War Office
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USER HANDBOOK

for

CHARGING SETS, E.D. 300w, 30v.

(B.S.A.)

PUBLISHED UNDER THE AUTHORITY OF
THE SIGNAL OFFICER-IN-CHIEF
THE WAR OFFICE
WHITEHALL W.1.

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FOREWORD

This Handbook has been provided with the object of assisting the operator in running and servicing the B.S.A. 300 watt charging set. It is essential that the operating and servicing instructions should be carried out in the manner detailed in this publication. The times at which servicing are to be carried out and the grades of lubricant to be used are shown in the relevant War Office Servicing schedule. Close attention to these instructions will be amply rewarded by greater reliability and efficiency.

Warning. The adjustments detailed in Chapter 3 should not be attempted unless:-

(a) You are sure they are necessary.

(b) You are authorised to do them.

(c) You are sure you are capable of doing them.

Do not make unnecessary adjustments, if in doubt, ask.

NOTICE

The subject matter of this publication may be affected by Army Council Instructions or Command Orders. When the information given in an A.C.I. or Command Order conflicts with any portion of this publication, the A.C.I. or Command Order will be taken as the overriding authority.

LIST OF ASSOCIATED PUBLICATIONS

	W.O. Code.
Servicing schedule for charging set 300 watt B.S.A.	-
Illustrated parts list for charging set 300 watt B.S.A.	

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GENERAL AND TECHNICAL DATA

Height	14 in.	(356 mm)
Width	15 in.	(381 mm)
Length	15 in.	(381 mm)
Weight (dry)	100 lb.	(45·4 Kilogrs) complete with Exhaust Pipe, Silencer and Canvas Cover

ENGINE DATA

Maker	B.S.A.
Type	-
Bore	2.1/2 in. (54·02 mm)
Stroke	1.3/4 in. (44·4 mm)
Swept volume	6·1 cu. in. (100 c.c.)
Rated speed	2,200 r.p.m.
B.H.P.	-
Fuel tank capacity	7 pints (4 litres)
Oil sump capacity	1/2 pint (28·35 centilitres)
Carburettor	B.S.A. Floatless type
Magneto	Lucas flywheel type FA1
Magneto make and break contacts	Gap-0·018 in.
Magneto capacitor	
Sparking plug	Champion J.8 points gap 0·030 in.

GENERATOR DATA

Type	Service design
Rated output	Volts D.C. 30
	Amperes 10
Number of brushes per set	4
Grade	Link H.M.8
Size of brushes	3/4 in. x 1/2 in. x 3/8 in.
Capacitors (Brushes to Earth)	12 μF, 50 V D.C. working
Capacitors (Control box)	-
Ammeter	Lucas type 20-0-20
Automatic cut out	CAV type DR24/1

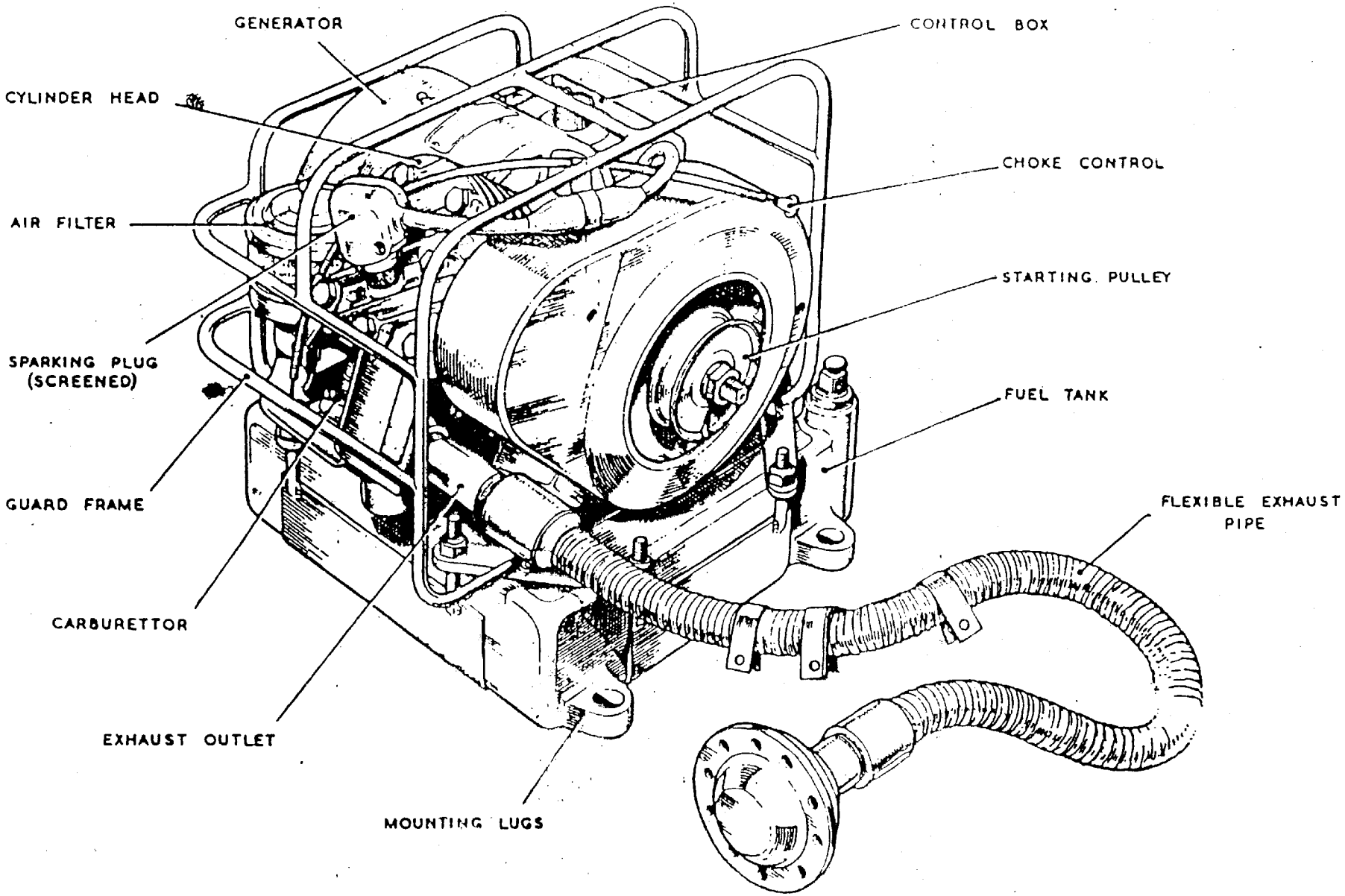


Fig. 1. The B.S.A. 300-watt Charging Set.

· DESCRIPTION ·

PURPOSE

The Charging set 300W. 30V. will normally be used for charging batteries up to 75Ah. capacity, used for Signals and communication purposes. It should not be used for charging heavy plate batteries, similar to those used in starting large vehicles and tanks, for two reasons:

(a) It would take a very long time, as the maximum output of this charging set is nominally 10 Amperes.

(b) When starting the charging set by means of the electrical starter, an extremely heavy current could flow in the starter winding and switch, possibly causing damage. This is due to the very heavy plates used in the construction of starter batteries. A communication battery is usually of a thin plate construction, therefore these very heavy currents do not arise.

1.1. GENERAL DESCRIPTION Fig. 1

The engine and generator are mounted on a cast iron base which forms the fuel tank. Three lugs project from the base and these are drilled to accept 1/2 in. holding down bolts in order that the set may be secured to the floor or to skids. A guard frame is secured to the base and a canvas cover is provided which fits over the guard frame. The engine may be started electrically from batteries or by means of a cord wound round the starting pulley.

1.1.1. The engine. The major engine components are:- The crank case and base plate, the cylinder and cylinder head, the piston and connecting rod, the crankshaft, camshaft, valve gear, carburettor, magneto, and governor.

The engine assembly is mounted on the crankcase face plate. The cylinder is mounted on the crankcase at an angle of approx. 50° to the left of the vertical centre line, viewed from the starting pulley end. The crankshaft is housed in the crankcase and the piston is connected to it by means of the connecting rod. The camshaft is also housed in the crankcase and is driven by the crankshaft by means of two gears. The camshaft operates the inlet and exhaust valves.

The carburettor is mounted on the left hand side of the engine. The purpose of the carburettor is to provide a means

of controlling the volume of fuel and air admitted to the engine cylinder. An air filter is mounted on the end of the air induction pipe which is connected to the carburettor. A flexible exhaust pipe is fitted on the end of the exhaust outlet.

The magneto is housed inside the flywheel and is of the flywheel type. The engine stop button which cuts out the action of the magneto is located on the control box side of the magneto armature plate. There are two valves, one to admit the mixture of air/gas into the cylinder and the other to allow the escape of exhaust gas from the cylinder. The valves open and close at predetermined intervals relative to each other and to the position of the piston in the cylinder.

The governor is housed in the crankcase, and is driven by the crankshaft. Its function is to control the engine speed and this is done by varying the supply of air/gas to the engine. The governor is connected to the carburettor control valve by means of a spring loaded rod.

1.1.2. The Generator. The generator comprises two major components, the frame and the armature. Four pole pieces are mounted inside the frame on which the field coils are wound. The armature is secured to the crankshaft by means of a long bolt screwed into the end of the crankshaft. The current generated by the machine is collected from the commutator of the armature by means of four carbon brushes.

1.1.3. The Control Box. The control box is mounted on the right hand side of the generator. The output of the set is controlled and metered at the control box. Two terminals are provided on the front of the control box from which the power is distributed to the external circuits. The output of the set can be varied by turning the control knob mounted on top of the box.

1.2. THE ENGINE

1.2.1. Working Cycle. Fig.2. The engine works on the four stroke cycle which means that one complete cycle of events necessitates movement of the piston up and down the cylinder four times or two revolutions of the flywheel. The up and down movement of the piston and the connecting rod is converted to rotary motion by the crankshaft and it can be seen from Fig.2 that one complete revolution of the crankshaft represents two strokes of the piston.

1.2.2. The Suction Stroke. The piston commences to move down the cylinder from the limit of its travel in the upward direction. At the same time the spring loaded inlet valve

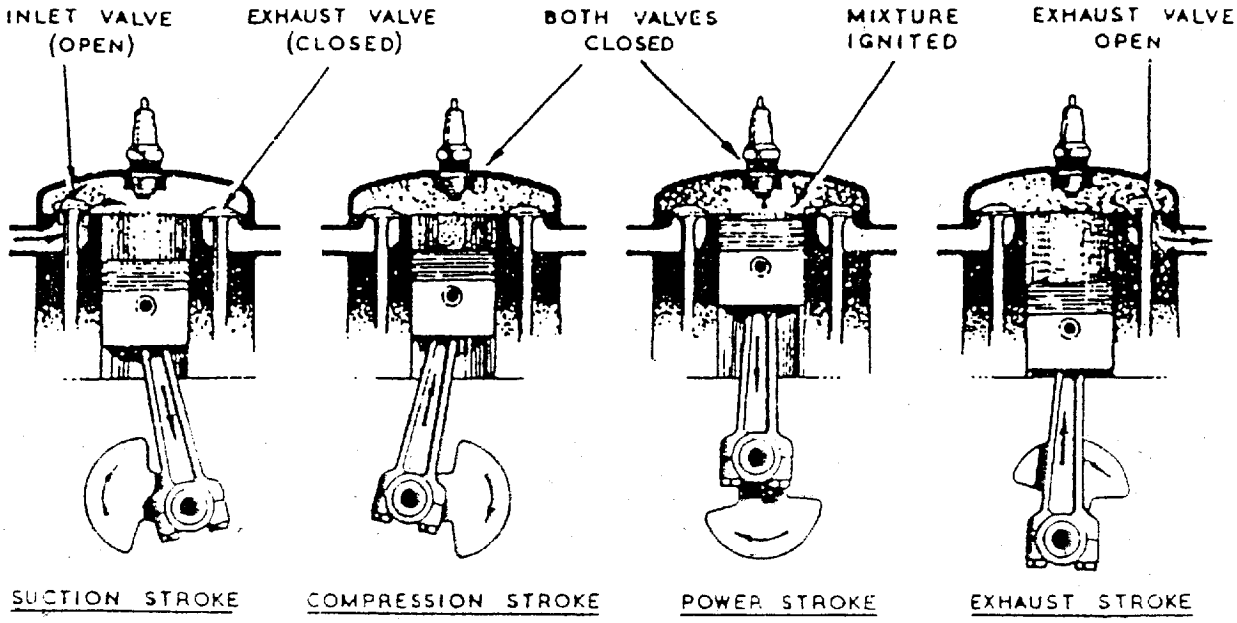


Fig. 2. The four stroke cycle.

is pushed open by the camshaft. The exnaust valve is closed. The downward movement of the piston acts like a pump and results in a charge of air/gas being drawn into the cylinder through the inlet valve opening. The inlet valve closes when the piston reaches the bottom of the stroke.

1.2.3. The Compression Stroke. Following the downward suction stroke the piston moves upwards and as both valves are closed the charge drawn into the cylinder during the suction stroke is compressed into a small area known as the combustion chamber. Towards the end of the stroke the magneto is timed to produce a spark which is discharged by the sparking plug in the combustion chamber and combustion of the air/gas mixture commences.

1.2.4. The Power Stroke. The heat of the burning gases causes them to expand and to exert a pressure at the back of the piston which forces it down the cylinder to the limit of its travel. The exhaust valve opens towards the end of the stroke but the inlet valve remains closed all the time.

1.2.5. The Exhaust Stroke. The exhaust valve is fully open. The piston moves upwards again and forces the burnt gases out of the cylinder through the exhaust valve outlet. The inlet valve commences to open towards the end of the stroke.

Some of the power developed by the engine during the power stroke is stored by the flywheel and this is utilized to carry the engine over the exhaust, suction and compression strokes.

1.3. DETAIL DESCRIPTION OF THE ENGINE; MOVING PARTS Fig.3

1.3.1. The Piston. The piston is made of aluminium alloy. It is fitted with two compression rings and one oil scraper ring. The purpose of the scraper ring is to remove surplus oil from the cylinder wall during the downward stroke of the piston. The compression rings prevent the escape of gas from the cylinder to the crankcase.

1.3.2. The Connecting Rod. The small end of the connecting rod is secured to the piston by means of the gudgeon pin. The pin is a steel tube and is secured in the bosses of the piston by means of two circlips. A bronze bush is pressed into the small end of the connecting rod and this is known as the small end bearing. The bearing is indirectly lubricated by oil thrown up by the timing gears. The other end of the connecting rod is known as the big end in this case it is not fitted with a bearing. It is fitted with a detachable cap so that the connecting rod can be easily connected or disconnected from the crankshaft. The part of the

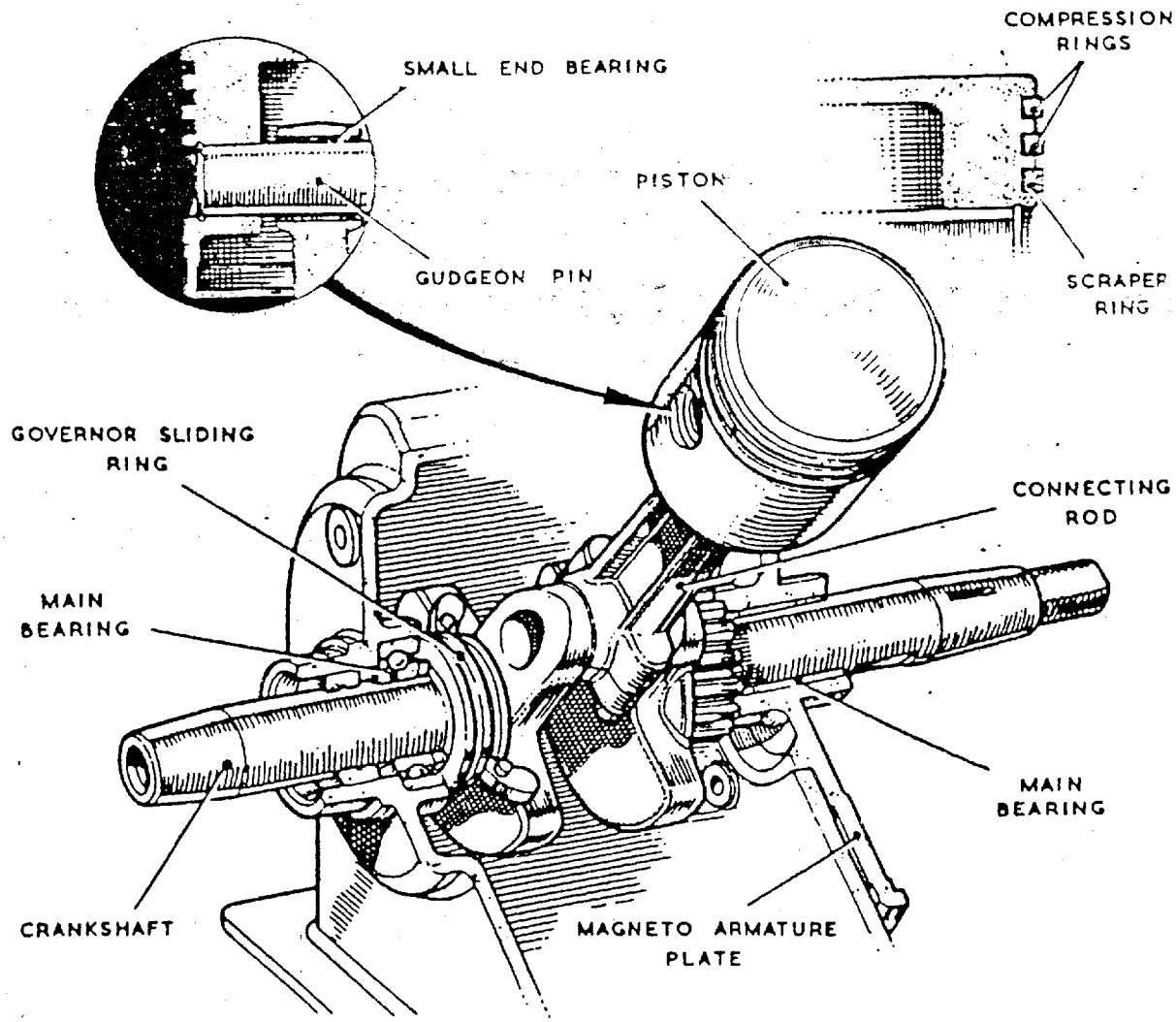


Fig. 3. The Piston, Crankshaft and Connecting Rod.

crankshaft to which the big end is attached is known as the crank pin. In this case the crank pin is hollow to allow oil to flow to the big end bearing through a hole in the pin.

1.3.3. The Crankshaft. The crankshaft is located in the crankcase and is secured in two bearings known as the main bearings. The bearing at the generator end of the crankshaft is a ball bearing and requires no attention between major overhauls. The bearing at the other end is a white metal one and is housed in the magneto armature plate; it is lubricated by oil thrown up by the timing gears. One of the timing gears is forged on the crankshaft and is located inside the white metal bearing. A packing shim is fitted between the boss of the wheel and the bearing to prevent the wheel chafing the end of the bearing and to ensure that the crankshaft is a snug fit between the main bearings.

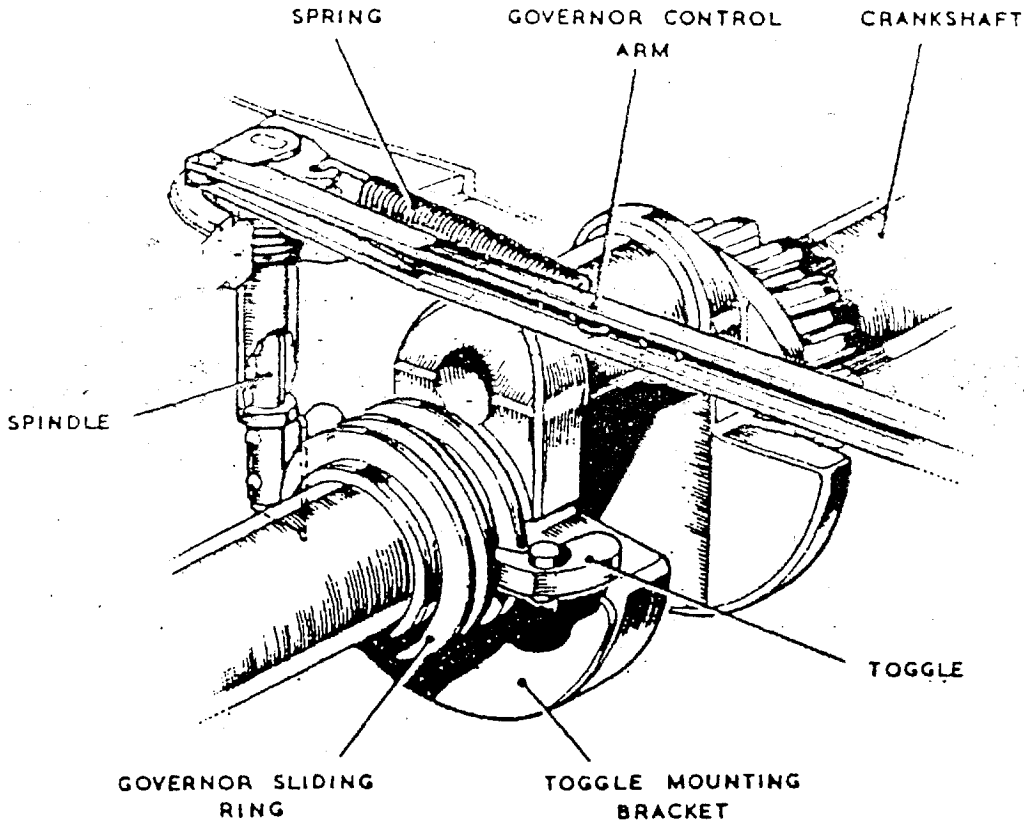


Fig. 4. The Governor.

1.3.4. The Governor Fig.4. The governor driving mechanism is fitted on the generator end of the crankshaft. It comprises a spindle, a sleeve having two parallel grooves cut in its periphery and a pair of toggles that pivot on a bracket secured to the side of the crank web. The top end of the spindle projects through the crankcase and is secured in position by means of a screwed bush. The bottom end of

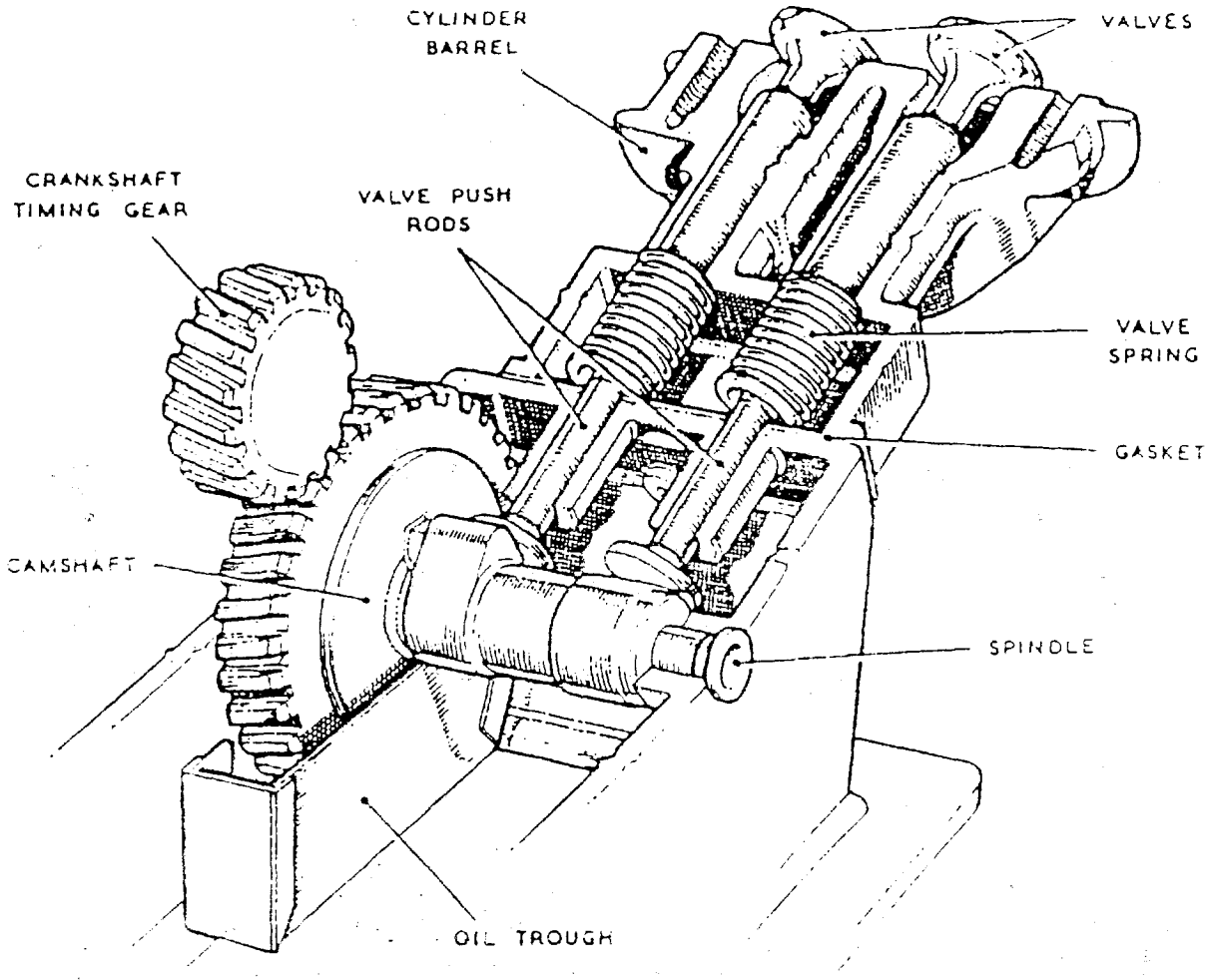


Fig. 5. The Camshaft and Valves.

crankcase. The permanent magnets are mounted inside the flywheel rim. The coil comprises two windings, the primary which produces a low voltage and the secondary winding in which the high voltage for the sparking plug is induced. The coil is wound on the leg of a T shaped former, the ends of the former are rounded off to ensure that there is a small air gap between them and the magnets inside the flywheel rim. The make-and-break contact assembly comprising fixed and moving contacts is operated by a flat machined on the crankshaft. The contacts are connected in series with the primary winding. The moving contact is secured to the breaker arm which is spring loaded against the crankshaft. The contacts are normally open except when the breaker arm is registering on the flat of the crankshaft. The surface of the crankshaft on which the contact breaker bears is kept clean and lubricated by means of a felt pad. A spark is produced by the magneto when the flywheel magnets pass over the ends of the T shaped former. When the magnets are passing over the ends of the former a magnetic field is set up about the coil causing a current to flow in the primary winding when the contacts are closed. The sudden change in

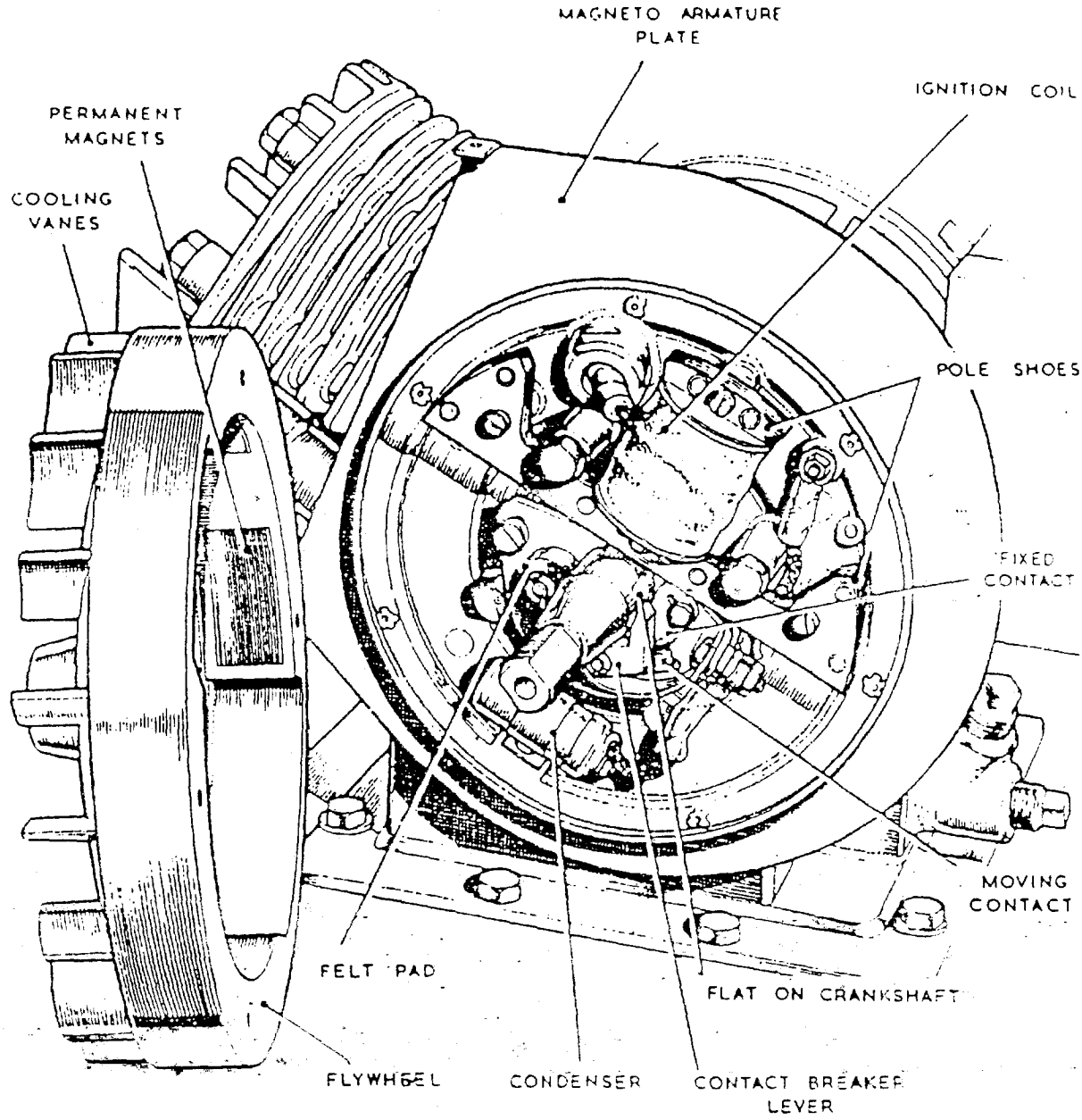


Fig. 6. The Magneto.

the conditions of the primary winding induce a high voltage in the secondary winding of the coil. During this period the contacts are operated by the crankshaft and the flow of current in the primary winding is interrupted. A spark is produced during each complete revolution of the flywheel but as mentioned in paragraph 1.2.1. one spark only is required during each cycle, the unwanted spark is discharged by the spark plug during the latter part of the exhaust stroke.

1.3.8. The Flywheel. The flywheel is keyed on a taper of the crankshaft and together with the starting pulley it is held in position by the nut screwed on the end of the crankshaft.

1.4. THE ENGINE; STATIONARY PARTS.

1.4.1. The Carburettor. Fig.7. The carburettor is mounted on the side of the engine. The air induction pipe is connected to the bottom of it. There are three controls attached to the carburettor; the choke which restricts the volume of air drawn in through the induction pipe, the throttle which is connected to the governor and regulates the speed of the engine and the fuel valve which regulates the amount of fuel delivered to the carburettor. The carburettor is connected to the top of the fuel tank by means of a short pipe and there is a non-return valve and strainer fitted in a second short pipe housed inside the fuel tank.

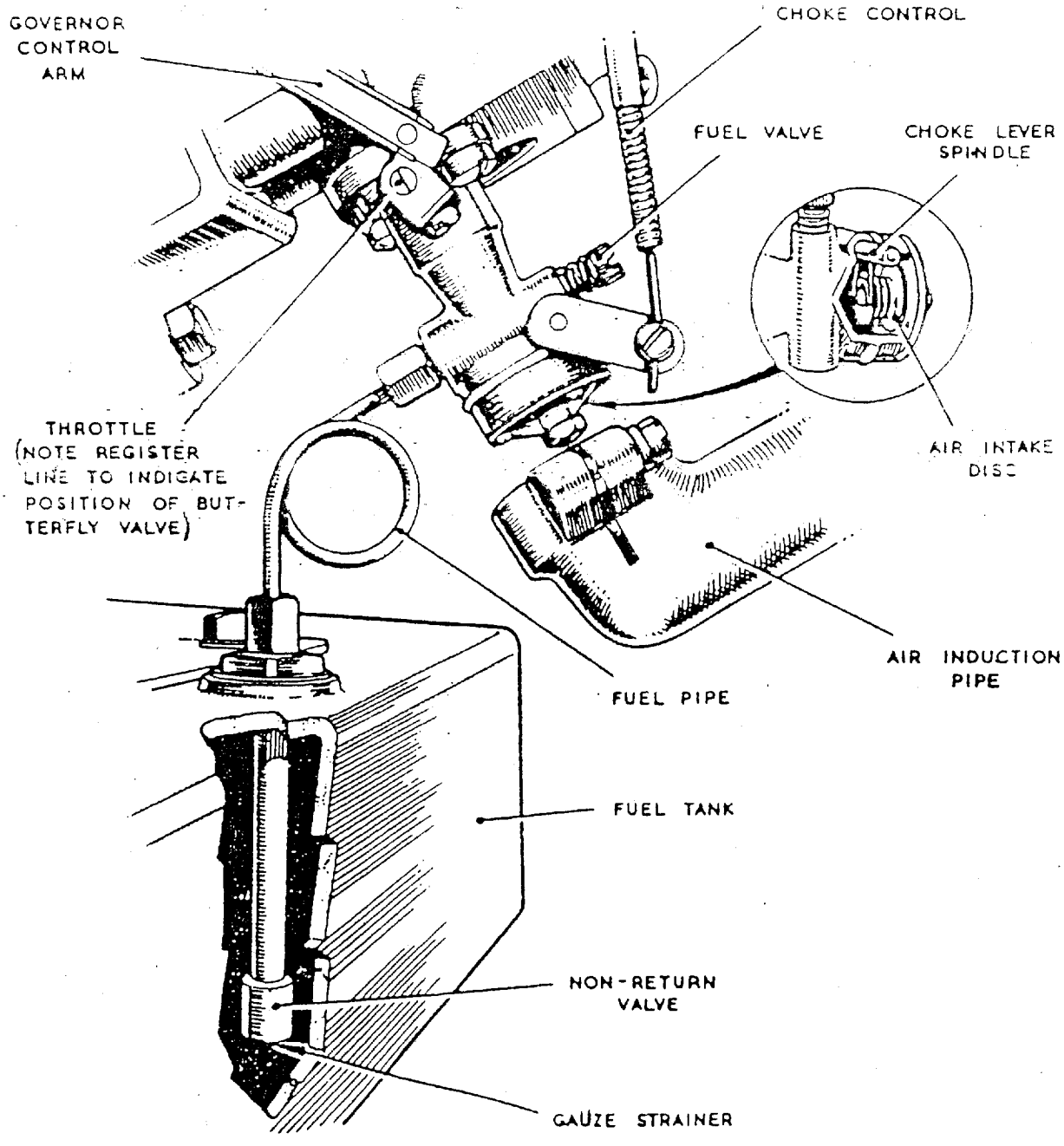


Fig. 7. The Carburettor.

Fuel is drawn from the tank during each suction stroke of the engine and the system remains primed because of the action of the non-return valve. The choke control is used when starting a cold engine. When the control is pulled out an increased volume of fuel is drawn from the tank and the air supply to the carburettor is limited to the volume passing through the four small holes in the choke valve. The efficiency of the engine largely depends on the correct setting of the fuel valve and it is recommended that in the case of new or reconditioned engines the setting should not be disturbed by the operator. The throttle control is a butterfly valve fitted on a spindle, it is located near the mounting flange of the carburettor. The valve controls the volume of air/gas mixture drawn into the cylinder. There is a slot in the end of the spindle to indicate the position of the butterfly valve, when the slot is parallel with the mounting flange of the carburettor the valve is fully open, in the maximum fuel position.

1.4.2. The Air Cleaner. Fig.8. The air cleaner is mounted on the other end of the induction pipe. It comprises a bowl, an element and support, an element locating skirt and a cap. The assembly is held in position by means of a long stud screwed into a crosspiece in the end of the induction pipe and a knurled nut on top of the cap. The purpose of the cleaner is to prevent the ingress of dust into the engine cylinder. The path taken by the air is shown in Fig.8 much of the dust is lodged in the oil as the downward current of air impinges on the surface of the oil and fine particles are trapped in the filter. The bowl assembly sits on a cork washer and it should be examined frequently to ensure that it is seated on the washer correctly and that the joint is not leaking.

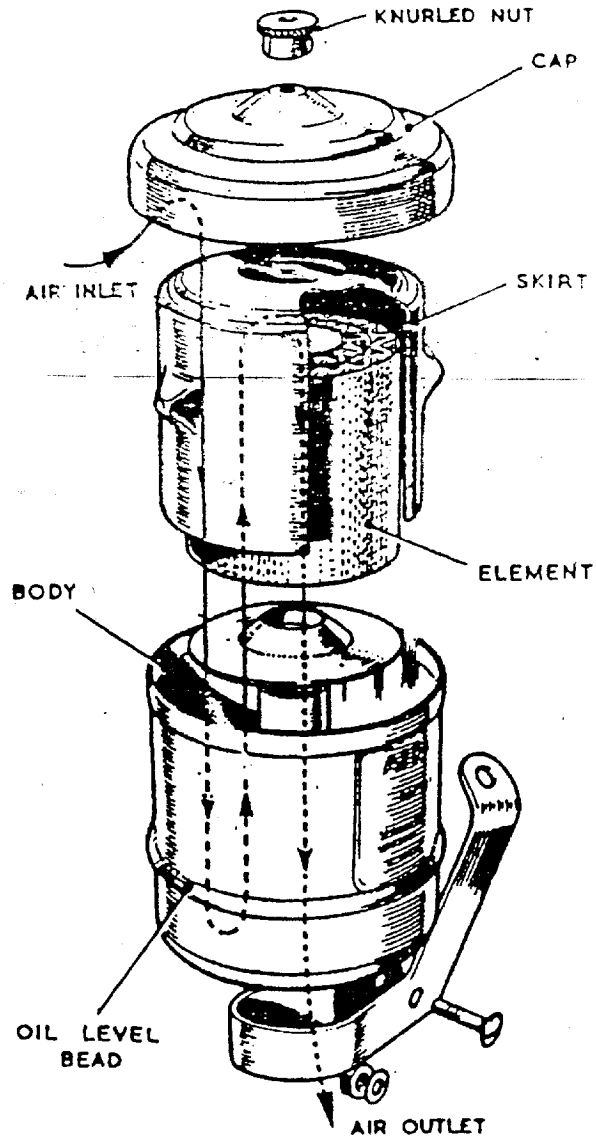


Fig. 8. The Air Cleaner.

1.4.3. The Fuel Tank. The capacity of the tank is seven pints and represents about seven engine running hours on full load. A vent screw is incorporated in the tank filler plug and a drain plug is fitted in the side of the tank underneath the filler plug. The non-return valve and strainer assembly can be removed from the tank as a unit for cleaning but it requires no adjustment. The strainer is a metal gauze fitted to the end of the valve housing. The valve comprises a small metal disc that normally sits on a shoulder of the housing. The end of the pipe fitted into the housing is slotted. During the suction stroke of the engine the valve is lifted off its seat and fuel is drawn from the tank through the slot in the end of the pipe to the carburettor.

1.4.4. The sump and lubrication System. Fig.9. The lubricating oil for the engine is stored in the sump at the bottom of the crankcase. A sump filler plug is fitted to the end of an extension pipe on the side of the engine, a drain plug

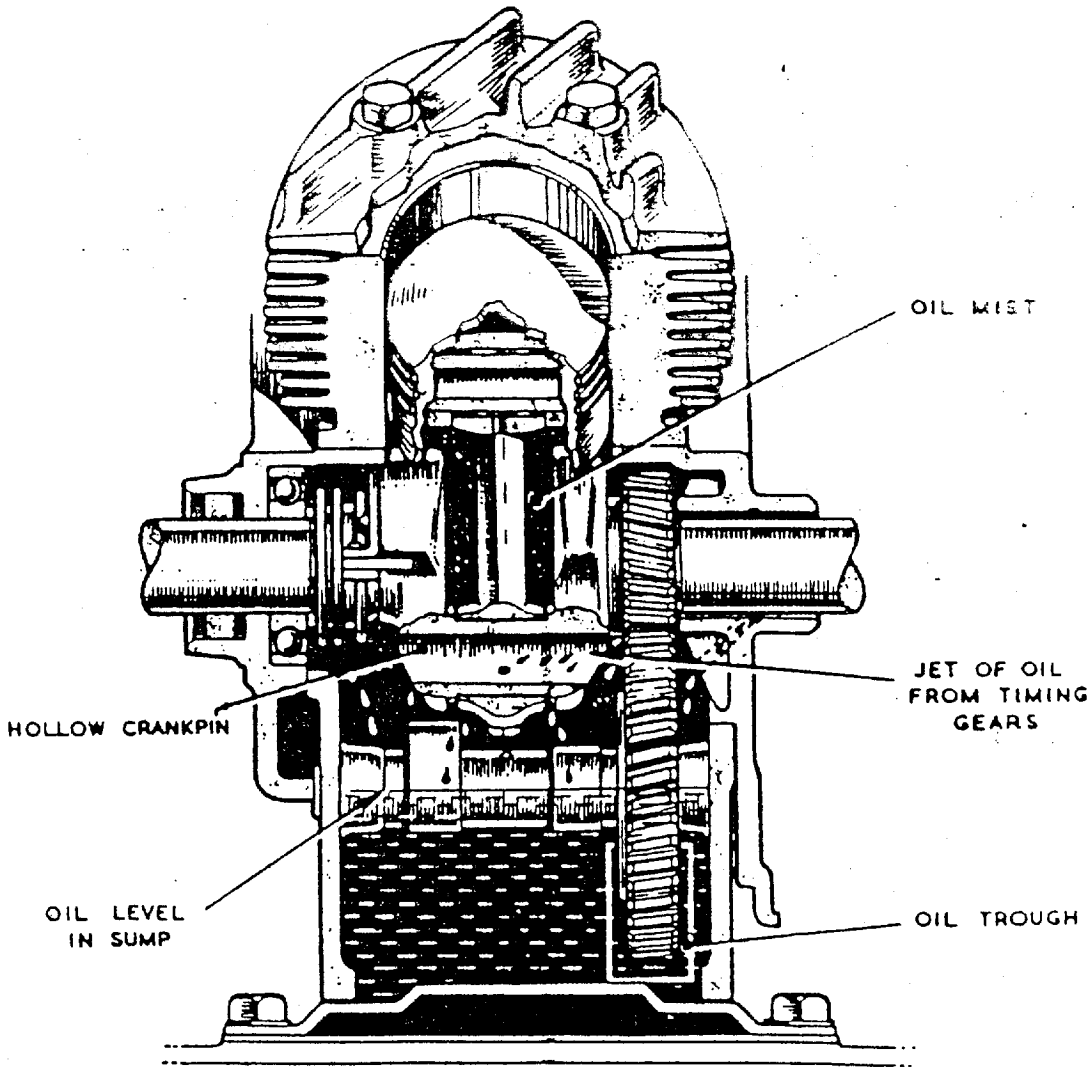


Fig. 9. The Lubrication System.

is also fitted in the extension pipe underneath the filler plug. A sump breather is mounted on top of the crankcase its purpose is to allow gases to escape from the sump when the engine is working. The breather requires no attention apart from being kept clean. All internal working parts of the engine are lubricated by oil thrown up by the timing gears. The camshaft gear is partly submerged in oil and as it rotates it carries some oil round with it. At the point where it engages with the gear on the crankshaft the oil is squirted out from the teeth of the camshaft gear. Each time the hollow crank pin passed the meshed gears a squirt of oil enters it and this provides lubrication for the big end bearing through the hole drilled in the crank pin. The cylinder, main bearing, and small end bearing are lubricated by oil mist built up inside the crankcase as a result of the continuous churning of the oil by the teeth of the timing gears.

1.4.5. The Exhaust System. The exhaust gases are led from the combustion chamber through the exhaust valve to an elbow which is screwed into the cylinder. A short length of pipe is screwed on to the elbow. A seven foot flexible exhaust pipe having a union at either end is screwed on to the short length of pipe and a muffler is screwed on to the other end of the flexible pipe. A drain plug is fitted at the bottom of the exhaust elbow.

1.4.6. The Cooling System. Cold air is drawn in by the flywheel fan through the front of the flywheel casing. The flow of air is directed at the cylinder by means of a duct in the flywheel casing. The engine should be sited so that the passage of air to the flywheel is not obstructed.

1.4.7. The Sparking Plug and H.T. lead. The plug and the lead are totally enclosed and screened. A radio interference suppressor is fitted in the middle of the H.T. lead.

1.5. THE GENERATOR

1.5.1. Operating principle. A generator is a machine that converts the mechanical power of the engine to electric power. In order that a generator may produce electric power it must satisfy three requirements. It must have a magnetic circuit, it must have an electric circuit, there must be movement of one of the circuits.

1.5.2. The Magnetic circuit. The influence of a magnet extends beyond its North and South poles to the air surrounding the magnet. The space surrounding the poles is said to

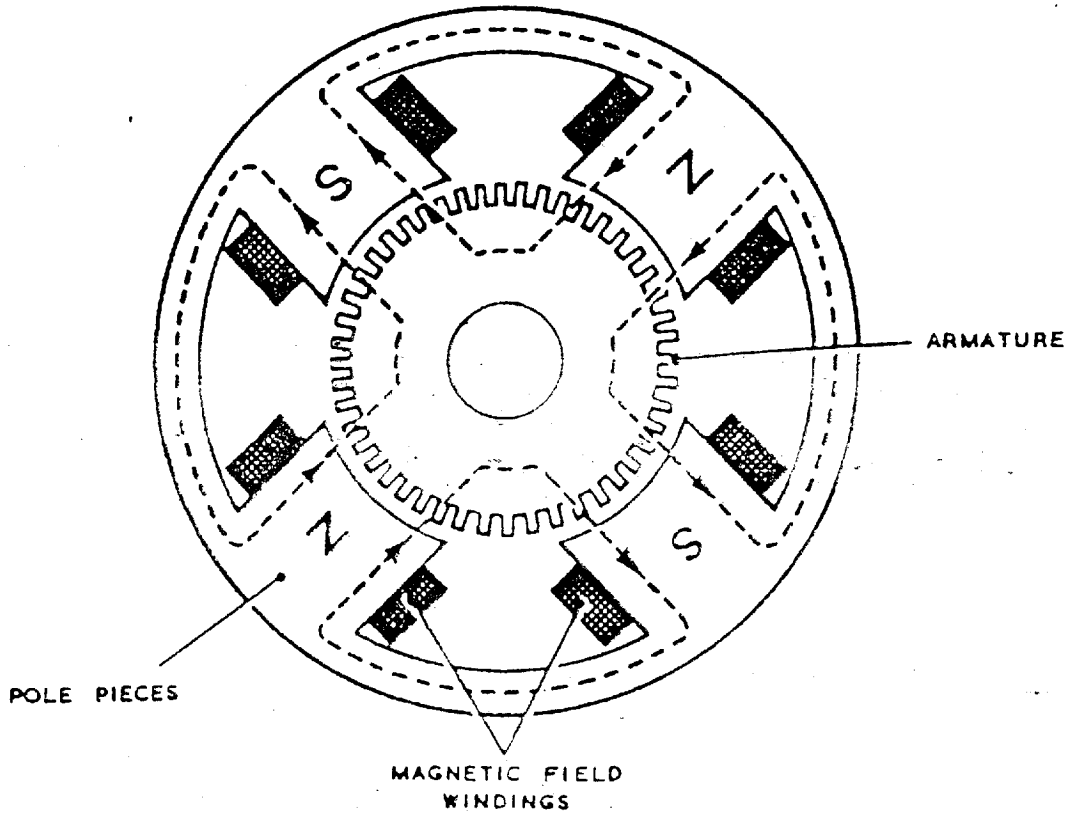


Fig. 10. Magnetic and Electric circuit.

be filled with lines of magnetic force and any point within this area is said to be within the magnetic field. The lines of force travel from the North pole through the surrounding air to the South pole, then through the body of the magnet and issue again from the North pole; this is known as the magnetic circuit. There are two kinds of magnets, permanent magnets and electro-magnets. An electro-magnet comprises an iron core on which a coil of wire is wound, the ends of the coil being connected to an electricity supply. The coil is known as a field winding. One of the advantages of the electro-magnet is that the strength of the magnetic field produced by it can be varied very easily by varying the current in the winding. There are four electro-magnets mounted inside the B.S.A. generator yoke.

1.5.3. The Electric circuit. The moving coils in which the current is induced are mounted on an armature and the ends of the coils are connected to a commutator. The current is collected from the commutator by means of fixed carbon brushes. The purpose of the commutator is described later.

1.5.4. Production of electric power. **Fig. 11.** When a coil is rotated between the poles of a magnet a voltage is induced in the coil. The value of the voltage depends upon the strength of the magnetic field and the rate at which the lines of force are cut by the coil. For a given coil being rotated at constant speed the value of the voltage is maxi-

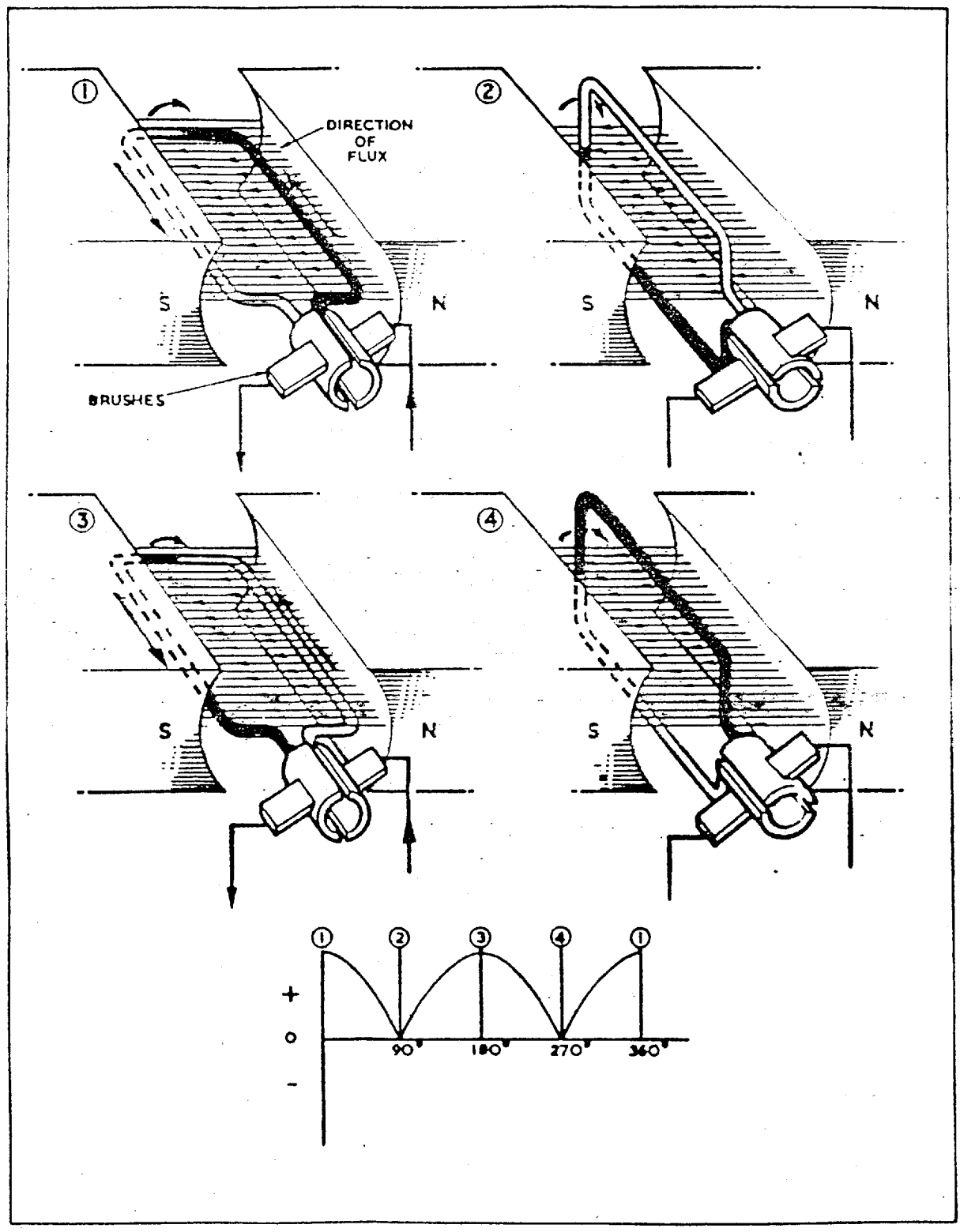


Fig. 11. A simple D.C. Generator.

mum when the maximum number of lines of force are being cut as in positions 1 and 3. At positions 2 and 4 the coil is moving in a direction parallel to the lines of force and no voltage is induced in it. The voltage induced in the coil during one complete revolution alternates between maximum in one direction through zero to maximum in the opposite direction. If each end of the coil is connected to a half ring the halves being insulated from each other and two brushes are arranged to bear on the half rings, then provided the brushes are located in the same plane as the poles one brush will always be +VE and the other will always be -VE. The pulsating voltage produced by one coil is not good for charging batteries, a constant voltage is much better. To achieve a near constant voltage a greater number of coils can be wound on the armature and the ends of the coils connected to narrow segments of the commutator. The number of poles can be increased to four or eight depending on the size of the frame. The combination of these two factors result in the production of a near constant unidirectional voltage at the brushes.

1.5.5. Flow of current. For reference purposes electric current is said to flow from the +VE of the generator through the external circuit and back to the generator through the -VE. In low voltage generators like the B.S.A. 300 watt it is usual to dispense with the return -VE wire; the -VE connection being made to earth at convenient points.

1.5.6. General description of the electrical equipment. Fig. 12. The main components of the electrical equipment are the generator and the control box. The generator comprises two main parts, the frame and the armature. The frame is made up of an end plate which is screwed to the side of the crankcase by means of three screws, a yoke in which the magnets and field windings are held and a brush gear plate assembly. The yoke registers on a spigot of the end plate and together with the brush plate it is held in position by means of four long bolts screwed into the end plate. The four shunt field coils are connected in series, one end of the winding is connected to the +VE brush, the other end is brought out to the regulator, the circuit is completed by earthing the sliding contact of the regulator. The starting winding is also wound on the same magnets. The purpose of the winding is to enable the machine to develop the extra power which is required when the engine is being started electrically. The shunt field winding is primarily designed for exciting the generator which requires only a little

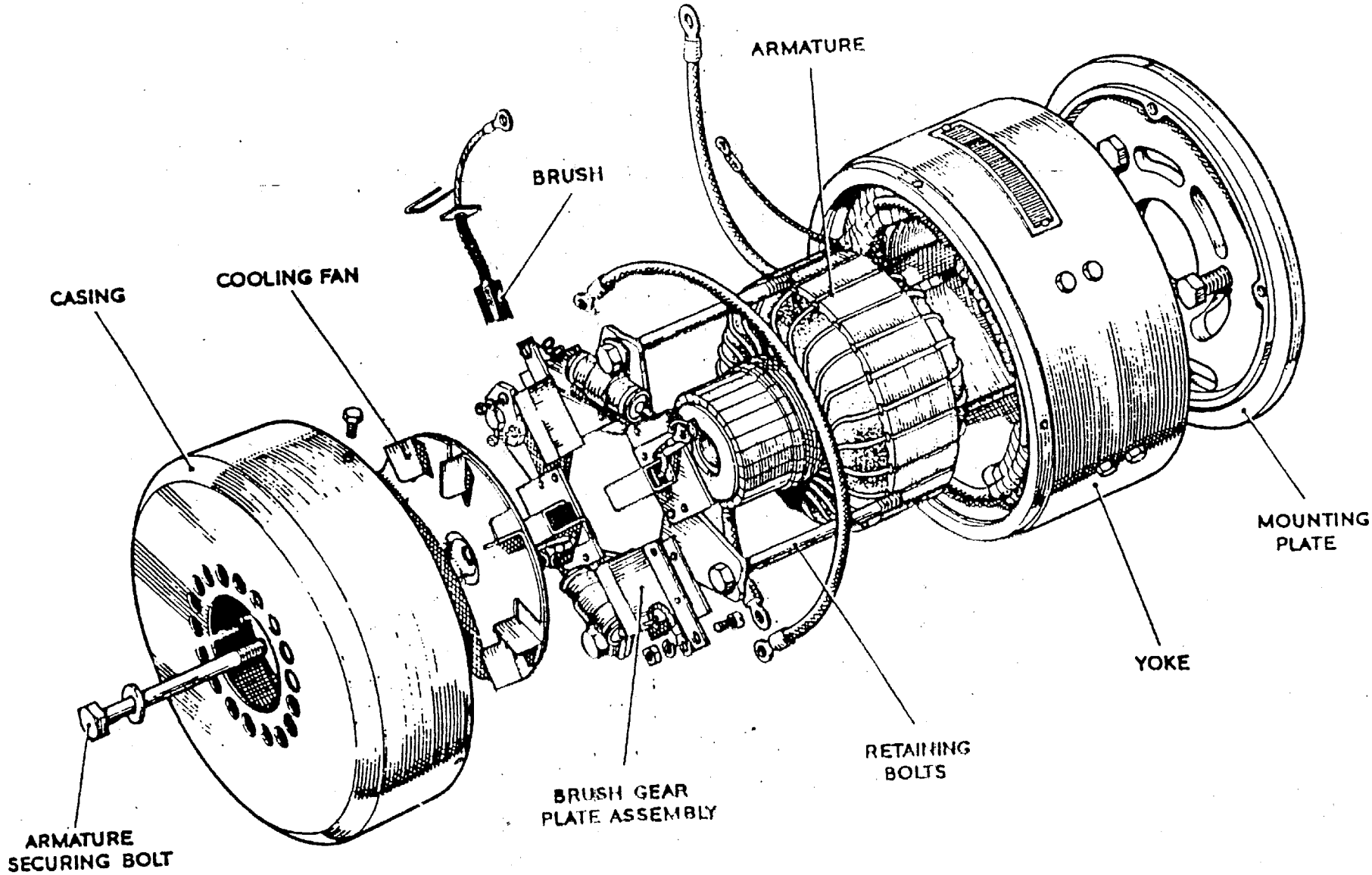


Fig. 12. The Generator

current; the extra power required from the machine when it acts as a motor is made possible by provision of the starting windings.

There are four carbon brushes mounted on the brush plate. Two brushes are connected together and the other two are individually connected to earth. Two capacitors are connected across the brushes; the purpose of the capacitors is to absorb any slight sparking between the brushes and the commutator.

1.5.7. The Armature. The armature is built up on a hollow shaft and is fitted on a tapered extension of the crankshaft. The assembly is held in position by means of a long bolt screwed into the end of the crankshaft. A cooling fan is mounted at the commutator end of the armature, it is held in position by means of the armature securing bolt. An end case is fitted over the commutator end of the machine and is secured to the yoke by means of a screw.

1.5.8. The Control Box. Fig. 13. The control box is mounted on the side of the generator. The control knob on top of the box is for regulating the output of the set. The two

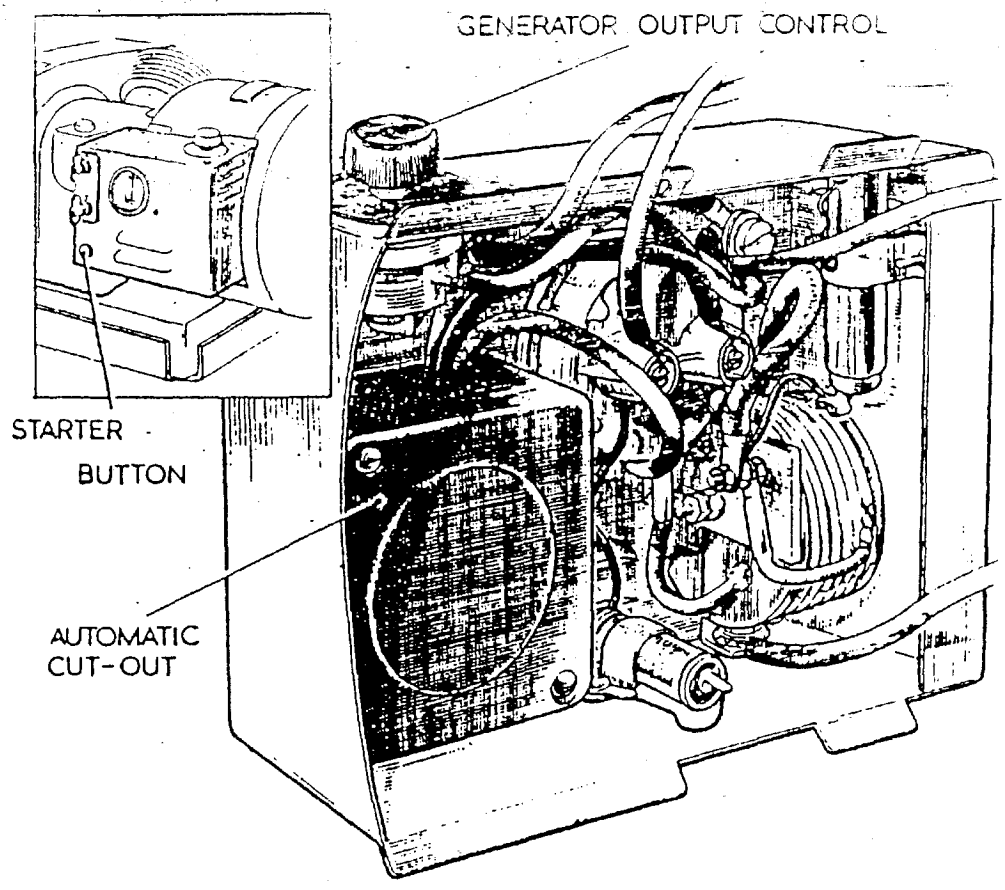


Fig. 13. The Control Box

terminals with wing nuts on the front of the control box are for the battery connections. They are aligned vertically and are marked +ve and -ve, the lower terminal which is positive is insulated from the case. An ammeter, to register the charging rate of the battery is adjacent to the terminals. The "Start" button is mounted at the lower left hand corner of the control panel. Inside the control box an automatic cut-out is housed. The cut-out comprises two coils wound on a common core and a pair of contacts one of which is spring loaded in the "Off" position. The inside coil known as the Shunt coil comprises a large number of turns of fine gauge wire, one end of it is connected to the ammeter lead and the other end is earthed. When the engine is started up and the generator voltage reaches a certain value the magnetic field resulting from the current flowing in the coil overcomes the action of the spring and closes the contacts. In this way the generator is automatically connected to the load. Conversely when the voltage of the generator falls below a certain value the action of the spring overcomes the magnetic force produced by the coil and disconnects the generator from the load. The outside coil is known as a series coil and is made of a heavier gauge wire than the shunt coil. Its purpose is to assist the action of the shunt coil in keeping the contacts closed when the generator is operating at the correct voltage and to ensure that the contacts are disconnected quickly when the voltage of the generator tends to fall below the voltage of the battery.

CHAPTER TWO

· OPERATION ·

2.1. General.

Upon receipt of a new set the loose items should first be removed from the packing case. The set may then be removed by undoing the nuts on the holding down bolts. The bolts and nuts should be put inside the packing case, the lid fastened on and the case returned to R.A.O.C. The only items removed from the set for ease of packing are:-

The exhaust pipe and muffler.

The twin battery charging connector. (The starting cord is enclosed in the folded canvas cover).

Before the loose items are assembled to the set depreservation in accordance with the instruction contained in the Depreservation leaflet packet with the set should be carried out.

2.2. Siting the set.

If the set is to be used as a stationary equipment at a site it may be housed inside a building but the exhaust outlet must be put outside the building. In order to reduce noise and vibration it is advisable to secure two wooden battens under the set. When the set is sited in the open ensure that it is placed in a sheltered position on firm level ground. Do not put the batteries on loose hardcore (clinker, cinders etc.) a short run of duck-board should be provided and this should be reasonably level when in position

2.3. Preparation for initial Start.

(1) Screw one end of the flexible exhaust pipe on to the exhaust outlet, place the pipe down wind from the set and screw the muffler on the end of the pipe.

(2) Fill the fuel tank with gasoline replace the filler plug and undo the vent screw a few turns.

(3) Fill the sump and the filler pipe with the correct grade of oil. Use the funnel provided in the tool kit when filling the fuel tank and the sump.

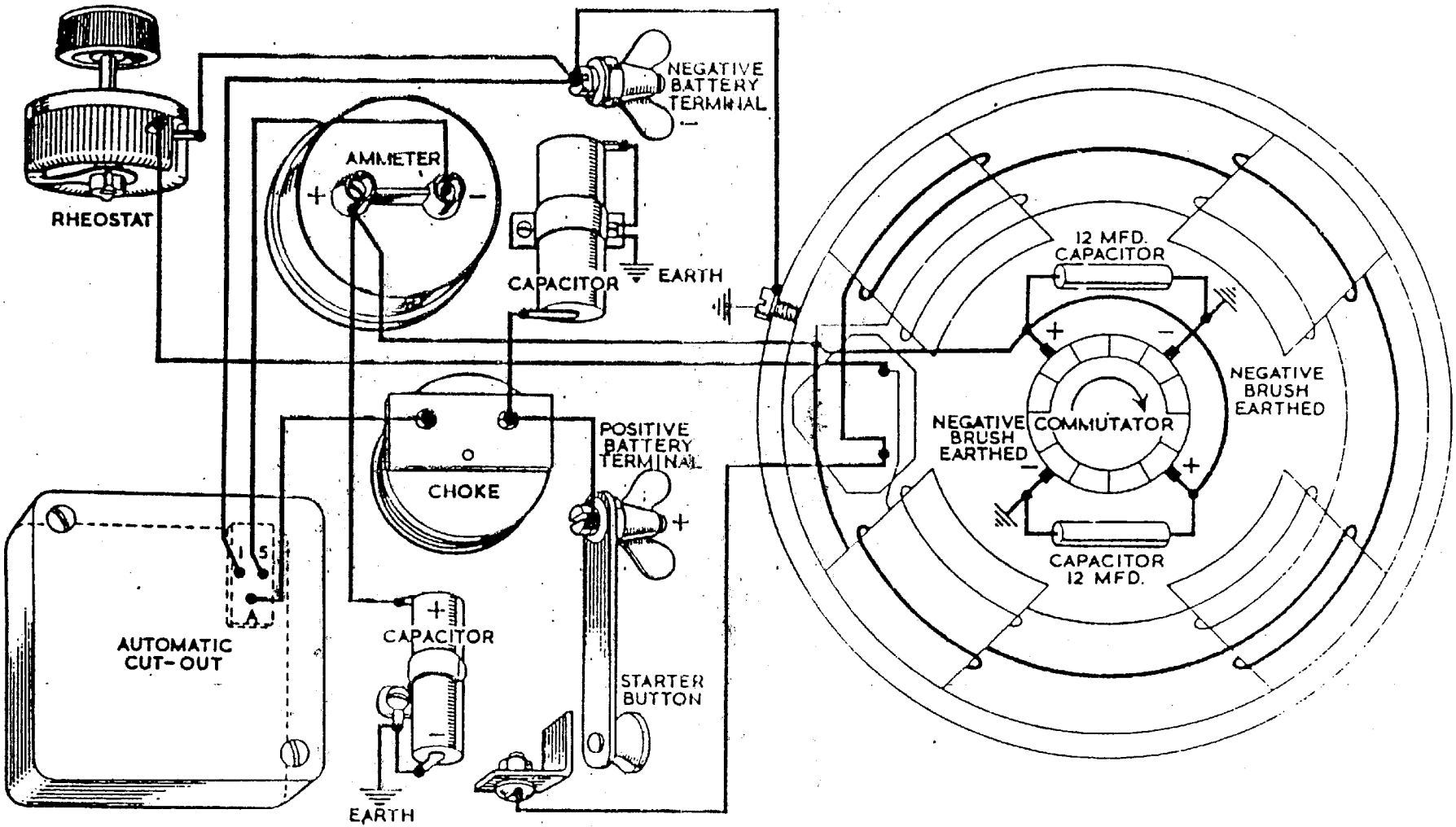


Fig. 14. Generator and Control Box Wiring Diagram

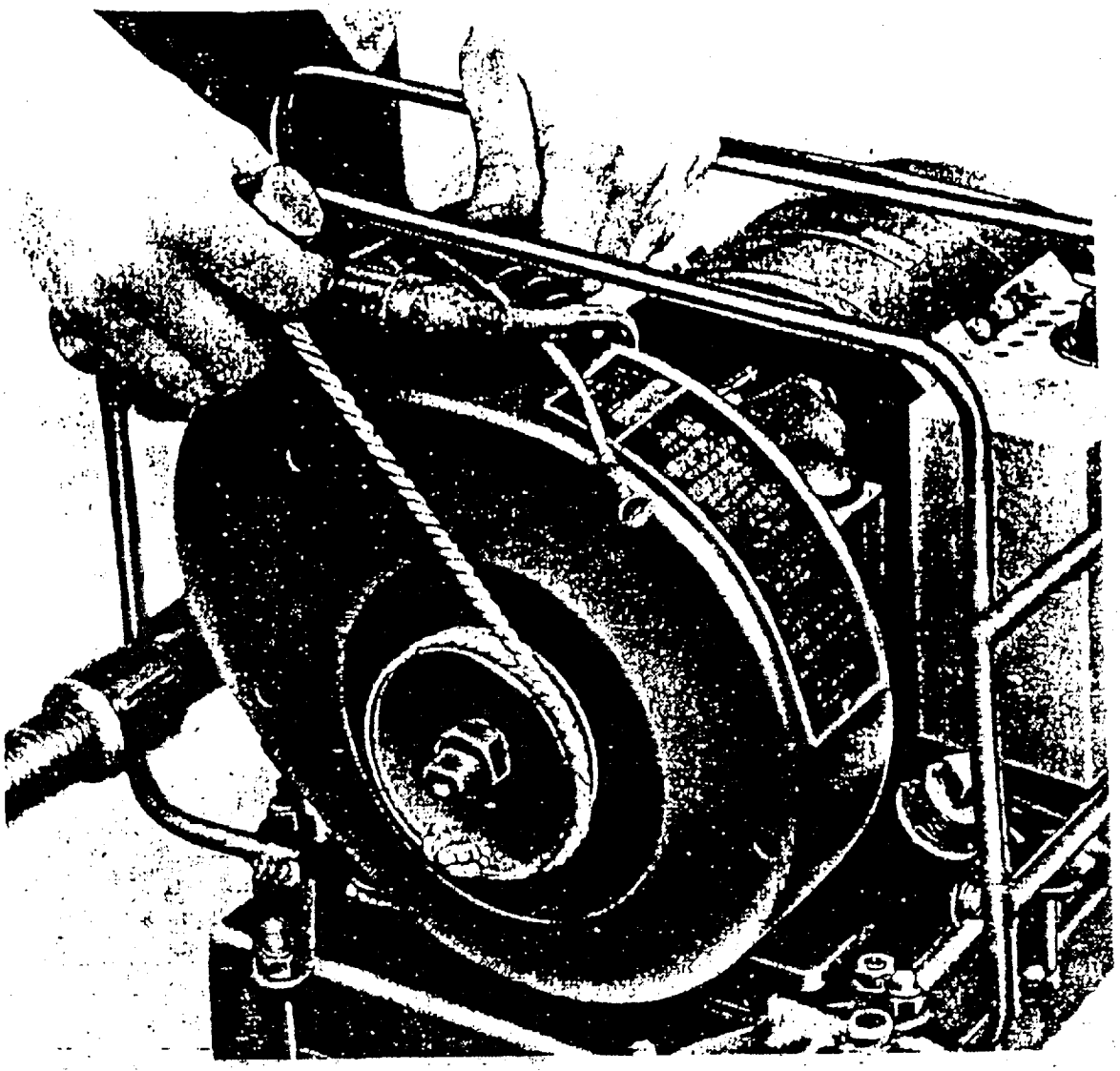


Fig. 15. Starting engine with starting cord.

2.4. Starting the engine by means of the starting cord. Fig. 15.

(1) Turn the output control knob to the position marked "OFF".

(2) Pull out the choke control.

(3) Engage the knot at the end of the starting cord into the slot in the starting pulley and wind the rope twice round the pulley in an anti-clockwise direction.

(4) Stand at the exhaust pipe side of the engine and pull the cord handle firmly without jerking it. The engine may not start at the first attempt and it will be necessary to repeat the operation until sufficient gasoline is drawn into the carburettor when the engine should start.

(5) When the engine commences to run push the choke in gradually to the half way position and when it is warmed up push the choke in fully. The engine should not be allowed to run longer than necessary with the choke control out.

(6) Allow the set to run for a few minutes on no load and examine it for leaks and cracks; listen for unusual noises or uneven running.

(7) See that the ammeter reading is zero.

(8) Stop the set by pressing the "STOP" button.

(9) Remove the sump filler plug and check the oil level.

(10) Replace the plug.

2.5. Subsequent Starts.

(1) Electric Starting. Connect the terminal of the battery marked +VE to the +VE terminal of the control box.

(2) Connect the battery -VE terminal to the -VE terminal of the control box.

(3) Check the level of the fuel in the tank.

(4) Check the level of the oil in the sump.

(5) Pull out the choke control if the engine is cold. NOTE; the choke should not be used when starting a warm engine.

(6) Turn the output control knob to the position marked "HIGH".

(7) Press the starter button.

(8) When the engine fires release the starter button.

(9) Push the choke in gradually and when the engine is warmed up push it in fully.

(10) Adjust the output control so that the battery is being charged at the correct rate.

When discharged batteries are connected to the set it must be started by means of the starting cord, it is advisable to allow the engine to warm up before turning the control knob to obtain the correct charging rate.

2.6. Closing down

(1) Stop the engine by pressing the "Stop" button.

(2) Coil up the starting cord and put it away.

(3) Disconnect the leads from the battery, coil them up and put them away.

(4) Fit the canvas cover.

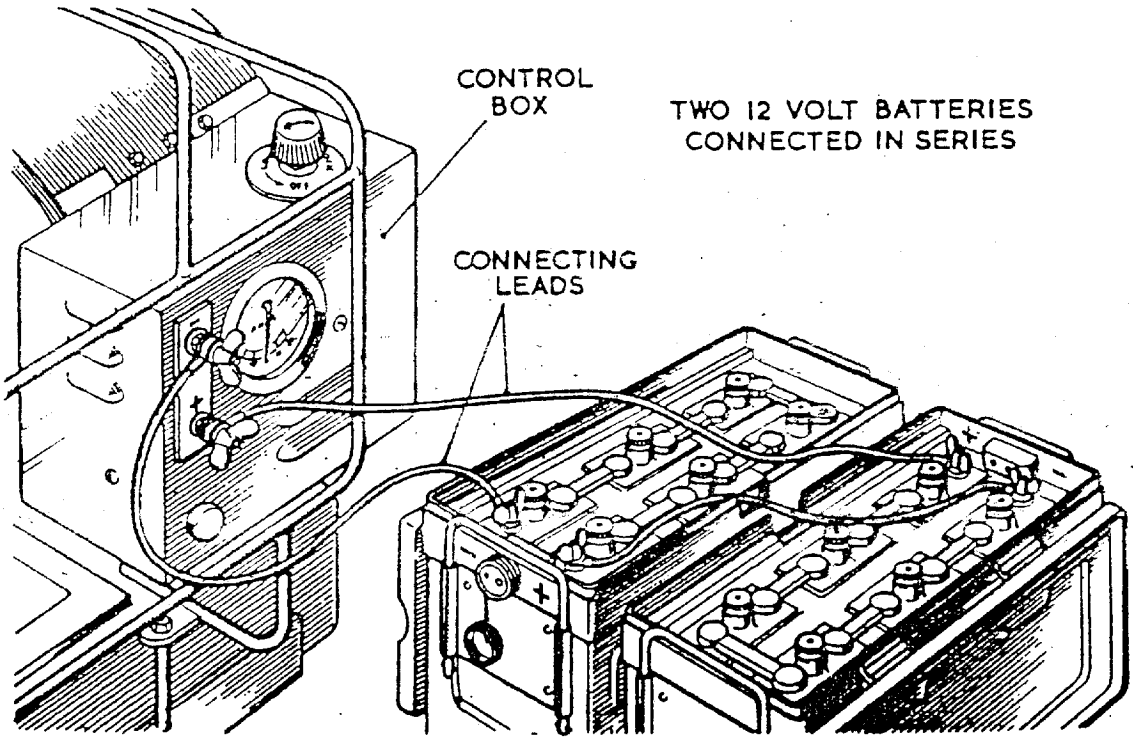


Fig. 16. Battery charging

2.7. Battery charging. Figs. 16 and 17.

When it is required to charge a battery it is necessary to ascertain its correct charging rate, this information is usually to be found on the side of the battery. Batteries are rated by their voltage and ampere-hour capacity. A battery may be made up of a number of two volt cells connected together in series. The usual batteries to be found in the Service are 2V. (1 cell), 6V. (3 cell) and 12V. (6 cell). Four identical 6V. batteries may be connected together in series to give an output of 24 Volts, or two

12 Volt batteries can be similarly connected, to give an output of 24 Volts.

The rate of charge and discharge is determined by the ampere-hour capacity, for example a 75 ampere hour fully charged battery can be discharged at the rate of 7·5 amps over a 10 hour period. When re-charging the battery however the fully charged condition is not always indicated correctly by the product of the charging rate and the time on charge. To check the condition of a battery the specific gravity of the electrolyte should be checked by means of a hydrometer. (Fig. 17).

It is inadvisable to charge a group of batteries of varying capacity from the same generator at once, but if this must be done the charging rate must not exceed the maximum charging rate of the smallest battery in the group.

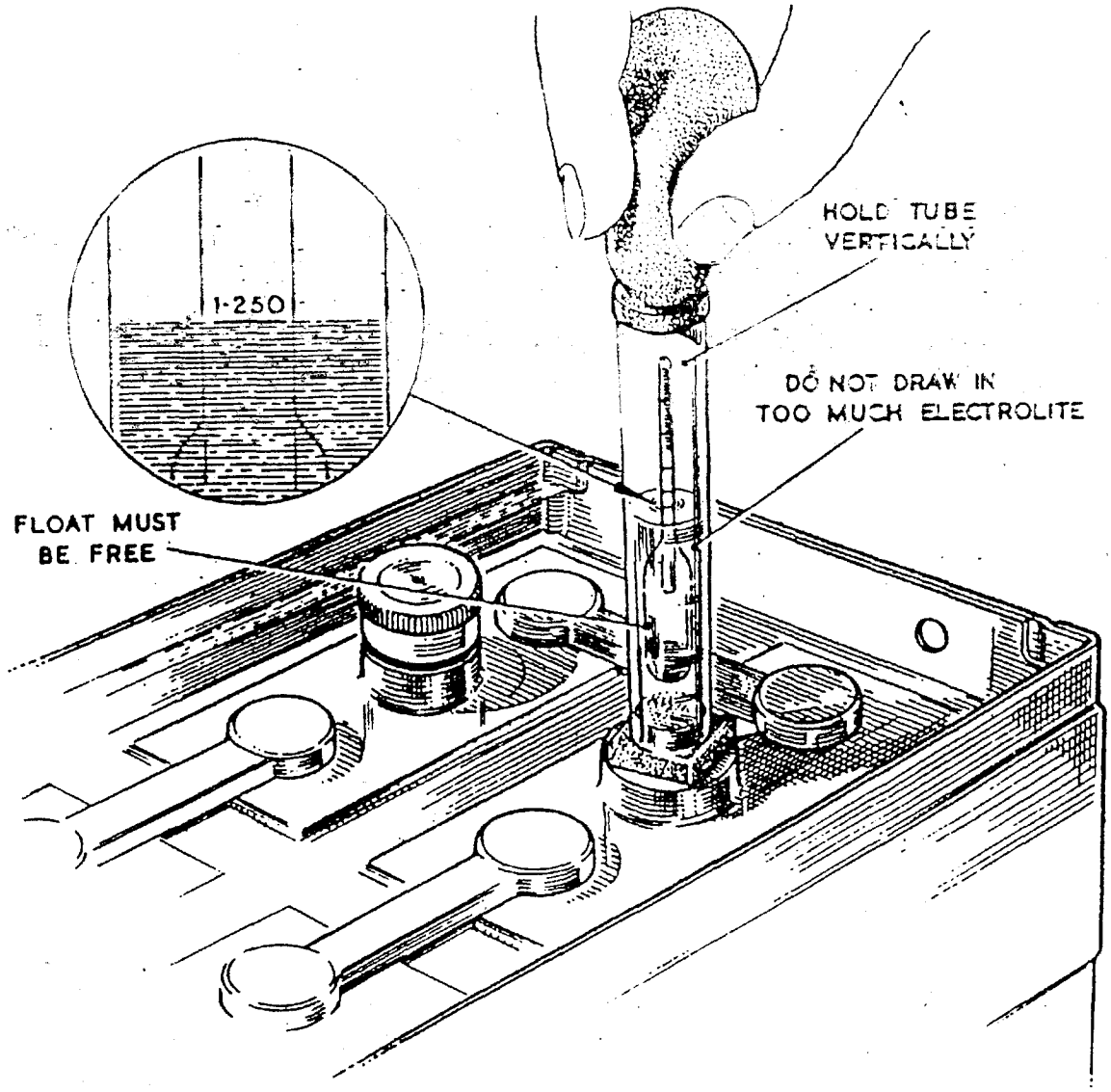


Fig. 17. Checking Battery Using a Hydrometer

CHAPTER THREE

· SERVICING AND ADJUSTMENTS ·

3.1. To drain the engine sump. Fig. 18.

The sump should be drained when the engine is hot. Provide a receptacle to hold the used oil. Remove the drain plug fitted at the front of the filler pipe and under the filler plug. Allow all the used oil to drain into the receptacle. Replace the plug and fill the sump with the correct grade of oil.

3.2. To drain the exhaust system.

Remove the drain plug at the bottom of the exhaust elbow and allow the system to drain. Replace the plug. The muffler and flexible exhaust pipe should be drained at the same time.

3.3. To drain the fuel tank. Fig. 18.

Remove the drain plug on the side of the fuel tank. The plug is located below the tank filler plug. Tilt the

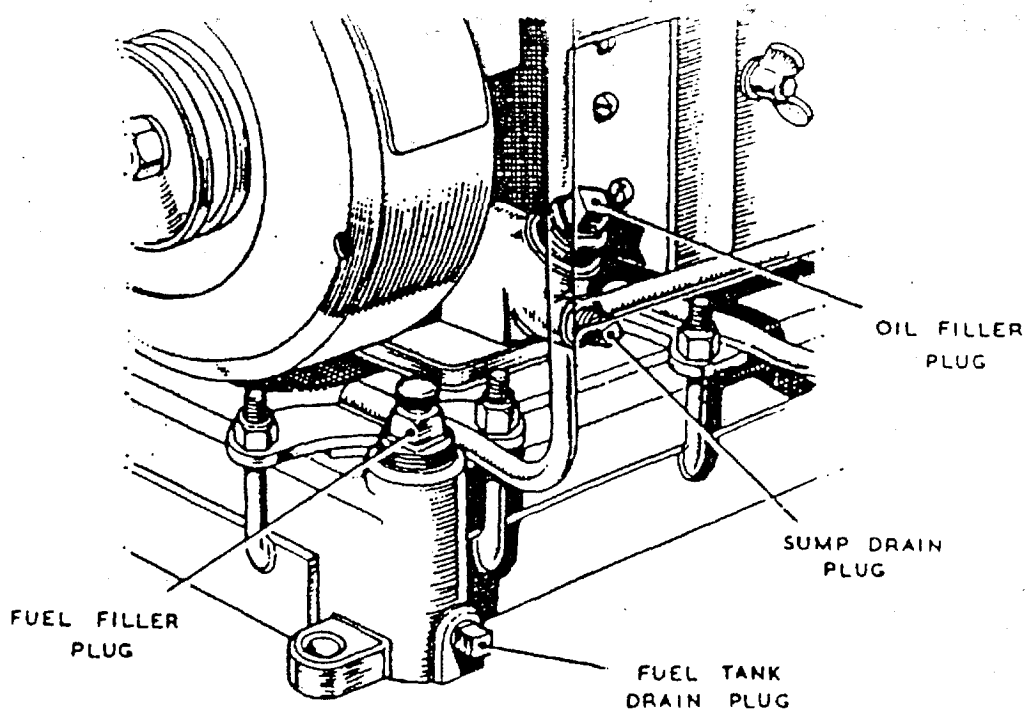


Fig. 18. Engine sump and Fuel tank drains.

set slightly so that any sludge in the tank flows out through the plug hole. Replace the plug securely when the tank is completely drained.

3.4. To remove the non-return valve and fuel filter from the fuel tank.

Undo the union nut connecting the fuel pipe to the non-return valve assembly. Slacken the union nut connecting the fuel pipe to the carburettor and swing the fuel pipe clear of the non-return valve assembly. Remove the assembly by undoing the flat nut on top of the tank. Examine the washer and replace it if necessary. Wash the assembly in clean fuel. Replace the assembly and connect the fuel pipe. Tighten up the nuts.

3.5. To clean the air cleaner. (see Fig.8).

Remove the knurled nut on top of the cleaner and lift off the cover. Remove the filter bowl. Remove the locating skirt and the filter element from the bowl. Wash the element and the skirt in clean fuel and allow them to dry. Clean out the sludge from the bottom of the bowl and wash it in fuel. When the bowl is dry fill it with lubricating oil to the level of the bead and assemble the filter element and skirt in it. Examine and clean the cork seating on which the bowl is fitted and replace the bowl. Replace the cover and the knurled nut.

3.6. To adjust the sparking plug gap. Fig.19.

Remove the screw and nut securing the sparking plug

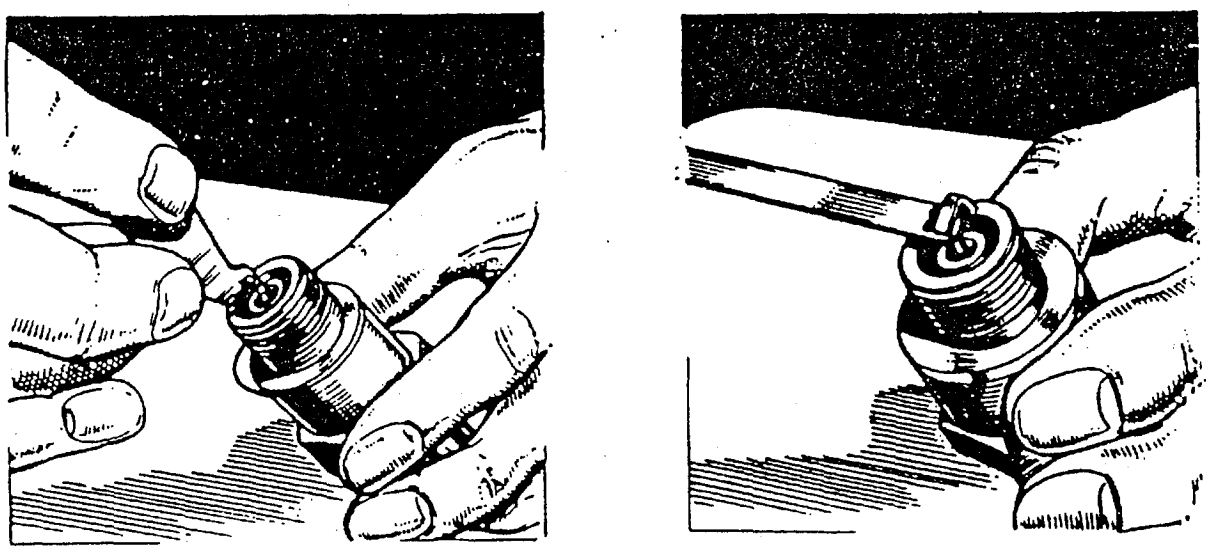


Fig. 19. Adjusting and checking Sparking Plugs.

cover and remove the cover. Disconnect the H.T. lead from the plug and remove the plug. Scrape off all carbon deposit from the plug taking care not to damage the insulation of the centre stem. Check the gap between the centre stem and the tongue projecting from the bottom of the plug by means of the gauge and if necessary adjust the tongue until the correct gap is obtained. Replace the plug, connect the H.T. lead to it and replace the cover.

3.7. To decarbonise the engine. Figs. 20 to 25.

3.7.1. To remove the engine components. Remove the flexible exhaust pipe by unscrewing it at the socket connection. Remove the choke control and H.T. lead clip from the flywheel casing and remove the casing by sliding it to the left off the two tongues of the magneto armature plate. Remove the air cleaner assembly. Remove the sparking plug cover, disconnect the H.T. lead from the plug and remove the plug. Remove the eight nuts securing the guard frame to the base and remove the frame by lifting it clear of the bolts and tilting the control box side of the frame upwards. Remove the nut, washer, and starting pulley from the flywheel end of the crankshaft. Attach the flywheel extractor as shown in Fig. 20. Do not screw in the two outer screws of the

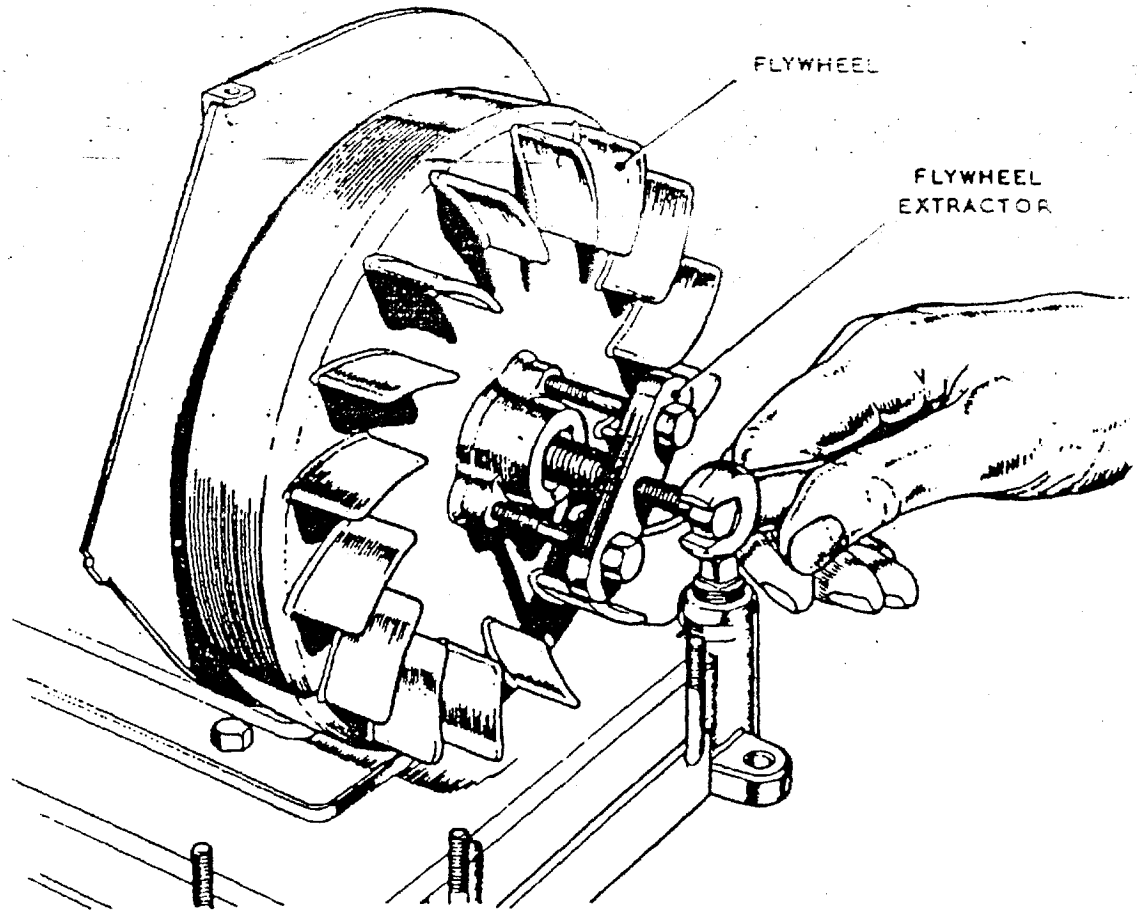


Fig. 20. Removing Flywheel.

extractor too tightly. Screw in the centre screw of the extractor until it locates against the end of the crankshaft and then tighten it up gently with a spanner. A sharp tap with a hammer on the head of the centre screw should loosen the flywheel. Remove the flywheel from the shaft. Remove the key from the shaft and store it in a safe place. Remove the magneto armature place assembly by undoing the four hexagon headed screws and sliding the assembly off the shaft. Take care not to damage the gasket and the oil seal. Put the assembly away in a clean dry place. Remove the exhaust elbow shield by undoing the lower right hand cylinder head bolt. Remove the lower left hand cylinder head bolt and swing the air cleaner pipe clip clear of the head. Undo the screw at the junction of the air inlet pipe to the carburettor a few turns; the screw is on the inside of the pipe. Pull the pipe gently towards you and remove it from the carburettor. Disconnect the choke wire from the carburettor by undoing the screw on the choke arm a few turns. Disconnect the governor control from the carburettor by undoing the screw securing the governor arm toggle to the spindle of the butterfly valve of the carburettor.

NOTE:- There is a slot in the end of the spindle to indicate the position of the butterfly valve.

Remove the fuel pipe, the non-return valve and fuel filter assembly. Plug the hole in the fuel tank with a piece of wood. Remove the carburettor by undoing the two cheese headed screws on the carburettor flange. Take care not to damage the joint. Undo the lock nut on the exhaust elbow a quarter turn and unscrew the elbow a quarter turn. Remove the short length of pipe from the elbow and remove the elbow. Undo the five cylinder head bolts and tap the cylinder head lightly all round under the cooling fins with a piece of wood. Remove the cylinder head taking care not to damage the gasket. Remove the three screws and washers and the two nuts and washers securing the cylinder barrel to the crankcase. Lift the barrel gently off the studs taking care not to damage the gasket. Support the piston as it emerges from the cylinder. Mark the skirt of the piston on the inside so that it can be put back correctly. Remove the circlips from each end of the gudgeon pin. Tap one end of the pin with a piece of wood and remove it from the piston.

NOTE:- The piston and connecting rod must be supported during this operation. Cover the engine with a clean sheet of paper.

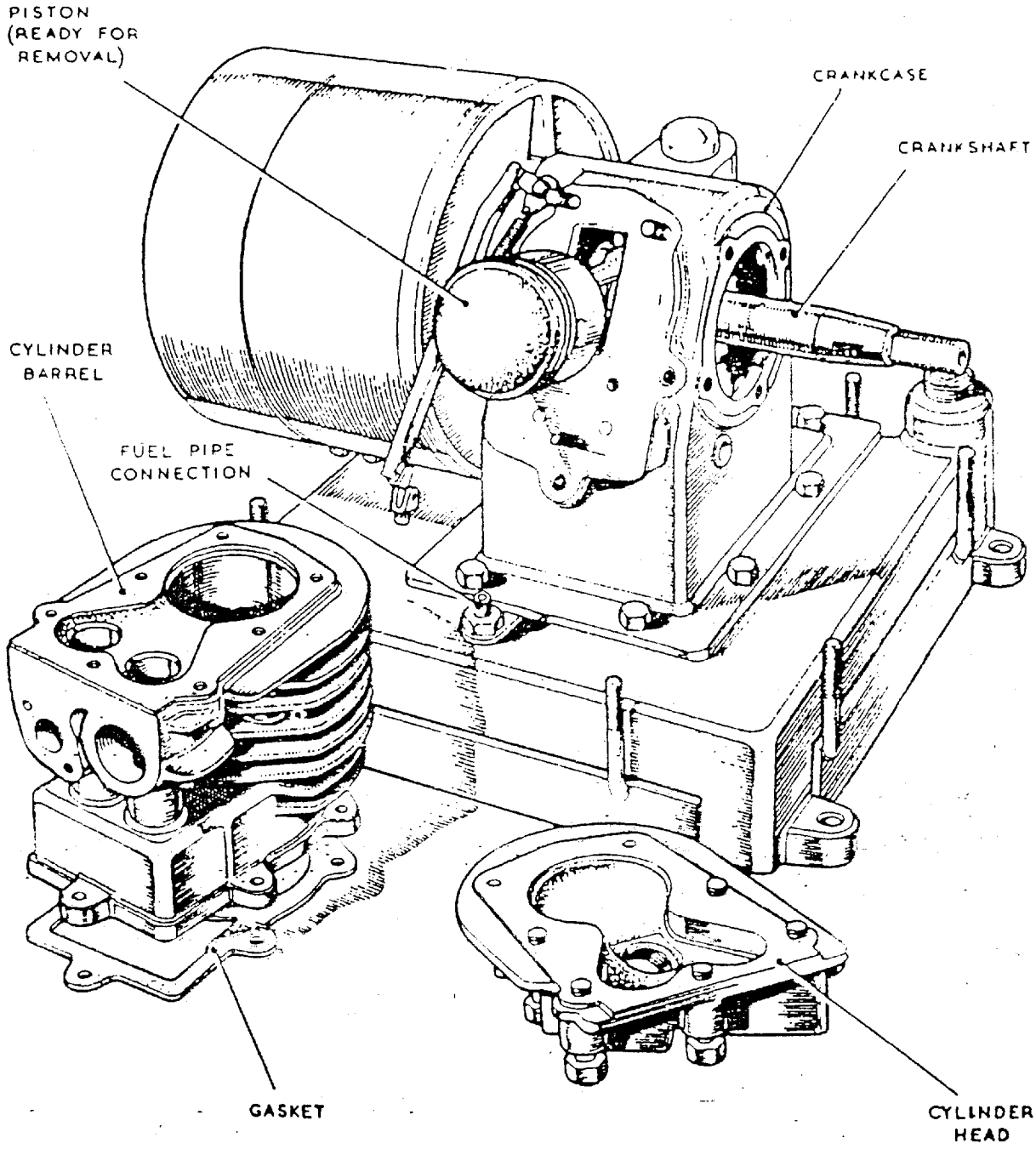
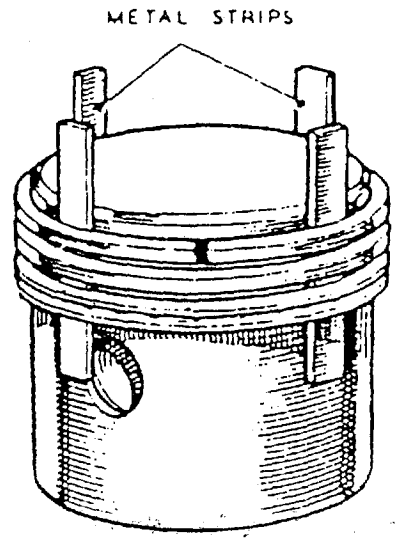


Fig. 21. Engine dismantled for decarbonising.

3.7.2. To remove the piston rings. Fig.22. Cut four strips of metal each 1/4 in. wide by 2 in. long from a cocoa can or similar container. Insert a strip between the bottom of the ring and the piston; it will be necessary to prize out the end of the ring to do this and great care must be taken to ensure that the ring is not broken by prizing it out too far.

Fig. 22. Piston rings - removal and assembly.



Slide the strip around the piston a little way and insert another strip beside it. Insert the other strips in a similar manner, the ring will now be clear of the groove and can be removed from the piston. Remove the other rings in a similar manner.

3.7.3. To remove the valves. Place the cylinder barrel on a clean box or bench so that the valve stems are faced upwards. Mark the back of the exhaust valve so that it will be replaced correctly. Press down the spring cups by means of two screwdrivers or tommy bars, discard one of the screwdrivers and hold the spring in the compressed position with the other. Draw out the cotter pin with a pair of pliers. Release the pressure on the spring gently and remove the spring cup and spring. Remove the valve. Remove the other valve assembly. Examine all the parts and requisition any replacements required. Scrape off all trace of carbon from the rings and wash them in fuel. Scrape off all trace of carbon from the back of the piston and the sides and bottoms of the grooves. Wipe the piston with a clean rag moistened in fuel. Scrape off all carbon from the cylinder head, gasket, valves and cylinder and wipe clean. See that no carbon falls into the valve guides when cleaning the cylinder.

3.7.4. Grinding the valves. Put a thin coating of medium valve grinding compound on the exhaust valve seat and put the valve into the exhaust port. Grind the valve by applying a light pressure on the handle of the tool provided and by turning it backward and forwards. Lift the valve off its seat frequently and turn it to a fresh position; continue grinding until no more bite is felt in the grinding compound. Remove the valve, clean the seat and the valve thoroughly. The grinding process must be repeated until a uniform ground area is seen on the valve and the seat; when this is evident the grinding should be completed by using a fine grinding compound. Grind in the inlet valve in a similar manner. All trace of grinding compound must be wiped away from the parts with a clean rag moistened in fuel.

3.7.5. Checking the valve clearance. Fig.23. Fit the valves in their appropriate position but do not fit the

small end bushes and the gudgeon pin, apply a slight smear of oil to the pin. Offer up the piston to the connecting rod ensuring that the mark you made on the inside of the piston skirt is lined up correctly and insert the pin in the piston. See that the pin enters the connecting rod bush correctly and that the piston and connecting rod are supported while the pin is being fitted. Fit the gudgeon pin circlips.

3.7.8. Assembling the cylinder. Clean the crankcase area for the cylinder gasket and apply a slight smear of oil with the finger to the cleaned surface. Fit the gasket over the two studs in the crankcase, ensure that the remaining holes are lined up correctly and smooth the gasket on to the oiled surface. Clean out the inside and the bottom of the cylinder and smear the inside with a little engine oil. Offer up the cylinder to the piston, the rings must be compressed to allow them to enter the cylinders. Note the position of the slot in the first ring as it enters the cylinder and rotate the second ring so that the gap in it is on the opposite side of the piston. The piston and connecting rod must be supported during this operation. Locate the cylinder in position and put the washers and nuts on the studs. Fit the three screws and washers and tighten up all the nuts and screws.

3.7.9. Assembling the magneto armature plate. Before assembling the plate to the crankcase it should be serviced in accordance with the instructions in para. 3.8. Clean the machined face on the side of the crankcase, apply a slight smear of oil to it and smooth on the gasket ensuring that the four holes are lined up correctly. Clean the machined face of the plate, offer it up to the crankcase and ensure that it is located squarely over the register on the crankcase. Fit the four screws and washers and tighten them. Check and if necessary adjust the magneto contacts see paragraph 3.8.

3.7.10. Assembling the flywheel and starting pulley. Clean the taper on the crankshaft and fit the key into the slot. Clean the bore of the flywheel and fit it on to the shaft. Tap the flywheel boss on either side of the crankshaft with a piece of wood and a hammer. Fit the starting pulley discs ensuring that the notched disc is on the outside, fit the washer and tighten up the nut securely.

3.7.11. Fitting the exhaust pipe. Clean out the exhaust elbow and ensure that the lock-nut is in position. Fit the elbow to within one quarter turn of its final position and screw on the short length of pipe. Tighten the pipe and swing it into its final position. Tighten up the locknut.

3.7.12. Servicing and fitting the carburettor and controls. Remove the three small screws from the bottom of the carburettor and take off the choke valve assembly. Clean out the four small holes in the valve plate with a pin and wash the assembly in clean fuel. Replace the assembly and tighten up the screws. Ensure that the fuel pipes are clear by blowing through them. Remove the wooden plug from the fuel tank and fit the fuel filter and non-return valve assembly. Fit the long stem of the fuel pipe to the filter assembly and screw on the union nut a few turns. Clean the carburettor flange and joint and re-fit the carburettor. Connect the fuel pipe and tighten the union nuts. Attach the governor arm toggle to the spindle of the carburettor butterfly valve and check that the governor arm spring is in position. Line up the slot in the end of the spindle so that it is parallel with the machined flange of the carburettor, (valve in fully open position) and tighten the securing screw in the governor arm toggle. See that the choke control knob is pushed "IN" and attach the other end of the choke wire to the choke arm and tighten the securing screw. Fit the air inlet pipe to the carburettor and tighten up the screw on the inside of the aplit coupling under the carburettor. (See para. 3.7.15. for adjustment of fuel valve).

3.7.13. Fitting the cylinder head. Fig. 25. Clean the cylinder head and the gasket. Fit the gasket and the head, screw in the two top bolts. Thread one bolt through the air inlet

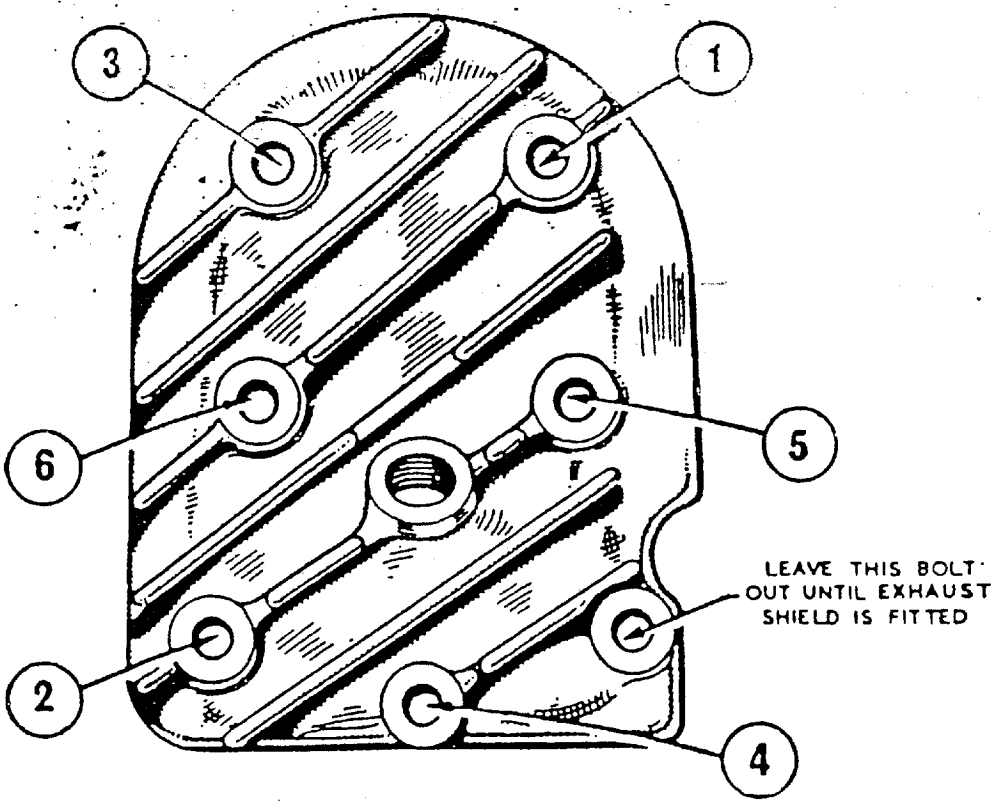


Fig. 25. Order of tightening cylinder head nuts.

pipe clip and the choke control clip and fit the bolt in the bottom left hand hole. Fit the remaining bolts and tighten up as shown in Fig.25. Fit the sparking plug and connect the H.T. lead to it. Fit the sparking plug casing.

3.7.14. Fitting the flywheel casing and guard frame. Slide the flywheel case into position and ensure that the tongues on the magneto armature plate fit into the slots in the case. Fit the clip securing the H.T. lead and the choke control to the casing.

NOTE:- It is advisable to service the generator before fitting the guard frame see para. 3.9.

The best method of fixing the frame is to tilt the control box side of it and line up the four fixing points on this side first. Line up the remaining fixing points and tighten up the nuts. Fit the exhaust elbow shield and the last cylinder head bolt.

3.7.15. To adjust the carburettor fuel valve. The valve seat and stem may be damaged if this adjustment is carried out with a screwdriver; the head of the adjusting screw should be rotated using the index finger and thumb. Do not screw the head of the adjusting screw in tight, as this will certainly result in damage to the valve seat and stem.

(1) Screw in the adjusting screw gradually until the valve is gently resting on the seat and then unscrew it 1½ turns.

(2) Start the engine and allow it to warm up.

(3) Apply full load.

(4) Screw in the adjusting screw gradually until the engine commences to lose speed due to weak mixture note the position of the slot in the head of the screw.

(5) Undo the adjusting screw slowly until the engine commences to hunt due to rich mixture and note the position of the slot in the head of the screw. Set the adjusting screw so that the slot is midway between the "rich" and "weak" positions.

NOTE:- In some cases the head of the adjusting screw is not slotted and the midway position will have to be estimated.

3.8. Servicing the magneto.

3.8.1. Cleaning. Clean the parts with a dry clean rag. Check the electrical connections and see that they are tight. Examine the tips of the pole pieces and ensure that they have not been rubbing against the inside rim of the flywheel. Open the contact points a little and clean them with a clean dry cotton rag. Examine the contacts again and if there is any sign of pitting, the contacts must be polished with a fine stone or emery cloth.

3.8.2. To Remove and Replace the contacts. Remove the split pin from the moving contact pivot pin. Remove the steel washer and the insulating washer. Remove the connection to the condenser from the square headed terminal post and slacken the inside nut on the post. Disengage the ends of the spring from the post and at the same time slide the moving contact breaker off the pivot pin. Clean the contact breaker and the cam. Dress the contact points. Put a few drops of oil on the pivot pin. Clean the points with a dry rag and put a few drops of oil on the cam. Engage the end of the spring between the head of the binding post and the insulating plate and fit the contact breaker lever on the pivot pin. Replace the bakelite and steel washers, fit the split pin and open out the ends of it slightly. Put a few drops of oil on the felt pad which bears on the surface of the cam.

3.8.3. To adjust the contacts. The magneto armature plate should be assembled and in the working position. Rotate the engine flywheel until the contacts are fully open. Check the gap by means of the gauge provided and if necessary adjust the gap by undoing the two screws securing the fixed contact plate a few turns. Move the plate in the required direction until the points are correctly set. Tighten up the two screws and re-check the gap between the points.

3.9. Servicing the generator.

3.9.1. To remove the end cover and the cooling fan. Undo the screws securing the control box to the generator a few turns. Remove the screws securing the end cover to the generator and slide off the cover. Remove the armature securing bolt at the end of the crankshaft and take off the fan.

3.9.2. To clean the commutator. Moisten a clean rag in fuel, hold it against the commutator and rotate the engine by hand.

If the commutator is still black and dirty it should then be cleaned with a piece of fine glass paper. All trace of dust should be wiped away with a clean dry rag.

3.9.3. To check and Replace the brushes. Fig.26. The brushes are held in position by means of U shaped pieces of wire having the ends folded inwards. Attached to each brush is a short length of copper wire and on this is threaded a coil spring and a back plate. The spring and back plate are secured under the wire clip and the lead from the brush is brought out to a terminal through the arms of the clip. To remove a brush. Remove the wire clip and draw out the brush from the brush holder. When a new set of brushes are fitted they must be bedded down to the radius of the commutator as follows:- Fit a strip of fine glass paper round the commutator rough side upwards. Fit the brushes into the brush holders and fit the wire clips but do not fold in the ends of the clips. Rotate the armature clockwise (viewed from the commutator end) until the ends of the brushes are the same radius as the commutator. Remove the brushes and the glass paper. Clean all parts with a dry rag. Fit the brushes and secure the ends of the clips. Connect the brush leads to the terminals. Replace the fan and tighten up the armature bolt securely. Fit the cover and the securing screw. Tighten the screws of the control box fixing.

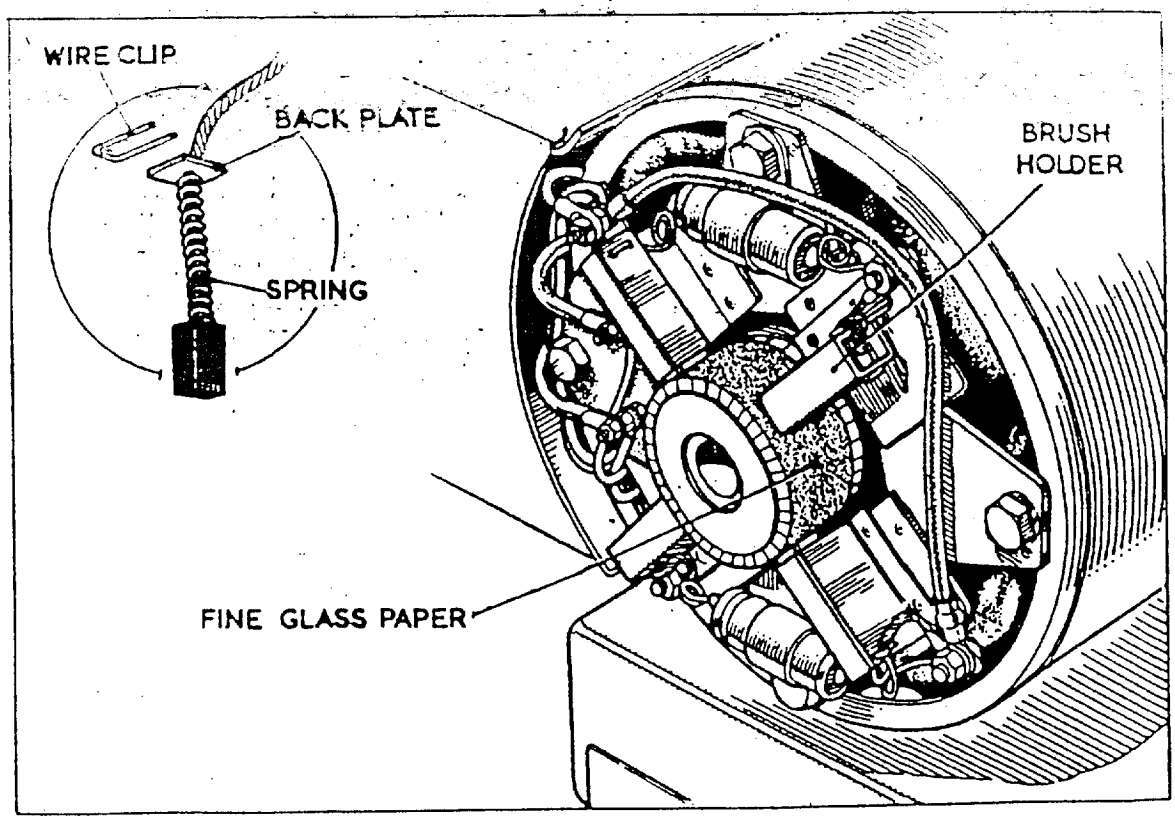


Fig. 26. Replacing Generator Brushes.

TROUBLE TRACING CHART

	FAULT	REMEDY
1.	**ENGINE FAILS TO START DUE TO FAILURE OF FUEL SYSTEM (A)**	
A.	Fuel tank empty.	Fill the tank.
B.	Fuel pipe blocked.	Remove the pipe and clear the blockage.
C.	Non-return valve not seating correctly.	Remove the assembly, wash it in clean fuel and blow through the gauze end of it.
D.	Air leaks in fuel system.	Check the connections and tighten up the union nuts.
E.	Choke control wire loose.	Tighten securing screw and check action of choke arm.
F.	Choke valve stuck in "open" position.	Remove air cleaner and induction pipe, remove choke valve housing, check that the spring is in position and that the valve is a sliding fit on the spindle.
G.	Fuel valve incorrectly adjusted.	Screw in the valve to the limit of its travel and then screw it out 1.1/2 turns, see para. 3.7.15.
2.	**ENGINE FAILS TO START DUE TO FAILURE OF IGNITION SYSTEM (B)**	
H.	Sparking plug dirty or points incorrectly adjusted.	Clean the plug and adjust the points.
J.	Insulation of sparking plug cracked.	Replace the plug.

	FAULT	REMEDY
K.	H.T. lead disconnected or broken.	Remove sparking plug, check connection of H.T. lead to it; lay plug on top of cylinder head crank engine and check spark between the points of the plug.
L.	Make and break contacts of magnetc dirty or incorrectly adjusted.	Clean and adjust the contacts. Check all connections on magneto armature plate.
M.	Capacitor defective.	Replace capacitor.
N.	Ignition coil defective.	Report to R.E.M.E.
P.	Batteries discharged.	Start the engine by means of the starting cord.
R.	Starting cord wound on starting pulley incorrectly.	Wind the cord on the pulley in an anti-clockwise direction.

3. ENGINE STOPS WITHOUT WARNING

A.	Fuel tank empty	Fill the fuel tank.
B.	Fuel-pipe blocked.	Remove the fuel pipe and clear the blockage.
C.	Failure of ignition system.	Check the spark at the plug as in K. above; check the make and break contacts and all connections on the magneto armature plate. Report if trouble persists.

4. ENGINE RUNS UNEVENLY

A.	Carburettor fuel valve incorrectly adjusted.	Adjust the setting of the valve see para 3.7.15.

	FAULT	REMEDY
B.	Governor not functioning correctly.	Check the movement of the governor arm. Check the tension of the governor spring.
C.	Sparking plug dirty or incorrectly adjusted.	Clean the plug and adjust the points.
D.	Sparking plug insulation cracked.	Replace the plug.
E.	Capacitor burnt out.	Replace the capacitor.
F.	Make and break contacts dirty or incorrectly adjusted.	Clean and adjust the contacts.
5.	ENGINE UNABLE TO CARRY LOAD DUE TO LACK OF POWER	
A.	Cylinder head gasket damaged.	Replace the gasket.
B.	Cylinder head bolts loose.	Tighten the bolts, see Fig. 25.
C.	Valves not seating correctly	Decarbonise the engine.
D.	Piston rings stuck in grooves	
6.	ENGINE OVERHEATING	
A.	Lack of lubricating oil.	Fill the sump.
B.	Engine overloaded.	Check the ammeter reading and adjust the output control knob.
C.	Passage of cooling air to the engine obstructed.	Site the set so that flywheel fan is facing into wind.

	FAULT	REMEDY
D.	Carburettor fuel valve incorrectly adjusted.	Re-set the valve, see para. 3.7.15.
E.	Valve sticking or piston rings stuck in grooves.	Decarbonise the engine.
7.	ENGINE KNOCKING	
A.	Engine overloaded.	Shed some load.
B.	Worn bearing.	Report to R.E.M.E.
C.	Engine mounting loose.	Tighten crankcase and cylinder barrel holding down bolts.
D.	Flywheel loose.	Tighten the nut on the end of the crankshaft securely.
E.	Carburettor fuel valve incorrectly adjusted.	Re-set the valve, see para. 3.7.15.
8.	NO OUTPUT FROM GENERATOR	
A.	Contacts of automatic cut-out in control box not closing.	Report to R.E.M.E.
B.	Brushes dirty or stuck in brush boxes.	Clean the brushes.
C.	Brushes worn.	Replace the brushes and bed them in.
D.	Commutator dirty.	Clean the commutator.
E.	Loose connection in generator or control box wiring.	Check all connections.
F.	Generator de-magnetised.	Report to R.E.M.E.

	FAULT	REMEDY
C.	Output regulator burnt out.	Report to R.E.M.E.

9. EXCESSIVE SPARKING AT COMMUTATOR BRUSHES

A.	Capacitor burnt out.	Replace capacitor.
B.	Open circuit in armature.	Report to R.E.M.E.
C.	Dirty brushes or commutator.	Clean the brushes and the commutator.
D.	Brushes worn.	Replace the brushes and bed them in.