KS-15717 DIESEL ENGINE-ALTERNATOR 10 KW MANUALLY AND AUTOMATICALLY CONTROLLED AND J86625 MAIN CONTROL CABINET

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2. GENERAL

2.1 Scope

2.11 This section covers installation and test of 10 KW KS-15717 four-cycle diesel engine-alternators made by the Kohler Company. These sets are rated as follows:

List No.	Type	Volts	Phase	Wires
4	Manual	230	1	3
5	Manual	208-240	3	4
6	Manual	230-240	3	3
7	Portable	230	1	3
8	Portable	208-220	3	4
9	Portable	230-240	3	3
11	Automatic	230	1	3

2.12 The J86625 Main Control Cabinet furnished with the List 11 Automatic Set is also covered in this section.

2.13 For information on J8622 Main Control Cabinets, which are Manufacture Discontinued, refer to BSP A301.553.

2.14 Requirements in the Job Specification supersede those in this section. However, information in this section or in associated sections will take precedence over the supplier's manuals when differences occur. An example of this is cleaning fluids, certain of which are prohibited in telephone offices.

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2.15 Paragraphs marked with an asterisk (★) apply only to automatically controlled sets. All other methods and requirements of this section apply to both manually and automatically controlled sets.

2.2 Apparatus Adjustment

2.21 Verify all apparatus before making the tests in this section. For detailed information regarding adjustment of relays, meters and apparatus refer to the information listed under Paragraph 2.3, Circuit Requirement Tables or Paragraph 6 in this section.

2.3 Associated Information

2.31 Tests in this section are based on the following circuit drawings:

Drawing	Title
SD-81100-01	Alarm Circuit - Unattended Office
SD-81223-01	Alarm Circuit - Attended Office
SD-81263-01	Single-Phase Engine-Alternator
SD-81264-01	3-Phase, 4W Engine-Alternator
SD-81327-01	3-Phase, 3W Engine-Alternator
SD-81346-01	Single-Phase Engine-Alternator & J86625C Automatic Control
SD-81347-01	Automatic Reserve Power Plant

2.32 The following handbook sections supplement the information in this section.

TITLE	HB	SECT
Antifreeze and Rust Inhibitor	19	133
Battery Information	18	19
Conduit	18	9
Floor Layout	30	-
Fuses, Fuse Mountings, Switches	19	3
Greases, Oils, Cleaning Fluids	19	1A
Information, Engine, General	19	131
Leveling	19	129
Loads, Artificial	19	24
Meters	19	20
"Phasing-Out" (3-Phase Only)	19	130
Piping, Practices and Tools	19	132
Verification	19	1
Wiring	18	6B

2.33 Job papers include the following:

Operating Instructions and Lubrication Chart.

Drawing listing accessories such as tools, spare parts, etc. shipped with each set.

Drawing H-269-352 showing vibration isolator locations.

2.34 Papers shipped with the set include a maintenance manual and parts list and BTL Operating Instructions and Lubrication Chart.

2.4 Precautions

2.41 Observe the general precautions included in Handbook 0 and in Section 131 of this handbook.

★2.42 Before making any adjustments on either the engine or control of an automatic set do the following: Operate BP Switch to BY- PASS position. Operate ENGINE CONTROL Switch to CONT DISC position. Disconnect positive lead at the starting battery. Also remove the 1-1/3 ampere alarm fuse supplying battery to the AC & ENG ALM circuit from the office equipment fuse panel.

★2.43 Avoid contact with terminals of the BP switch as outside power is always present on the switch.

★2.44 A fuse in the Main Control Cabinet protects the engine water jacket heater. This is the fuse in the line to terminal H1. REMOVE THE FUSE AND DO NOT INSTALL UNTIL WATER HAS BEEN PUT INTO THE COOLING SYSTEM. Be sure to remove the fuse before draining the radiator.

2.45 Do not start the engine with Battery Charger HI-LO Switch in HI position as this may blow the charger fuse. Operate switch to LO, start engine and return switch to HI if battery still requires a high charge.

2.46 Short demonstration runs less than 30 minutes duration or runs where engine water temperature does not reach 120° F. should be avoided as this is injurious to the engine.

2.5 Description

2.51 Engine, radiator, alternator and exciter are mounted on a common base. The manual sets, Lists 4 through 9, are enclosed in a sheet metal housing which includes the metering equipment. The housing is not suitable for outdoor installation. These sets are approximately 5'-7" long, 2'-0" wide, and 4'-3" high and weigh approximately 1910 pounds. See Figures 1 and 2.

2.52 The List 11 automatic set is furnished less the sheet steel housing and includes a wall-mounted Main Control Cabinet. Over-all dimensions for the engine-alternator are the same as given in Paragraph 2.51, but the weight is 1,700 pounds. The Main Control Cabinet weighs about 385 pounds and contains relays, meters, transfer switch, control switches and battery charger. See Figures 3 and 4.

2.53 Battery chargers are furnished with the sets. These are wall-mounted for manual sets. The charger is already installed in the Main Control Cabinet. If a KS-15661 charger is furnished it will be wall-mounted for all sets.

2.54 The sets are cranked by a 32 volt starting winding on the exciter.

2.55 A high gravity lead-acid battery is furnished with portable sets. Either KS-15777 lead-acid or KS-15578 nickel-cadmium batteries may be furnished for stationary sets.

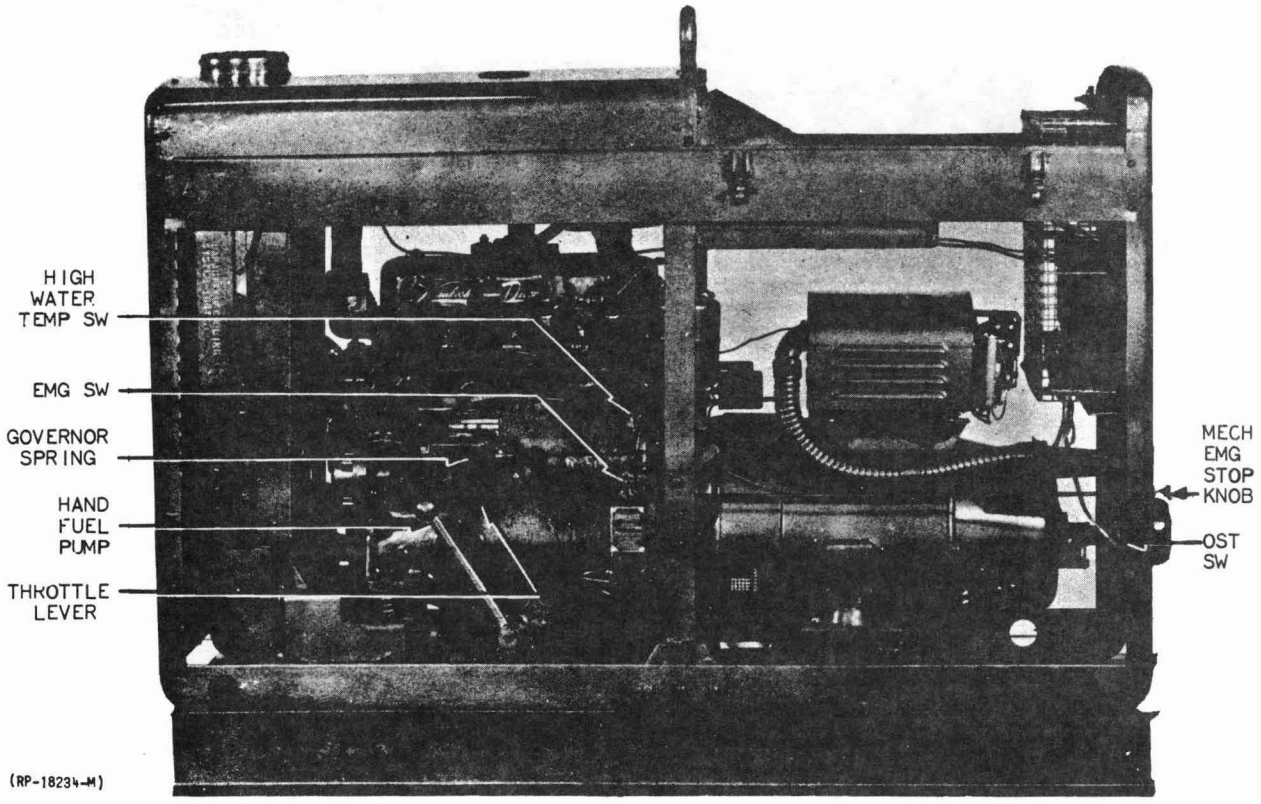

FIG. 1 KS-15717 ENGINE-ALTERNATOR-SIDE PANELS REMOVED (LISTS 4 THROUGH 9) (PAR. 2.51)

3. RECORDS

3.1 Record test, maintenance, and battery charge information on the following forms:

ID-946	Engine-Alternator Test Record
ID-1275	Lubrication Record
ID-1285	Storage Battery Report
ID-1313	Test Trouble Record
ID-1315	Summary of Tests

4. INSTALLING EQUIPMENT

4.1 Tools

Code	Description
No. 3 or 102	General Kit
No. 267	Pipe Threading Kit
R-2759	Water Rheostat, 6KW (Two for 1-Phase set, three for 3-Phase set)
or	
R-2746	Water Rheostat, 30 KW (One for 1-Phase set, only)
R-2705	Tachometer
R-3076	Manometer
R-3233	Extension, Tachometer, 12"
R-3404	Phase Sequence Indicator (3-Phase sets only)

4.2 Test Apparatus

ITE-4137	AC Continuity Test Set
ITE-4297	Auto-Transformer

4.3 Gauges

79B	Gauge, Gram, Tension, Barrel Type, 0-1000
79C	Gauge, Gram, Tension, Barrel Type, 0-200

4.4 Supplies

Code	Description
R-3164	Sodium Chromate (5 lb. tin)
R-3429	Trichloroethane
KS-2423	Cloth, Twill Jean
KS-7860	Spirits, Petroleum
Purchase Locally	Boric Acid - 1/2 lb per gallon of water (Neutralizer for nickel-cadmium battery electrolyte)
Purchase Locally	Bicarbonate of Soda - 2 lbs. per gallon of water (Neutralizer for lead acid battery electrolyte)
Purchase Locally	Casite (1 quart, as required)
	Hook up wire for water rheostats

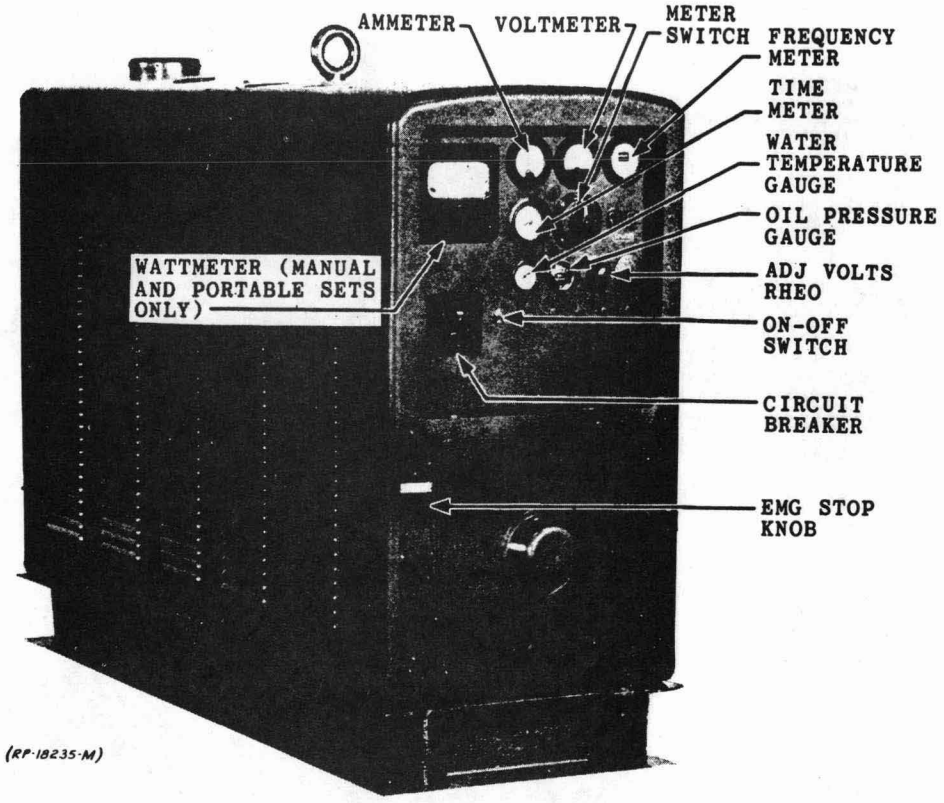

FIG. 2 KS-15717 ENGINE-ALTERNATOR (LISTS 4 THROUGH 9) (PAR. 2.51)

5. INSTALLATION

5.01 Before the set is placed in position check the slope of the mounting area and lay out isolator support points from Drawing H-269-352. If the mounting area slopes more than 1/4 inch in ten feet in any direction, the telephone company should be requested to correct the condition. Cut out any compressible floor covering such as linoleum or asphalt tile at each isolator position. Refer to Section 129 in this handbook for these operations.

5.02 Have the riggers move the set into position and install the vibration isolators under the set. No final leveling is required.

5.03 Inspect each set for damage, correct rating, accessories, tools and loose parts. Remove any blocking from relays on the set or in the Main Control Cabinet.

5.04 Protect the immersion heater on automatic sets by removing the F13 fuse from the wall-mounted Main Control Cabinet. Do not reinstall this fuse until water has been put into the engine radiator.

5.05 Fill the radiator. Capacity of the cooling system is 16 quarts. Observe water, antifreeze and rust inhibitor information in Section 133 of this handbook. Use only soft water. When filling the system of automatic sets, open the ventcock on the water heater housing to bleed the air and close the vent when water appears.

NOTE: Do not use alcohol as antifreeze.

5.06 Manual sets will have either a Kohler Co. battery charger or a KS-15661 charger furnished loose. This will be wall-mounted. On the Kohler Co. charger verify that the movable jumper is connected to the 32 volt terminal on the terminal strip in the back of the charger. For the KS-15661 charger, refer to the manual furnished with the charger for instructions and adjustments. The wall-mounted Main Control Cabinet already contains a charger.

5.07 Charge the starting battery in accordance with the section in Handbook 18 on engine starting batteries. Operate the charger as follows:

5.071 Manual Sets: Operate HI-LO switch to HI. Adjust HIGH RATE switch to tap giving desired charging rate on the charger ammeter.

★5.072 Automatic Sets: This control is arranged so that a 230 volt ac source may be connected directly to the charger. Remove plug fuses F6 and F7 in the Main Control Cabinet. Connect the source to terminals R1 and R2 in the Main Control Cabinet. Be sure ENGINE CONTROL switch is on CONT DISC position and BP switch is on BYPASS before connecting the ac source.

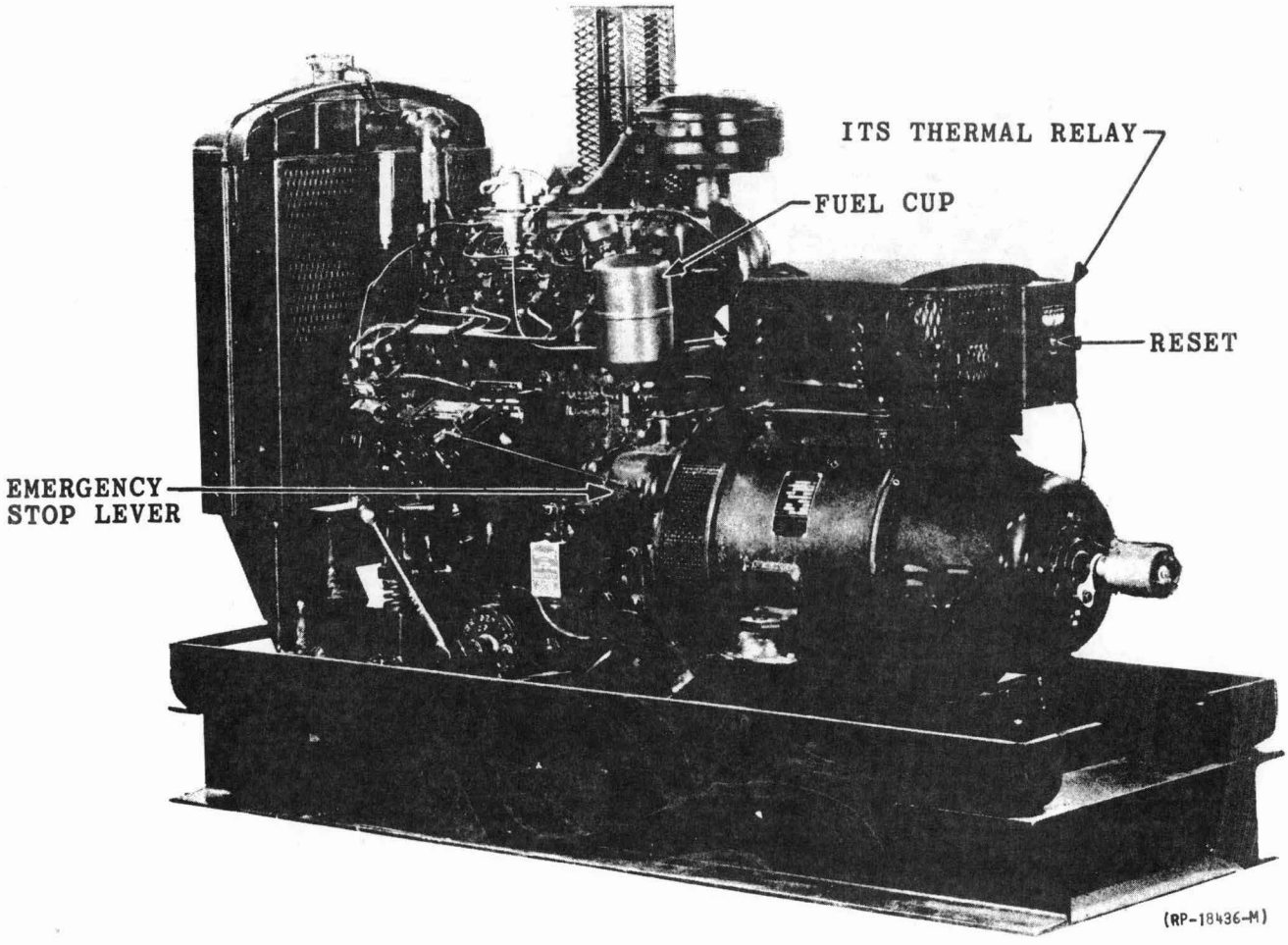

FIG. 3 KS-15717 LIST 11 ENGINE-ALTERNATOR (J86625C) (PAR. 2.52)

Install the fuse in the charger. Operate HI-LO switch to HI. Adjust rheostat for desired charging rate on charger ammeter.

5.08 After the initial charge, adjust the charger to float the battery at the following voltage:

Type of Battery	Float Voltage
Lead-Acid, High Gravity	35.5-36.1
Lead-Acid (KS-15577)	34.4-35.0
Nickel-Cadmium (KS-15578)	35.0-36.25

5.09 Open crankcase drain to remove any oil or residue. Close drain and fill crankcase with specified oil to HIGH mark on dipstick. Put oil in air cleaner. See Lubrication Chart on Operating Instructions. Observe requirements for use of Casite. Capacity of crankcase is about 6 quarts.

5.10 Verify exciter and collector ring brushes as follows:

5.101 Each brush shall be free in its holder.

5.102 Exciter brushes shall not override the end of the commutator or the groove, if provided, or ride on that part of the bar connected to the armature conductors.

5.103 Collector ring brushes shall not project over the edges of the rings.

5.11 Place Operating Instructions as directed by the customer.

5.12 Remove tools and any other loose items from the machine.

5.13 Turn the engine over with the hand crank to be sure the crankshaft and alternator armature are free to rotate.

5.14 Check that pointers on all meters indicate zero. Adjust to zero, as required, by means of the zero-adjusting screws on each meter.

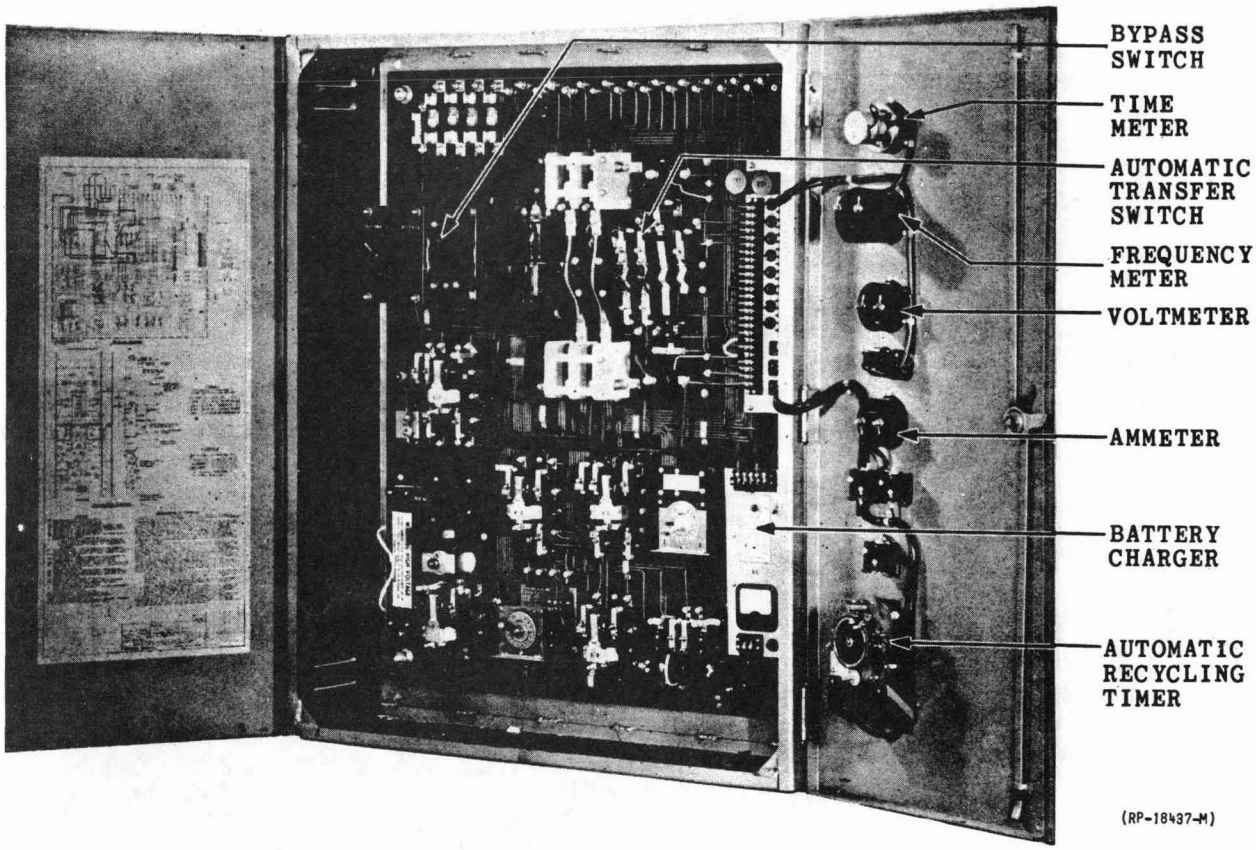

FIG. 4 KS-15717 LIST 11 MAIN CONTROL CABINET (J86625C) (PAR. 2.52)

★6. RELAYS, TRANSFER SWITCH AND TIMERS

★6.1 Freedom of Operation

6.11 The armature of V, BR, LO, RS and SE relays shall operate freely without binding. Gauge by feel by operating relays manually.

6.12 The contact operating plate of the MH relay shall operate freely. This relay is solenoid-operated and the requirement will be checked during test.

★6.2 Contact Surfaces

6.21 Contact surfaces shall be free of gummy substances, dirt and build-ups which might interfere with reliable contact.

6.22 Use R-3429 Trichloroethane for cleaning. Refer to Section 101 in this handbook for method of using the trichloroethane and method of removing buildups with abrasive paper. It is not necessary or desirable to burnish contacts to make them appear shiny.

★6.3 Contact Alignment

6.31 Relay contacts shall be so aligned that, when closed, the outer edge of one contact does not extend over the outer edge of the other by more than 1/32 inch.

★6.4 Contact Sequence

6.41 All NO contacts on a relay shall make at approximately the same time and all NC contacts shall break at approximately the same time.

★6.5 Relay Contact Separations

6.51 The minimum separations between movable and stationary contacts shall be as follows:

Relay	Min. Separation Inches
BR	1/8
LO	3/32
RS	1/8
SE	1/8
V	1/16

6.52 Check NC contact separation after manually operating the relay.

6.53 Readjust position of stationary contacts if contact separation is below minimum requirement. Refer to Section 101 in this handbook for readjustment information on similar type relays.

★6.6 Relay Contact Pressures

6.61 Pressure between relay contacts shall be 40 grams or more. Use 79C Gram Gauge to check pressure. Pressures are measured with contacts closed and NO contacts are closed by operating the relay manually.

6.62 Adjust stationary contacts if pressures are below the minimum. Refer to Section 101 in this handbook and adjust stationary contacts as explained in that section for similar type relays until contact pressures are above minimum.

6.63 Recheck contact separation after adjusting contacts for pressure requirement.

6.7 Transfer Switch (TS)

6.71 Operate the switch manually from one position to the other. If friction or binding is observed at the joints in the linkage, remove dirt with a cleaning cloth moistened with a few drops of KS-7860 petroleum spirits and apply a few drops of KS-6232 light mineral oil at each joint. Remove dirt from the surface of the plunger with the cleaning cloth. Do not use any oil on the plunger. Do not oil the bearings that support the main contact arm shaft as these are Oilite bearings which require no lubrication.

6.72 Contact alignment shall be such that when contacts are completely closed the edges of the movable contact shall not extend over the edge of the stationary contact more than the following:

Contact	Inches
Main	1/8
Auxiliary	1/32

6.721 Shape auxiliary contact springs that are out of alignment with R-2120 Pliers. Correct alignment of main contacts by loosening the movable contact arm at the shaft, adjusting as necessary and tightening.

6.73 The switch has two pair of control contacts as well as additional auxiliary contacts the same size. The control contacts are the pair of contacts on each throw position next to the main contacts. The stationary control contacts shall be adjusted to break when the plunger is 1-7/32 inches down from its top position. Raise plunger to top position, set a scale on top of the coil frame and observe distance to bottom of leather washer. Lower the plunger slowly until control contacts just make. Read scale distance between top of coil frame and leather washer. Readjust stationary control contacts to meet the requirement. Operate plunger manually to other throw position and check the make point of this pair of control contacts. Readjust if necessary.

6.74 Contact pressure between main contacts shall be 680 grams or more. Use 79B Gauge. Operate switch manually from one position to the other and check in each position.

6.75 Contact pressure between auxiliary contacts and control contacts shall be 40 grams or more. Use 79C Gauge. Operate switch manually from one position to the other and check in each position.

★6.8 Timers

6.81 To set TD and RST timers proceed as follows. Disengage the arm associated with the knurled knob from the teeth of the plate behind the dial. Move the arm until the black pointer coincides with the time listed below and release the knurled knob.

6.811 Set TD timer to 15 minutes. This gives 13 minutes hold-over time and 2 minutes cool-off time. The engine-alternator carries the load 13 minutes after outside power returns, load is transferred and the engine runs 2 minutes at no load before shutting down.

6.82 EFT and EST timers have a screw adjustment through the cover. EFT operates in about 2 minutes to indicate failure of engine to start. EST provides about 10 seconds delay for engine warmup before load transfers to the engine-alternator. If readjustment of time is necessary, insert blade of a KS-6854 screwdriver through the hole in the cover and turn adjusting screw clockwise to reduce time delay or counterclockwise to increase time delay.

6.83 When the ET timer is furnished set it as follows. To set for a given day take screws out of the upper left hand corner of the frame and place a screw in the DAY star-wheel for each day to be passed over. Rotate the star wheel clockwise until the DAY arrow points to the current day. Set the ON tripper on the large dial to the desired starting time and the OFF tripper to the desired time for restoring load to outside power. Set to time of day by turning the small dial in a counterclockwise direction until the red arrow on the large dial points to the hour mark and the small dial points to the minute mark.

★6.9 Electrical Requirements

6.91 Check relay electrical requirements according to Circuit Requirement Tables.

6.92 V relay is similar to KS-15519 List 1 relay covered in Section 114 in this handbook. Refer to Section 114 for information on selecting inductor taps and for adjusting R potentiometer in order to meet Circuit Requirement Table pickup and dropout voltage requirements.

7. INITIAL START

★7.01 On automatic sets be sure no outside power is connected to the cabinet (terminals 1L1, 1L2, 1L3) at this time. Remove outside power fuses from the ac service cabinet or remove fuses F11 and F12 in the Main Control Cabinet. Do not connect outside power before the Acceptance Test, Paragraph 9.

★7.02 Position Main Control Cabinet controls and switches as follows:

Control	Position
ENGINE CONTROL Switch	CONT DISC
ENGINE TEST Switch	ON
BP Switch	AUTOMATIC
TS Transfer Switch	Normal Line (Note)

NOTE: Operate TS switch manually to this position.

★7.03 Install all fuses in Main Control Cabinet except plug fuses F6 and F7 and cartridge fuses F11 and F12. These will be installed later when the set is placed on an automatic start basis or for the Acceptance Test.

7.04 Depress Overspeed Trip reset button on the Overspeed Trip.

7.05 Open fuel valve in suction line to engine and open fuel cup valve at bottom of fuel cup. If a fuel supply solenoid is furnished, it will open when the engine begins cranking.

7.06 When starting for the first time, or, if fuel system is empty, open the valve in the line to the hand pump and operate hand pump to fill the fuel cup. Remove the plug in the top of the fuel cup and pump until fuel runs out of the hole. Stop pumping and replace the plug. Close the valve in the line to the hand pump.

NOTE: This valve must remain closed while engine is running.

7.07 Depress 1TS Thermal Switch reset button on engine control.

7.08 Reset MECHANICAL STOP by pushing the knob in against the panel.

7.09 Reset EMERG SW located on the left side of the engine by pushing its arm toward the radiator.

★7.10 Depress RESET button on the J86625 Main Control Cabinet.

7.11 Operate REMOTE EMERGENCY STOP switch, if provided, to NORMAL position.

7.12 Start engine.

7.121 Manual Sets: Operate ON/OFF switch on engine panel to ON.

NOTE: On sets with a housing there is an ON/OFF switch located in the engine cabinet above the alternator. This should always be kept in the OFF position.

★7.122 Automatic Sets: Operate ENGINE CONTROL switch inside the Main Control Cabinet to AUTO START position.

★7.13 Ten seconds after speed and voltage of an automatic set are satisfactory, EST timer times out and operates TS transfer switch to engine-alternator position.

7.14 Where possible check engine-alternator speed using the R-2705 Tachometer with R-3233 Tachometer Shaft Extension. (See Note 1 and 2) Speed is checked at front end of engine crankshaft. Speed should be approximately, but not greater than, 1890 rpm.

NOTE 1: To gain access to the engine crankshaft on sets with a housing, remove the cover plate on the housing below the radiator.

NOTE 2: If radiator ducts make the use of a tachometer at the front end of the set impractical, speed may be calculated from the formula: RPM = 30 x Frequency. The frequency is indicated by vibrating reeds on the Frequency Meter. The reed vibrating the most indicates the frequency; if two reeds vibrate an equal amount, the actual frequency is halfway between the two reeds.

7.141 If it is necessary to adjust speed, proceed as follows. Loosen the locknut (lower nut) on the screw that holds the end of the governor spring. Turn the upper nut clockwise to raise speed (increase spring tension), or, counter-clockwise (decrease spring tension) to lower speed. After speed adjustment has been made, turn the lower locknut tight against the bracket to lock the setting.

7.15 Turn voltage regulator rheostat (ADJUST VOLTS) on engine control until alternator voltage is same value as outside power line voltage.

7.16 Lube oil pressure gauge should read 20 pounds or higher.

7.17 A fuel pressure gauge may be furnished on top of the secondary fuel filter. The gauge does not have to be read and there is no pressure requirement. However, it will indicate a no-fuel condition in case of trouble.

7.18 Run the engine for about 30 minutes at no-load. Observe any oil, fuel, water or exhaust leaks.

7.19 During this 30 minute period "phase-out" three-phase engine-alternator voltage with a three-phase outside power source. Use the R-3404 Phase Sequence Indicator and proceed in accordance with Section 199B in Handbook 21 or Section 130 in this handbook.

7.20 Stop the set. Operate ON/OFF switch to OFF or ENGINE CONTROL switch to CONT DISC position.

7.21 Correct any leaks.

8. PRELIMINARY TEST

TIME: A one hour test consisting of thirty minutes run at each of the following loads: 5 and 10 KW.

LOAD: Water rheostats connected to engine-alternator side of a transfer switch (provided by the telephone company) for manual sets, to load side of circuit breaker for portable sets, and to the load connections (terminals 2L1, 2L2, 2L3) in the Main Control Cabinet for automatic sets.

8.01 The telephone company may wish to have a representative witness the Preliminary Test as well as the Acceptance Test. Notify the telephone company as soon as the starting date for the Preliminary Test has been determined.

8.02 Remove the 1/4 inch plug from the engine exhaust manifold and connect the R-3076 Manometer. Use the 1/4 to 1/8 inch brass adapter. For method of filling and adjusting the manometer see Section 131.

★8.03 Position controls and switches as follows:

Control	Position
ENGINE CONTROL Switch	CONT DISC
ENGINE TEST Switch	ON
BP Switch	BYPASS
TS Transfer Switch	Normal Line (Note)

NOTE: Operate manually to this position.

8.04 Connect water rheostat load. Separators should be in minimum load position.

★8.05 In the Main Control Cabinet jumper terminals 4 and 5 on the BP switch.

8.06 Start engine. Operate ON/OFF switch to ON or ENGINE CONTROL switch to AUTO START.

8.07 Run the engine for about 15 minutes at no-load to warm it up. At the end of this time record speed, frequency, volts, lube oil pressure, water temperature and time meter reading. Operate VOLTMETER switch on Main Control Cabinet to EMERGENCY position to read engine-alternator voltage.

Use tachometer, engine gauges, engine or Main Control Cabinet meters.

8.08 Connect the test load to the engine-alternator as follows: close circuit breaker on a manual set; operate BP switch to AUTOMATIC position on Main Control Cabinet of an automatic set.

8.09 Apply 5 KW and then 10 KW load with the water rheostat. Each load should be carried for 30 minutes. Record the following at each load at the end of the 30 minute period: speed, frequency, volts, amperes, KW (when meter is furnished), lube oil pressure, water temperature and time meter reading.

NOTE 1: When a wattmeter is not furnished calculate and record KW. The formula is:

$$KW = \frac{\text{LINE-TO-LINE VOLTS} \times \text{LINE AMPERES}}{1000}$$

(This formula is correct on water rheostat loads or other unity power factor loads such as resistance grids).

NOTE 2: If a wattmeter is not furnished the line currents for a single-phase set operating at 230 volts at various loads are as follows:

Load	Amperes	KW
1/4	10.9	2.5
1/2	21.7	5.0
3/4	32.6	7.5
Full	43.5	10.0

NOTE 3: The maximum KW load that the engine-alternator will carry decreases as the altitude above sea level increases. The engine-alternator must be able to carry at least the KW indicated below:

Feet Above Sea Level	KW Load
Up to 3000	10.0
3500	9.75
4000	9.5
4500	9.25
5000	9.0
5500	8.75
6000	8.5
6500	8.25
7000	8.0

8.10 With the set running at full-load determine exhaust back pressure with the R-3076 Manometer in accordance with Section 131 in this handbook. Record back pressure on the test sheet.

8.11 Throughout the run check meters for any signs of internal damage or lack of freedom of movement.

8.12 This test must meet the requirements in Paragraph 10.

8.13 At the end of this test the set may be shut down, or, it may be desirable to continue with the Full Load Acceptance Test, Paragraph 9.

9. FULL LOAD ACCEPTANCE TEST

TIME: Minimum length of this test is 1-1/2 hours.

LOAD: Office load, with the customer's permission, supplemented with water rheostat load, as necessary. Connect the water rheostats to the load side of the breaker on manual sets and across load connections 2L1, 2L2, and 2L3 in the Main Control Cabinet of automatic sets.

CONDITIONS: If the Acceptance Test is a continuation of the Preliminary Test with water rheostat load only, start with Paragraph 9.4. If both office and water rheostat loads are used start with Paragraph 9.1 or 9.2.

★9.1 For an automatic set do the following:

★9.11 Disconnect outside power connections for charger to terminals R1 and R2 in the cabinet. Install plug fuses F6 and F7 in the Main Control Cabinet.

★9.12 Operate controls and switches to the following positions:

Control	Position
BP Switch	BYPASS
ENGINE TEST Switch	OFF
ENGINE CONTROL Switch	AUTO START
TRANS TEST Switch	NORMAL

★9.13 Remove jumper from terminals 4 and 5 of BP Switch in Main Control Cabinet.

★9.14 Connect office load and water rheostat load to terminals 2L1, 2L2, and 2L3. Water rheostats should be at minimum load position.

★9.15 Connect outside power (normal line) to the plant by installing the proper fuses.

★9.16 Operate BP switch to AUTOMATIC position. The outside power source will cause transfer switch (TS) to operate to normal line position and the outside power will carry the load.

9.2 Start the set. Operate ON/OFF switch to ON or ENGINE CONTROL switch to ON.

9.3 With engine running and water rheostat load reduced to minimum, transfer various office loads to the engine-alternator.

9.31 Manual Sets: Close the circuit breaker on the engine-alternator and transfer various office loads to the set by operating load transfer switches to emergency or engine-alternator position.

★9.32 Automatic Sets: Operate TRANS TEST switch to TEST. About 13-15 seconds later the automatic transfer switch is energized and transfers office load to the engine-alternator.

NOTE: If the engine-alternator shuts down for any reason, transfer of office load back to outside power will not be automatic. It will be necessary to operate TRANS TEST switch to NORMAL to cause this transfer.

9.4 Adjust water rheostats to obtain full load.

NOTE: For single-phase sets without wattmeters operating at 230 volts, the line current should not exceed 43.5 amperes on water rheostat load only, or, 54.5 amperes for combined water rheostat and office load. The 54.5 amperes is the .8 power factor load condition.

9.5 Record speed, frequency, volts, amperes, KW (if meter is furnished), lube oil pressure, water temperature, and time meter reading. Calculate and record KW if water rheostat load only is used, or, KVA if load is combined office and water rheostat loads.

Use tachometer, engine panel meters and gauges, or control cabinet meters.

9.6 After 30 minutes adjust water rheostat load as required for full load and record data as in Paragraph 9.5. Continue to run at full load for the balance of 1-1/2 hours. Adjust load and record data every 30 minutes.

9.7 At the end of the 1-1/2 hour run, reduce water rheostat load to minimum. Transfer the various loads back to outside power, open the circuit breaker where provided and shut the set down.

9.71 Manual Sets: Operate transfer switches for the loads used to outside power position, open the circuit breaker and stop the set.

★9.72 Automatic Sets: Operate TRANSFER TEST switch to NORMAL. The load transfers to outside power after TD timer operates. After the load transfers to outside power operate BP switch to BYPASS and shut the set down by operating ENGINE CONTROL switch to CONT DISC or ENGINE TEST switch to OFF.

10. TEST REQUIREMENTS

10.1 The requirements listed below are the Preliminary Test and the Acceptance Test.

10.2 Speed should stay within the range 1800-1890 rpm.

10.3 Voltage should stay within ± 5% of the original no-load setting for all loads, hot or cold. (Multiply no-load cold voltage in Paragraph 7.15 by .05 calculate allowed variation above and below original setting).

10.4 Lube oil pressure should not drop below 20 pounds per square inch.

10.5 Water temperature should not exceed 190° F.

10.6 Exhaust back pressure at full load should not exceed 13.6 inches of water (1 inch of mercury).

10.7 Meters should evidence no sign of lack of freedom of movement or other defects.

11. ENGINE TROUBLE CONTROL AND ALARMS

FOREWORD: These tests can be done at any time before the set is put on full automatic operation. The switches have been tested and adjusted at the factory. Adjustments may be made if so noted. Otherwise, if switch is damaged or defective, a replacement should be obtained.

11.1 Preliminary Operations

11.11 Disconnect artificial load.

★11.12 On automatic sets operate controls and switches to the following positions:

Control	Position
ENGINE CONTROL Switch	CONT DISC
ENGINE TEST Switch	ON
BP Switch	BYPASS

★11.13 On automatic sets jumper terminals 4 and 5 on the BP switch in the Main Control Cabinet.

★11.14 Replace the 1-1/3 ampere fuse for AC & ENG ALM circuit that was removed earlier.

★11.15 Operate ACO key on AC & ENG ALM to silence alarm for power failure.

11.2 Overspeed Trip Switch

11.21 TEST: Start the engine with ON/OFF switch or ENGINE CONT switch. Overspeed the engine by pushing down the throttle lever located just below the governor spring. While the engine is being overspeeded by one person, a second person should use a tachometer with extension at the front end of the engine and observe the speed at which the switch operates to shut down the engine. After a period of about 2 minutes EF (Engine Failure) lamps of AC & ENG ALM and office alarm light, major alarm sounds, and ground is applied over lead ATTA to distant point.

11.22 REQUIREMENT: The switch should operate within the range 2030-2140 rpm.

11.23 RESET: Depress Reset button on Overspeed Trip Switch. The set will start. Alarms will be cancelled on an automatic set.

11.24 ADJUSTMENT: To adjust operating point, first remove the cover plate below the engine control panel on enclosed sets. Loosen the set screw in the slot in the cover of the switch. Rotate the cover clockwise to lower operating point, or, counterclockwise to raise operating point. Tighten set screw and recheck operating point.

11.3 High Water Temperature Switch (HWTS)

11.31 This switch closes and shuts down the engine after a delay of 1/2 - 2 minutes if cooling water temperature reaches about 205° F. No adjustment of this switch should be attempted. The switch should not be tested for operation on the engine. However, it may be removed from the engine and tested for closure at this temperature in a bucket of water. Heat the water and check operating point with an R-1032 thermometer.

11.32 With the engine running simulate closure of the switch by shorting its terminals. Hold the short until shutdown occurs which should be in 1/2 - 2 minutes.

11.33 About 2 minutes after shutdown, EF lamps of AC & ENG ALM and office alarm light, major alarm sounds, and ground is applied over lead ATA to distant point.

11.34 Operate ON/OFF switch to OFF or ENGINE CONTROL switch to CONT DISC.

11.35 Depress 1TS RESET button on engine. Depress RESET button on Main Control Cabinet to cancel alarms.

11.4 Lubricating Oil Pressure Switch (LOPS)

11.41 This switch is in parallel with the High Water Temperature Switch. If lube oil pressure falls to about 6-1/2 pounds the switch closes. Do not adjust this switch.

11.42 Open one of the leads to this switch and connect a Continuity Tester across the switch. The switch should be closed with engine stopped. Start the engine. When lube oil pressure reaches about 6-1/2 pounds the switch should open. Stop the set. Disconnect the tester and reconnect the lead on the switch.

11.43 Alarm indications are same as Paragraph 11.33.

11.44 Depress 1TS RESET button on engine. Depress RESET button on Main Control Cabinet to cancel alarms.

11.5 Overtime Cranking

11.51 This condition need not be checked if operation in Paragraph 11.32 is satisfactory.

11.6 Low Fuel (If Provided)

11.61 Clip a grounded lead to LG terminal in Main Control Cabinet. Lamp LG on low fuel alarm lights, minor alarm sounds, and ground is applied over lead ATD to distant point.

11.62 Operate ACO key on Low Fuel Alarm to silence audible alarms.

11.63 Remove ground from LG terminal. LG lamp goes out and ground is removed from ATD lead.

12. EMERGENCY STOPS

12.1 If a remote emergency stop switch if provided, verify that operation of the switch shuts down the set. An automatic set shuts down immediately. A manual set shuts down and goes through a cranking cycle before stopping in 30-120 seconds. Operate ON/OFF switch to OFF, remote EMERGENCY ENGINE STOP switch to NORMAL, and reset 1TS.

12.2 With the set running at no lead, pull out the EMERGENCY - PULL TO STOP knob on sets with a housing. On sets without a housing push the lever just behind the EMERG SW toward the radiator as far as it will go. The engine stops immediately. Operate ON/OFF or ENGINE CONTROL switch to CONT DISC. Reset EMERG SW.

★13. AUTOMATIC OPERATION TESTS

FOREWORD: During tests in Paragraphs 13.3, 13.4 and 13.5 the engine-alternator will be required to take over the office load. Previous tests assure it is ready to do so. However, if any of the equipment is in service it will

be necessary to ask the telephone company representative for permission to make the tests. If the engine-alternator should fail while carrying the load, and outside power is available, transfer of load to outside power will be automatic.

★13.1 Preliminary Operations

13.11 Operate controls and switches to positions indicated below:

Control	Position
ENGINE TEST Switch	OFF
BYPASS Switch	BYPASS
ENGINE CONTROL Switch	CONT DISC
TRANSFER TEST Switch	NORMAL

13.12 Remove jumper from terminals 4 and 5 of BP switch, if not already removed.

13.13 Connect outside power to terminals 1L1, 1L2 and 1L3 by installing fuses as necessary.

13.14 Operate BP switch to AUTOMATIC position.

13.15 Operate ENGINE CONTROL switch to AUTO START.

★13.2 ENGINE TEST Switch

13.21 Operate ENGINE TEST switch to ON. Engine starts without delay and operates at no load. Allow engine to run a few minutes to warm up. Operate ENGINE TEST switch to OFF. Engine stops immediately.

★13.3 TRANSFER TEST Switch

13.31 Operate TRANSFER TEST switch to TRANS TEST position.

13.32 The engine starts after about 3-5 seconds. The PF (Power Failure) lamps of AC & ENG ALM and office alarms light, minor alarm sounds, and ground is applied over lead ATB to distant point as soon as the engine starts. If engine failed to start, PF alarm would come in 4-6 minutes after the switch was operated.

13.33 Operate ACO key of AC & ENG ALM to silence audible alarm.

13.34 The transfer switch operates about 10 seconds after the engine starts and comes up to speed and transfers the office load to the engine-alternator. As soon as the transfer occurs, PO (Proper Operation) lamps of AC & ENG ALM and office alarm light, minor alarm sounds, and ground is applied over lead ATC to distant point.

13.35 Operate ACO key to silence audible alarm.

13.36 Operate TRANSFER TEST switch to NORMAL. PF lamps are extinguished and ground is removed from ATB lead. The engine-alternator continues to carry the load for about 10 minutes and the transfer switch is operated to transfer load back to outside power. PO lamps are extinguished and ground is removed from ATC lead. The engine runs for about 2 minutes after the transfer and then shuts down.

★13.4 Remote Start Test

13.41 Clip a grounded lead to terminal RS in the Main Control Cabinet.

13.42 The engine starts after about 3-5 seconds. The sequence of events is the same as covered in Paragraphs 13.32 and 13.34.

13.43 After about 30 minutes PF lamps are extinguished. The engine-alternator continues to carry the load for an additional 10 minutes after which time the automatic transfer switch operates to transfer the load to outside power. The engine continues to run for about 2 minutes and then shuts down. The sequence of events at the time of transfer to shutdown are the same as in Paragraphs 13.34 and 13.36.

★13.5 Power Failure Test

13.51 If the telephone company representative will allow it, open the outside power service switch. The sequence of events is the same as in Paragraphs 13.32 and 13.34.

13.52 Operate ACO key of AC & ENG ALM to silence minor alarm.

13.53 Allow the engine-alternator to carry the load for a few minutes. Close the outside power service switch. The sequence of events will be the same as in Paragraph 13.36.

14. ACCESSORY TESTS

14.1 Water Jacket Heater

14.11 This test may be made at any time in the installation after water has been put in the radiator and with controls set for automatic operation as in Paragraph 13.

14.12 For J86625 Cabinets install F11 (to terminal 1L1) and F13 (to terminal H1) fuses.

14.13 The water jacket heater should bring the water temperature up to approximately 65° F and hold it there. Adjust switch as described in Paragraph 12.3. Use water temperature thermometer on engine.

15. ADJUSTMENTS

15.1 Water Heater Switch

15.11 Turn the adjusting knob so that the pointer indicates a higher or lower setting as required. If the water temperature is already too high allow the engine to cool and again turn on the heater. If the temperature is too low continue with the test until the temperature stabilizes.

15.2 Voltage Regulator

15.21 This set is equipped with a REGOHM voltage regulator. The voltage is set with ADJUST VOLTS rheostat.

The only adjustment on this regulator is a screw adjustment on the dashpot which can be used to control "hunting" or "sluggish voltage." This adjustment is made available by removing the cover of the plug-in unit.

15.3 Lubricating Oil Pressure

15.31 Lubricating oil pressure is regulated by a spring and valve. The valve is located on the exhaust side of the engine just above the front engine support. Actually, no adjustment is provided. However, a slight stretching of the spring in addition to cleaning the valve and seat may make some change in the pressure. This spring and valve may be reached by removing the hex head screw. (With the engine shut down).

16. MAINTENANCE DURING INSTALLATION

16.1 Lubrication

16.11 Check oil level daily during the installation period. When oil level has fallen more than 1/2 the distance between the top line (HIGH) and the bottom line (ADD OIL) on the dipstick, fill crankcase to top line (HIGH) with specified oil.

17. GENERAL TROUBLES AND POSSIBLE CAUSES

17.01 Low Lubricating Oil Pressure

Low oil level
Oil incorrect viscosity
Faulty gauge
Obstruction in oil lines
Oil strainer clogged
Pressure regulator valve dirty or not functioning properly

17.02 No Fuel or Insufficient Fuel

Low fuel supply
Obstruction in fuel lines
Restricted fuel filters
Air in fuel lines
Loose fuel lines or cracked connections
Suction line valve not open
Valve open in line to hand pump
Fuel cup leaks
Faulty pump
Faulty fuel shut off solenoid (optional) ←

17.03 Difficult Starting

Low Battery, loose connections
Insufficient fuel (See 17.02)
Restricted air intake
High lube oil viscosity

17.04 Smoky Exhaust

High exhaust back pressure
Restricted air intake
Incorrect fuel
Incorrect timing
Engine temperature too low

17.05 Lack of Power

Speed too low
Engine temperature too low
Incorrect injector timing, governor adjustment, etc.
KW load too high
Excessive exhaust back pressure
In addition, see Paragraph 17.02

17.06 High Water Temperature

Clogged radiator or restricted duct openings
Low water level
Loose fan belt
Room temperature too high
Thermostat stuck closed
Air in cooling system
Excessive KW load

17.07 Low Water Temperature

Thermostat inoperative or stuck open

17.08 Irregular Speed

Air in fuel lines
Dirty injector nozzles

17.09 No Voltage or Low Voltage

Loose or open connections
Engine speed too low
Reversed polarity exciter field

17.10 Erratic Voltage

Loose or poor connections
REGOHM dashpot not properly adjusted
Poor commutation due to rough commutator, insufficient brush pressure, incorrect brush position, dirty commutator, etc. ←

→ Arrowed lines indicate new or changed information

[Vertical line at side of paragraphs indicate requirements.

R. W. HILLEGAS

Superintendent, Installation Engineering

Reason for Reissue:
(1) To include fuel shutdown solenoid option.
(2) To substitute R-3429 Trichloroethane for KS-8372 Trichloroethylene.
(3) To add ID-946 Engine Alternator Test Record in Paragraph 3.

Replaces Section 231 dated 9-21-61.