GENERATING SET 2 K.V.A. NO. 2 ONAN AMERICAN OTC-5BH

OPERATING INSTRUCTIONS

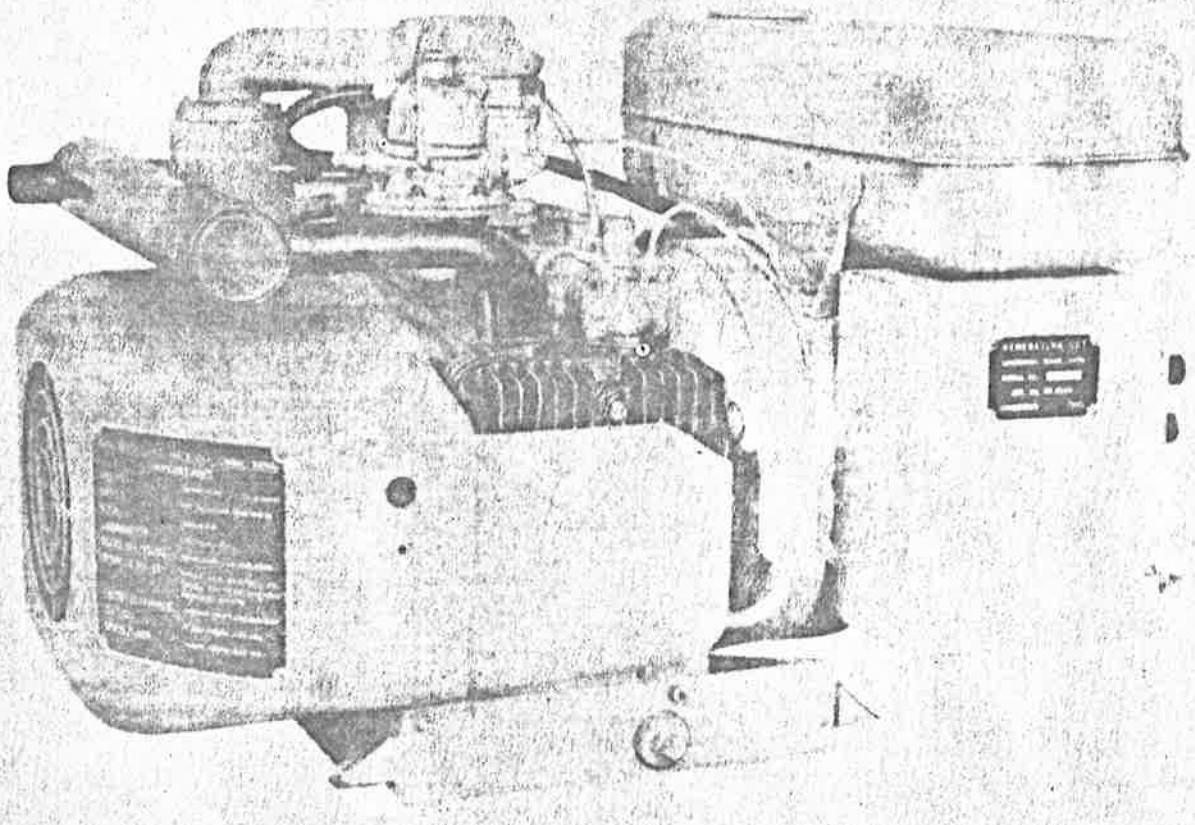

Figure 1. Side view of ONAN AMERICAN OTC-5BH without frame.

SAFETY NOTICE

1. This equipment develops high voltages which are dangerous and may be fatal if contacted by the operating personnel. Before attempting to make adjustments or changes on wiring or controls, stop the unit and disconnect one battery cable.

2. Before filling the petrol tank stop the plant.

3. If the unit is operated in a closed room, proper ventilation must be provided and all exhaust gases must be piped outdoors. Exhaust gases are poisonous and may cause death if inhaled by the operating personnel.

4. Observe every safety precaution possible while operating this power unit.

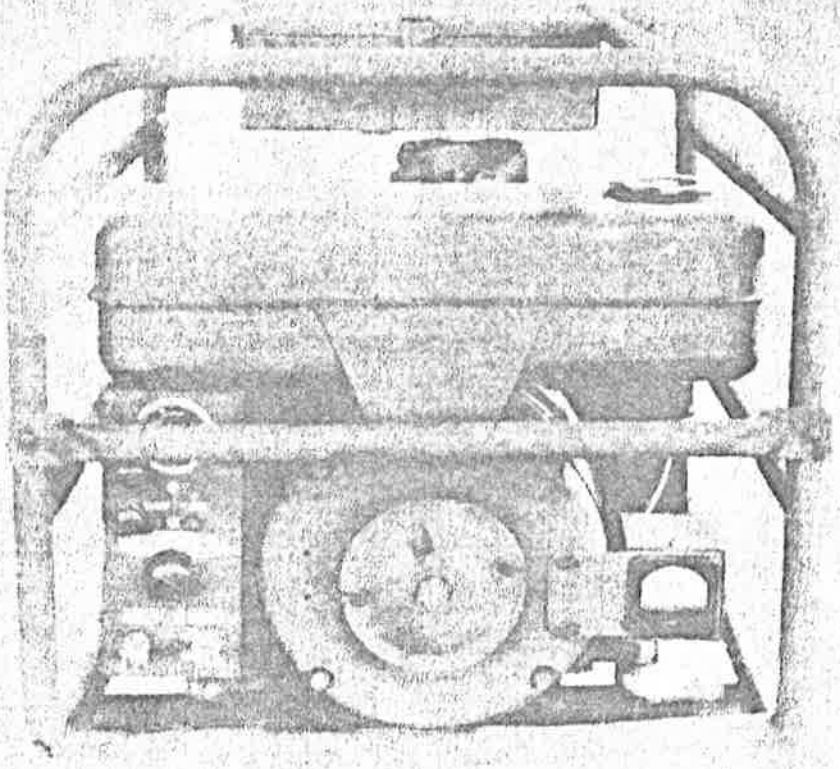

Figure 2. Rear view of ONAN AMERICAN OTC-5BH showing the control panel, rope sheave, frame, and location of tool kit and spare parts box.

Starting Instructions

This plant can be started either manually or electrically.

When the plant is started manually, the starting rope must be wound around the rope sheave on the generator end of the unit (See Fig. 2) in the direction indicated by the arrows on the pulley. The engine is cranked by pulling on the handle of the starting rope.

When the plant is started electrically, the batteries must be connected to the terminals on the control panel. Then by pushing the "Start" button on the control panel, (See Fig. 2) current from the batteries flows through the Series Field winding in the generator and through the armature. As a result of this current flowing through the generator windings, the generator starts to "motor" or revolve cranking the engine. If the self starter is used, the starter button should not be pressed continuously but in periods of not more than five seconds with equivalent stops in between until the engine starts.

6. Before starting.

a. Check the oil level in the crankcase.

b. Check that the petrol tank is full.

Make certain the air vent in the fuel tank cap is clear, otherwise an airlock may be caused.

d. Make certain the shut-off valve below the fuel tank is turned on, otherwise no petrol will get to the carburettor.

Depress starter button. Or pull starter rope wound around the rope sheave in the direction indicated by arrows on the sheave for manual start.

An automatic choke is used on the carburettor, so no manual choking is necessary.

In order to stop the plant, merely push in the stop button located on the control panel, and hold it in until the plant comes to a complete stop.

END

CONTROL PANEL SPECIFICATIONS

20. A small control panel is mounted on the generator end of the plant. On this panel there is a D.C. ammeter, a variable rheostat, start-stop button, battery terminals, and A.C. load terminals. In the control panel, there are condensers, a reverse current relay, and a start relay. On the other side of the generator housing, an A.C. voltmeter is mounted to record the A.C. output (See Fig. 2, E.M.E.R. 221 and Fig. 1 below).

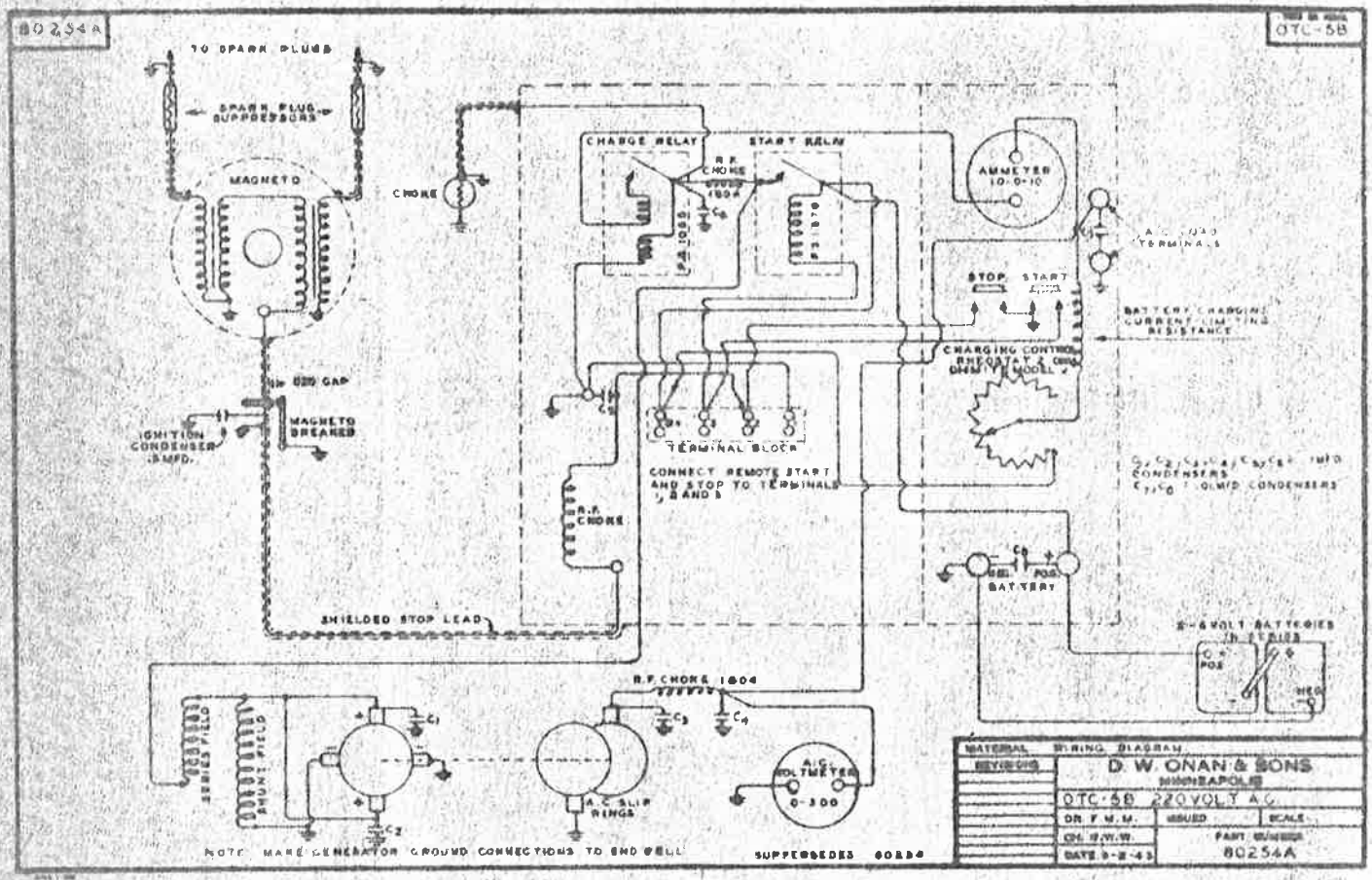

Figure 1. Wiring Diagram of OTC-5BH.

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GENERATING SET 2 K.V.A. NO. 2 ONAN AMERICAN OTC-5BH

GENERAL DESCRIPTION

1. The wireless generating set 2 K.V.A. ONAN AMERICAN OTC-5BH is to be used as the electrical supply source for wireless sets.

ENGINE SPECIFICATIONS

2. The engine is an opposed twin cylinder, four stroke cycle, air cooled, petrol engine. It has a $2\frac{5}{8}$" bore, with a $2\frac{1}{4}$" stroke. The compression ratio is 5.9 to 1. This engine produces 3.4 horse power at 1800 r.p.m.

Weights and Dimensions

3. The ONAN OTC-5BH generating set complete with accessories and frame weighs about 270 lbs.

Dimensions (overall): — Height $21\frac{3}{4}$"
Length $28\frac{1}{2}$"
Width $21\frac{1}{2}$"

Crankcase

4. The crankcase is made of a cast iron or cast aluminium fastened to a removable oil base. The cast iron cylinders are removable from the crankcase. Any "blow-by" gases or water vapor in the crankcase are drawn out through the crankcase ventilator breather pipe to mix with the air being drawn into the carburettor.

Crankshaft and Bearings

5. The cast steel alloy crankshaft has a drilled hole from each of the two main bearing journals to the adjoining connecting rod bearing journals to allow for the passage of oil. The front bearing for the end of the crankshaft is pressed into the crankcase, while the rear bearing is pressed into a rear bearing plate which is bolted to the crankcase. Both front and rear bearings are made of steel backed hi-lead bronze, $1\frac{7}{8}$" in diameter.

Oil Seals

6. A leather and steel oil seal is used on each end of the crankshaft to prevent the oil from flowing out through the main bearings and working into the magneto mechanism in front or the generator in the rear. The front oil seal is pressed into the gearcase cover, while the larger rear oil seal is pressed into the rear bearing plate. The earlier units had a cork type oil seal pressed and cemented into the front gearcase cover instead of a metal oil seal.

Connecting Rods

7. Connecting rods are of cast aluminium of the solid metal bearing type. The big end bearing is split and is retained in place by two cap screws. The aluminium of the connecting rod forms the bearing surface that rides on the connecting rod bearing journal of the crankshaft. The gudgeon pin is a free fit in the little end which is of unlined aluminium.

(*a*) Some of the later models have a forged steel connecting rod with a steel backed babbitt bearing insert at the big end. In these rods, the little end will have a bronze bushing for the gudgeon pin.

Piston

8. The piston is a three ring die cast aluminium type $2\frac{5}{8}$" in diameter. The gudgeon pin is a push fit in the piston and is retained by a circlip that snaps into a recess at each end of the gudgeon pin.

(*a*) Some of the later models may have three ring cast iron pistons. These cast iron pistons are interchangeable with the aluminium ones as long as both of the pistons in the engine are of the same type.

(*b*) On both types of pistons, there are three rings, two compression rings, and one oil ring. The two upper tapered rings have the word "TOP" stamped on the surface of the ring to be placed toward the head of the piston.

Cylinders

9. The cast iron cylinders are fastened to the crankcase by five studs. Each cylinder has fins cast on the outer surface to aid in cooling the cylinder walls. The standard bore is $2\frac{5}{8}$" — Stroke $2\frac{1}{4}$". The total piston displacement is 24.35 cu. in.

Cylinder Heads

10. The cast iron cylinder heads are separate for each cylinder.

Camshaft

11. The cast iron camshaft operates the valves, the fuel pump, the plunger type oil pump and the magneto ignition breaker point plunger. The forward end of the cam shaft is supported by a ball bearing, while the opposite end of the shaft rides in a steel-backed babbitt-lined bearing. A Welch expansion plug prevents the oil from escaping out the rear camshaft bearing. This rear bearing is $1\frac{1}{4}$" in diameter.

Timing Gears

12. The cast iron camshaft gear with its integral governor mechanism is driven by a helical cut steel gear on the crankshaft. The camshaft gear is pressed and keyed on the camshaft. The crankshaft gear which is keyed on the crankshaft, is held on by a large circular oil flinger nut. This nut has two holes in it for the prongs of a spanner wrench.

Valves

13. The valves are of the conventional poppet valve type, they are operated by adjustable valve lifters which are in contact with the camshaft. The correct valve clearance is 0.010" for the intake and exhaust valves.

Lubrication System

14. The lubrication system makes use of both the pressure and spray methods in lubricating all of the moving parts of the engine. The oil filler opening is located in the top of the crankcase. In it, there is a screw plug which has a bayonet or dipstick incorporated in it for measuring the oil level. A positive displacement piston type pump located in the bottom of the oil sump and operated by an eccentric on the camshaft forces oil to the crankshaft main bearings. From there, the oil is forced through the drilled crankshaft to the big end connecting rod bearings. The oil is then sprayed from the crankpins and bearings to lubricate all other internal parts of the engine.

(a) The old oil may be drained by removing a pipe plug in the lower part of the oil base.

(b) The lubricating system holds 2½ American quarts of oil.

(c) Some of the later models have a gear type oil pump which is driven from the crankshaft gear.

Fuel System

15. The petrol is drawn from the two gallon tank by a standard automotive type AC fuel pump. The petrol is then forced into either a Zenith TU3YI downdraft type carburettor or a Marvel-Schebler VD downdraft type carburettor (both types have been used). Any petrol with an octane rating of 68 to 82 can be used in this engine. Each carburettor has two adjustments, an adjustable main jet, and an adjustable idle mixture jet.

(a) The automatic choke consists of a thermostat mounted directly on the choke butterfly shaft of the carburettor. This thermostat element is heated by a nichrome heating element obtaining current from the D.C. winding of the generator.

(b) The air for the carburetor is drawn through a dry type air filter.

Ignition System

16. The ignition current is supplied from a flywheel type magneto. Two permanent magnets are fastened on the inside edge of the flywheel. Two complete ignition coils, primary and secondary in each one, are mounted on stationary laminated steel cores within the flywheel. A set of ignition breaker points in the primary circuit are operated by a non-metallic plunger from an eccentric on the camshaft. The high tension current travels to the standard size sparking plugs where it ignites the gases in the cylinder. The complete system is shielded to suppress electrical interference.

Governor

17. The governor is composed of a series of steel balls operating in ramps cut in the cast iron camshaft timing gear. The ramps are so designed that as the speed of the engine increases, the balls, which tend to move outward from the center of the shaft, also move forward and force the governor cup away from the face of the timing gear (See Fig. 7 E.M.E.R. 223). A thrust bearing located at the center of the cup presses against the governor shaft paddle, causing it to move forward; this in turn rotates the governor shaft at the top of which is located the governor arm linked to the throttle arm of the carburettor. A spring with adjustable tension is fastened to the governor arm. This spring holds the governor arm against the movement of the governor cup and steel balls. When the centrifugal force on the steel balls balances the spring tension, then the engine runs at that set speed. By changing the spring tension we change the engine speed. The speed is maintained at about 1800 r.p.m.

Cooling System

18. This air cooled type engine has cooling fins cast on the outside of the cylinder head and cylinder block. Cooling air is forced over these fins by blower fins which are cast integral with the magneto flywheel. The air stream from the blower fan is directed and controlled by a sheet metal blower housing.

GENERATOR SPECIFICATIONS

19. The generator is of the combined A.C. D.C. type with both windings wound on the same armature core. A series and shunt winding provide the field for both windings on the armature. The direct current has an output of about 10 amps. at 15 volts for charging two 6 volt batteries in series. The alternating current has an output of about 8 amps. at 230 volts of 60 cycle A.C. current for operating the wireless sets.

(a) There are four brushes on the commutator and two brushes on the slip rings or collector rings for a total of six brushes.

(b) The outer end of the armature is supported by a sealed ball bearing.

(c) The inner end of the armature shaft is tapered and fits into the end of the crankshaft. A through bolt fits through the hollow armature shaft, and holds the armature against the crankshaft. The inner end of the armature is supported by the rear main crankshaft bearing.

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FIRST ECHELON MAINTENANCE

Daily Maintenance

1. Petrol—Keep the two gallon petrol tank nearly filled with clean petrol having an octane rating of from 80 to 82 octane.

2. Oil—Check the oil level daily with the dipstick in the oil filler plug. See Figure 1. Add a good clean oil of the proper viscosity when the oil level is below the full mark. See paragraph No. 13 for the proper viscosity of oil to be used. DO NOT OVER FILL.

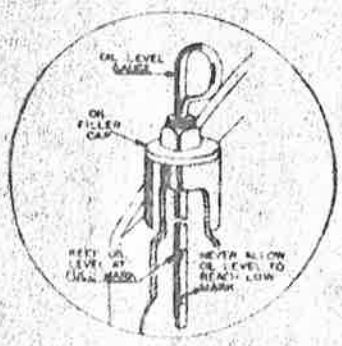

Figure 1. Oil filler opening and oil level gauge.

3. Cleaning—Keep the engine and generator parts clean, especially the fins on the cylinder head and block.

Weekly Maintenance

4. Batteries—Make certain the battery connections are clean and tight. Keep the electrolyte level about ½" over the plates by adding clean distilled water. Do not fill to overflowing.

5. Minor Lubrication—Place a drop of light lubricating oil on the following points: throttle shaft bearings of the carburetor, governor ball joints, governor paddle shaft, and the choke shaft of the carburettor.

Monthly Maintenance

6. The average monthly service covers about 200 hours of operation. If the plant is used more than that a month, then give the plant the following check up at the end of 200 hours instead of at the end of the month.

7. Sparking Plugs—Remove the cover from the sparking plugs and the sparking plugs from the cylinder heads. Clean and reset the plug point gap at 0.025". See Figure 2.

8. Fuel System—Remove the glass bowl from the fuel pump. Clean both the bowl and screen and then replace.

Figure 2. Checking the gap between the electrodes.

9. Ignition—Remove the cover from the ignition point breaker mechanism. Turn the engine over by hand until the breaker points are at their widest open position. Clean the points; set the gap at 0.020" unless otherwise specified on the breaker point cover. See Figure 3. This specified setting is very important, do not guess at the setting.

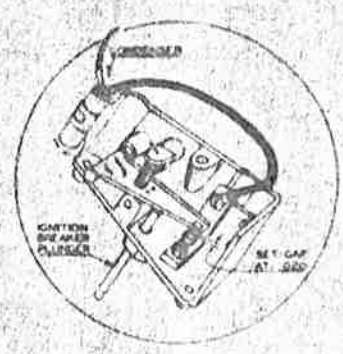

Figure 3. Ignition Breaker Mechanism with the cover removed.

10. Air Cleaner—Remove the air cleaner (See Fig. 4) and wash it out in petrol. Allow it to dry, then put a light oil on the filter element. Allow the excess oil to drain out, then replace the air cleaner.

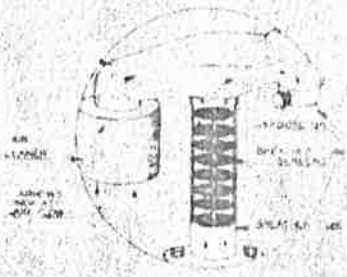

Figure 4. Air Cleaner, Crankcase Breather Tube and Breather Strainer.

11. Generator—Remove the cover band, and inspect the commutator and collector rings, clean if necessary. Wipe with a clean lintless cloth to remove any oil. Then if necessary, use a strip of fine sandpaper (never use emery cloth) to polish the commutator or collector rings. After that, check the brushes for good contact and easy riding in the brush holders. When the brushes are worn down to less than ¾" long, replace them.

12. Oil Change—Drain the oil from the crankcase while the engine is warm. Replace the plug and fill with 2½ American quarts of fresh oil. See Figure 1.

13. For all temperatures **above** 0° F. use 10 H.D. oil (previous British equivalent M120 or M120X). If the temperature is **below** 0° F. use 10 H.D. oil mixed with 10% (half pint) of good clean paraffin.

14. **Important**—If an oil and 10% paraffin mixture is being used in the engine, the mixture must be drained from the crankcase, and a new mixture put in every 50 to 60 hours of operation. If the average temperature is above 80° Fahrenheit or below 50° Fahrenheit, the oil should be changed every 100 hours of operation. If the average temperature is between 50° and 80° Fahrenheit, the oil should be changed every 200 hours of operation.

Six Monthly Maintenance

5. About every six months or every 1200 hours, perform the following operation. Remove the generator rope sheave, bearing gasket cover and gasket on the generator. Remove the old bearing grease and replace with about one tablespoon of good ball bearing grease that will not run out when it gets warm. Do not use a cup grease.

SERVICE AND ADJUSTMENT

Carburettor Adjustment

16. The Onan American OTC-5BH will be equipped with either a Zenith TU3YI or a Marvel-Schebler V.D. downdraft type carburettor. Both types have two adjustments, a Main Jet adjustment and an Idle Mixture adjustment. See Figures 5 or 6.

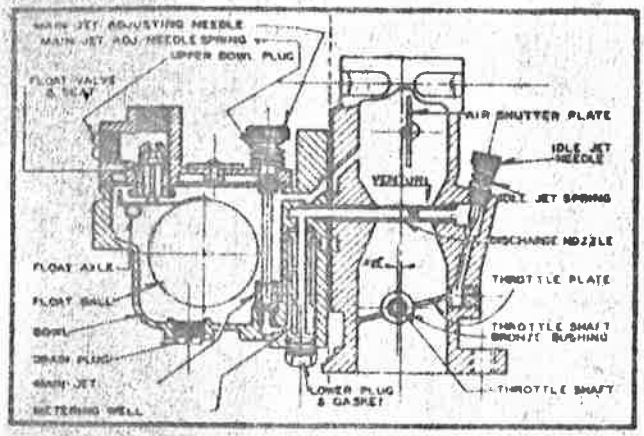

Figure 5. Cross Section of Zenith TU3YI Carburettor used on some OTC-5BH Units.

17. Both carburettors are very simple in operation and construction and require little attention other than periodic oiling of the choke and throttle shafts, and a cleaning about once a year to keep the carburettor bowl free from sediment. However, changes in the type of fuel, or in operating conditions may make readjustment necessary. The engine should be run for approximately half an hour before making any final adjustment on the carburettor. By that time, the plant will have warmed up to its normal operating temperature, and the adjustments will be correct.

18. If the engine runs unevenly under half or full load, the main jet adjustment should be changed. See Fig. 5 and 6. Make this adjustment while the plant is operating under full or nearly full load by turning the knob to the left at least one full turn to enrich the mixture. Then turn it slowly to the right until the plant begins to lose speed and power. At this point, turn it slowly to the left again until the engine regains maximum speed and power. The main jet will then be correctly adjusted. Usually from $\frac{1}{2}$ to 2 turns open on the Marvel-Schebler, and from 2 to 4 turns open on the Zenith Carburettor will be the correct setting for smooth and economical operation.

19. At times, it will be necessary to open the main jet slightly more. But never over $\frac{1}{2}$ turn, to correct a "hunting" condition which will cause the engine to alternately gain and lose speed. It is possible to drown out a "hunting" condition by using a too rich mixture, but if a fractional turn of the adjusting knob will not correct this, it will be necessary to change the setting of the Governor Fulcrum Adjusting Screw. See the Governor Adjustment paragraphs No. 27-29 for instructions.

20. If the engine runs unevenly under light load, or no load, the Idle Jet Needle (See Fig. 5 and 6) should be turned to the right until it is closed. Then turn it slowly to the left or open it to the spot at which the engine runs smoothest. Usually from $\frac{1}{2}$ to $2\frac{1}{2}$ turns open is the correct setting for smooth and economical operation for both types of carburettors.

21. Irregular operation, hard starting, or loss of power may indicate a clogged main jet. The fuel passage in the jet is very small, and if foreign material should get through the screen and filter bowl on the fuel pump, it may lodge in this jet. Be careful not to burr or distort the jet while cleaning it. Use air to blow out any obstruction, as using a piece of wire or anything similar may enlarge the size of the jet and make economical operation impossible.

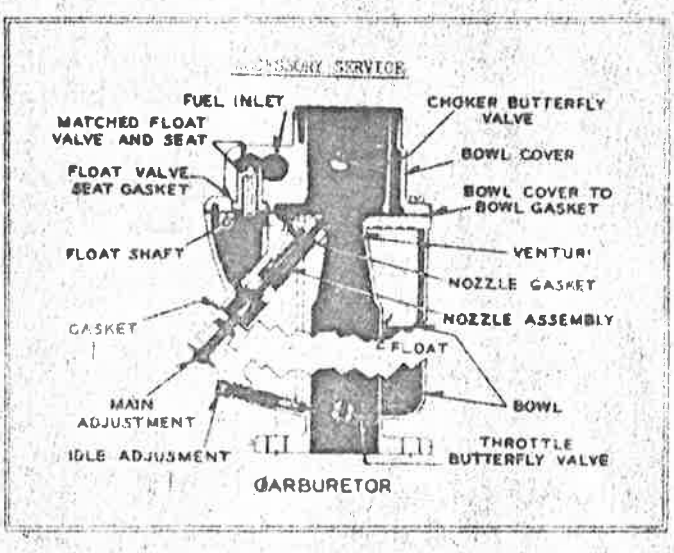

Figure 6. Cross Section of Marvel-Schebler V.D. Carburettor used on some OTC-5BH units

22. If the carburettor has been dismantled for cleaning, an approximate setting of the jets will be 2 turns open for the main jet, and $1\frac{1}{2}$ turns open for the idle jet. However, as soon as the engine has warmed up, make the correct adjustments as outlined in the preceding paragraphs.

Automatic Choke Adjustment

23. The automatic choke consists of a thermostat mounted directly on the choke butterfly shaft of the carburettor (See Fig. 6) and operated by a nichrome heating element, obtaining current from the D.C. generator winding. A valve mounted on a choke shaft, which is off-center in the body, is operated by the thermostatic coil. If the air temperature discharging from the cylinder is approximately 70°, immediately after the engine is started, the thermostat holds the choke valve so it just closes the air passage between the air cleaner and the carburettor. When the engine is cranked and the air passes from the cleaner to the carburettor, the off-center position of the choke shaft allows the valve to be pushed open slightly by the air stream working against the tension created by the thermostat on the shaft.

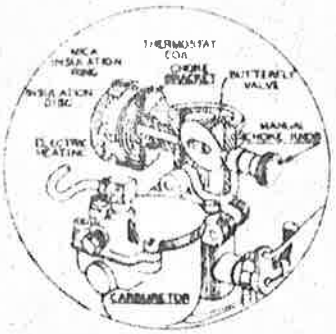

Figure 6. Zenith Carburettor with Automatic Choke attached to the choke shaft.

24. During the period while the engine is warming up to normal operating temperatures, the small choke shaft knob or wheel, located on the end of the shaft (See Fig. 6) will indicate the choke valve is oscillating rapidly. As the engine reaches normal temperature, the oscillation will cease and the choke valve is open. With the engine cold, turning the choke knob to the left, counter-clockwise, should result in the carburettor being completely choked. With the engine at operating temperature, the choke valve will turn approximately 75 degrees in clock-wise direction.

25. The pressure at which the choke valve is closed, can be determined by turning the manual choke knob in a counter-clockwise direction. When turned in a clockwise direction, the choke thermostat should return the knob in a counter-clockwise rotation, to where no further movement of it by hand is possible, indicating that the choke butterfly is in the closed position.

26. Improper operating of the choke assembly will be indicated by hard starting or irregular running during the warm-up periods. A proper adjustment of the assembly can be made by loosening the small screw clamping the thermostat housing to the carburettor choke shaft boss and rotating it in a clockwise direction (when looking at the choke knob), to decrease the air mixture, or in a counter-clockwise (when looking at the choke knob) to increase the air mixture, to a position where it will give the results indicated in the foregoing paragraphs. Re-tighten the clamp screw securely after the proper adjustment has been made.

Governor Adjustment

27. The proper operation is essential for correct engine speed and generator output. Unless the entire governor arm is removed from the governor paddle shaft, the only adjustments necessary will be a slight increase or decrease of spring tension at the knurled adjustment screw. See Figure 7. Turning this screw to the right (clockwise) increases the tension on the spring and consequently the speed of the plant. Turning it to the left, decreases the speed. After proper adjustment has been made to bring the voltage output to the proper figure (not to exceed 240 volts) the screw should be locked securely with the lock nut turned down tightly against the spring housing of the governor arm. Place a few drops of oil on the ball joints of the governor arm linkage.

28. If the governor arm has become loosened from the governor shaft which extends above the top of the gearcase cover (See Fig. 7), loosen the clamp holding the arm to the shaft. Insert a screw driver in the slot in the top of the governor shaft. Turn the shaft clockwise as far as possible. Hold it in that position. Allow the governor adjusting spring to hold the arm in a normal idle position and relock the clamp screw. Then the governor adjusting screw will be reset as indicated in the preceding paragraph.

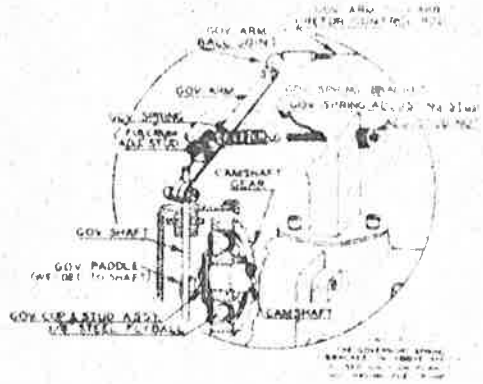

Figure 7. Governor Operating Mechanism.

29. The fulcrum adjusting screw on the governor arm, (see Fig. 7) is only set if the main adjusting screw does not provide satisfactory regulation. The fulcrum screw provides more or less sensitivity. Turn the screw clockwise to increase the sensitivity and counter-clockwise to decrease it. Be careful to avoid conditions where the governor will "hunt" i. e. continue to oscillate so that the engine is speeding up and slowing down. Increase the sensitivity slightly in that case.

END