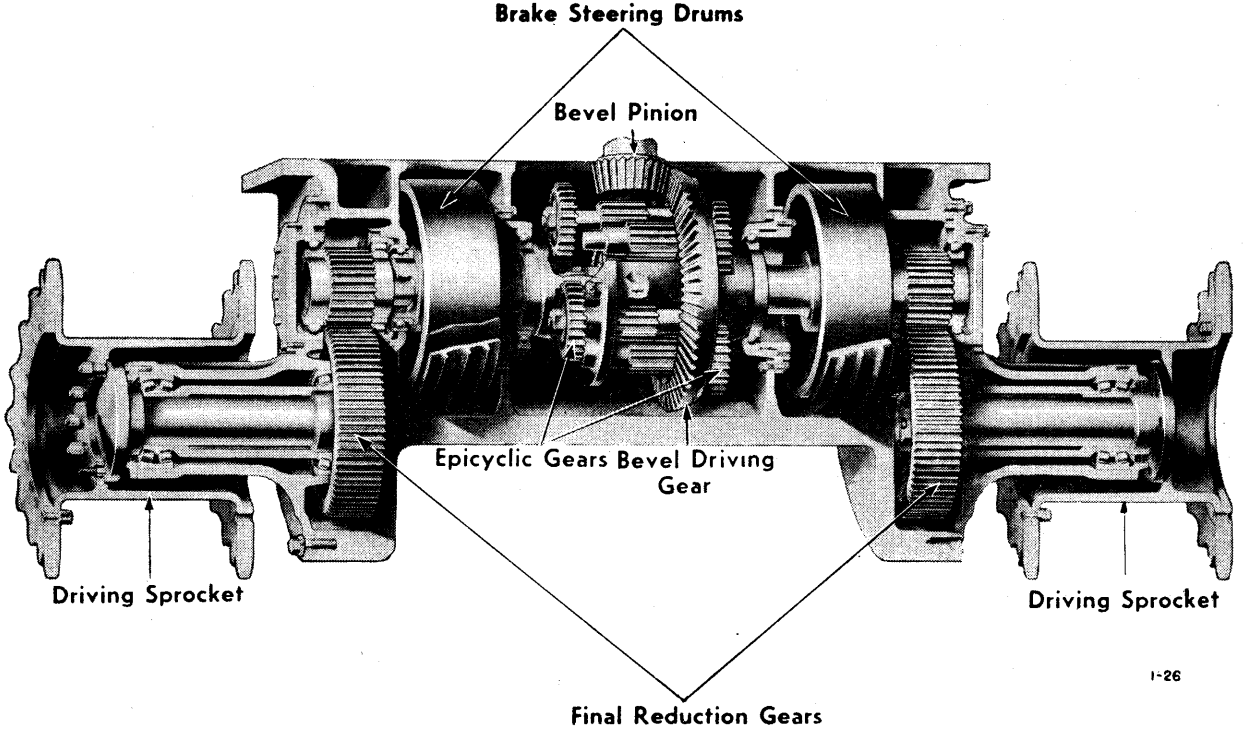

Fig. 26. Front axle assembly, showing Final Drive

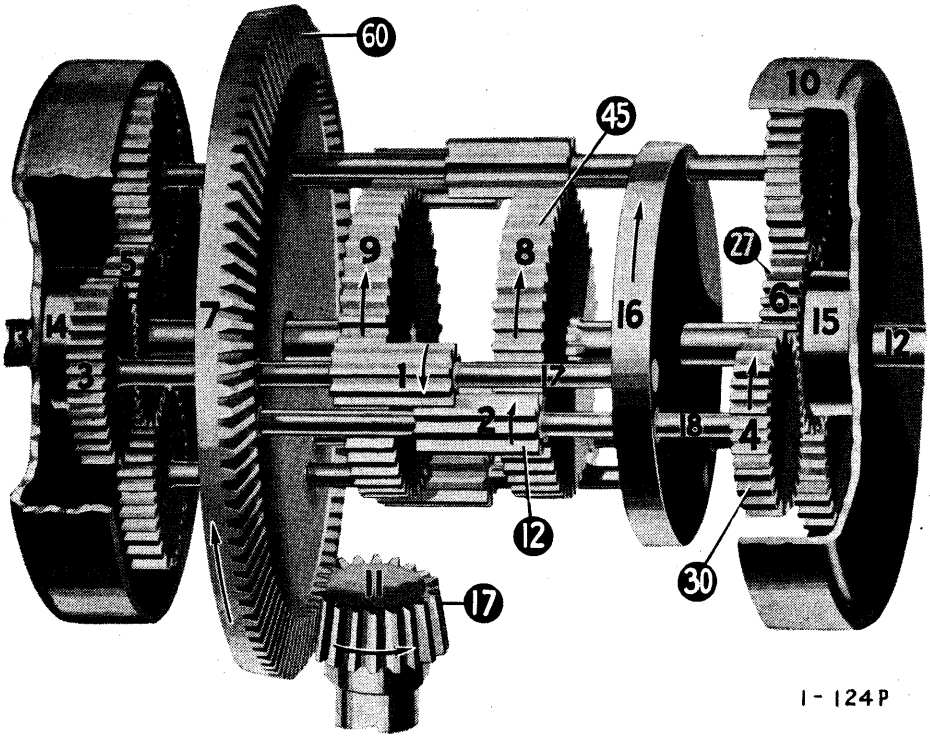

Fig. 27. Controlled Differential Assembly

to one main propelling point, no control is necessary from the driving compartment.

The gear shafts for the various accessories, such as generators, air compressors etc., extend on both sides of the transfer case.

Main Drive Shaft and Universal Joints:

A long tubular main drive shaft is used to transmit the power from the master clutch to the gearbox. This shaft is coupled to the master clutch shaft at one end and the gearbox input shaft at the other by means of needle roller bearing type universal joints.

These universal joints, which are identical with those used on the drive shaft from each engine, absorb shaft misalignment and so eliminate as much vibration as possible.

Gearbox:

The gearbox(see Fig. 2) is of the straight tooth constant mesh type and has five forward gears and one reverse. Selector dog clutches of the crush type are used to engage the various trains of gears and are controlled by the gear lever situated at the rear of the gearbox on the left of the driving seat.

In the A.C.Mk. 1 Tank gearbox the input shaft on the engine side is at a lower level than the output shaft on the front axle side, this being necessary in order to provide a suitable range of gears and to accommodate other features of design. Unlike a car gearbox, there is no straight through direct drive, the nearest approach to direct drive being in fourth gear where the ratio is 1.02 to 1. Top gear represents an overdrive wherein ten revolutions of the input shaft give 13 revolutions of the output shaft. It will be noted that in all forward gears the output shaft rotates in the opposite direction to that of the input shaft, but this is corrected in the final drive gearing.

The gearbox is lubricated by an internal gear type pump and oil is circulated under pressure to the various shafts. In addition to the internal pump an external scavenging pump draws off the hot oil and sends it through an oil radiator.

Differential:

On the front end of the gearbox, the bevel pinion on the output shaft meshes with the bevel driving gear

(crown wheel) transmitting the drive to the controlled differential in the front axle assembly. See Fig. 26.

The object of the controlled differential is to enable the direction of movement of the Tank to be changed at will. It should be remembered that the Tank can only be steered by making one track move faster than the other and the controlled differential supplies the means for slowing down the track on one side and proportionately speeding it up on the other side. This is accomplished in the controlled differential which acts in a somewhat similar manner to the differential fitted to a motor car, excepting that the usual bevel gears are replaced by simple spur gears and an epicyclic train of gears at each side of the crown wheel.

The following explanation of the construction and operation of the differential should be read in conjunction with Fig. 27, of which the numbers in circles represent the number of teeth in the gears and the plain numbers refer only to its description.

For the sake of convenience of description the differential can be divided into four sections,-first the bevel pinion and crown wheel; secondly, the differential unit incorporating the small pinions and shafts (1) and (2) and the large gears (8) and (9) with their corresponding shafts; thirdly, the brake drums and the epicyclic gears (4) and (6) and (3) and (5), and fourthly, the main drive shafts (12) and (13). From Fig.2, it will be seen that there are three sets of small pinions (1) and (2) which are supported by the end plate (16) and the crown wheel centre section. Each pair of small pinions (1) and (2) are integral with their respective shafts and are meshed together, as well as meshing with the large centre gears which in turn are splined to the driving axles. Gears (5) and (6) are integral with the short shafts (14) and (15) respectively as well as with the brake drums, and these units as a whole are free to rotate around the main driving axles (12) and (13). Pinion (1) which is integral with shaft (17) also carries the integral pinion (3) which meshes with gear (5) which in turn is integral with the brake drum. Correspondingly, on the other side, pinion (2), half of which meshes with pinion (1), is integral with shaft (18) and pinion (4) which in turn meshes with gear (6) and the corresponding brake drum.

When the Tank is moving forward in a straight line the crown wheel (7) will rotate, carrying with it the

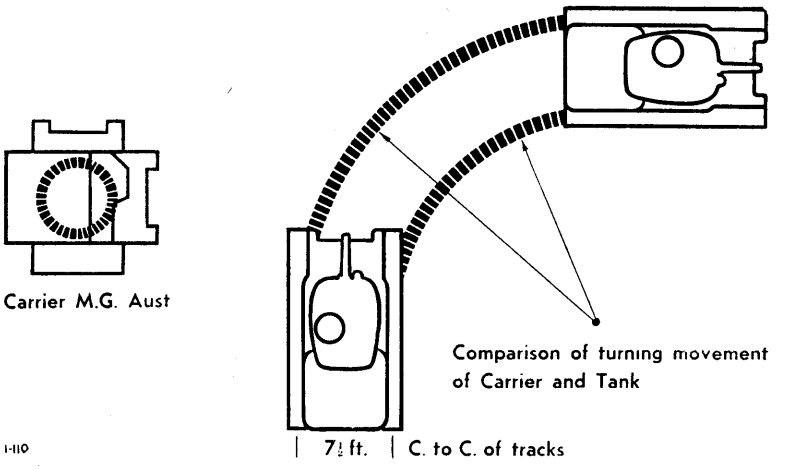

Fig. 28. Tank turning circle with R.H. brake fully applied and controlled differential steering in action. The ratio of sprocket drives derived from the computations is 200:122. Comparison of turning movement of Carrier and Tank

differential assembly. Pinions (1) and (2) and gears (9) and (8) will not turn individually but will remain in the same relation to each other and rotate with the crown wheel. Similarly, pinions (3) and (4) and gears (5) and (6) will rotate about the shaft without altering their position in respect to each other. In other words, with the Tank moving straight ahead and the brakes in the off position the whole assembly driven by the bevel pinion rotates as a unit.

Steering:

Let us now consider the case when the Tank is to be turned to one side. If we require to turn to the right (as seen from the driver's seat) the right hand brake steering lever is pulled back causing the brake band to contract on the drum 10 (See Fig. 27) preventing control gear (6) from turning with the differential assembly as a whole. As the differential assembly turns it carries the pinion shaft and pinion gears (2) and (4) with it.

The external pinion (4) however, must revolve on the dead gear (6). Consequently pinion (2) which is integral with the pinion shaft, drives the main drive shaft gear (8) in a reverse direction to its normal rotation when the Tank is going straight ahead.

The retarding of drive gear (8) through the action of the controlled differential is less than normal rotation of the gear when turning at the same speed as the crown wheel 7, so that the drive through jack shaft 12, is slowed down.

The converse is the case for the left hand drive. Pinion (1) meshing with pinion (2) rotates in an opposite direction. This drives the main drive gear (9) in the same direction as its normal rotation, causing jack shaft 13 to speed up as much faster than the crown wheel as jack shaft 12 has been retarded.

So, by braking on the right hand brake steering drum, the right hand main drive shaft slows up, decreasing the speed of the right hand track while the left has been speeded up.

The gearing of the differential is so arranged that with one brake hard on, the corresponding sprocket will do 122 revolutions while the opposite sprocket does 200 revolutions. The ratio of these two speeds controls the turning radius. Fig. 28 illustrates this point.

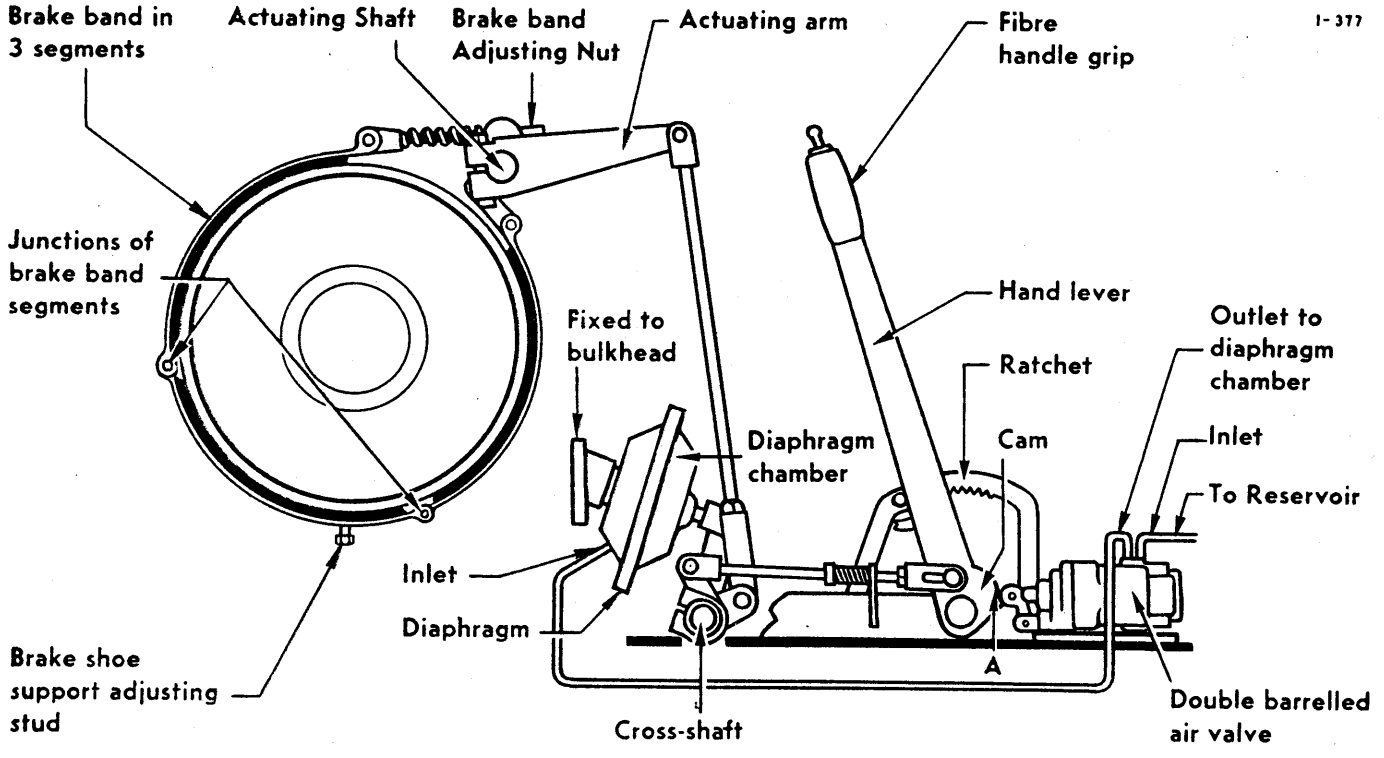

Fig. 29. Brake system

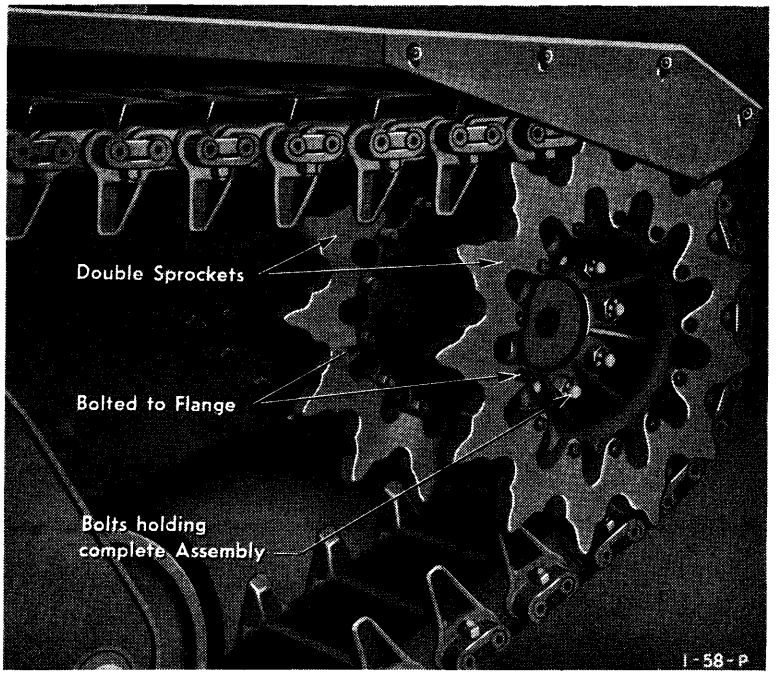

Fig. 30. Driving sprocket

Brakes:

Integral with the differential (see Fig. 29) are two brake drums which revolve with it, either of which can be slowed down by manipulation of one of the driver's steering control levers. As explained in the description entitled "Differential", the incorporation of an epicyclic gear train prevents the tracks from stopping altogether except when the vehicle itself is stopped. These driver's control levers, one for each track, apply the usual type of band brake, and in addition, have a compressed air system to assist their application. This system, which consists of a compressor driven through a take-off on the transfer box, supplies air to a receiver located on the floor of the fighting chamber from which air is delivered through a control valve. This control valve is operated by a cam which forms part of the base of the steering control lever, the air being supplied to a diaphragm chamber, the diaphragm of which is linked through levers to the brake shoes.

This cam is designed for gradual application of the brakes and allows them to remain applied as long as the lever is operated. It will also allow the immediate release of the brake when the control lever is pushed forward to the "off" position.

Track Drive:

On each of the two extremities of the differential a main drive shaft passes through a hollow shaft to the final drive which consists of a spur gear driven by a spur pinion; this spur pinion drives the sprocket hub.

Each track is driven by a sprocket which consists of an inner and an outer ring. The sprockets used on vehicles fitted with steel tracks have 20 teeth and sprockets used in conjunction with rubber tracks have 13 teeth. Fig. 30 explains the method of mounting the sprockets on each side of the nose of the Tank.

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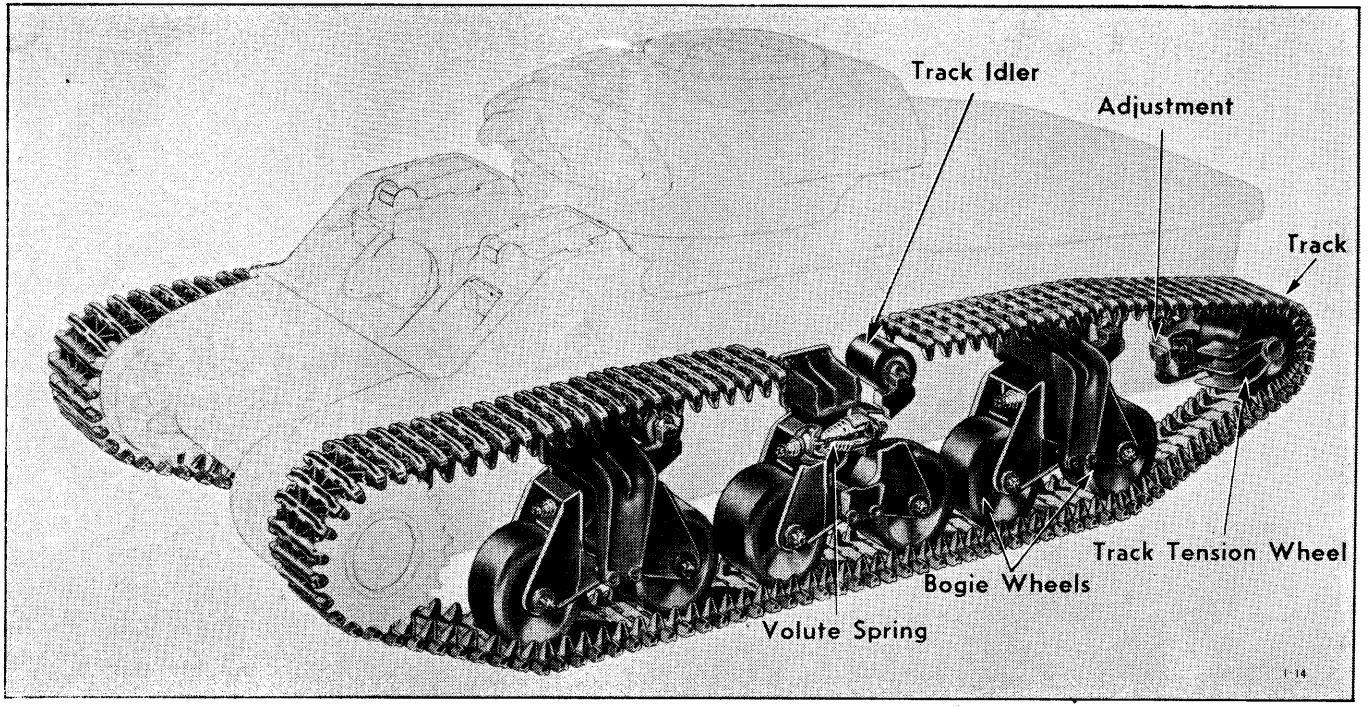

Fig. 31. Details of track and suspension arrangements

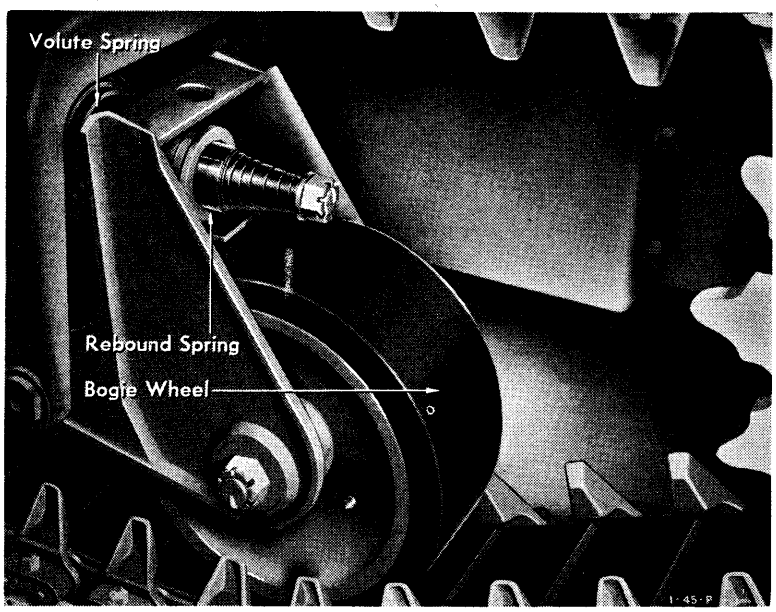

Fig. 33. Volute and rebound springs

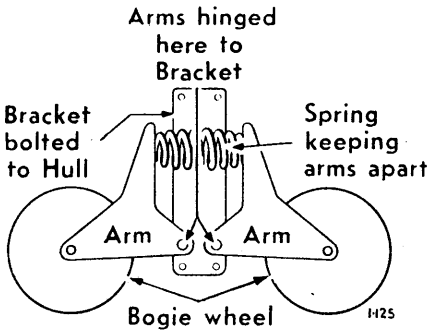

Fig. 32. Bogie assembly

The general layout of the suspension system, together with the various components and their relationship to one another, can be gathered from a study of Fig. 31.

Three identical bogie assemblies on each side carry the weight of the Tank. Each assembly consists of two bogie wheels; each wheel is supported by the outer ends of an arm (bell crank in shape), the centre of which is pivoted to the main bogie bracket. See Fig. 32. Located between the upper portion of the arms of each bogie is a volute spring which is supported on a horizontal rod, see Fig. 33.

These springs support the weight of the Tank and absorb the shocks when travelling over uneven ground surfaces. A small spiral spring, mounted externally on one end of the spring rod, acts as a recoil shock absorber. The weight of the upper portion of the track is carried by a small rubber tyred roller mounted on the top of each bogie assembly.

Two large rubber tyred wheels support the track at the rear end of the Tank. The wheels are mounted in brackets bolted to the hull by four bolts. The bracket is slotted at the bolt holes to provide fore and aft movement for adjusting the track tension, and is operated by an adjusting screw.

All the bogie and idler wheels are ball bearing mounted and are equipped with greasing points and dirt seals.

Tracks:

The tracks are of two types (1) all steel, or (2) steel links with rubber pads. As different drive sprockets are used for each of these types of tracks, the vehicle is equipped according to the type of track to be used.

Steel Track:

Each track consists of links of alloy steel, 4 ins. pitch, joined together by pins of ⅞ in. diameter, which are secured in position by lead plugs, or, alternatively by expanded tubular containers one to each pin.

Rubber Track:

Each rubber track consists of track links which are reversible, enabling the wearing surface of each side to be used.

The rubber track link consists of a steel frame covered with vulcanised rubber and two track pins mounted on compressed rubber bushings.

The units are assembled into an endless track by steel end connections which are secured to the ends of the pins by wedges. The steel end connections also serve as guides to keep the track in alignment with the bogie wheels, idlers and drive sprockets. The outer ends of the connectors act as driving lugs and engage the teeth of the final drive sprockets.

For slippery travel, grousers can be clipped on each pad, or alternatively, on every second or fourth shoe, according to ground conditions. These grousers are made of steel and fit into the ends of the track pins where they are secured by screws. The grousers project from the wearing surface of the track thus giving extra grip on slippery ground surfaces, with consequent improved traction.

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ELECTRICAL SYSTEM.

Each of the three engines is fitted with its own generator, voltage regulator, starting motor, distributor, ignition coil and battery. To guard against trouble from flat batteries, the three batteries are inter-connected by change over switches whereby all the lamps and ignition load can be transferred to any one of the three batteries.

Similar safety precautions have been applied to engine starting. An emergency starter switch is mounted on the instrument panel, whereby each engine can in turn be started by all three batteries connected in parallel after first disconnecting at the engine bulkhead the other two engines by means of their separate clutches. These circuits will be found fully described in the wiring system section of this manual.

A separate generator, complete with voltage regulator unit and batteries, caters for the load taken by the two machine gun cooling water pump motors, the wireless and intercommunication equipment and the fire extinguisher equipment.

The turret traverse is operated by means of a 40 volt electric motor complete with its control unit, the current being supplied by a generator driven off the transfer box which is situated below the turret.

In the interests of clarity detailed descriptions of the above electrical equipment have been itemised under the following headings.

ENGINE UNITS: Generator, voltage regulator, starting motor, battery, distributor and ignition coil.

INSTRUMENT PANEL: Emergency starting, lighting and wiring circuits.

TWELVE VOLT CIRCUITS: Machine gun cooling water motor, fire extinguishing system and wireless circuit.

FORTY VOLT TURRET TRAVERSE OPERATING MECHANISM.

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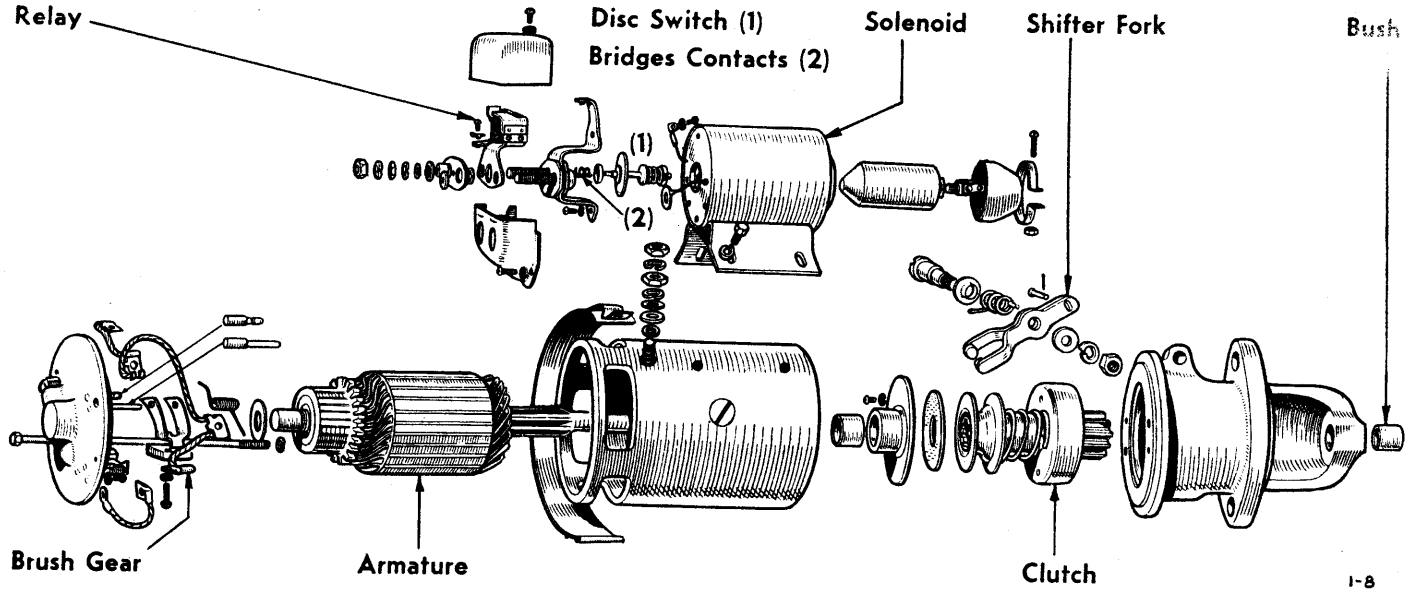

Fig. 34. Starter Motor, dismantled

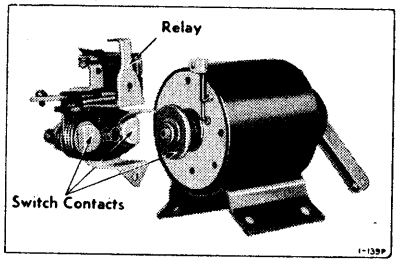

Fig. 35.
Starter switch and solenoid

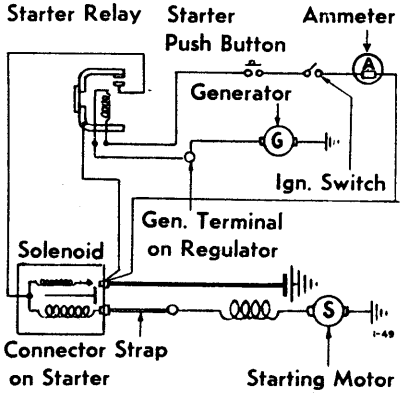

Fig. 36.
Wiring diagram of
starter circuits

Generator:

The generator is located in the engine "V" and is driven at 1.96 times engine speed by means of a belt which also drives the water pump.

The generator is of the two brush type arranged for six volt earth (frame) return. The output is self-regulating and is controlled by a combined current and voltage regulator unit which inserts additional resistances in the generator field circuit when the voltage or current exceeds predetermined values, thus automatically controlling the output according to the load on the battery and its state of charge.

When the battery is discharged (or flat) the generator gives a high output, so that the battery receives a quick recharge to bring it back to its normal state in the minimum possible time. On the other hand, if the battery is fully charged the generator will only give a "trickle" charge sufficient to supply the drain taken by the ignition coil and to keep the battery fully charged without causing damage through overcharging.

Voltage and Current Regulator Unit:

The three voltage and current regulator units are mounted side by side on the right hand side of the engine bulkhead. Each unit consists of a voltage and current regulator, the operation of which is described under "Generator".

The cover of this unit must not be removed, or any of the wires disconnected from their terminals, otherwise the regulator and generator may be burnt out.

Starting Motor:

The starting motor of each engine (See Fig. 34) is bolted to the right side of the engine in front of the flywheel housing. A solenoid switch and relay (See Fig. 35) is mounted on the outside of the motor. When the starter button on the instrument panel is pressed, the solenoid first engages the starter pinion with the flywheel ring gear and then closes the switch for the cranking current. To prevent the starter engaging when the engine is running, a relay is used in conjunction with the solenoid and connected to the armature terminal of the generator. As soon as the generator commences

to charge, a reverse current flows through the relay coil, keeping it open and thus rendering the solenoid push inoperative. For correct functioning the idling speed should always be set high enough to keep the ammeter indicating on the charge side.

Starter Operation:

One starter push button and three toggle switches are mounted on the instrument panel whereby all three or any one or two engines can be operated at will. A wiring diagram of starter circuit is shown in Fig. 36.

Battery:

Each engine unit has its own battery. These three six volt batteries, each having a capacity of 130 amp. hours, are located on the floor of the central compartment, two on the right hand side and one on the left, the positive terminal being earthed. A metal cover fits over the batteries to protect them from damage and to secure them in position. An inspection opening in the cover gives access to the filler plugs. A flat lid secured by two wing nuts covers this opening.

On the original batteries a special vent plug and cell cover are fitted, which make it impossible for the battery to be topped-up above a safe level. This device consists of a small rubber bellows, or valve, which is fitted below the vent plug and expands when the vent plug is removed, thus closing the gas vents on either side of the vent plug recess.

Ignition:

Ignition is by six volt battery and coil system. Located in the instrument panel (see section "Instrument Panel") are three ignition switches, one for each engine. There is also another switch on the left-hand side of the turret, just below the hatch; by pressing this switch the commander can, simultaneously, switch off all three ignition circuits and thus stop the vehicle.

The distributor is driven by a vertical shaft at the rear of the engine by means of an extension of the oil pump drive. The distributor consists of a contact breaker operated by an eight lobe cam. A condenser is connected across the contact breaker points to obviate sparking at the points and also to assist the functioning of the coil. A centrifugal automatic advance mechanism is housed in the body of the distributor. Vacuum advance is also operated by the variation of the vacuum in the inlet manifold.

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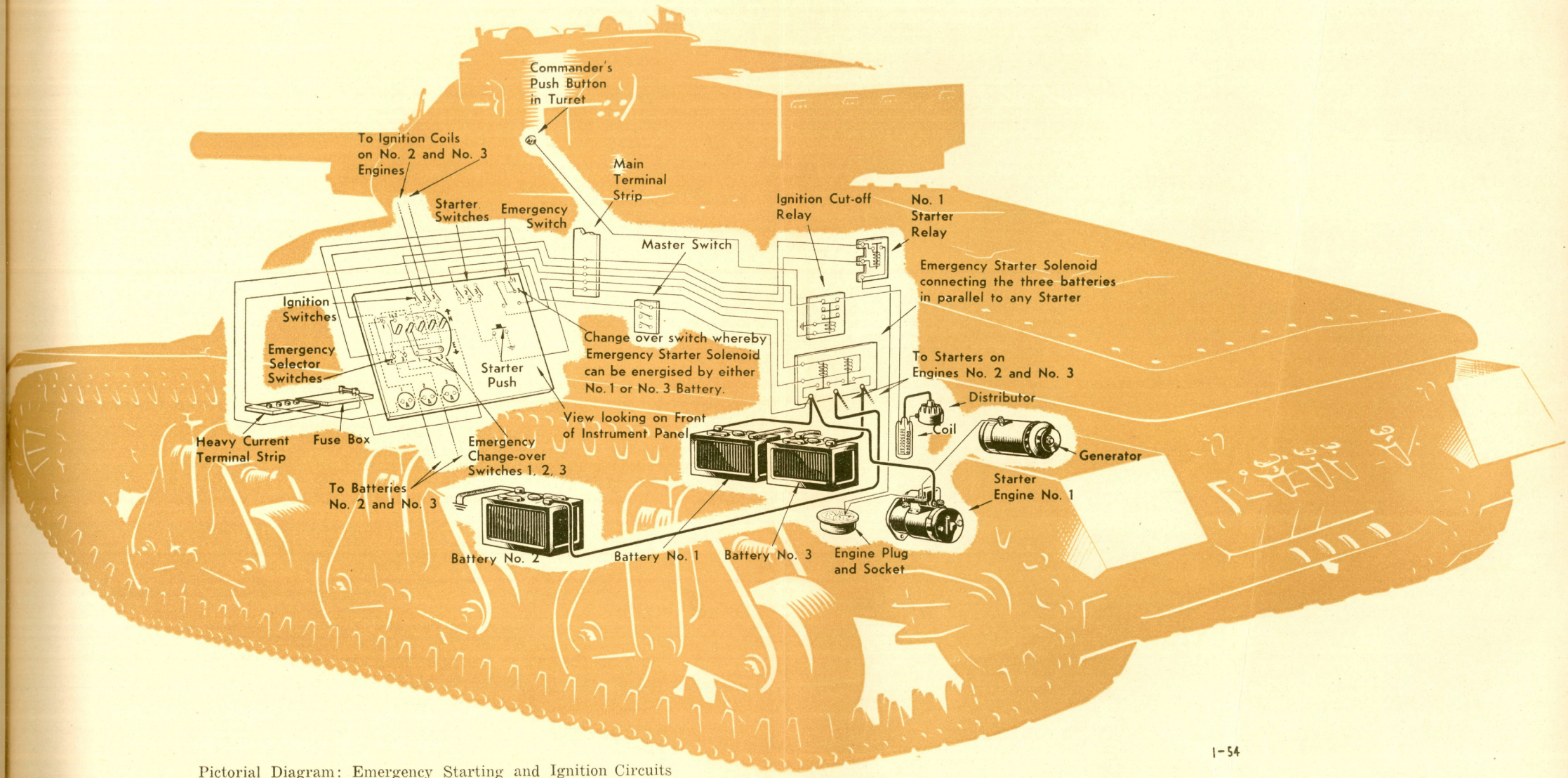

Pictorial Diagram: Emergency Starting and Ignition Circuits

INSTRUMENT PANEL, EMERGENCY STARTING LIGHTING AND WIRING CIRCUITS

Instrument Panel:

The panel is mounted directly in front of the driver. Situated along the top of the panel is a row of eleven switches. The first on the left controls the head lamps, the next two the tail lamps - one blue and one red. The next group of three are the ignition switches, then come the three starter switches (one for each engine) and on the extreme right the two emergency switches. Below these are the two tail lamp indicators and the starter push button.

Midway down the panel on the left hand side are five knife switches by which the lamp load, petrol pump, ignition and solenoid circuits to each engine can be connected to any of the three batteries in case of failure of its own battery. These switches should be left pointing upwards in their "Normal" position, unless it is desired to cut a battery out for any reason.

To the right of the knife switches is the ammeter for the 12 volt radio, machine gun cooling motors, and Graviner fire extinguishing circuits, and to the right of this are the switches for the instrument panel and interior lights, with the exception of the turret interior lights, which are operated by a separate switch in the turret.

Below are three red lights which go out as soon as the oil reaches operating pressure, and also the ammeters and temperature gauges for each engine.

To the right of the driver will be found one of the Graviner fire extinguisher switches and the horn push.

Wiring:

The wiring is carried out in metallic covered cable. Each cable is fitted with a metal sleeve at either end and has an identification number. A key setting out these numbers will be found in the Workshop Repair and Maintenance Manual.

So that the engine unit can be removed with disturbing any of the wiring a circular engine plug and socket consisting of a base having 28 sockets and a detachable plug having 28 pins, is mounted on the engine sub-frame between the two engines.

The main terminal strip is located at the right of the instrument panel and a fuse box containing six fuses is located behind the panel. The fuses controlling the following circuits, reading from left to right, are:- horn, headlamp, tail lamps, instrument panel and interior lights, turret lights and fuel pumps.

In order to carry the various six, 12 and 40 volt circuits to the revolving gun turret, a base junction connector consisting of a series of brass contacts engaging with a series of slip rings, is mounted on the floor of the turret, from which the wires are taken to a five way fuse box mounted on the left hand side of the turret. This controls the commander's ignition cut-off switch, spot light, interior lights, machine gun cooling motor and the wireless set.

Lighting Circuit:

The Tank is equipped with two headlamps mounted on either side in line with the front gunner's and driver's position and two tail lamps, one blue and one red. These are controlled by the driver from the instrument panel. On the panel there are two tell-tale lights which light up with the tail lamps.
NOTE: As the tell-tale lights are wired in parallel with the tail lamps they only indicate that the lights have been switched on; it should be remembered that they will still be "on" even though the tail lamps may be inoperative due to a broken globe, broken cable, or similar defect. A spot light is mounted on the side of the turret; it is controlled by a switch located on the left hand wall inside the turret and also by another switch at the spot light.

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TWELVE VOLT CIRCUITS

The 12 volt generator is driven from the rear of the transfer box at slightly under engine speed. The voltage regulator unit, which controls the output from this generator, is mounted on the left hand wall of the front compartment, near the forward gunner's position.

The generator supplies a 12 volt battery which is composed of two 6 volt units of 17 plate 130 amp. hour capacity in series. These are situated in a central position behind the driver, and require battery maintenance as laid down in weekly maintenance.

Machine Gun cooling motors:

There are two machine gun cooling motors, one situated in the turret and the other on the forward bulkhead to the left of the gearbox. These motors drive rotary pumps which are integral with the drive and casting. They draw between five and six amps and are protected by individual fuses, the switch for the forward motor being situated on the left of the front gunner while that for the motor in the turret is located to the left of the traverse control. The forward motor is supplied directly from the 12 volt terminal strip mounted on the transfer box below the turret floor and the turret motor is supplied from the turret fuse board. The motors require very little attention other than occasional lubrication and brush gear examination.

Graviner Fire Extinguisher System:

This system is installed for the suppression of fire in the engine compartment and consists of bottles containing about 6 lbs. of pure methyl bromide at a pressure of 60 lbs. per sq. in. which can be released by electric control. Piping from the bottles is taken round the carburettor and sump of each engine. The bottles are fitted with a fuse which is ignited electrically, thus allowing the contents of the bottles to discharge. The bottles are arranged, one in front of No. 1 and two in front of No. 2 engines.

In order that the system may function automatically two flame switches to each engine are installed. These switches are designed so that when the temperature in the vicinity reaches 480 degrees F., a heat sensitive unit fires a fuse and closes the operating circuit. Two of the flame switches are situated in the fan aperture and one at the front of No. 3 engine. The remaining three are lower down, one near the base of each engine.

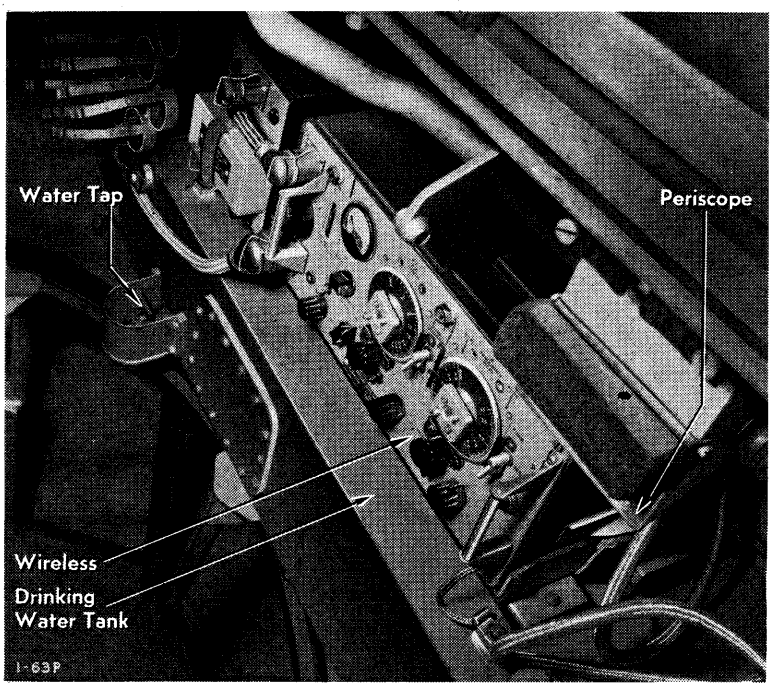

Fig. 37. Turret interior showing location of wireless

In addition, and connected in parallel with the flame switches, are two push button switches which can be operated manually. One is situated to the right of the driver and the other on the engine room bulkhead in the fighting chamber above the oil pressure gauges. A cover shield over each push button prevents any accidental operation.

Wireless:

A 12 volt supply is taken to the lower turret terminal strip which in turn supplies the No. 19 wireless and Intercommunication Set. This is illustrated in Fig. 37.

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FORTY VOLT TURRET TRAVERSE OPERATING SYSTEM.

In order that the turret with its basket may be traversed clockwise, or anti-clockwise, at any desired speed up to its maximum, a specially controlled shunt motor is employed. The motor is situated in the turret and geared to an internal toothed circular rack by means of a pinion driven directly from the traverse motor shaft.

The motor is supplied, at a pressure of 40 volts, from a generator situated below the turret floor and driven directly from one of the idler gears of the transfer box.

As the generator is not driven at constant speed (due to the variable speed of the engines) an adequate form of voltage regulation becomes necessary. This is achieved by the generator being wound with two separate shunt fields each having its own vibrator type regulator. There is no battery in this circuit, the traverse motor being fed from the generator. The output from the generator is controlled by the two regulators.

The traverse motor is of conventional design, its only peculiarity being the method of control which incorporates a small shunt motor having a constant speed of approximately 650 r.p.m. The controller hand traverse gear is linked up through differential gearing in such a way that when hand traverse is employed the motor armature remains stationary. This arrangement eliminates the additional friction required to turn the traverse motor armature which, when the controller is in the "off" position, is held rigid by means of a solenoid brake operating through the controller. Both control motor and reversing switch are housed in the controller housing, the reversing switch being so arranged that, when the controller handle is moved right the turret traverses right, and vice versa.

To provide against excessive current draw, a current limiting relay is inserted in the negative supply line. Normally a spring maintains this in the closed position. When the load becomes excessive, however, the operating coil opens the circuit and a "hold on" coil maintains this condition until the load becomes normal.

Operation:

As the generator is driven direct from the transfer box the starting of one or all engines immediately provides the supply to the traverse motor. It is essential, however, in order that the generator should not be damaged, that the voltage regulator be correctly adjusted. Any adjustment or repair to this unit should only be carried out by competent repair staff.

The speed control motor is connected between the positive contact of the controller and the negative main, therefore in other than "off" position of the controller the control motor will run at its normal speed.

The reversing switch controls the direction of current flow through the armature and is connected between the positive main and the armature, the control motor being connected to the other side of the armature. The action of the control motor is such that a series of impulses are passed to the traverse motor, the period of these impulses depending on the position of the controller handle. In its "full on" position the controller connects the traverse motor directly across the 40 volt mains.

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Fig. 38. "Crews Front"

CREW DRILL

1. General:

Crew Drill lays down the procedure which will be followed by the Crew at all times. It includes all routine whether the tank be stationary, on the march or in action.

2. Object:

The object of Crew Drill, the basis of which is the same for all tanks, and which is modified to render it suitable for each type, is to ensure that the necessary actions of the crew are carried out in an orderly and systematic manner and in the most rapid and efficient way.

3. Movements:

All movements around the tank will be carried out at the double.

4. Interchangeability of Personnel:

In order to ensure that all members of the crew can in an emergency, carry out each of the normal tasks allotted to each other member, personnel of crews will be frequently changed during Crew Drill.

5. The Crew:

The crew of the A.C. Mk. 1 Tank consist of five men who are allotted specific individual duties and are numbered as under:

No. 1 Crew Commander.
No. 2 Hull Gunner.
No. 3 Driver.
No. 4 Turret Gunner.
No. 5 Turret Gun Loader and Wireless Operator.

6. Positions of the Crew in the Tank:

No. 1 Observing from Turret.
No. 2 In Hull Gunner's seat.
No. 3 In Driver's seat.
No. 4 On left hand side of 2 Pdr. Gun.
No. 5 On right hand side of 2 Pdr. Gun.

Fig. 39. "Crews Right." *Note:* Crew is dressed in line with centre of turret

Fig. 40. "Crews Mount"

7. "Crews Front": (See Fig. 38)

This is the normal position of the Crew when dismounted. Crew will be three paces in front of tank facing front and "At Ease" and dressed as follows:-

No. 1 One pace to right of offside track.
No. 2 In front of offside track.
No. 3 In line with centre of tank.
No. 4 In front of nearside track.
No. 5 One pace to left of nearside track.

8. "Crews Right": (See Fig. 39)

Crew on right of tank. No. 5, 1½ paces from track, facing front and in line with centre of turret. Crew commander on the right.

9. "Crews Left":

Crew on left of tank. No 1. 1½ paces from track facing front and in line with centre of turret.

10. "Crews Rear":

The crew will fall in as for "Crews Front", but three paces in rear of, and facing rear of tank.

11. "Inspect Maintenance":

The detail as laid down will be carried out. Crews will form "Crews Front" and stand "At Ease" on completion of their duties.

12. "Report":

This order will be given when all the crews have formed "Crews Front" on completion of paragraph 11 above.

Crew commanders will report to their Troop Leaders and Troop Leaders to their next senior.

13. Form of Report:

The form of report will be "Maintenance and/or Armament Correct Sir".

14. "Mount": (See Fig. 40)

On the command "Mount" the crew will come to attention, turn about and mount in the following order:

		Positions
No.3	Through Driver's hatch.	Driver's seat.
No.2	Through Hull Gunner's hatch.	Hull Gunner's seat.
No.5	Through Turret hatch, followed by	R.H. side of 2 pdr. gun.
No.4	Through Turret hatch, followed by	L.H. side of 2 pdr. gun
No.1	Through Turret hatch	

Note: If only the command "Mount" is given the engine will not be started. If the command "Start up" is given previous to "Mount", No. 5 and No. 3 will be in position in the tank when the command "Mount" is given. In this case, the crew will mount in the following order:-

No.2 As before.
No.4 Through Turret hatch followed by
No.1 Through Turret hatch.

15. "Alert":

All resume positions as for "Mount" above.

16. "March at Ease":

Crew may relax. No. 1 must be on the alert for orders. Gunner remains in seat. Remainder of crew rest, but remain in normal positions. Head phones will not be removed.

17. "Dismount":

The crew will "Dismount" in the reverse order to that laid down in paragraph 14 and form "Crews Front".

INSPECT MAINTENANCE:

The crew will be formed up at "Crews Front" sometime previously to the time set for the commencement of the day's operation. On the command "Inspect Maintenance" the crew will come to attention, turn about and carry out the duties enumerated below:-

No. 1 Crew Commander:

(a) Inspect for oil leaks on ground under tank.
(b) Inspect general condition of suspension.
(c) With rubber tracks: Inspect track wedges and nuts for tightness, wear and for broken track connectors, any foreign particles wedged in between rubber treads.

With steel tracks: Check for broken links, pins and for loose or missing lead plugs, any foreign particles wedged in between links.

(d) Check for track tension i.e. ½ in. sag between support rollers for rubber tracks; 3/16 in. for steel tracks
(e) Check final drive cover case for leaks.
(f) In conjunction with No. 5 check lights and horn.
(g) Inspect sprocket nuts for looseness.
(h) Check external stowage and stowage inside equipment boxes.
(i) When other members of crew have completed maintenance and are in position, will notify No. 3 to start up.
(j) Tracks: Will guide tank back two track lengths while inside wedges and nuts are checked.
(k) When all members of crew have dismounted receives reports.
(l) At all times exercises supervision over other members of crew and details No. 2 to do duties as required.

Duties of No. 2:

(a) Turn about.
(b) Assists No. 1 in inspection of tracks and suspensions.
(c) Is available for any further duties allotted by No. 1.
(d) When tank is moved back will inspect inside offside track for loose wedges, wedge nuts and cracked connectors.

Duties of No. 3:

(a) Turn about.
(b) Follows No. 5 through driver's hatch, close hatch.
(c) Release Hull gunner's hatck lock.
(d) Check oil level in gearbox and final drive, top up if necessary.
(e) Check oil level in air compressor sump.
(f) Check steering lever (i.e. 1½ ins. free travel)
(g) Check all switches off.
(h) Check emergency change over switches all "Up".

(i) Turn on 6 volt Master switch,
(j) Turn on 12 volt Master switch.
(k) Check in conjunction with No. 1 all lights, horn.
(l) When notified by No. 1, starts up by -

1. Switch on three ignition switches.
2. Switch on three starter switches.
3. Observe warning lights.
4. Depress clutch to reduce load on starter motors.
5. Press starter button.
6. When engine starts observe warning lights, if all lights do not go out stop motor and ascertain cause.
7. Receive report from No. 5 re oil and air pressure on gauges.
8. Check 3, 6 volt ammeters for charge.
9. Check 12 volt ammeter for charge.
10. When motors are warmed sufficiently moves tank back two track lengths under direction of No. 1 (Do not slip clutch when doing this)
11. Check motors for operation, acceleration, idling, unusual noises.

(m) When satisfied motors are operating correctly and are fit for operation, switch off. Open 6 and 12 volt master switches, dismount, report to No. 1.

Duties of No. 4:

(a) Turn about.
(b) Mount on to tank.
(c) Assist No. 5 in opening Turret hatch.
(d) Remove rear inspection plates (3) using special key.
(e) Remove inspection plate from air passage around No. 3 motor
(f) Check fuel and water level, replenish if necessary.
(g) Check No. 3 engine oil level.
(h) When notified by No. 5 of the result of check of oil level in No. 1 and No. 2 engine oil sumps, will top up if necessary.
(i) Check for obvious defects, looseness, fuel, oil and water leaks.
(j) Replace inspection plates (care must be taken with light gauge metal plate over No. 3 engine as the incorrect fitting of this plate will cause engines to overheat.

(k) Check stowage in rear equipment bin.
(l) Take post.
(m) When tank is moved back inspect inside of nearside track for loose wedges, nuts and cracked connectors.
(n) Report to No. 1.

Duties of No. 5:

(a) Turn about.
(b) Open driver's hatch.
(c) Pass through driver's compartment into turret.
(d) Release turret hatch locking catch and assist No. 4 in opening turret hatch.
(e) Check oil in No. 1 and No. 2 engines, and report results to No. 4.
(f) Check for obvious defects, looseness, fuel, oil or water leaks.
(g) Grease clutch throwout bearing (3 shots)
(h) Stand by while engines are started and check oil and air pressure. Report results to No.3
(i) Dismount and report to Crew commander.

"Start Up"

This command will be given from the "Crews Front" position. On this command Nos. 1, 3 and 5 will come to attention and turn about. Nos. 2 and 4 will stand fast. Nos. 1, 3 and 5 will carry out the duties enumerated below:

Duties of No. 1:

(a) Turn about.
(b) When driver signifies that motors are running correctly will turn about and stand at ease. (This will notify Troop Leader that tank engine is running correctly)

Duties of No. 3:

(a) Turn about.
(b) Mounts into driver's seat.
(c) Switch on 12 and 6 volt master switches.
(d) Will start up as outlined in section (1) of (Inspect Maintenance)
(e) When motor is running satisfactorily will extend the right hand through driver's vision port, palm downwards.
(f) When No. 1 turns about will withdraw hand.

Duties of No. 5.

(a) Turn about.
(b) Mount into turret.
(c) Observe oil pressure gauges as engines are started.
(d) Report to No. 3.
(e) Remain in turret in Loader's position.

MAINTENANCE AT THE HALT DURING OPERATION:

Maintenance inspection at the halt will be carried out from the "Crews Front" position.

Previous to the dismount signal being given the driver will be ordered to "Switch off".

When the motors are stopped and the crew dismounted the command will be "10 or 20 minutes halt, Inspect Maintenance".

The following duties will be performed:-

Duties of No. 1:

(a) Turn about. Check tracks, sprocket nuts and suspension for obvious looseness and defects.
(b) Feel all bogie, idler and support roller bearings for overheating.
(c) Clear away any stones or debris jamming or grooving bogie, idler and support rollers.
(d) Question driver re performance of vehicle.
(e) Inspect stowage bins and external equipment for security.
(f) Exercise general supervision over crew.
(g) Receive reports from crew and report to Troop Leader.

Duties of No. 2:

As for "Inspect Maintenance" with exception of (d)

Duties of No. 3:

(a) Turn about.
(b) Will report to commander any defects noted during the period of operation.
(c) Check level of oil in gearbox and controlled differential.
(d) Will inspect generally interior of driver's compartment for defects and oil leaks.
(e) Take post and report to No. 1.

Duties of No. 4:

As for "Inspect Maintenance" with exception of (m).

Duties of No. 5:

(a) Turn about and mount through Turret.
(b) Check oil in No. 1 and No. 2 engines, report result to No. 4.
(c) Check for obvious defects, looseness, fuel oil or water leaks.
(d) Dismount, report to No. 1.

TERMINATION OF THE HALT:

At the termination of the halt the command will be "Crews Front", "Start Up" and "Mount" as detailed previously.

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CREW ROUTINE MAINTENANCE

DAILY MAINTENANCE ON COMPLETION OF DUTY

CLEAN TANK

Lubricate:

Suspension if Tank has been run through water or mud.
Clutch, extractor race and throttle controls. (Oil can).

Check:

Fuel level in tanks - replenish - dipstick.
Fuel lines and tanks for leaks.
Lubricating oil levels - replenish - dipstick.
Battery electrolyte level if radio has been in use continuously during the day. Battery terminals for corrosion. Clean if necessary. Clamps tight after cleaning. Security of battery in carrier. Filler caps for security.
Oil lines for leaks.
Level of transmission oil - replenish - dipstick.
Looseness of exhaust manifolds - tighten if necessary
Clean air cleaners if working in dusty or dirty conditions.
Radiator for water level - replenish. No oil in water.
Radiator, hoses, water pumps and engine blocks for leaks.
Fan and drive not slipping.
Tighten loose nuts and bolts.
Make any minor adjustments.
Level of oil, air compressor.

TRACK GROUP

Check:

For cracked, bent or broken links, connectors, wedges and nuts.
Replace if necessary:-

Lead plugs.
Broken track pins.
Worn rubber plates.

Dead links:-
Replace plate if necessary
Excessive wear or stretch in links or pins.
Track Tension:-
Adjust if necessary to prescribed tension
Check on level with brakes off.

SUSPENSION IDLER AND SPROCKET GROUP

Check:

Idler and Bogie wheels for:-
Free, and bearings not worn.
Tyres secure and undamaged, no flats.
Sprocket nuts secure.
Track adjusting wheels for:-
Security of locking nuts, lock plates, and lock pin.
Volute springs for:-
Jamming and sagging.
Brackets and arms for cracks etc.

STEERING AND BRAKE GROUP

Check:

Steering levers for:-
Operation and adjustment. Report to Sqn. Mech. Sgt.
Faulty brake operation generally.
Water drain cock, air cylinder, turn on until all water out.

ENGINE GROUP

Check:

Air cleaners for:-
Security and oil level.
Water thermometer connections secure - no leaks.

FUEL SYSTEM GROUP

Check:

Filters for:-
Leaks.
Drain sediment traps.
Fuel pipe for leaks.

CLUTCH GROUP

Check:

Clutch pedal for free travel.
Clutch pedal for bottoming on hull plate before Clutch . fully disengaged.
Control rods for freedom of movement and not fouling.
Nuts and bolts secure.

TRANSMISSION GROUP

Check:

Gear lever operating correctly.
Final drive for leaking gasket and nuts tight.

TURRET GROUP

Check:

Gun elevation.
Turret on hand traverse.
Operation of power traverse.
Operation of turret lock.
Wireless secure in its mounting.
Equipment for correct stowage.
Power traverse oil reservoir level (dipstick)

INTERIOR HULL

Check:

Drivers compartment for:-
- Security and serviceability of all spare vision prisms.
- Accelerator for correct operation.
- Safety belts secure and serviceable.
- Equipment for correct stowage.

Hull gunner's compartment for:-
- Freedom of operation of gun, elevation and traverse.
- Equipment for correct stowage.

ELECTRICAL AND WIRING GROUP

Check:

Lights and warning devices operating correctly.
Ammeter and voltmeter reading correctly.

Battery switches turned off.

25 HOUR - 250 MILES MAINTENANCE INCLUDING DAILY AFTER DUTY

CLEAN TANK

Check:

Battery charge by hydrometer. Report if any readings under 1,200. Do not test immediately after adding distilled water. Top up and test after a run.

TRACK GROUP

Check:

For cracked, bent or broken links, connectors, wedges and nuts. Replace if necessary.
Broken track pins.
Worn rubber plates.
Dead links, replace plate if necessary.
Excessive wear or stretch in links or pins.
Track tension. Adjust if necessary to prescribed tension.
Check on level with brakes off.

SUSPENSION IDLER AND SPROCKET GROUP

Lubricate:

Each side: Track adjusting wheel (1 nipple)
Idler wheels (3 nipples)
Bogie wheel bearings (6 nipples)
Fulcrum pins (3 nipples)
Track adjusting thread - oil can.
No nipples lost, blocked or damaged.
Seals not forced.

Check:

Track adjusting wheel for:-
Security of locking nuts, lock plates, and cotter pins.
Excessive play in wheel bearings.
Wheels true, security of wheels (tyres).
Idler wheels for:-
Excessive play in bearings, free or no flats.
Security of mounting. Retaining bolts secure.

Sprockets for:-

Security of sprocket assembly and rings. Condition of teeth.
Teeth true.

Bogies for:-

Attachment to hull, not bent or damaged.
Cracks in all components.
Spindles and fulcrum pins secure and for wear.
Arms, not bent and in alignment.
Springs not broken. Springs not weak.
Wheels free and bearings not worn.
Tyres secure and not worn. No flats.
Arms for nuts and split pins secure and not lost.

STEERING AND BRAKE GROUP

Lubricate:

Interior Hull:-

Steering Levers.
Pivot pins.
Control rods and clevises.
Cross shafts and guides.
Controlled differential actuating arms. (nipples and oil cans)
Air valves. Remove two plugs from valve body under driver's seat and blow water out. Note: Close air line cock before removing plugs. Then turn on momentarily.

Check:

Steering levers for:-

Operation and adjustment. Adjust if necessary.
Lever holding devices free, secure and undamaged.
Correct free travel of levers.
Nuts, split pins and pivots secure.
Steering and control rods and levers (mechanical) length correct and not bent.

Controlled differential for:-

Brake band adjustment. Sqn. Mech. Sgt. to adjust for faulty brake operation generally.

ENGINE GROUP

Lubricate:

Water pumps: Use grease gun with water pump grease.
Generators and starter motors (oil can 3 drops only)
Distributor shaft, screw down grease cup 3 turns.
Distributor advance mechanism. Few drops of oil on felt pad under rotor.

Check:

Security of hose clips.
Hoses by feel for internal failures, not perished.
Radiator relief valves and overflow pipes free.
Water pumps for:-
- Security and leakage.
- Security of nuts and bolts.
- Belts for tension.

Fans for:-
- Security of mountings.
- Blades true and clear of shrouding.
- Bearings for wear.
- Belts for condition and tension. Jockey pulley bearings for wear. Springs for condition.

Oil canisters for:-
- Security and no leaks.
- Oil pipes for security and leaks.

Oil cooler for:-
- Security. Exterior clean. No leaks.

Engine sump for:-
- Cleanliness and no leaks.
- Drain plugs secure.

Air cleaners for:-
- Security and oil level.
- Correct grade of oil.
- Clean element as prescribed.
- Drain, washout, refill to correct level.
- Air inlet to cleaners not obstructed.

Water and oil gauges for:-
- Connections secure and no leaks.

Rev. counter for:-
- Security.

Cylinder head for:-
- Holding down bolts tight (tradesmen only to check).
- No sign of head gaskets leaking.

Exhaust and water manifolds for:-
- Security, no leaks and gaskets correct.
- Exhaust pipes secure and not leaking.

Starter motors and generators for:-
Mounting brackets secure and not cracked.
Nuts and bolts secure.
Cylinder blocks for:-
Cap screws and gaskets secure and no leaks.
Engine mountings for:-
Security.
Engine movement normal.
Transfer case oil level (level plug and dipstick).

FUEL SYSTEM GROUP

Check:-

Fuel tank for:-
Security in hull. No leaks. Filler caps secure.
Air vents and breather pipes clear.
Filters in place and clean.
Fuel pipes for security and no leaks.
Fuel pumps for operation and security.
No fuel or oil leaks. Drain holes clear.
Filters for:-
Security and elements clean.
Drain sediment traps.
Note: Use no rags or fluffy materials in cleaning filters.

CLUTCH GROUP

Lubricate:-

Control rods, clevises (oil can)
Extractor race (1 nipple)
Outrigger bearing (1 nipple)

Check:

Clutch pedal for free travel.
Clutch pedal for bottoming on the hull plate before clutch fully disengaged.
Control rods for:-
Freedom of movement and not fouling.
Security of brackets.

TRANSMISSION GROUP

Lubricate:

Gear control linkage (1 nipple and oil can)

Speedo drive. Remove cable and grease.
Tachometer drive. Remove cable and grease.
Universal joints and splined sleeves, one nipple each.

Check:

Oil cooler for:-
Cleanliness and no leaks.
Gear lever for:-
Correct operation.
Security.
Final drive for:-
Leaking gaskets.
All nuts and bolts secure.
Front axle and gearbox (combined supply) level of oil.

TURRET GROUP

Lubricate:

Gun mountings and control linkages.
Turret race (pack under spur drive gear)
Periscope (1 nipple)
Power traverse gearbox with engine oil as prescribed. Dipstick.
Power traverse control linkages (oil can).
Flaps, pistol slits and vision ports (oil can)
Cupola rollers (oil can).

Check:

Gun for elevation.
Turret on hand traverse.
Operation of power traverse control.
Operation of turret lock.
Power traverse electrical connections, clean and tight.
Wireless secure in its mountings.
All fittings secure.
Flaps, pistol ports and vision slits for operation.
Equipment for correct stowage.
Ammunition racks secure.

INTERIOR HULL GROUP

Driver's Compartment
Lubricate:

Periscope (1 nipple)
Shutters, flaps etc. (oil can)

Seat linkage (oil can)
Accelerator linkage (oil can)

Check:

Rubber protection pads for security and condition.
Instrument panel for security.
Instruments secure.
Unions secure, and no leaks.
Connections clean and tight.
Shutters and flaps for free operation.
Seat for adjustment.
Security of all boxes and fittings.
Security and serviceability of all spare vision prisms.
Safety belts secure and serviceable.
Equipment for stowage.
Nuts and bolts tight.
Accelerator linkage for correct operation.

Hull, Gunner's compartment
Lubricate:

Periscope (1 nipple)
Shutters, flaps etc. (oil can)
Gun mounting linkage (oil can)

Check:

Freedom of operation of gun, elevation and traverse.
All fittings secure and serviceable.
Equipment for correct stowage.
All nuts and bolts tight.

Fire fighting equipment

Check:

Weight of containers (full)
Security of pipes, and spray holes clean.
Connections tight.
Flame switches not damaged.
Portable extinguishers , full, secure and no leaks.

EXTERIOR HULL GROUP

Lubricate:

All doors and flaps, hinges.)
Periscopes.) oil can.
Towing shackles hinge bolts.)

Check:

Security of all external fittings, brackets etc.
Operation of all doors, flaps, catches and locks.
Distorted, buckled or damaged plates.
Signs of rust. Clean and paint.
All nuts and bolts tight.

ELECTRICAL AND WIRING GROUP

Check:

(Inside hull with batteries switched "ON")
Operation of switches and interior lights.
All exposed wires for breaks, and cracks, frays and foulings.
Junction boxes for security, fuses intact, spare fuses correct, connections tight no frayed ends.
Note: Inspect fuses with battery switches "ON".
Conduit screening not frayed, broken or kinked.
Unions tight.
Ammeters reading correctly.
Starter solenoids for security.
Operation of engine cut-off switches.
Operation of warning devices.
Spark plugs: clean and adjust gap.
(Outside hull)
Security of lamps and brackets.
Operation of all lamps.
Correctly focussed.
Lamps watertight.
Terminals clean and secure.
Conduit shieldings and connections tight.
Nuts and bolts tight.

ROAD TEST

By Sqn. Mech. Sgt.

Engine running - Tank stationary.

Check:

Ease of starting.
Idling speed.
Operation of instruments.
Oil pressures and temperatures correct.
Running of each engine separately.
Operation of powered turret.
Unusual noises.
Exhaust smoke (colour)

Tank on movement
Check:

Instruments.
Engagement of clutch.
Engine's pulling power.
Easy engagement of gears.
Acceleration.
Ease of steering.
Unusual noises.

Stop and start on hills
Check:

Efficiency of brakes.
Engine clutches engagement. No slip.

50 HOURS OR 500 MILES MAINTENANCE

(In addition to Daily or 25 hour or 250 miles maintenance)

CLUTCH GROUP

Lubricate:

Clutch outrigger bearing (1 nipple) grease sparingly.
Clutch withdrawal race (1 nipple) grease sparingly.

ENGINE GROUP

Lubricate:

Clean engine oil filters.
Remove element and clean out chamber of filter.
Change engine oil.
Apply smear of grease to distributor cam.
12 volt generator, three drops of oil.

100 HOURS OR 1000 MILES

(In addition to Daily and 25 hour or 250 miles maintenance)

Check:

Drain and refill radiator (or every 6 months)
Wear on clutch linings.

INTERIOR HULL GROUP

Check:

Ammunition racks secure and clean.
Fire fighting equipment for:
Blockage in lines.
Weight of containers (full)

300 HOURS OR 3000 MILES

(In addition to Daily and 25 hour or 250 miles maintenance)

FUEL SYSTEM GROUP

Check:

Clean filters.
Renew elements (new gaskets)
Drain and clean tanks.

TRANSMISSION GROUP

Lubricate:

Drain and refill front axle, gearbox, and transfer box according to Lubrication Schedule.
Dismantle and repack universal joints.

ELECTRICAL GROUP

Lubricate:

Starter motors (at overhauls)

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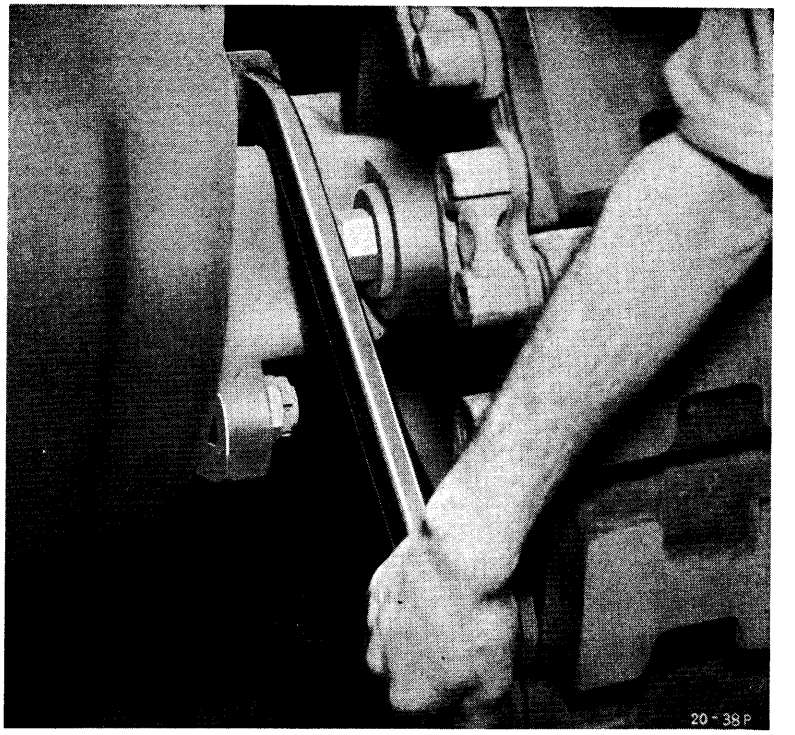

Fig. 41. Wrench 1-11009 used on tensioning wheel bracket nuts

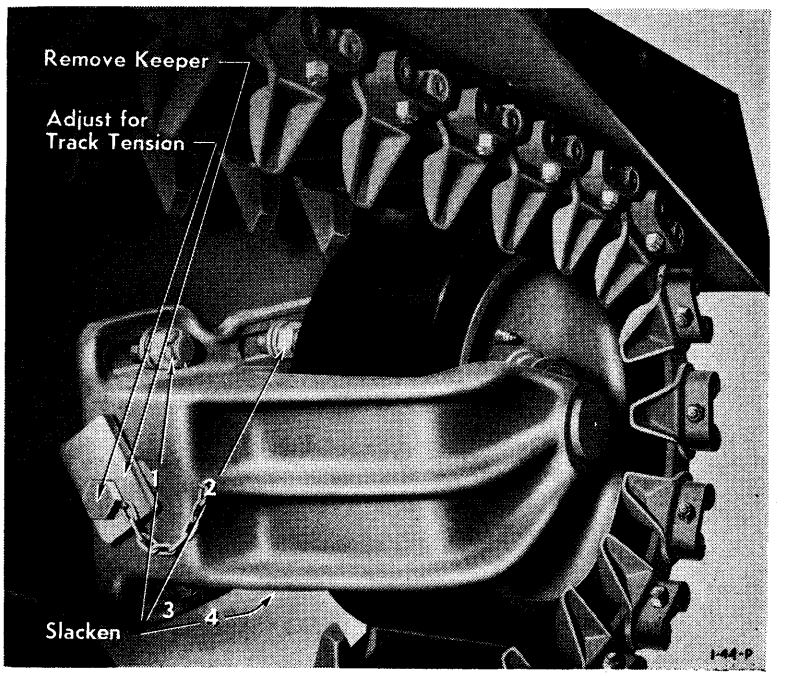

Fig. 42. Adjustment of rear tensioner

RUBBER TRACKS:

The rubber track shoes are reversible and should be turned when worn to such an extent that further wear would cause the tubular metal section of the link to become damaged. Damaged or unserviceable units should be removed from the track and replaced with new units.

To remove a Track:

1. The track tension must be released as far as possible. Loosen the four lock and clamping nuts securing the track tensioning wheel bracket to the hull with wrench No. 1-11009, see Fig. 41. It is important not to loosen the two rear nuts too much or unevenly, otherwise the bracket will dig into the hull at its front edge and refuse to slide.

Remove the pin and locking plate from the track adjusting screw, see Fig. 42. Turn the screw anti-clockwise with wrench No. 1-11009, see Fig. 43, until the slots in the bracket have reached the limit of their travel.

The bracket cannot be drawn forward with the adjusting screw, so if the bracket does not slide, do not force the screw beyond its maximum travel; this occurs when a circlip on its inner end contacts the threaded block inside the bracket. Further force may push the circlip out of its groove and allow the screw to come right out of the block. Difficulty would then be experienced in re-engaging the thread in the block. The next two operations will usually cause the bracket to slide.

2. Drive the Tank forward or push it backwards to transfer the slack in the track to the front.

3. Place the track strainer tool No. 1-11033 on the track, as shown in Fig. 44, with the arms gripping the sprocket. Run out the cable and attach the hooks to the track as close as possible to the first bogie wheel. Tighten the strainer sufficiently to relieve the tension from the links to be disconnected.

4. Remove the nuts and wedges from an inside and outside connection, midway between the sprocket and the first bogie wheel and drive off the end connections.

Fig. 43. Wrench 1-11009 used on track adjusting screw

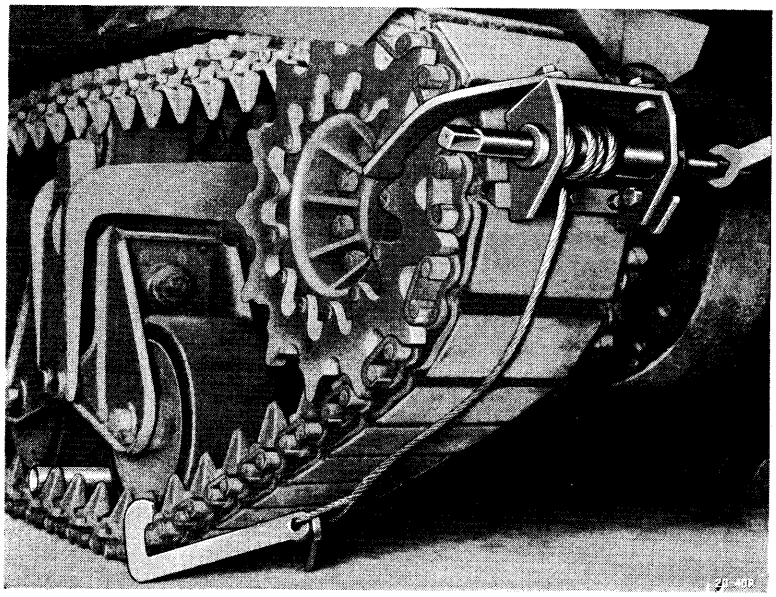

Fig. 44. Track Strainer for rubber tracks with blocking tube No. 1-11033 in position. Block tube tool shown in position immediately in front of second bogie wheel

5. Slacken off and remove the track strainer.

6. Move the upper portion of the track towards the rear of the Tank, over the sprocket and idler wheels, with a crow-bar.

7. Push or pull the Tank off the tracks. If both tracks are to be removed, disconnect them before moving the Tank. The Tank has to be moved 14 feet to clear the tracks. If sufficient space is not available the tracks may be cleared by jacking up the hull, one side at a time, until the bogie wheels are clear, then haul the track from under.

To replace a track:

1. Lay the track on the ground and haul the Tank over it so that the end of the track projects approximately 30 ins. beyond the centre of the front bogie wheel.

2. Bring the other end of the track over the tensioning and idler wheels to the sprocket.

3. Place a blocking tube tool, or crow-bar, see Fig. 44, in front of the second bogie wheel.

4. Take up as much slack as possible from the top portion of the track by turning the sprocket either with the engines or with a long bar. If only one track is being replaced the opposite side brake should be pulled hard on.

5. Couple the track strainer to the track as previously described.

6. Pull the ends of the track together with the strainer. Driving the sprocket slightly with the engines and the opposite side brake on will assist in removing the slack from the top portion of the track.

7. If the track is exceptionally tight bring the ends together with a pair of coupling clamps, tool No. 1-11066, see Fig. No. 45, one on each side of the track.

8. Replace the side connections, wedges and nuts.

9. Remove the clamps, strainer and blocking tube, and adjust the track.

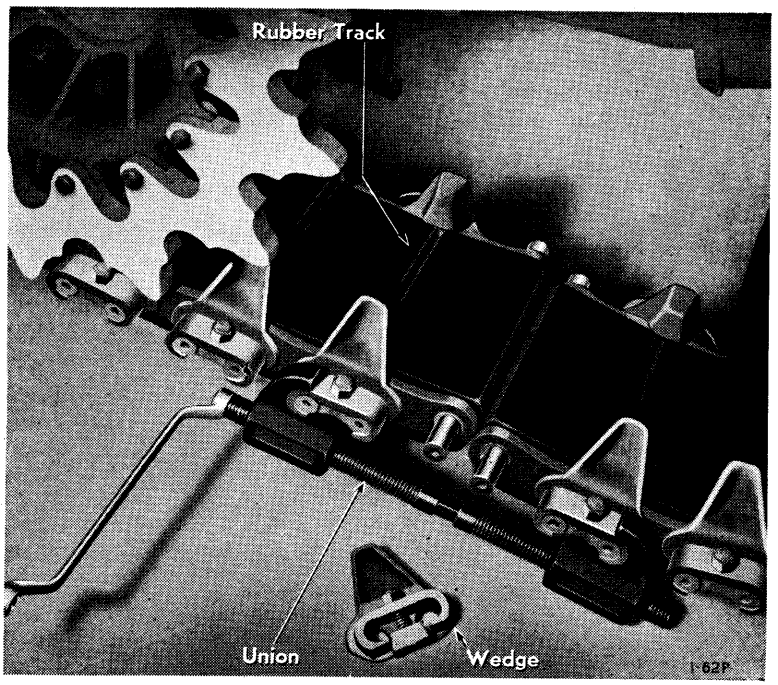

Fig. 45. Turnbuckle service tool in position. Track horn is shown in the foreground, complete with wedge, bolt and nut

To adjust a track:

1. The four lock and clamping nuts in the tensioning wheel bracket are loosened as described in track removal. To tighten the track turn the track adjusting screw clockwise.
NOTE: The correct track tension is determined as follows. Place a four feet straight edge on top of the track between the track idler wheels; the sag of the track measured at the centre of the straight edge should be $\frac{1}{2}$ in.

2. When the track is adjusted, tighten the clamping nuts and lock nuts securing the tensioning wheel bracket to the hull with wrench No. 1-11009, see Fig. 45. Replace the locking plate and pin on the track adjusting screw.

To remove or replace a link:

1. Move the Tank so that the link to be removed is near the top of the driving sprocket.

2. Proceed with operations Nos. 1 to 4 under "Track Removal". When driving the Tank forward (as described in "Track Removal" in operation No. 2) stop when the link to be removed is midway between the sprocket and the first bogie wheel.

3. One or two links can be removed or replaced at this stage.

4. Place the blocking tube tool in front of the second bogie wheel.

5. Proceed with operations Nos. 6 to 9 as described in "Track Replacement".

6. Adjust the track as previously described.

STEEL TRACKS

To break track:

1. Loosen off the tensioning wheel as directed in operation No. 1 under "Track Removal" in Rubber Track Maintenance.

2. Place the track strainer, tool No. 1-11015 on the track at the tensioning wheel end as shown in Fig. 46. letting the holding arms fall into the pockets at the

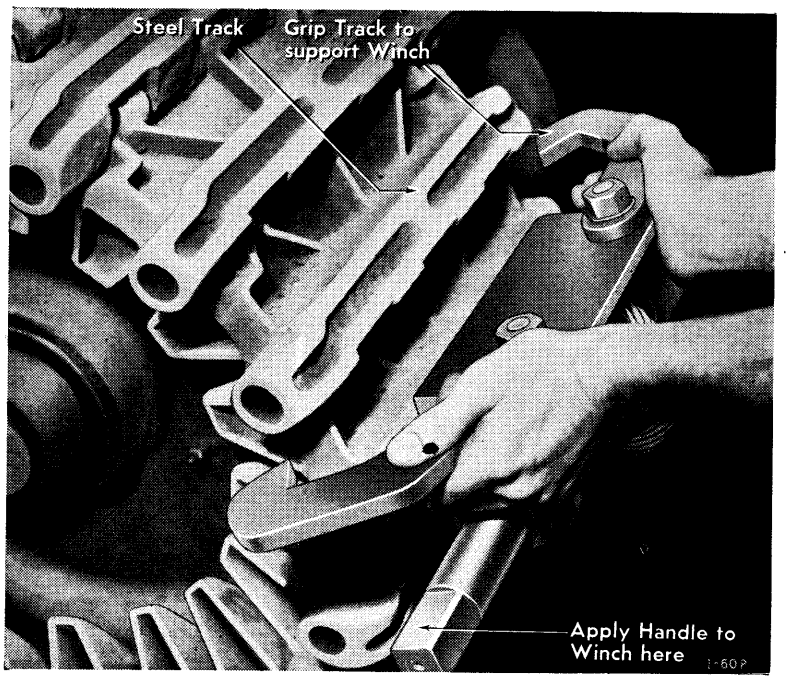

Fig. 46. Clamping winch into side recesses of track

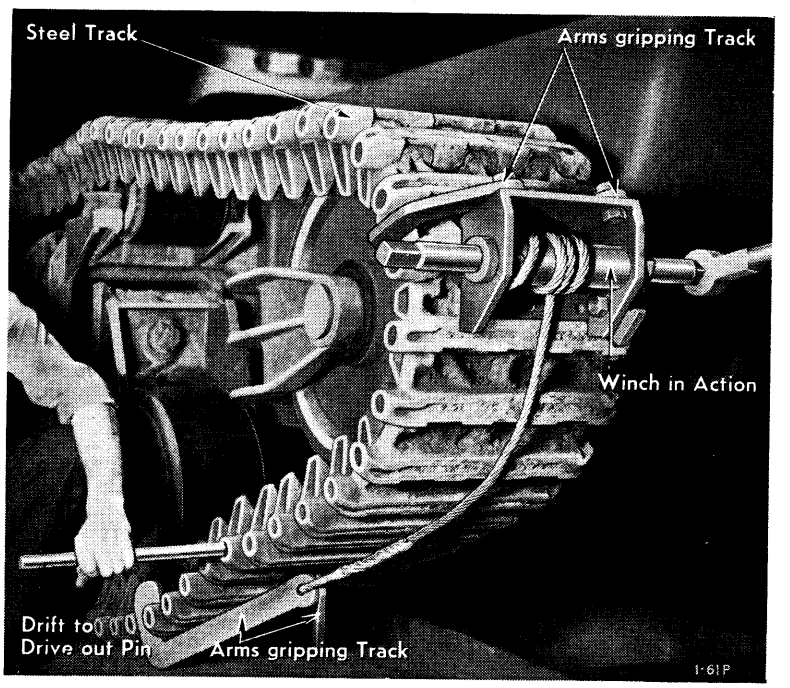

Fig. 47. Undoing steel track

outer ends of the links. Run out the cable and attach the hooks to the track as close as possible to the first bogie wheel as in Fig. 47. Tighten the strainer until the portion of the track below the tensioning wheel is relieved of tension. Any track pin in this section may then be driven out. See Fig. 47.

To shorten track:

If the track is to be shortened, remove the desired number of links and tighten the strainer until the ends of the track are together and the holes lined up for insertion of the link pin.

To remove track:

1. Slacken off and remove the track strainer.

2. Either use the engines in creeper gear to wind off the upper portion of the track, and then tow or push the Tank back 14 feet to clear the track, or alternatively tow or push the Tank forward 41 feet to clear the track. If both tracks are to be removed, disconnect both before moving the Tank.

3. If sufficient space is not available to move the Tank the tracks may be cleared by jacking up the hull, one side at a time, until the bogie wheels clear the track. Haul the track from under the bogie wheels until clear.

To replace a track:

1. Lay the track on the ground and tow or push the Tank on to it, so that the end of the track projects approximately 30 ins. beyond the centre of the front bogie wheel.

2. Bring the other end of the track over the tensioning and idler wheels to the sprocket.

3. Place a blocking tube in front of the second bogie wheel from the sprocket.

4. Take up as much slack as possible from the top portion of the track by turning the sprocket either with the engines or with a long bar. If only one track is being replaced, the opposite side brake should be pulled hard on.

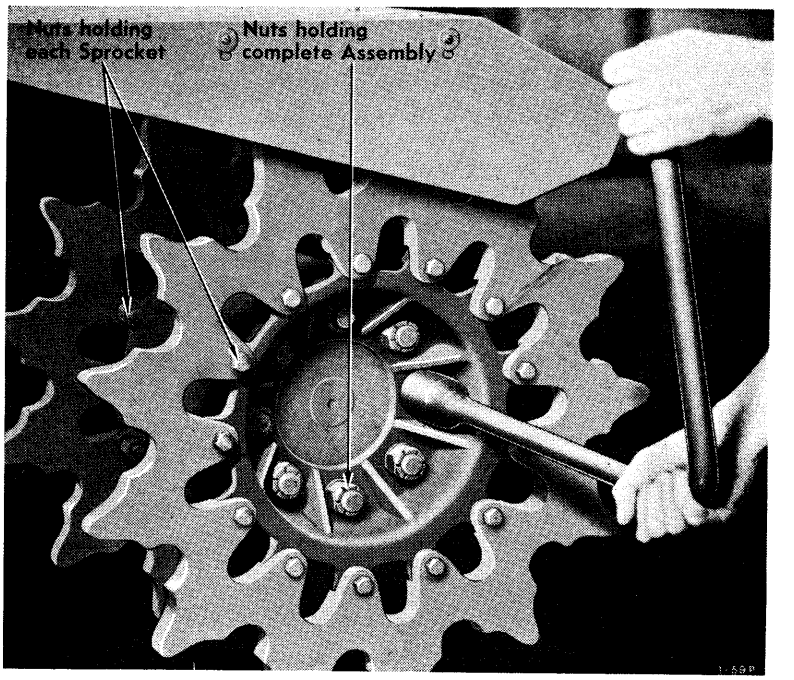

Fig. 49. Removing sprocket complete

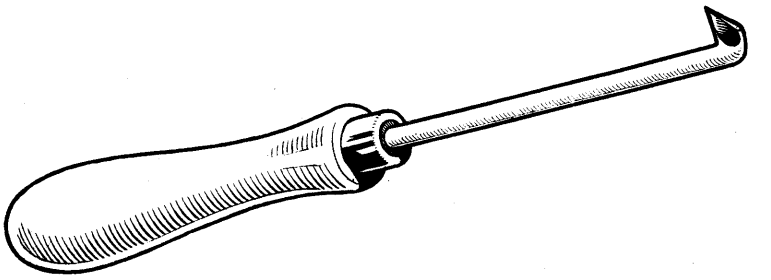

Fig. 48. Track groove cleaning tool, No. ADD (SR) 76

5. Place the track strainer tool, Fig. 47, on the track with the extension arms gripping the sprocket. Run out the cable and attach the hooks to the track as closely as possible to the first bogie wheel. Tighten the strainer until the ends of the tracks are together and the holes lined up for insertion of the track pin.

6. Drive in the track pin and lock in position with the lead plug or retainer. When the lead plugs are driven out of the track links a ring of lead is left in the locking groove. This must be removed before the new plug is inserted, otherwise the purpose of the groove is defeated and the plug will fall out. Fig. 48 shows this tool which has a hardened diamond point. Pushing the point into the lead and turning in the groove will remove the obstructing metal.

7. Remove the track strainer and blocking tube. Adjust the track as previously described.

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SUSPENSION AND SPROCKET GROUP MAINTENANCE

Tighten all the nuts holding sprocket hub to drive shaft flange with special spanner No. 1-11010, See Fig. 49.

At the same time ensure that the nuts and lock nuts securing the sprockets to the sprocket hub are tight.

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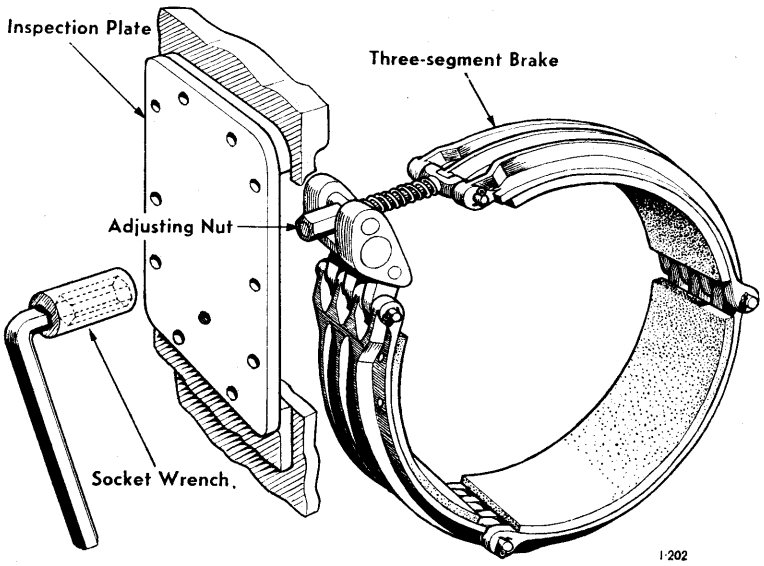
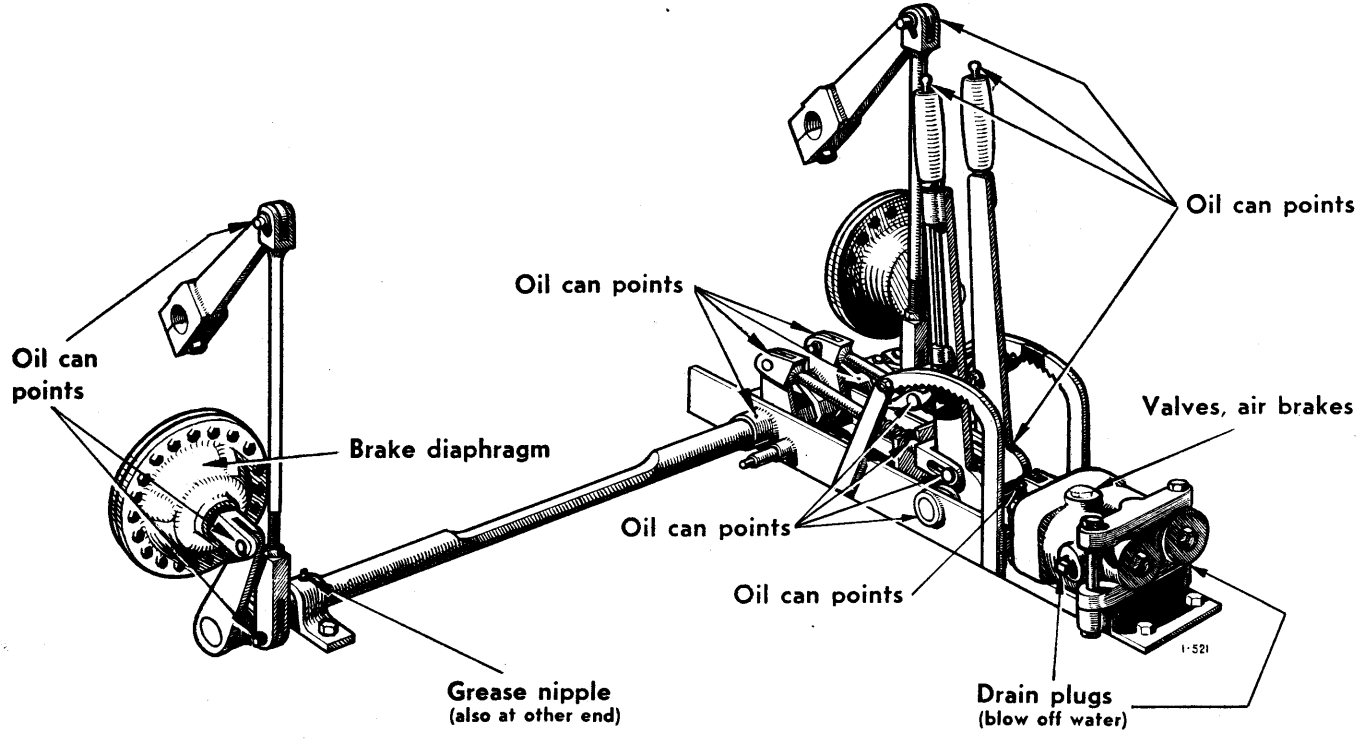


Fig. 50. Adjustment of brake bands



Steering and brake levers and control rods, showing lubrication points

To adjust brake bands:

Remove brake inspection covers (one from each set of brakes) and tighten top adjusting nut with special spanner No. 1-11013, see Fig. 50.

WARNING: This tool is for manual operation only, no other leverage is to be applied.

The adjusting nut has a groove, 3/16 in. deep, milled into the inner face. This groove registers with the cross pin through which the adjusting rod passes. It will be realized that, as the nut is tightened, the cross pin will rise out of the groove and drop back in again as each half turn is made. The depth of the groove provides the necessary band clearance, therefore any greater leverage than that provided with the special spanner will defeat the purpose of the groove and result in a binding brake. Care must be taken to have the groove registering with the pin when adjustment is complete.

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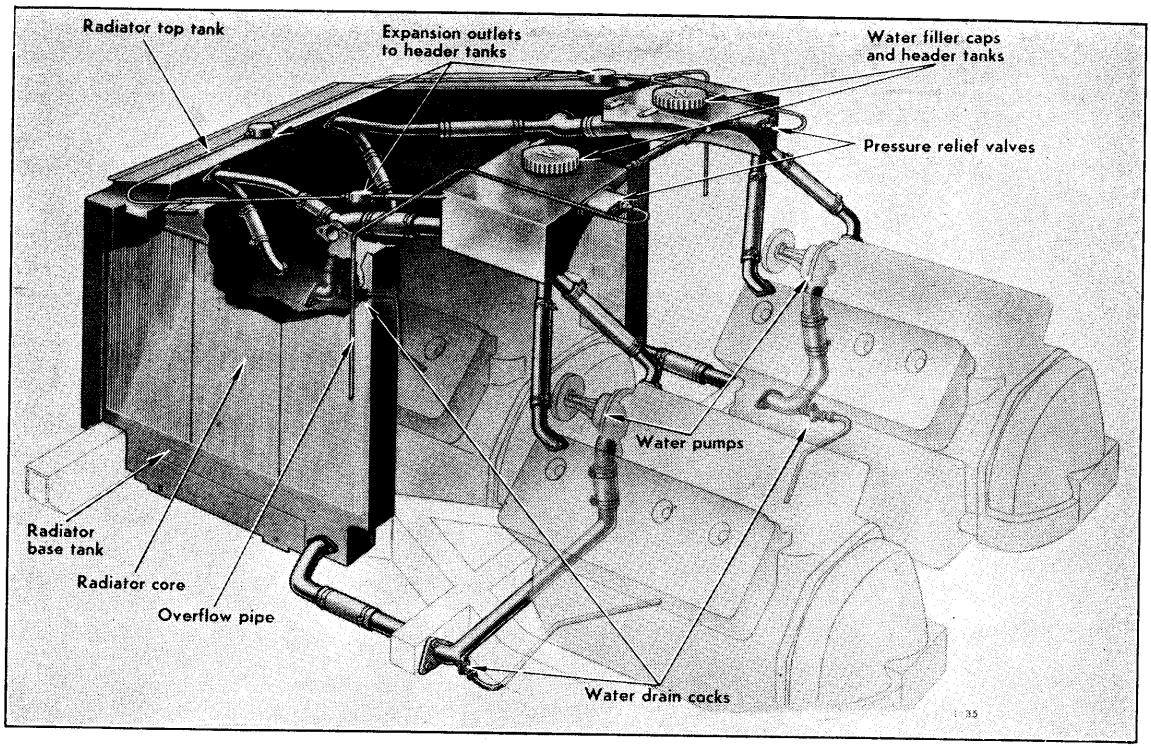

Fig. 51. Water circulation system

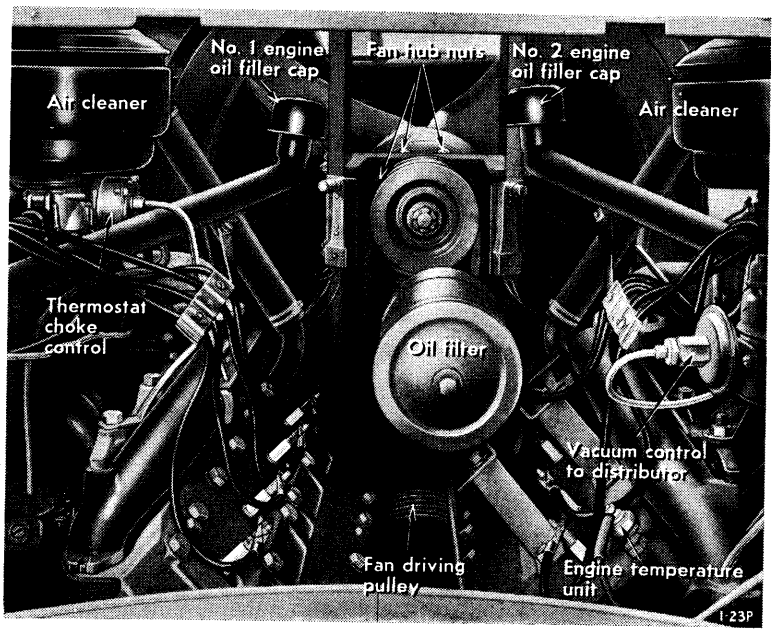

Fig. 52. Nos. 1 and 2 engines through opening in bulkhead

Hose clips:

Use screw driver to tighten where necessary. See Fig. 51.

Fan Belts:

The jockey pulley keeps an automatic tension on the belts until the belt stretch becomes excessive. The belts will then have to be replaced. This is a workshop job.

Fan Mounting Bolts:

These secure the fan hub to the flange of the fan shaft. Tighten if required with 13/16 in. ring spanner. Then replace split pins. See Fig. 52.

Fan Housing Securing Bolts:

These hold the fan bearing housing, (a box type casting) to the two vertical channel members situated in the centre of the fan aperture. Tighten these bolts with 7/8 in. ring spanner holding the heads with similar sized socket wrench. See Fig. 52.

Water Pump Belt Adjustment:

Loosen generator bracket adjusting nut with 5/8 in. ring spanner and prise generator upwards until belt is in correct tension, then tighten adjusting nut.

The correct tension of belt is when it deflects from 3/4 to 7/8 in. out of straight line between the two pulleys when pressure is applied halfway between each pulley.

Water Temperature Units:

These are situated on the right hand cylinder heads of each engine at the rear or clutch end. See Fig. 52.

Test tightness of electrical connection nut with pliers. Do not use force.

If the unit is leaking at its joint with the block, remove the electrical lead and apply 15/16 in. socket wrench or box spanner and gently tighten. Connect the wire and replace the nut.

Oil Pressure Gauge unit:

Tighten nut with pliers if required. See Fig. 52 for location.

Tachometer or Rev. Counter:

Situated under turret basket. Remove floor plate for access. Tighten flexible tube unions at both ends if required. Use pipe grip of pliers.

Exhaust Pipes:

Check tightness of clamp bolts, use 5/8 in. socket wrench on lower bolts and 19/32 in. socket on upper flange nuts. Hold heads with similar spanners. Do not overstrain.

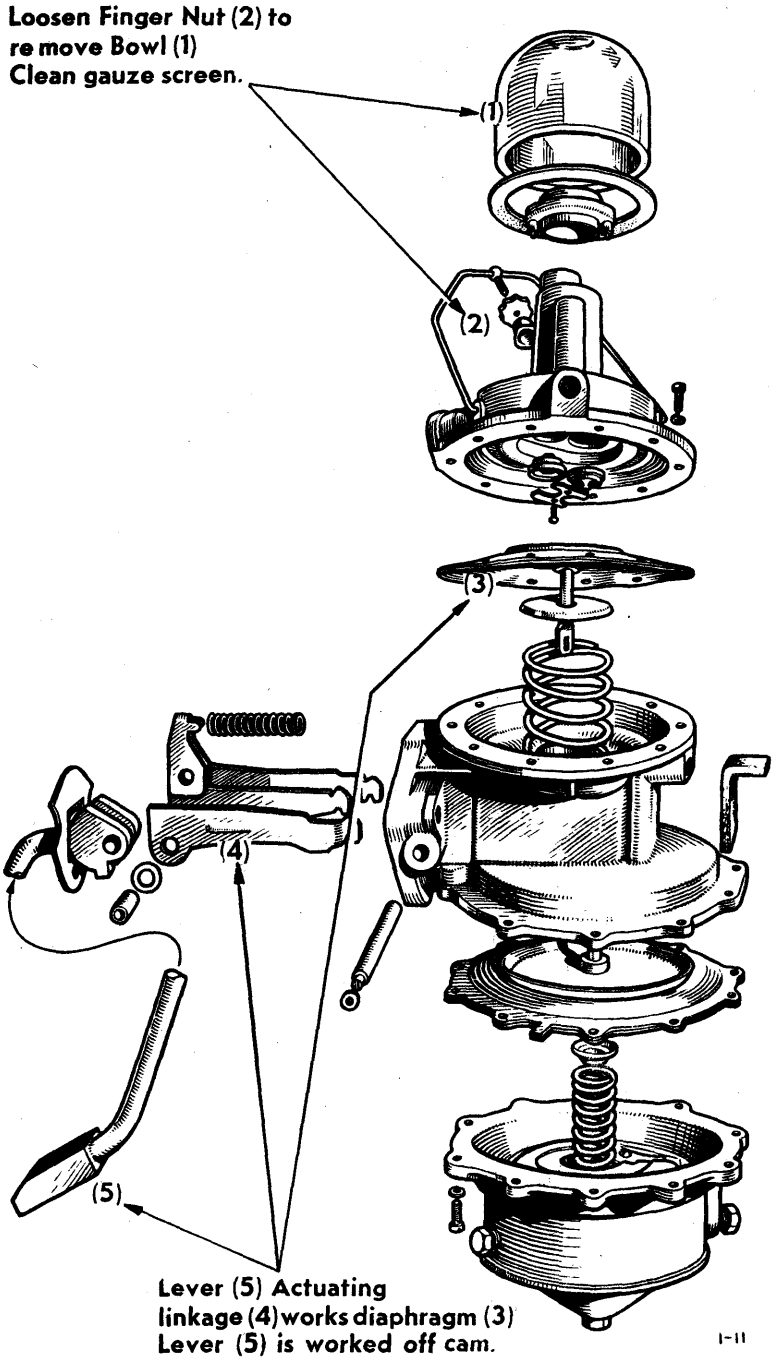

Fig. 53. Mechanical Fuel Pump, dismantled view. Bowl and filter screen *only* to be adjusted by crew. *Other components* NOT *to be dismantled by crew*

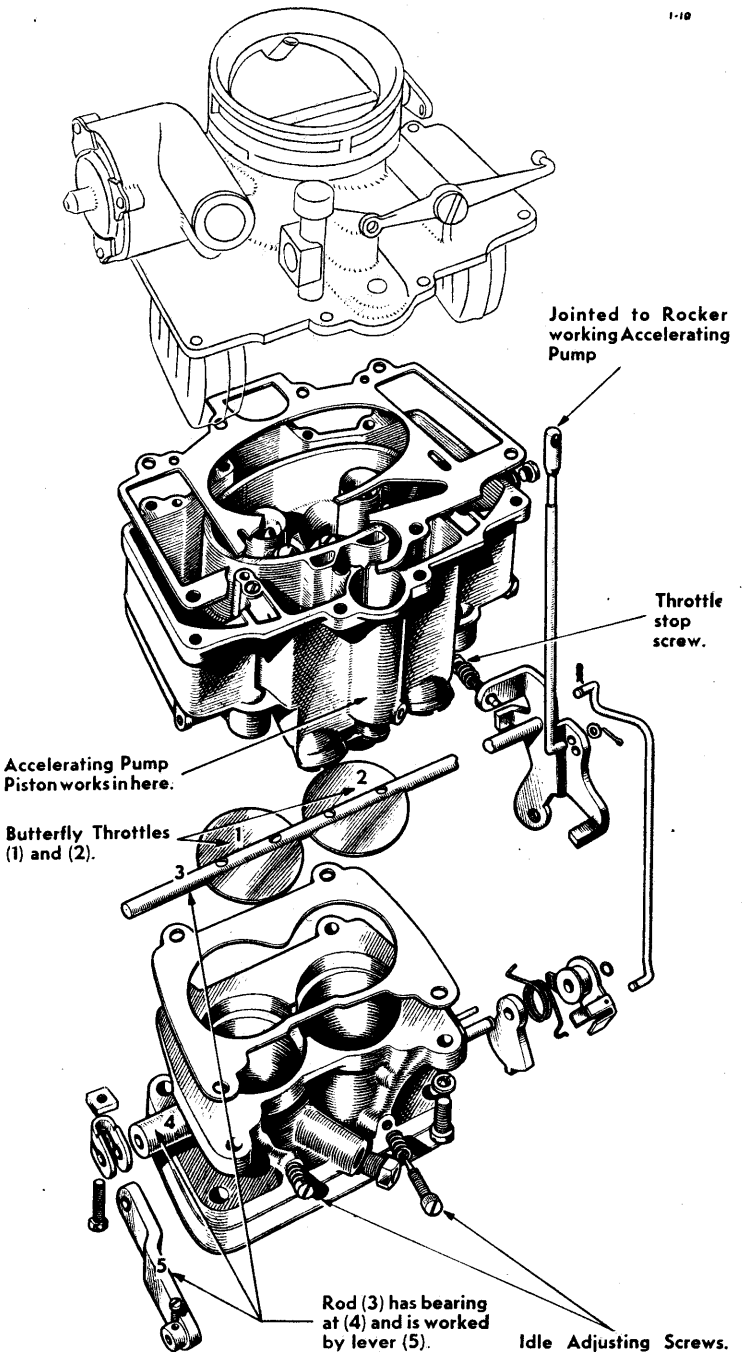

Fig. 54. Dismantled view of Carburettor. See also Fig. 20

FUEL SYSTEM GROUP MAINTENANCE

Engine pump fuel filters:

Remove stirrup nut on top of filter bowl, lift off bowl and remove gauge screen. See Fig. 53. Clean any foreign particles from filter gauze by washing in fuel. Take care not to damage the cork gasket at base of filter bowl.

Replace the gauze and bowl and before finally tightening the stirrup nut revolve the bowl to ensure a good seating on the gasket.

Carburettor Adjustment:

When starting a cold engine fitted with a Stromberg carburettor, the accelerator should be depressed and then released, before cranking the engine. This will set the fast idle.

Idling Adjustment:

1. Prop out individual clutches on Nos. 1 and 2 engines.

2. Run the engine to be tested until it is thoroughly warm so that choke valve is wide open and throttle stop screw is on slow idle.

3. Set throttle stop screw so that engine speed approximates 450 - 500 r.p.m.

4. Adjust the two idle mixture screws so that the engine runs smoothly without loping or stalling at this speed. See Fig. 54.

NOTE: Turn screws clockwise to lean mixture and counter-clockwise to enrich mixture. Approximate setting is five-eighths of a turn from seated position.

Float Level adjustment:

The fuel level should be set to five-eighths in. below the top surface of the float chamber. The level corresponds to the lower level of the sight plug when the engine is idling, and may be checked without dismantling the carburettor.
Important - The fuel level can be checked at the sight plug only wile the engine is running.

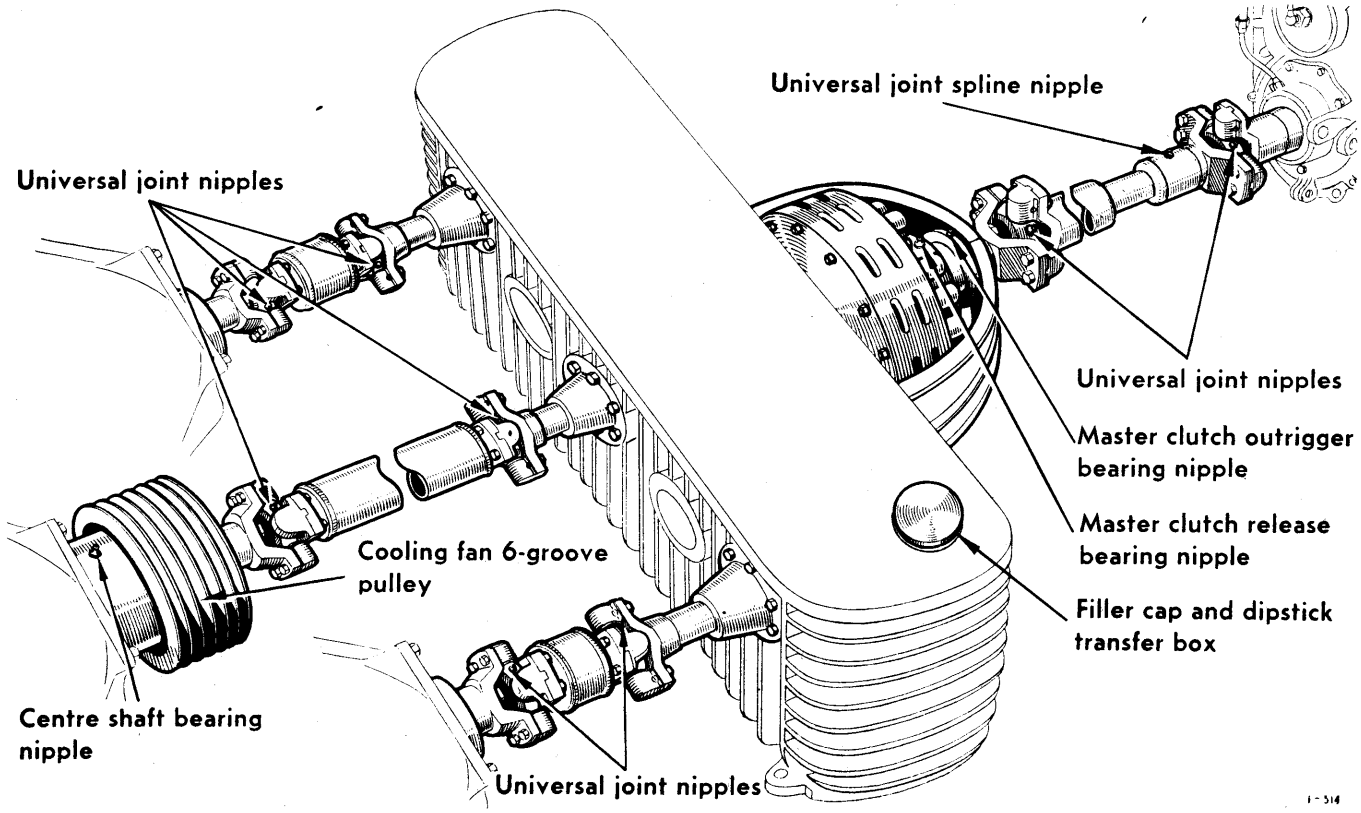

Fig. 55. Universal Joints and Master Clutch Lubrication Points

Carburettor air cleaner:

Three "Hat" type oil bath air cleaners are used, one on each carburettor and are attached to the carburettor air horn by a band and clamp screw.

To Dismantle:

1. Remove the cleaner from the carburettor.

2. Remove the wing nut from the top of the cleaner and lift the top out of the lower body, setting it down in an upright position to prevent the oil in the element from running up to the inside of the top cover.

3. Take the lower body and thoroughly wash all oil and dirt out of the sump.

4. Wash the top section and cleaning element thoroughly in fuel. Drain or blow the element out with compressed air until dry.

5. Refill the sump with Engine oil. See Lubrication Schedule for grading. Reassemble and attach to the carburettor, making sure that the cleaner is properly seated on the carburettor and the clamp screw is tight. NOTE: Do not overfill the cleaner, as this will restrict the air passage and cause a rich carburettor mixture.

CLUTCH GROUP MAINTENANCE

Adjustment:

If the master clutch does not disengage when the clutch pedal is fully depressed, the front linkage rod should be shortened by removing the clevis pin from the fork at the front end of the rod fastening to the clutch pedal. The fork should then be screwed on to the rod until the desired travel is obtained.

Clutch Maintenance:

The moving parts of the clutch linkage rods should be oiled when the vehicle is being greased. The extractor race is fitted with a nipple for daily lubrication and the outrigger bearing also has a nipple. See Fig. 55 for location of nipples.

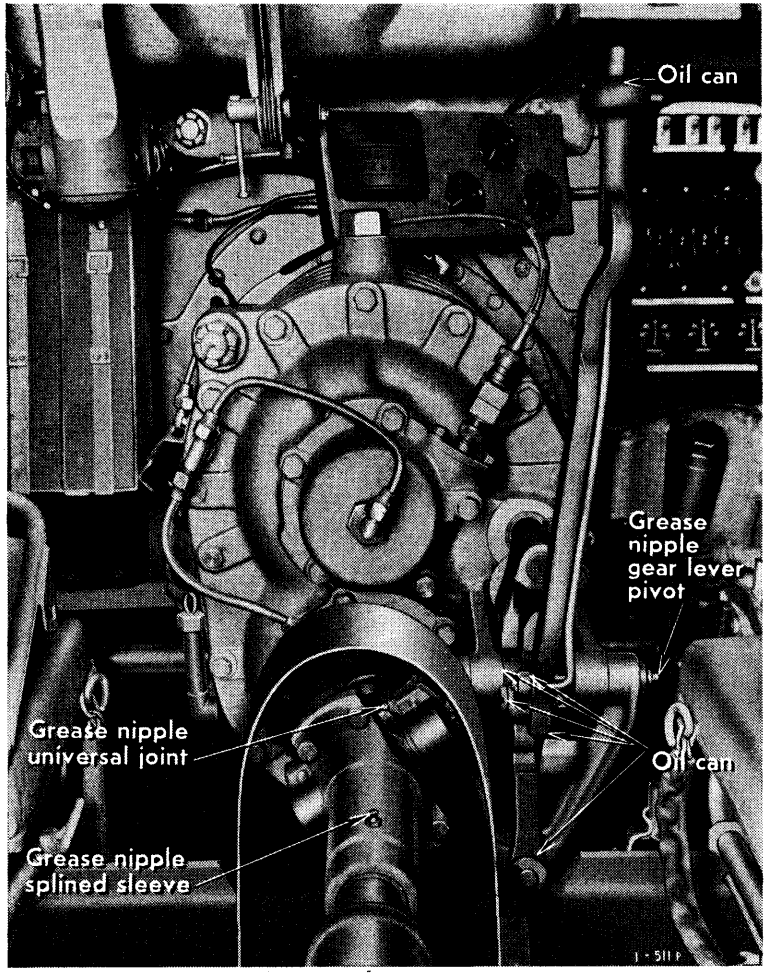

Fig. 56. Gear control lubrication

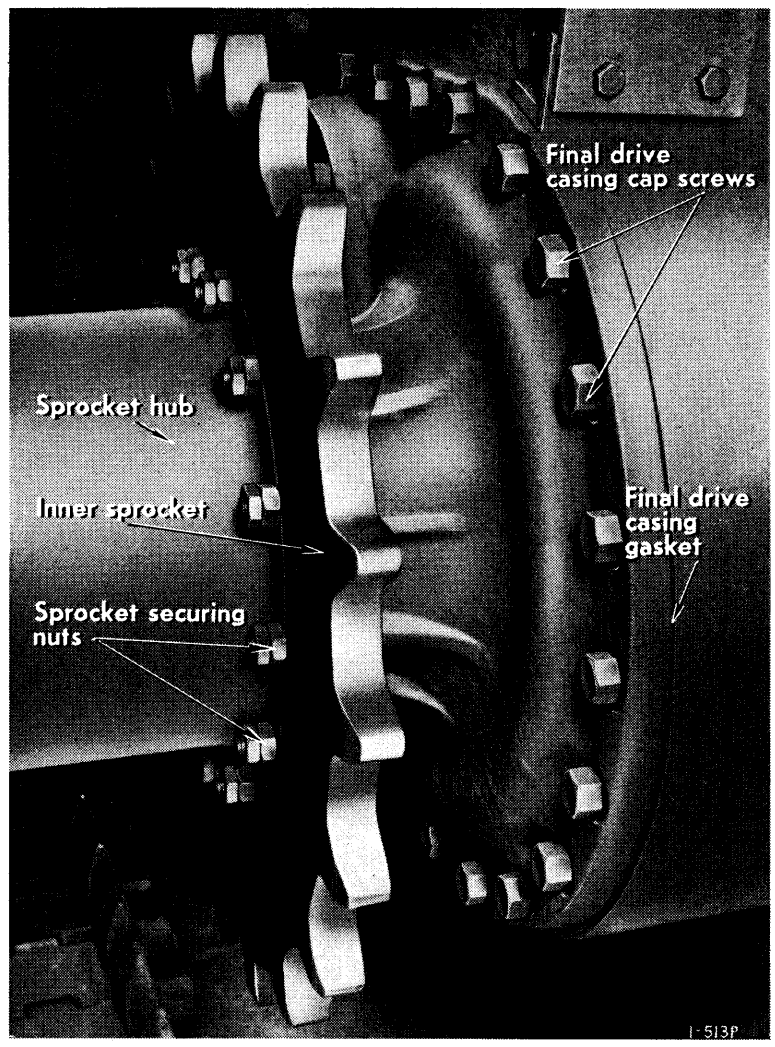

Fig. 57. Final drive cover case showing cap screws

TRANSMISSION GROUP MAINTENANCE

Gear control lubrication:

The nipple is fitted at the end of the cross shaft. Other moving parts are lubricated with the oil can. See Fig. 56.

Main Drive shaft and universal joints:

In a vehicle of this nature some vibration is always experienced consequently the inspection and tightening of the studs securing the universal joint should be done frequently. See Fig. 55 for location of nipples.

Final Drive:

Tighten all the cap screws securing the final drive cover plate to the hull (see Fig. 57) using $1\frac{1}{8}$ in. spanner.

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FIRE FIGHTING EQUIPMENT GROUP MAINTENANCE

Graviner System:

Warning: The Graviner system should be tested electrically every 25 hours or 250 miles and particular care should be taken that 12 volt current is not passed to the bottles as this will cause them to operate.

See that the containers are full by removing the adaptor plug located on top of each bottle and by loosening the securing clamp. The weight of the bottle will then indicate the quantity of liquid it contains.

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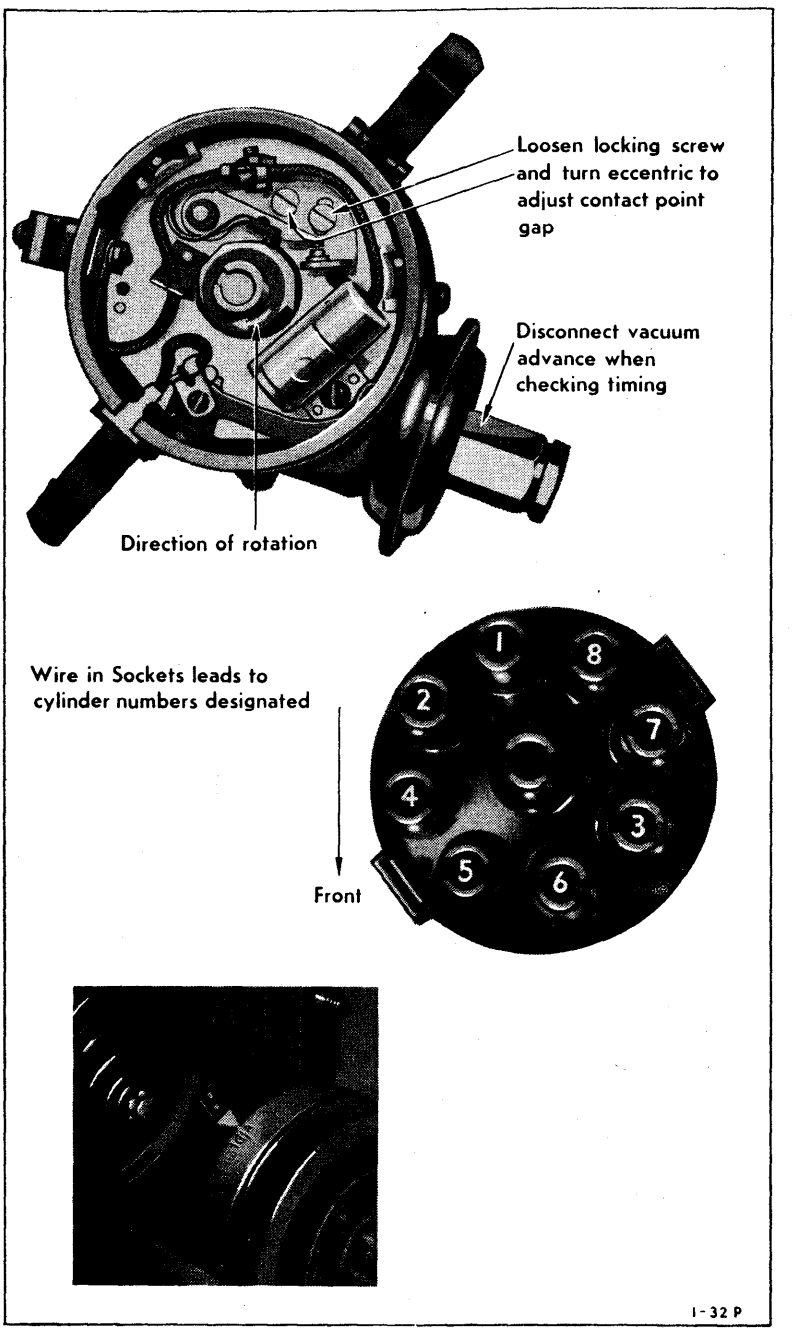

Fig. 58. Distributor showing timing

Battery vent plugs:

To prevent overfilling a special cover is fitted to each cell of the battery.

This device consists of a small rubber bellows, or valve, which is fitted below the vent plug in each cell, and expands when the vent plug is removed, closing the gas vents on either side of the vent plug recess.

Battery Maintenance:

Add distilled water until the level reaches the bottom of the vent plug recess, that is to a height approximately $\frac{3}{8}$ in. above the separators.

Any excess distilled water will overflow as there is no escape for the air trapped inside the cell.

Care should be exercised to avoid holding the valve down when adding the distilled water as this would defeat the proper functioning of the device.

NOTE: Instructions are moulded on the tops of the plugs stating that they must be screwed down when charging. The only time the plugs should be removed is when the battery is being filled or topped up.

Inspect the battery terminals for cleanliness and tightness. Loose or corroded connections will increase the generator voltage to dangerous limits and also cause the starting motor to function indifferently. The terminals should be cleaned and smeared with vaseline to prevent corrosion.

Battery testing:

Check the specific gravity of the electrolyte with a hydrometer. Brush all dirt from the top of the battery and remove the vent plugs. When using the hydrometer see that the float is not sticking to the glass wall. The specific gravity readings at 80 degrees F. should be:

Fully charged	1.260 - 1.240
Half charged	1.190 - 1.180
Fully discharged	1.120 or less

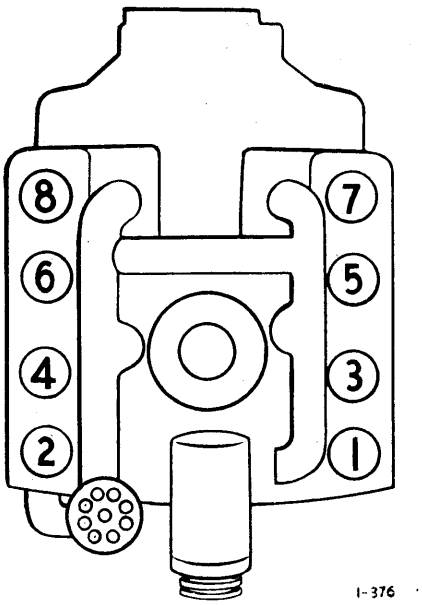

Fig. 59. Front of Engine. Cylinder numbering.
Firing Order: 1, 8, 7, 3, 6, 5, 4, 2

A correction of 0.004 should be added to the specific gravity reading for each 10 degrees F. above 80 degrees, or subtracted for each 10 degrees F. below 80 degrees. Do not attempt to take the specific gravity of a cell which has just been topped up. The reading of each cell in a battery should be within 0.020 if the cells are in equal condition. If a reading in one cell differs greatly from the other two, it should be reported immediately.

Distributor Adjustment:
Emergency repair to be done only under special instructions:

The correct adjustment of the contact breaker gap is 0.0125 in. to 0.0175 in.

To adjust the points, turn the engine until the heel of the contact breaker lever is lifted to the full extent by one of the cam lobes. Then, after slackening the contact support locking screw, adjust the gap to within the above limits by turning the eccentric screw, then by tightening the locking screw and re-checking the gap. See first illustration in Fig. 58.

Ignition Timing:
Emergency repair to be done only under special instructions:

The ignition should be timed so that the spark occurs when the piston reaches a point five degrees before top dead centre (T.D.C.) The crankshaft pulley is marked I.G/A. (See third illustration Fig. 58) and when this mark is opposite the small pointer attached to the crankcase the piston in No. 1 cylinder is five degrees before T.D.C. To time the distributor, set the engine in the above position, then disconnect the vacuum line and loosen the distributor housing clamp screw. Rotate the distributor anti-clockwise until the contact breaker points just separate, with the rotor pointing to No. 1 insert in the distributor cap. Hold the cam against the direction of rotation and retighten the distributor clamp screw. Recheck the timing to make sure that the distributor did not rotate while tightening and re-connect vacuum line. A fine adjustment can be obtained by making use of the slot in the clamping plate.

The firing order of the cylinders is as follows: 1,8, 7, 3, 6, 5, 4, 2. (See Fig. 59).

Fig. 60

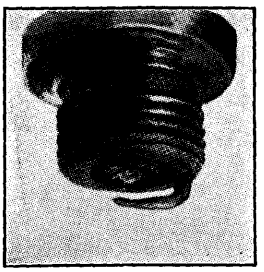

Fig. 61

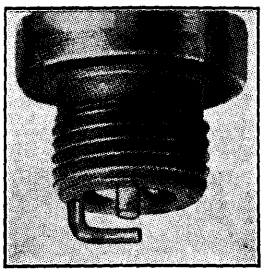

Fig. 62

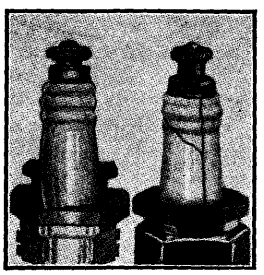

Fig. 63

Some Spark Plug Troubles

Spark Plug Maintenance:
Spark Plugs:

The spark plugs, type AC-104 have a 10 m/m thread the correct gap being 0.025 in. to 0.030 in. The gap should be checked every 25 hours or 250 miles.

In setting the gap never bend the centre electrode, this will probably crack the porcelain insulator. Always bend the side electrodes in towards the central electrode.

Gaps set too wide will cause misfiring under load or at speed. Gaps set too close will cause uneven running at high speed. If the gaps are incorrectly set, unsatisfactory performance will result through no fault of the plugs.

Some spark plug troubles:

Fouled: Indicated by oil and carbon deposit on insulator and metal part of plug. Spark plug will misfire or fail to fire at all. (Fig. 60).

To correct: Check spark plug gaps. Clean and test spark plug for possible insulator fractures. If plugs are O.K. and fouling is persistent, report.

Burnt and worn: Indicated by blistered and burnt insulator and possible eroded electrode points; will cause pre-ignition and faulty motor operation, especially at high speed and under load. (Fig. 61).

To correct: Fit new spark plugs.

Fractured: A fractured insulator will cause complete plug failure. A fracture above part exposed to combustion can never be caused by engine heat; it is due to a hit or to a poorly fitting spanner being used for fitting or removing plug. Fractured at part exposed to combustion may be caused by plug operating at too high a temperature. (See Fig. 63).

To correct: Fractured above: Replace with new plug. Fractured at lower end and insulator appears to be badly burnt, report.

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DRIVING INSTRUCTIONS

A. STARTING UP:

1. Ensure that engine is correctly warmed up.

2. That instruments are all correct.

3. Depress clutch pedal.

4. Allow engine revolutions to drop to 350 r.p.m.

5. Engage second gear normally. If on a steep slope engage first gear.

6. If on the level release the knobs on top of steering levers by pulling slightly on levers, then release steering levers. (These act as hand brakes)

7. If on a slope release the knobs on top of steering levers as before thus disengaging ratchet and pawl, but hold levers on until drive has been taken up by engine.

8. Rev. up engines to 1500 r.p.m. and gradually let out clutch.

9. When clutch is fully engaged accelerate until Tank has gained sufficient momentum to engage next highest gear.

10. Let up accelerator, depress clutch and move shift lever into neutral, let up clutch for a couple of seconds, depress clutch again and move shift lever into next highest gear, then allow clutch to engage smoothly and accelerate. (Note: Do not force the lever). Let out clutch smoothly and accelerate engine ready to engage the next highest gear. Repeat 9 and 10 until top gear is engaged.

B. OPERATING:

When operating Tank gear changing must be anticipated in advance.

When changing down the following procedure must be followed:

1. Ensure that vehicle is not moving too fast for lower gear to be engaged. For example, if the

Tank was moving at 20 m.p.h. in fifth gear, it would be found that in fourth gear the engine would have to exceed 3750 r.p.m.

2. Depress clutch pedal.

3. Engage neutral.

4. Engage clutch and momentarily speed up engine to increase the speed of the drive shaft so that the speeds of the engaging gears will be approximately the same.

5. Disengage clutch and quickly move gear shift lever to engage the gear.

6. Smoothly engage the clutch.

NOTE: Change down same as normal double clutch on motor trucks.

Engine revolutions must not be allowed to fall below 1000 r.p.m. under load.

Never "lug" the engine below 1000 r.p.m.

"Lugging" means having such a load on the engine that even at wide open throttle the tachometer reads less than 1000 r.p.m.

Maximum speed is 3600 r.p.m. and should only be maintained for very short periods.

Maximum permissible speed in fifth speed is 24 m.p.h.

It will be found that the best method of driving after the driver has become experienced in the operation of this Tank is by keeping the engine speed as constant as possible and varying the vehicle speed by engaging higher or lower gears. Instruments must be checked frequently, particularly oil pressure and temperature, if temperature exceeds 200 degrees F. engines must be cooled off.

C. STEERING

The steering on this Tank is carried out by means of two levers situated in driver's compartment. Those levers operate brake bands. When the right lever is pulled back the Tank steers to the right.

When moving along a cambered road it will be found that the Tank tends to run off the camber to the side of the road. If on a country road and there is no traffic keep to middle of road on top of camber. If on main road steer by making deliberate corrections. Do not ride the steering levers.

The controlled differential form of steering gives minimum turning diameter of 58 feet. Do not forget this when operating in congested or wooded areas and go into your turn earlier than you would with "skid" steering.

Do not turn sharply or at excessive speed and remember than a thrown track on these vehicles takes hours to replace and usually results in buckled bogie wheels. However, where it is essential to make a sharp turn, engage the next lower gear and keep the accelerator well down. Whenever turning keep the motor pulling and do not let your foot off the accelerator.

Remember, that these tracks usually come off at the back, and if you can keep your track tight at the back it will not come off.

D. STOPPING

Slow down by allowing friction of tracks to bring vehicle to halt wherever possible. Remember that the brakes have to do the three jobs of steering, braking and holding the vehicle stationary, and use them as little as possible. It will generally be found that if the Tank is slowed down for the purpose of turning a corner, a lower gear will require to be engaged to take you through the corner, so engage your lower gear in advance and allow this to slow you down.

Do not, however, make the common mistake of using your gears always for the brake.

In an emergency remove foot from accelerator and at the same time pull back both levers evenly.

Leave the clutch engaged until the Tank has been slowed up and then disengage the clutch. The engine acts as a brake and also, which is more important, acts as a steadying agent and helps to prevent those wild swerves across the road which frequently happens on a sudden application of the brakes.

When the Tank is stopped engine is to be kept running at 350 r.p.m. until ready to be moved off again.

Avoid prolonged idling periods.

E. OBSTACLES

Before attempting to negotiate steep inclines, declines, ridges, deep shell holes, trenches, fallen trees, or any obstacles, always shift the change speed lever into a lower speed and thus prevent needless labouring of the engine and the possibility of stalling it.

When negotiating a very steep incline a little experience will teach the operator how to manipulate the Tank at the top of the incline. If the slope is very abrupt, as in the climbing of a ridge or log, the front of the Tank will climb almost to the vertical position and will drop forward with a severe jolt if the operator is not skilful in controlling the vehicle as it passes the balance point. With the vehicle in this position the experienced operator can control the descent by the proper application of the brake levers. The vehicle will then resume a horizontal position easily and without a severe jolt. Operators should accustom themselves to keep some tree or other guide in sight at high angles of climb so as to be instantly aware if one track is pulling ahead of the other, in order to prevent the vehicle from tipping on its side. Do not attempt to drive on a slight slope at right angles to the slope, as the side thrust on the tracks may throw the tracks off or if the slope is steep enough, turn the vehicle over.

Trenches too wide to be spanned and too steep to be descended can be negotiated by a towing cable or cables, the second Tank lowering the first Tank over the edge gradually, until it is able to secure traction on the bottom of the hole. The third Tank assists the second the same way, and so on, until the last Tank reaches the edge. The last Tank will have to drop from the line, allowing the others to go on, unless by that time the ground on the edge of the trench is worn to a degree that it is able to go over the edge alone. The first Tank to enter the trench should demonstrate its ability to climb out of the trench before the others enter it.

The Tank should not be used for pushing over stumps trees etc. The Tank is not built for this work and carries armourplate to protect the crew from gunfire, not

to push over trees and stumps. Besides giving away your position by noise and by observation of the disappearance of tree tops it damages the Tank. Such parts as the front step, final drives and mudguards are very vulnerable to shocks given them which they have not been designed to withstand. Charging earth banks or dropping into shell holes and washaways can also cause misalignment of the final drive and broken suspensions.

F. TOWING

1. To start engine:

(a) Towing Tank to be in first or second gear.
(b) Towed Tank to be in third or fourth gear.
(c) (This practice is not recommended unless absolutely necessary).

2. In towing there are several precautions that the driver must take to avoid trouble or unnecessary delay. Changes of direction must always be made by a series of slight turns so that the vehicle being towed is as nearly as possible directly behind the one doing the towing. Soft muddy ground is to be avoided, since track may slip on such a surface. If it is necessary to cross a muddy area, the driver should be careful to straighten out both vehicles before entering it, as it is more difficult to pull a Tank at an angle than when following in tow.

The maximum speed when towing should not be more than 12 miles per hour.

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GENERAL NOTES ON DRIVING

Starting engines:

Before starting the engines, check petrol, oil and water; then make sure that the gear lever (on your left) is in "neutral" position. All gear change positions are illustrated in Fig. 64. Also check to see that all the emergency knife switches on the instrument panel are pointed upwards in the position marked "N" (Normal position). Now switch on the master switch which is situated on the right hand bulkhead about shoulder high when you are seated at the controls. Next press down the switches marked "Ignition" on the instrument panel and if the fuel is not up to the level of the stand pipe in the header tank, the Autopulse electric fuel pumps will automatically operate until the fuel reaches the aforementioned level.

Now switch on the three engine "Starter" switches, press the starter push button and all three engines should start simultaneously. If trouble is experienced from weak batteries, see instructions under "Emergency Starting" for procedure. When engines are running a period of warm up is required which includes approximately two minutes for air compressor to store sufficient air for brake operation.

Checking oil pressure:

The driver should obtain commander's O.K. regarding engine oil pressures shown on gauges on rear bulkhead. The normal operating pressure is 25 lbs. per sq. in. at 2,000 r.p.m.

If the red light fails to go out immediately after starting or comes on while the engine is operating at ordinary speeds, the pressure gauge reading should at once be checked. If this is reading low no attempt should be made to run the engine until the cause has been ascertained.

The fault will lie either in the gauge or in the pump. To find out which unit needs attention, remove the gauge connection and turn the engine over with the starter.

If oil issues at full bore, then the gauge only is faulty, and the vehicle can still be driven. The first opportunity should be taken, however, to have the gauge adjusted by workshop personnel.

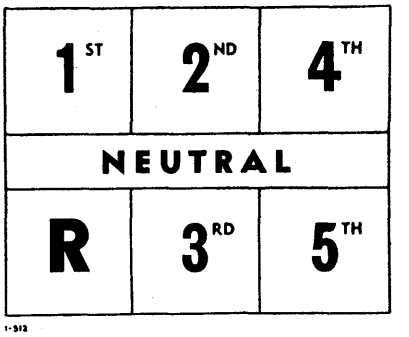

Fig. 64. Gear change positions

If oil does not flow, the indication is that the pump requires attention. This work must be performed by workshop personnel only.

Checking 6 volt Generator Charging Rates:

When the electrical system is functioning correctly, the reading shown on the three ammeters on the instrument panel is a good indication of the state of charge of the batteries. If a battery is in a low state of charge the generator will give a high output and a high reading will be recorded on the ammeter. Conversely, if during the day time running, the ammeter shows a low reading, this indicates that the battery is in a fully charged state and does not require a high rate of charge. If an ammeter shows a low reading when the battery is in a low state of charge, the electrical system is at fault. Report immediately.

Check the running of each engine individually by switching off the following ignition switches:

Switches	2	and	3	to test	No. 1	Engine
"	1	and	3	" "	" 2	"
"	1	and	2	" "	" 3	"

Starting off:

Operate the clutch pedal (master clutch control) and then engage second gear by bringing the gear shift lever into the position shown in Fig. 64. The first gear is generally known as the "creeper" gear and is used only in exceptional circumstances; for this gear and reverse the gear lever must be latched out.

When second gear has been engaged, ease the clutch back gently, increase the engine speed by gradual pressure on the accelerator pedal and the vehicle moves off. With the two steering levers in the fully forward position, the Tank will proceed in a straight line. By pulling on the right hand lever the vehicle turns to the right and if the left hand lever is pulled the Tank turns to the left. Conventional changes of gears higher than first are engaged at speedometer readings as specified under the heading of "Maximum Training Speeds" in the Condensed Specifications section of this manual.

Note: Any rapid movement of the accelerator pedal causes a jet of petrol to be injected into the inlet manifold, thus giving a rich mixture.

Do not use the clutch pedal as a foot rest as constant pressure, however slight, will eventually produce wear of the clutch release bearing and clutch facings.

Always let the clutch in gently and take the load gradually from a standing start.

Emergency Starting:

The three engines can be started by two starting motors, but one starting motor is only capable of cranking the three engines when hot and when the battery is fully charged. Thus it will be seen that the engines can always be started even though one of the three batteries is flat.

Batteries in Parallel to Three Starter Motors:

Should, however, the three batteries be so run down that the starting motors are not capable of cranking the engines fast enough to start, all three batteries should be connected in parallel and the three starters operated simultaneously. The batteries may crank the engines at sufficient speed to obtain a start.

To connect the three batteries in parallel, operate the emergency change-over switch (i.e. the switch on the extreme right in the top row) whereby the starter parallel switch can be energised from either No. 1 or No. 3 Battery. Then press down the second switch from the right and after switching "on" the three ignition and starter switches, press the starter push button. All three batteries are now connected in parallel to the three starting motors.

Batteries in Parallel to One Starter Motor:

The three batteries can be connected in parallel to any one of the three starters by operating the two right hand switches in the top row, as described above, and selecting the ignition and starter switch for the required engine. This method requires that the individual clutches be first disengaged.

No special provision has been made for operating the individual clutches of the three power units from the driver's seat, but levers are provided on the power unit so that individual clutches can be singled out for tune-up purposes.

The clutch levers on No. 1 and No. 2 engines only are accessible. Disengaging these two clutches will leave No. 3 engine only connected to the transfer box. Should an engine be faulty the unit can be located by disengaging No. 1 and No. 2 individual clutches, using wood blocks mentioned in Packing List at the end of this manual.

Next start each engine independently by switching on its ignition and starter switch, then by pushing the starter button for each engine in turn. In this manner the engine with the faulty battery or starter motor will be quickly located.

If the starting system on No. 1 or No. 2 engine is faulty, it can be started from the other engines by engaging its individual clutch. If the starting system on No. 3 engine is faulty this engine can be started by engaging the clutch on either No. 1 engine or No. 2 engine.

Should a battery be faulty the ignition current to the engine normally fed by that battery can be supplied from one or other of the two good batteries by operating the five emergency selector and change-over knife switches. The first two knife switches from the left hand side of the panel control the three batteries, while the remaining three are connected one to each engine. If battery No. 1 is discharged, pull down the first or second knife switch and then the knife switch for No. 1 engine to the position marked "E", thus feeding the ignition circuits to No. 1 engine from No. 2 or No. 3 battery.

Similarly, the solenoid and ignition circuit to any other engine can be energised by any battery through operation of the knife switches in accordance with the plate on the instrument panel.

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General Notes on maintenance:

Military units are becoming increasingly dependent for their efficiency on mechanically propelled vehicles for both fighting and administration. In the majority of modern fighting units, fire power is either delivered or is brought into action by mechanically propelled vehicles.

Thus it is vital that such vehicles should be maintained in the highest state of mechanical efficency.

Maintenance is a term used to describe the complete system including "routine maintenance", "inspection" and "repairs". Routine maintenance is the performance of certain necessary duties at specified periods and/or mileages to ensure that wear, deterioration and consequent repair of the vehicle are reduced to a minimum.

Inspection is a vitally important and integral part of any system of maintenance and is necessary to determine:-

1. whether routine maintenance is being carried out efficiently and regularly.

2. whether all component parts of the vehicle are in good mechanical order.

3. the extent and cause of wear, deterioration, failure and damage.

Inspection should be followed by the prompt execution of all repairs or adjustments as may be necessary. Drivers should concentrate on the simple tasks of cleaning, lubrication, minor adjustments and preservation as well as the noting and reporting of defects. Unit officers and N.C.O's should frequently inspect and supervise routine maintenance to ensure that this work is performed efficiently and regularly.

As distinct from methods adopted in private or commercial life, the military system of routine is based on the capacity of drivers not only to operate, but to look after and maintain their vehicles, as well as to be capable of diagnosing and rectifying minor running faults without continual resort to technical assistance and specialised garage tools and equipment.

It is vital that adequate time for maintenance and inspection be provided. Every opportunity should be taken during periods of halt for the vehicle to be looked over. In the field, mechanised units may be called on to fight for several days in succession, which may necessitate maintenance being carried out at night. It should be a point of honour in mechanised units that no vehicle crew goes to sleep, even after the hardest day, until their vehicle is as fit as they can make it.

As far as possible, the crew of any A.F.V. should be allotted permanently to a vehicle and should always work together at maintenance. Not only does this ensure that maintenance is done quickly and efficiently, but also that, in spite of casualties, there will always be a man in the crew who knows the peculiarities of the particular vehicle.

General Notes on Lubrication:

The lubrication of the individual components of the Tank has been discussed in detail and the recommended periods and lubricants are set out in the appended schedule, as well as in the Lubrication Chart.

It should be borne in mind that the periods recommended for the lubrication of these various components are based upon normal operating conditions. Exigencies of active service may necessitate the Tank being operated under conditions which depart considerably from the normal. In these circumstances, the selection of suitable periods must be left to the discretion of those responsible for the maintenance of the vehicle.

It is impossible to lay down rigid schedules for draining periods for the reason that, under service conditions, the vehicle may be operated in low gear (or other indirect gears) under extremely heavy loads for long periods. Such conditions are not truly reflected in the speedometer readings, whereas the schedule is made out in terms of mileage. It is all the more necessary, therefore, to accept the mileage figures as the maximum and from intimate knowledge of work actually done by the vehicle, to select suitable draining periods and provide adequate general lubrication.

The importance of regular and adequate lubrication of the various components of the Tank cannot be

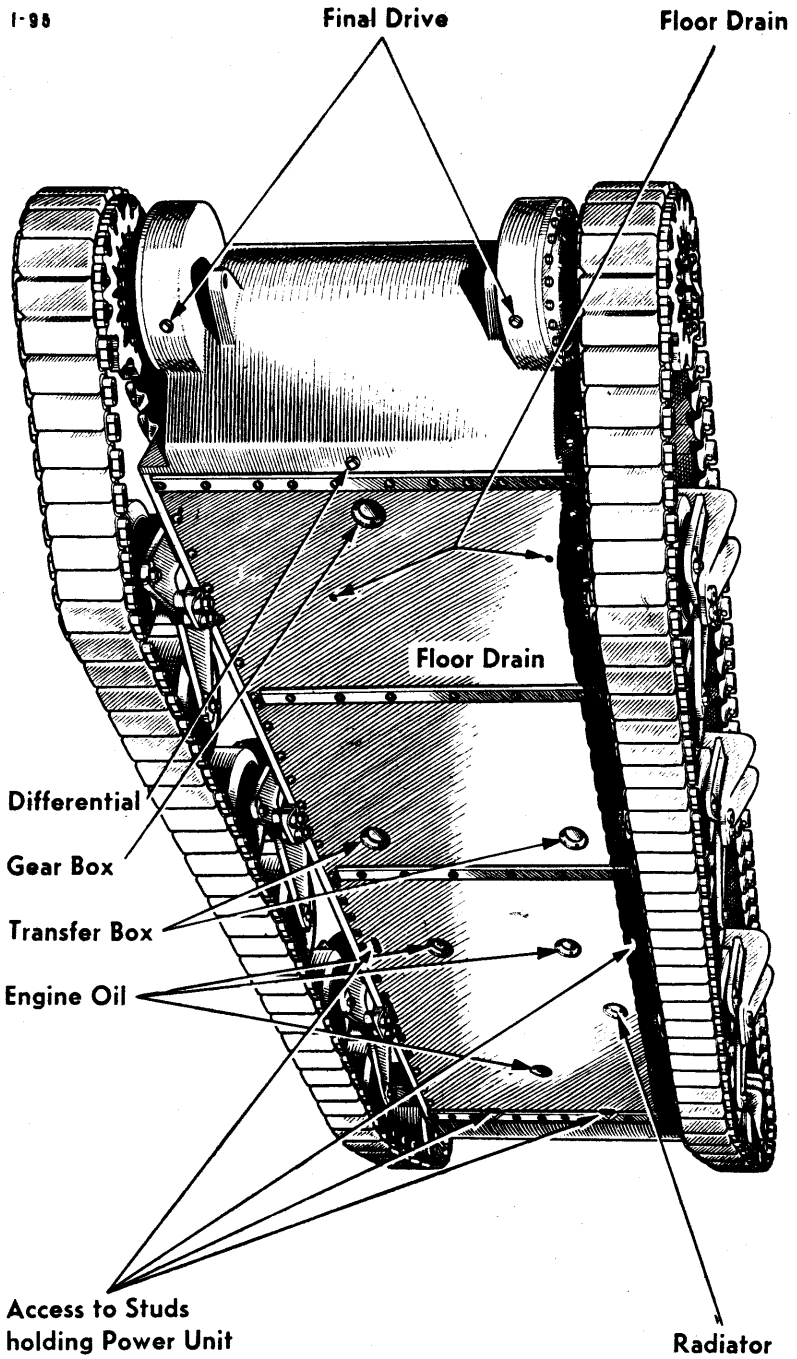

Fig. 65. Underside of Tank showing covers for drain holes

over-emphasized. The attention of all those concerned with the driving and maintenance of the vehicle is drawn particularly to the necessity for cleaning funnels and filters used in replenishing lubricating oil, as explained elsewhere in this manual, as well as for cleaning nipples and lubricating points before applying the grease gun or lubricant container.

Oil Filters:

It is important that proper attention be given to draining of sediment and changing of the filter cartridge in accordance with the Lubrication and Maintenance Schedule.

Oil changing:

The sump should be drained and flushed out with flushing oil if available (not kerosene). See Lubrication and Maintenance Schedule for other instructions. It is advisable to allow the engine to idle for five minutes before draining flushing oil. A circular coverplate in the bottom of the hull, directly under the engine (see Fig. 65) must be removed to obtain access to the drain plug. The sump should always be drained immediately after a long run when the oil is hot and sediment in the oil is in suspension. This sediment should be carefully examined for metallic and non-metallic particles. If necessary, use a magnet and if the presence of metal is confirmed the matter must be reported for workshop attention.

Keep oil and oil vessels clean:

Before opening any oil drum or tin, always wipe the top of the container clean, otherwise any dirty oil or dirt which may have accumulated on the top of the container may find its way into the engine. Before using any measure or funnel, make sure that it is clean. After use, funnels or measures which have been used for engine oil only may be swilled out with petrol from the spare petrol can and the oily petrol returned either to the spare can again or poured into the petrol tank. The comparatively small quantity of clean engine oil thus introduced into the petrol will not have a detrimental effect on the subsequent running of the engine. When flushing out funnels or measures which have been used for gear or transmission oils, the oily petrol must be discarded and, in no case, poured into the petrol tank.

Use of Grease gun:

Always clean grease nipples before using gun otherwise grit and dirt will be forced into the bearings with the lubricant.

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CORRECT USE AND CARE OF TOOLS

General Note:

Any tools which have been exposed to moisture should be dried and smeared with a light oil film before packing to prevent rust.

Strainers - Track:

Keep cables free from kinks or overlapping of coils on drum. Remove all mud and grit after use. Lubricate wearing surfaces with engine oil. Keep serving on splices in good condition.

Jacks - Lifting:

Remove all mud and grit. Lubricate screw and pawl with engine oil. Always operate the jack squarely under the load, otherwise the screw will be subject to severe bending stress. Close the jack right up before stowing to protect the screw.

Hawsers - Steel towing:

Keep cables free from sharp bends or kinks. Use packing to protect cable if it has to contact sharp or square corners. Always screw shackle pins right home before applying load. Do not run over hawsers with tracked vehicles. Keep serving on spliced ends in good condition.

Grease Guns - Lubricant:

Maintain in clean condition at all times. When taken apart for filling, place components on a clean surface to avoid the entrance of dirt.

Do not lay the grease gun on the ground at any time. Clean thoroughly and replace in roll after use. If leakage of lubricant occurs at the nozzle or piston, immediately call attention to the fact.

Wrenches - Stillson:

Only to be used where standard adjustable or fixed wrenches or spanners will not function.

Do not use on hardened steel surface or damage to teeth of wrench will result.

Do not apply wrench to any machined surface of which the finish must be preserved.

Do not subject the wrench to side strain by using as bending tool.

Wrenches - Adjustable - Crestalloy:

The wrenches must be so placed on the nut that the moving jaw is ahead of the handle in the direction in which force is applied. If when operated on a tight nut the wrench has to be opened so far that the moving jaw extends beyond the body, the next larger size wrench should be selected.

Wrenches - Box:
Wrenches - Open end:

Always select the correct size wrench for the job. If too large a wrench is used it will cause damage both to the wrench and the nut. Engage the full depth of the nut whenever possible. To loosen or finally tighten a nut always use a box wrench or ring spanner whenever possible. Do not use hammers on wrenches.

Pliers:

Do not use cutting edges on hardened material. Diagonal and side cutting pliers, when in good condition, are excellent for removing split pins. Lubricate pliers to keep the joints free and keep water out.

Screwdrivers:

Do not use as cold chisels or tommy bars. Have the blades correctly re-dressed if damaged; faulty blades will damage screw slots and make them difficult to remove or tighten. Use the correct size driver - with blade full width of the slot.

Cold Chisels:

Do not use on hardened steel. If dulled, have them sharpened at first opportunity. Take an angle cut wherever possible.

Hammers:

Do not use a hard face hammer on machined parts, use copper drift or wood block.

Files:

Keep files free from mud, water and grease. Do not allow them to rub together in the tool kit.

Press on file in cutting stroke only and never on the return stroke.

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DON'TS

ENGINE

Don't start off without oil, water and petrol.
" over rev. the engine.
" over rev. the engine before changing to the next gear.
" mix oil in the sump. Keep the same grade.
" forget to tighten cylinder head hose connections if necessary.
" tighten the cylinder head bolts except with a tension wrench in the proper order.
" rush off from cold. Let the engine warm up.
" attempt to start the engine in gear.
" drive off with any red light showing on dash.

CARBURETTOR

Don't keep stamping on the accelerator.
" forget to clean the filters in the pumps.
" forget to clean the air filters.
" pour petrol straight from the drum to the tank. Use a funnel with a clean filter.

ELECTRICAL

Don't disturb the breaker points without good cause.
" keep grinding away on the self starter. Try to find the reason why the engines won't start.
" check voltage regulators with a spanner to see which wires are alive.
" overoil the distributor. Two drops are sufficient.
" forget to keep the battery topped up.
" inspect battery level with a match.
" forget to see that emergency switches are in normal position.

DRIVING

Don't ride the clutch.
" drive off with the brakes on.
" let the clutch in with a jerk.
" slam the air brakes on.
" forget your log book.

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TANK A. C. MK. 1 - LUBRICATION SCHEDULE

Chart No.	No of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
1.	3.	Cadillac Engines	Engine oil D D 30 except first fill, then use D D 20 Flushing oil DD 20	Capacity 2¾ galls. each engine	Check level and add oil if necessary. Dipsticks of Nos. 1 and 2 engines accessible from Turret Basket. Dipstick of No.3 engine from centre hatch of rear cover plate. Filler caps accessible from same hatch.	First 250 miles after new engines or overhaul. Drain flush and refill with engine oil D D 20. Drain plugs accessible from cover plates underneath hull.	First 500 miles after new engine or overhaul. Drain flush and refill with engine oil D D 30	Drain flush and refill with engine oil D D 30	
1A	3	Engine Oil Filters				Remove drain plug when draining engine sump, also after flushing engine. Replace plug. If not flushing engine sump, remove plug, drain and replace plug.			Remove cover by taking out cap screw. Remove used element. Clean out container. Replace new element. Fit new gasket under cover. Tighten and check no leaks with engine running.

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
30	3	Air Cleaners	Engine Oil D D 30	Capacity $\frac{3}{4}$ pint	On dusty roads or conditions. Drain clean lower bowl and wash element in kerosene or fuel. Drain and refill.	Ordinary conditions. Drain, clean lower bowl and wash element in kerosene or fuel. Drain and refill			
8 and 9	2	Gear Box and Front Axle which includes Final Drives	Engine Oil D D 30 Flushing Oil D D 20	17 galls.	Check level. Add oil if necessary. Dipsticks of axle and gearbox in Filler caps. Filler caps of front axle in front of gunner, on bulkhead panel. Filler cap of gearbox at rear end near gunner.	At first 250 miles after new or overhaul, drain, flush and refill. Drain plugs: Gearbox accessible by removing coverplate under hull. Front Axle and Final Drives, plugs under hull.		At first 1000 miles from new or after overhaul. Drain flush and refill.	Drain, flush and refill.
15	1	Transfer Box	Engine Oil D D 60	4 galls.	Check level. Dipstick at top right end of box. Accessible from turret basket.	At first 250 miles after new or overhaul, drain flush and refill. Drain plugs under hull accessible by removing coverplate.		At first 1000 miles from new or after overhaul. Drain, flush and refill.	Drain, flush and refill.
22	1	Air Compressor	Compressor oil or Engine oil D D 30	2/3rds pint	Check level. Filler plug in sump. Fill to collar on plug. When below collar add oil.			Drain, flush and refill.	

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
28	1	Air Compressor Chain	C.G. (AL)			Smear grease over inner surface of chain.			
7 and 7A	8	Universal Joints and Splines	F.G.	2 shots each nipple		Use grease gun 6 joints and 1 spline serviced from basket. 1 joint from Forward Compartment. 1 from engine compartment.			
31	1	Central propeller shaft bearing (on housing rear of fan drive pulley)	C.G. (AL)	2 shots				Use grease gun. Do not overforce. Accessible from opening in engine bulkhead between fan and belts.	
6	1	Master clutch release bearing	F.G.	1 shot	Grease gun, do not overforce as grease retainer will be damaged				
6	1	Master clutch outrigger bearing	F.G.	2 shots			Grease gun do not overforce as grease retainer will be damaged.		

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
28	1	Air Compressor Chain	C.G. (AL)			Smear grease over inner surface of chain.			
7 and 7A	8	Universal Joints and Splines	F.G.	2 shots each nipple		Use grease gun 6 joints and 1 spline serviced from basket. 1 joint from Forward Compartment. 1 from engine compartment.			
31	1	Central propeller shaft bearing (on housing rear of fan drive pulley)	C.G. (AL)	2 shots				Use grease gun. Do not overforce. Accessible from opening in engine bulkhead between Fan and belts.	
6	1	Master clutch release bearing	F.G.	1 shot	Grease gun, do not overforce as grease retainer will be damaged				
6	1	Master clutch outrigger bearing	F.G.	2 shots			Grease gun do not overforce as grease retainer will be damaged.		

Chart No.	No of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
5	6	Clutch operating mechanism Cross shaft and linkage	Engine Oil D D 30	Few drops		Use oil can on all pins and bearing surfaces.			
12	1	Gear lever pivot	C.G. (AL)	1 shot		Use grease gun on nipple			
12A	4	Gear lever control joints	Engine Oil D D 30	Few drops		Use oil can			
11	2	Brake cross shaft	C.G. (AL)	1 shot		Use grease gun on nipples			
16	16	Brake control joints	Engine Oil D D 30	Few drops		Use oil can. Few drops on all joints.			
21	3	Accelerator pedal and control joints	Engine Oil D D 30	Few drops		Use oil can on all joints and bearings			
29	3	Engine Water pumps	Water pump grease	Two shots		Use special grease gun on nipples.			
14 & 14A	3	Distributor shafts	F.G.	3 turns		Fill grease cups, give 3 turns.			
19A	3	Distributor cam	C.G. (AL)			Smear only on cam.			

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
19A	3	Distributor breaker arm spindles.	Engine Oil D D 30	1 drop				Use oil can 1 drop only	
26 and 26A	3	Distributor shaft advance mechanism	Engine Oil D D 30	3 or 4 drops		Use oil can. Remove Rotor. Oil on felt pad. Replace Rotor.			
27 and 27A	10	Carburettor controls	Engine Oil D D 30	1 or 2 drops		Use oil can on all joints and bearings each engine.			
13	3	Engine Generators	Engine Oil D D 30	3 drops only.		Use oil can each end of generators.			
13A	1	12 volt Generator (2 types) oil and grease lubricated.	Engine Oil D D 30 or Chassis Grease (AL)	3 drops or 2 turns of grease cup		Use oil can or 2 turns grease cup under turret basket			
27B	3	Starter Motors	Engine Oil D D 30	3 drops only		Use oil can, cup rear end.			
23	1	Turret power traversing Gearbox	Engine Oil D D 30 and Chassis Grease (AL)	1 pint	Check level and oil if necessary. Dipstick in filler cap.	Use grease gun on nipple		Drain, flush and refill.	

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
23A	1	Turret hand control traversing gear.	Fibre Grease	2 shots		Use grease gun on nipple			Dismantle and smear grease on gears and shaft.
25	1	Turret traversing rack and pinion	Chassis Grease (AL)	1 lb.		Hand pack underneath cover of driving pinion & revolve turret into 6 positions to distribute grease.			
24	1	Turret ball race ring bearing.	Fibre Grease	6 shots in different positions		Use grease gun on nipple			Repack bearing after dismantling.
20	2	Turret mantlet mounting pins	Chassis Grease (AL)	2 shots each		Use grease gun on nipples.			
2	12	Suspension Bogie Wheels	Chassis Grease (AL)	Where relief valve fitted several shots until grease issues from valve		Use grease gun on nipples, where relief valves not fitted, do not overforce.			
2	2	Tensioning wheels	" "	" "		" "			
3	6	Idler wheels	" "	" "		" "			

Chart No.	No. of points	Item	Lubricant to be used	Quantity	Daily or 50 miles	25 hours or every 250 miles	50 hours or every 500 miles	100 hours or every 1000 miles	300 hours or every 3000 miles
4.	12	Fulcrum Pins	Chassis Grease (AL)	3 shots		Use grease gun on nipples.			

Abbreviations: C.G. (AL) - Chassis Grease (AL)

F.G. - Fibre Grease

INTERCHANGEABLE OILS AND GREASES

A. C.Mk. 1 TANK

For Emergency Use.

D D Grades	Commercial Equivalent Grades.				
	Mobiloils Mobil-greases	Shell Oil and Greases	Castrol	Atlant-ic	Caltex
D D 20	Arctic	Silver Shell	Light "Gem"	Light Medium	Motor Oil 20
D D 30	Mobiloil "A"	Single	"C.W." or X	Medium	Motor Oil 30
D D 60	Mobiloil "B"	Golden	"C" or XXL	Sup. Heavy	Motor Oil 60
"C.G." (Chassis Grease)	Mobil-grease. 2X (Hand Gun) 2B (Press-ure Gun)	Aero Shell No.5.	P.G. or T.C.	Chassis-lube	Chass-islube "S"
"F.G." (Fibre Grease)	Mobil-grease No.5.	W.B. Grease	U.J.	Fibre Grease	Marfax No. 2
"W.P." Water Pump Grease	Mobil-grease No.6.	Shell Water Pump Grease	W.P.	Water Pump	W.P.

BRITISH WAR DEPARTMENT - Interchangeable Grades

M 120	=	D D 20
M 160	=	D D 30
M 400	=	D D 60
Grease G.S.	=	Fibre Grease
Grease M.T.	=	Chassis Grease

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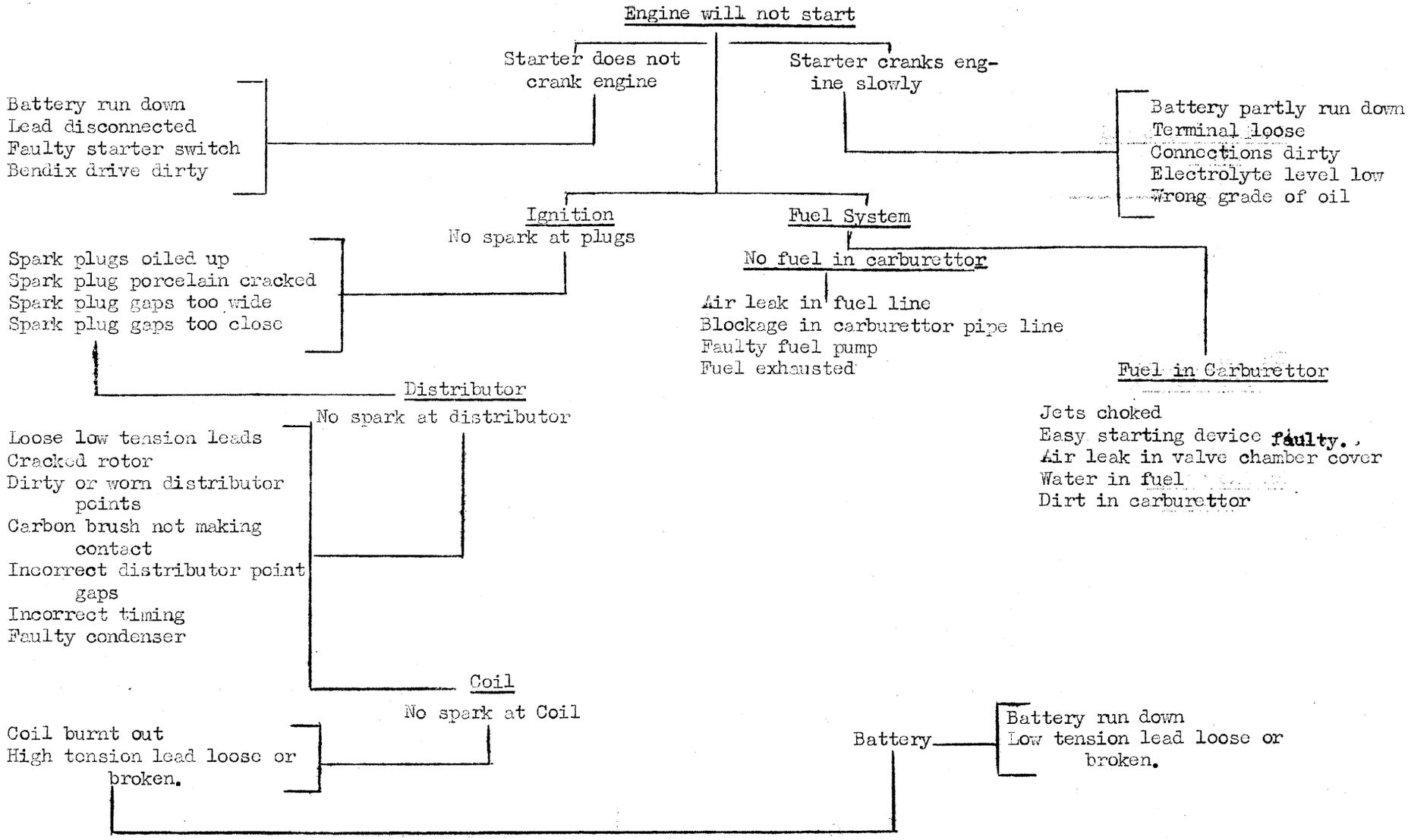
TROUBLE FINDING TABLE.

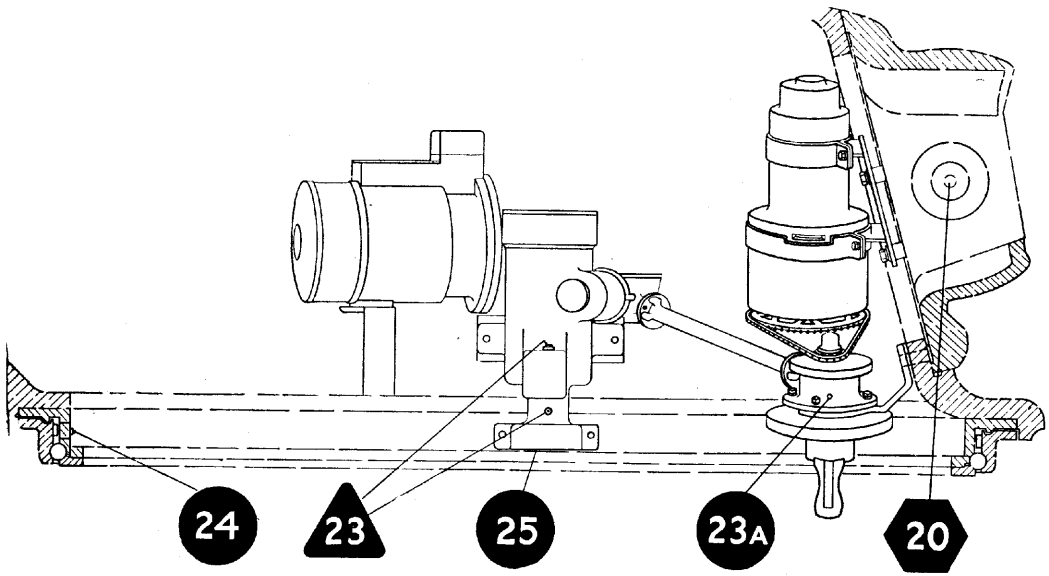


LUBRICATION CHARTS

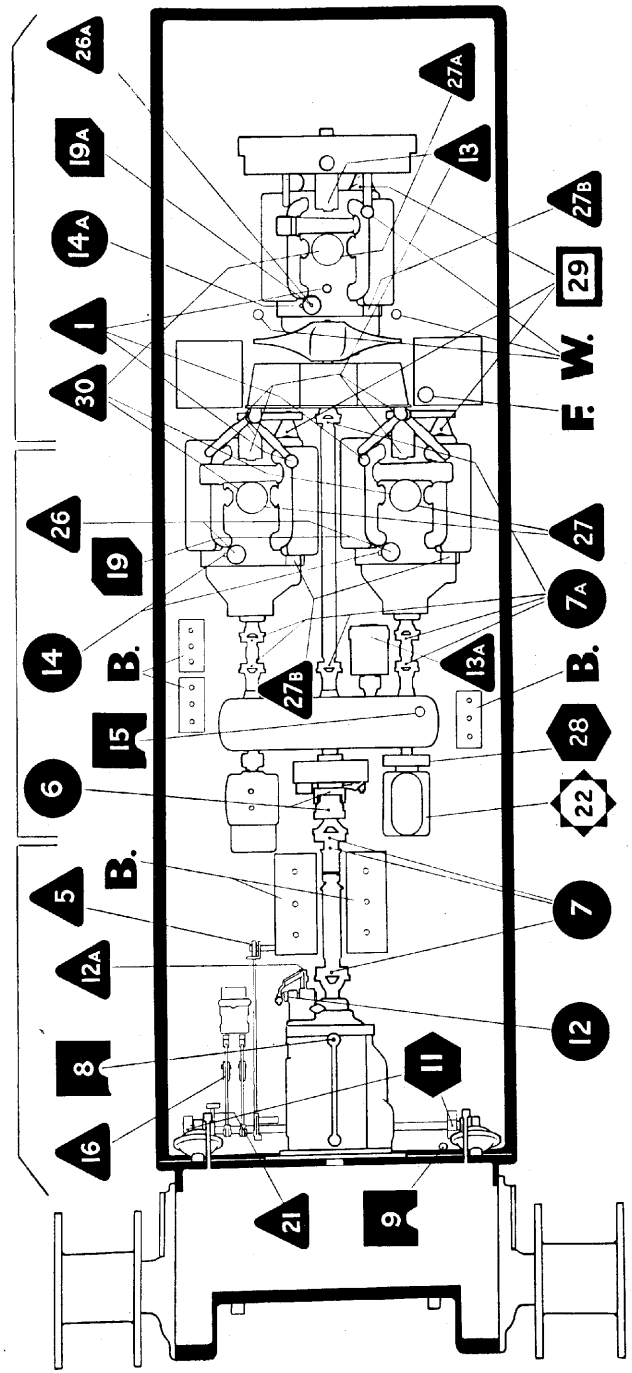
THE NUMBERS APPEARING ON THE SYMBOLS CORRESPOND WITH THE NUMBERS APPEARING IN THE LUBRICATION SCHEDULE

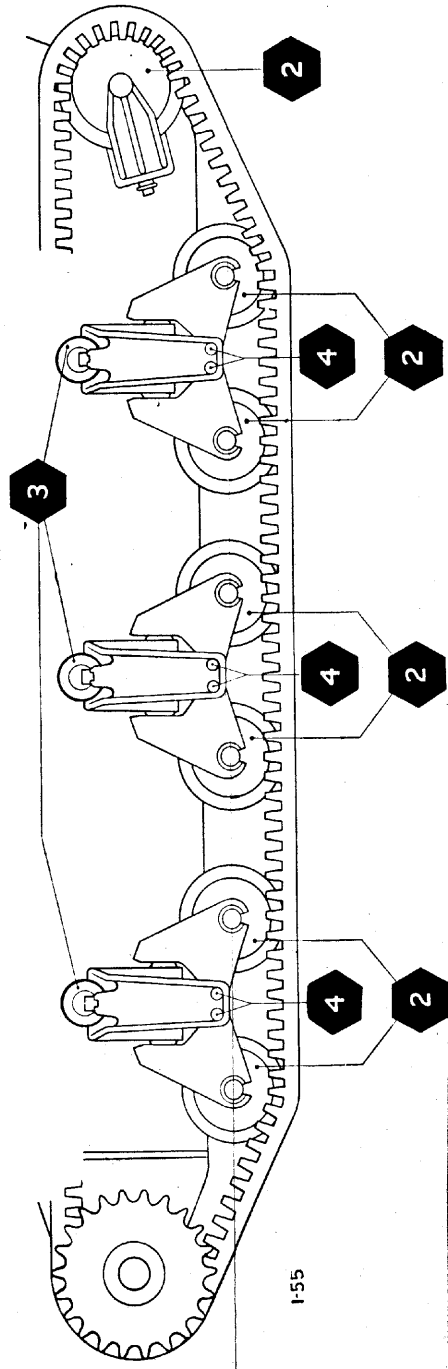
- Engine Oil D↑D 30
- Engine Oil D↑D 60
- Chassis Grease (A1)
- Fibre Grease
- Water Pump Grease
- Compressor Oil
- Petrolatum or Vaseline

KEY TO CHART SYMBOLS

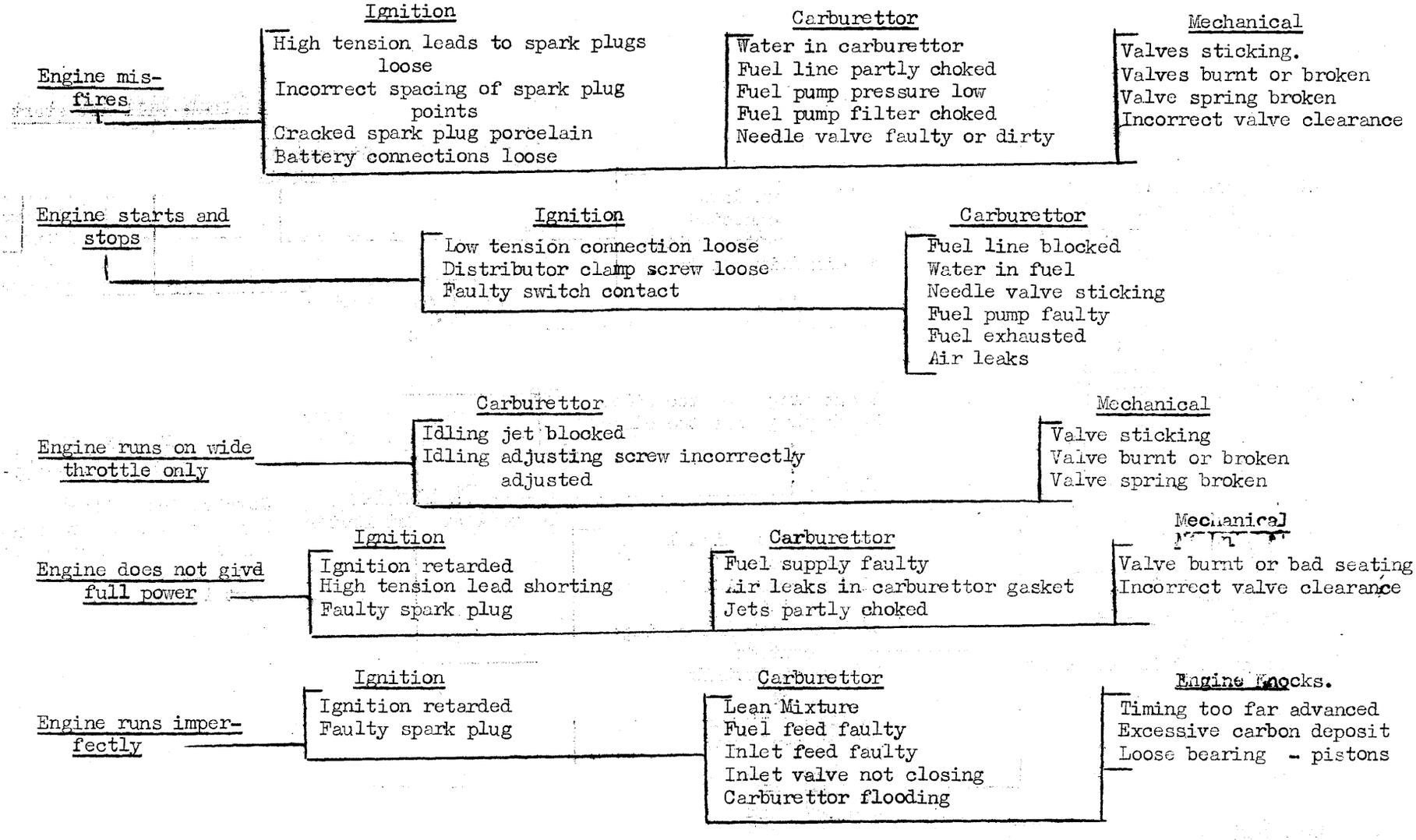


TURRET LUBRICATION POINTS





1-55


Engine mis-fires
Ignition
High tension leads to spark plugs loose
Incorrect spacing of spark plug points
Cracked spark plug porcelain
Battery connections loose
Carburettor
Water in carburettor
Fuel line partly choked
Fuel pump pressure low
Fuel pump filter choked
Needle valve faulty or dirty
Mechanical
Valves sticking.
Valves burnt or broken
Valve spring broken
Incorrect valve clearance
Engine starts and stops
Ignition
Low tension connection loose
Distributor clamp screw loose
Faulty switch contact
Carburettor
Fuel line blocked
Water in fuel
Needle valve sticking
Fuel pump faulty
Fuel exhausted
Air leaks
Engine runs on wide throttle only
Carburettor
Idling jet blocked
Idling adjusting screw incorrectly adjusted
Mechanical
Valve sticking
Valve burnt or broken
Valve spring broken
Engine does not give full power
Ignition
Ignition retarded
High tension lead shorting
Faulty spark plug
Carburettor
Fuel supply faulty
Air leaks in carburettor gasket
Jets partly choked
Mechanical
Valve burnt or bad seating
Incorrect valve clearance
Engine runs imperfectly
Ignition
Ignition retarded
Faulty spark plug
Carburettor
Lean Mixture
Fuel feed faulty
Inlet feed faulty
Inlet valve not closing
Carburettor flooding
Engine Knocks.
Timing too far advanced
Excessive carbon deposit
Loose bearing - pistons

FAULT FINDING TABLE

12 VOLT WIRELESS, GRAVINER AND M.G. COOLING MOTOR CIRCUITS

Sumptoms	Possible Causes
Wireless Set:	12 volt battery main switch off.
	Loose or broken connections in 12 volt circuit.
No current at Wireless set.	Blown fuse in turret fuse box.
	Battery needs attention.
	Generator not charging (for possible causes refer 6 volt generator fault finding table).
Graviner System:	12 volt battery main switch "OFF"
No current at Graviner bottle plugs.	Loose or broken connection in Graviner wiring.
	Faulty operating switch.
	Battery needs attention.
M.G. Cooling Motors:	12 volt battery main switch "OFF".
	Loose or broken connections in wiring.
Motor fails to operate.	Faulty switch.
	Blown fuse.
	Battery needs attention.

FAULT FINDING TABLE

40 VOLT TURRET TRAVERSE CIRCUIT

Symptoms		Possible Causes
Turret will not operate	Controller motor does not operate	Turret lock not disengaged.
		Broken connection in 40 volt circuit:- Loose connection at Generator; Regulator; Base Junction connector; Current limit relay; Turret lock; Controller.
	Controller motor operates.	Broken or loose connections between controller and Traverse motor.

PACKING LIST

ARMAMENT AND ASSOCIATED STORES

Item	Location
Respirators anti-gas outfits anti-dimming (4) Mk. VI.	Carried where convenient.
Bleaching powder (2 lb tins) (1)	R.H. outside bin
Ointment anti-gas No. 2 (2 oz. Contrs) (5)	One in each respirator haversack
Pistol, signal No. 1 Mk. III* (1)	In case L.H. turret wall.
Flannette (4 yds)	Outside turret bin
Appartus, camouflage, nets 15 ft. x 35 ft. (1)	Outside turret bin.
Jacks, lifting 15 ton screw type (2)	R.H. outside bin
Jacks, lifting 15 ton base plates (2)	R.H. outside bin
Crowbar, 5 ft. 6 in. with chisel and claw ends (1)	R.H. outside bin
Chisels, cold $\frac{5}{8}$ in. (N.I.V.) (1); 1 in. (N.I.V.) (1)	R.H. outside bin
Drifts, steel round $\frac{1}{8}$ in. x 6 in. (N.I.V.) (1); $\frac{1}{4}$ in. x 6 in. (1); $\frac{3}{8}$ in. x 6 in. (1); $\frac{1}{2}$ in. x 6 in. (1)	R.H. outside bin
Files, Bastard half round 10 in. (1) Second cut square 6 in. (1); Smooth H.S.E. 8 in. (1); Handles medium (2)	R.H. outside bin
Hammers, engineers ball pein 1$\frac{1}{2}$ lb. (1); Hammers, handled sledge straight pein 7 lb. (1)	R.H. outside bin

Item	Location
Pliers, side cutting 8 in. (N.I.V.) (1 pr.) Pliers, Diagonal cutting 8 in. (N.I.V.) (1 pr.) Pliers, Multigrip 4 in. (N.I.V.) (1 pr.) Pliers, 10 in. (N.I.V.) (1 pr.)	In rolls R.H. outside bin
Screwdrivers G.S. (Aust) 3 in. (1) 6 in. (1) 12 in. (1)	R.H. outside bin
Saws, hack 10 in. (N.I.V.). (1) Saws, hack, blades medium (N.I.V.)(12)	R.H. outside bin
Spanners, adjustable, crescent type (N.I.V.) 6 in. (1), 8 in. (1), 12 in. (1), 24 in. (1)	R.H. outside bin
Spanners D.E., S.A.E. (N.I.V.)- $\frac{1}{4}$ in. x 5/16 in. (1); $\frac{3}{8}$ in. x 7/16 in (1); $\frac{1}{2}$ in. x 9/16 in. (1); $\frac{1}{2}$ in. x 19/32 in.; 19/32 in. x 11/16 in. (1); $\frac{5}{8}$ in. x $\frac{3}{4}$ in. (1); $\frac{3}{4}$ in. x 13/16 in. (1); 25/32 in. x $\frac{7}{8}$ in. (1); 15/16 in. x 1 in. (1); 1-1/16 in. x $1\frac{1}{4}$ in. (1); $1\frac{1}{8}$ in. x 1-5/16 in. (1); $1\frac{1}{4}$ in. x $1\frac{1}{2}$ in. (1)	R.H. outside bin
Wrenches Pipe (Stillson) 12 in. (1); Multihex, box, long ten degrees angle pattern (Herbrand No.5723). $\frac{3}{8}$ in. x 7/16 in. (1); $\frac{1}{2}$ in. x 9/16 in. (1); $\frac{5}{8}$ in. x 11/16 in. (1) $\frac{3}{4}$ in. x 13/16 in. (1); $\frac{7}{8}$ in. x 15/16 in. (1); 1 in. x 1-1/16 in. (1)	R.H. outside bin
Padlocks, iron, galv. $1\frac{1}{2}$ in. with two keys (4)	One each on three bins. outside. One fitted to main switch.
Wire, copper, soft, 20 S.W.G. ($\frac{1}{2}$ lb. reels) (2)	Turret bin
Cotton waste, coloured, 2 lbs.	Turret bin

Item	Location
Axes, felling (1) " pick 4½ lbs (1) " heads (1) " helves (1)	Outside bin
Bucket, water, canvas Mk. V (1)	Turret bin
Shovels, G.S. (2)	Outside bin
Brush, hand, bass Mk. 1 (1)	Outside bin
Manchette-15 in. blade with sheath and lanyard (2)	Turret bin
Stoves, oil, wickless, No.5 (Primus (1); Repair outfits (Primus) (1)	R.H. bulkhead driver's comp.
Boxes, cartridge illuminating (12 flares) (1)	L.H. turret
Boxes, grenades, hand (1)	L.H. turret under cupola
Cases, Map G.S. No. 1 Mk. 1 (1)	R.H. rear roof turret
Periscopes, Drivers complete (1) Forward gunner's complete (1) Commander's complete (2) Prisms (spare) (12)	Six in turret over wireless set, three on each side of front compartment in hull
Telescopes, sighting, No.24B., Mk. V. Telescopes, sighting, No.24B., Mk. V. (spare)	R.H. front of turret
Binoculars, prismatic (1 pr.)	Container front turret, gunner's respirator.
Cutters, wire folding Mk. 1 (1 pr.) Cutters, wire, Dennert high tensile wire, (1 pr.)	Turret bin.

Item	Location
Gloves, wiring (2 prs.)	Turret bin
Tape insulating $\frac{3}{4}$ in. $\frac{1}{4}$ lb. rolls ($\frac{1}{2}$ lb.)	Turret bin
Arms, semaphore, (1 set)	Rear supporting arm turret basket.
Strips, and discs (N.I.V.) ground and air communication	Carried, where convenient.
Lamps, signalling, Hellensen (2 sets)	L.H. bulkhead above escape hatch.
Gloves, anti-gas (3 prs.) Hoods, anti-gas (1 pr.) Jackets, light anti-gas (1 pr.) Overboots, anti-gas (1 pr.) Trousers, light anti-gas (1 pr.) Valises, anti-gas clothing (1)	In two bins. One at rear of driver. One at rear of forward gunner.
Outfits, first aid No. 248 (1)	R.H. turret wall behind loader.
Belts, safety (5)	Fitted to seats.
Clamps, track coupling rubber track (1)	Outside bin.
Punches, Short, steel track link pin removing (1) Long, steel track link pin removing (1)	Outside bin.
Tracks, links (spare) (6)	Rear of vehicle
" " connections (spare) (12)	Outside bin
" " " nuts (spare) (12)	Outside bin
Strainers-Track, steel or (1)	Outside bin
Track, rubber (1)	Outside bin
Track, handle (1)	Outside bin
Track, handle, extension (1)	Outside bin

Item	Location
Tubes, track blocking (14 in. long x 2½ ins. bore water or steam pipe) (2)	Outside bin
Wrenches, brake, turret, traverse motor (1); Spark plug (1)	Outside bin
Track adjusting and Bogie wheel spindle nuts (1) Fulcrum pin and bogie wheel Bracket nuts (1) Sprocket hub nuts (1) Grease nipple (1) Steering brake adjusting nuts (1)	In box outside bin.
Handbook, Tank, A.C.Mk. 1 (1) Books, records of design changes (1) Log book, Tank (1) Log book, gun (1)	Container on R.H. side of driver.
Belts, fan, spare (3)	Outside bin
Brackets, fire extinguisher 1 qt. (4)	One in hull, one in turret, two outside.
Brushes, engine, cleaning 20 in. (1)	Outside bin.
Blocks, wood, jacking 25 in. x 9 in. x 9 in. (2)	Outside bin.
Cans, oil 1 pt. (Buffer oil) (1)	Outside bin
Cans, oil cylindrical 1 qt. filled (1)	" "
Cans, oil lubricating forced speed ½ pt. (1)	" "
Cans, 2 gal. oil (2)	" "
Extinguishers, fire, 1 qt. filled (4)	Brackets
Funnels, petrol 6 ins. dia. with 9 in. stem. (1)	Outside bin
Injectors, lubricant Hand compressor type 16 oz. (1) Hand compressor type 32 oz. (1)	In case outside bin. " "

Item	Location
Bulbs, electric spare - 32 C.P. 6 V. (3) 6 C.P. 6 V. (3) 1-5 C.P. 6 V. (10)	L.H. bulkhead
Lamps, electric vehicle - Head (2) Tail (2) Spotlight (1)	Mounted on vehicle.
Horns, electric (1)	Mounted on vehicle.
Battery, 6 volt 15 plate (5)	Fitted in vehicle.
Fuses, cartridge, spare 20 amps (3) 30 amps (2)	Carried where convenient.
Gauges, gap spark plug, universal (1)	Outside bin
Lamps, inspection portable 6 volt (2)	One in case fitted R.H. side of water tank in turret. One in case in outside bin.
Ropes, towing, steel, 3½ in. x 30 ft. (1) with eye and thimble both ends.	Along L.H. side of hull.
Boxes, ration (5 men 1 day) (3) Boxes, Cooker (1) Boxes, cooking utensils (1)	Two on R.H. bulkhead. One on L.H. bulkhead. R.H. bulkhead behind drivers compartment. R.H. bulkhead.
Covers, canvas, A.C.Mk.1 Tank (3 pieces) (1 set)	L.H. track cover plate
Tanks, petrol auxiliary 44 gals (1)	Rear of engine compartment

Item	Location
Brushes, gash tool No.3 (N.I.V.) (1)	Carried where convenient.
Files - Contact (1) Magneto (N.I.V.) (1)	Carried where convenient.
Pliers, chain nose 4 ins. (N.I.V.)(1 pr.) Pliers, side cutting 4 ins.(N.I.V.)(1pr.)	Carried where convenient.
Screw drivers, G.S. (Aust)	Carried where convenient.
Wire, electric push back (Beldin type (N.I.V.) (10 ft.)	Carried where convenient
Fuse wire, 5 amp. (2 ft.) 10 amp. (2 ft.)	Carried where convenient
Cans, lubricating, No.11 Mk.1 (1)	Boxes, R.H.rear wall of turret
Cups, sponge, No. 4 Mk. 1. (1)	Boxes R.H.rear wall of turret
Funnels, filling, cylinder, No.1 Mk.II (1)	Boxes R.H.rear wall of turret
Gauges, strik[illegible] protusion No. 16 Mk. 1. (1)	Boxes, R.H.rear wall of turret
Lanyard, cocking No. 4 Mk. 1. (1)	Boxes R.H.rear wall of turret
Drifts, No. 18 Mk. 1. (1)	Boxes R.H.rear wall of turret
Screwdrivers, adjusting, sights, No. 1. Mk. 1. (1)	Boxes R.H.rear wall of turret
Wrenches, breech mechanism No. 253 Mk. 1. (1)	Boxes R.H.rear wall of turret
Bags, spent cases, (2 p[illegible].(1)	Boxes R.H.rear wall of turret

Item	Location
Boxes, spare parts and tools, Ordnance Q.F. (2 pr.) Mks. LX to XA (N.I.V.) (1)	Boxes R.H. rear wall of turret
Cleaners, bristle, No. 1 Mk. 1 (1)	Boxes R.H. rear wall of turret
Cleaners, wool No. 5 Mk. 1. (1)	Boxes R.H. rear wall of turret
Covers, breech, Q.F. 2 pr. gun, No. 1. Mk. 1. (1)	Boxes R.H. rear wall of turret
Covers, muzzle, No. 3 Mk. 1. (1)	Boxes R.H. rear wall of turret
Keys, removing, jammed Q.F. cartridge No. 3 Mk. 1 (1)	Boxes R.H. rear wall of turret
Ordnance Q.F. 2 pr. Mk. X (or) (1) Mk. LX Mk. X bodies (or) Mk. LX bodies (1)	Boxes R.H. rear wall of turret
Ordnance, Q.F. 2 pr. Mk. LX to XA 3 in. How. Mk. 1 and 1A and 25 pr. Mk. 11. Rollers, actuating shaft (spare) (1) Bushes, firing, hole Mk. 1 (1) Springs, main Mk. 1. (1)	Boxes R.H. rear wall of turret
Tommies, actuating shaft, Q.F. 3 pr. 2 cwt. Mk. 11, 2 pr. Mks. LX to XA and 6 pr. 7 cwt. Mks. 11 and 111 and 3 in. Mks. 1 and 1A Howr. Mk. 1. (1)	Boxes R.H. rear wall of turret
Handbook 2 pdr. [illegible] and X (1) Handbook V.M.G. Mk. XX1 C.1. (1) Bren C.1. (1)	Container R.H. of driver.
Boxes, magazine, Bren, .303 in. M.G. Mk. 1. (2)	Turret bin.
Brushes, rod, cleaning cylinder, Bren .303 in. M.G. Mk. 1. (1)	Holdall mounted R.H. side of turret roof.

Item	Location
Guns, machine, Bren. .303 in Mk.1. (1)	Butt box and clip R.H. side of turret.
Barrels, assembled, spare (1) Mk. 1* (or) Mk. 1.	Holdall mounted R.H. of turret roof.
Springs, return (spare) (1)	Holdall mounted R.H. of turret roof.
Holdalls, Bren .303 in M.G. (N.I.V.) (1)	Holdall mounted R.H. of turret roof.
Magazine, Bren, .303 in M.G. No. 1. Mk. 11* (36)	12 in rack L.H. of wireless. 24 in boxes turret bin.
Mops, rod, cleaning, cylinder, Bren .303 in M.G. Mk. 1.	L.H. side, above 2 pdr. ammunition containers.
Wallets, spare parts. Bren .303 in. M.G. Mk.1. filled (A) (1)	L.H. side above 2 pdr. ammunition containers.
Rods, cleaning, .303 in. M.G. Mk. 11. "B" (1)	L.H. side above 2 pdr. ammunition containers.
Sub-machine gun, Thompson (N.I.V.) (1)	Butt box and clip R.H. rear of turret
Boxes, carrier magazines (1)	Front loader's seat in turret.
Brushes, cleaning breech (1)	Holdall

Item	Location
Brushes, cleaning, brass (1)	Holdall
Cans, oil (1)	Gun
Handbook (1)	Publications container.
Magazines X X type (box) 20 rounds (15)	Boxers carriers magazines
Pullthroughs (1) Gauge (2) Rods, cleaning (1)	Holdall Holdall Holdall
Boxes, spare parts and tools, Vickers .303 in. M.G. filled (B) (2)	Under commander's seat.
Cases, spare parts and tools Vickers .303 in M.G. Mk. 1* filled "A" (C) (2)	One in turret wall. One rear of forward gunner.
Bags, spent cartridges (N.I.V.) (2)	Attached to Vicker's gun
Guns, machine Vickers .303 in Mk. XX1 Coaxial (1) Hull (1)	 One in turret One in hull
Pumps, centrifugal, electric cooling tank, Vickers, machine guns (N.I.V.) (2)	One in turret One in hull
Tanks, water, Vickers, machine guns (N.I.V.) (2)	One in turret One in hull
Wireless Sets, No.19 (2) Mk.11 (Aust)	One in L.H. bulkhead. One R.H. rear of turret.
Cases, spare parts, No. 5 (Aust)	R.H. of turret in front of loader's respirator container.