Technical Information

DIAGNOSTIC REPAIR MANUAL
for
GENERAC STANDBY GENERATORS

Manual Part Number 63185
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TABLE OF CONTENTS

PART 1 - GENERATOPR SPECIFICATIONS AND FEATURES

PART 2 - STANDBY GENERATOR FAMILIARIZATION

PART 3 - METER AND CONTROL PANEL COMPONENTS

PART 4 - OPERATIONAL TESTS AND ADJUSTMENTS

PART 5 - TROUBLESHOOTING AND DIAGNOSTIC TESTS- AC POWER SECTION (DIRECT EXCITED BRUSH TYPE UNITS)

PART 6 - TROUBLESHOOTING AND DIAGNOSTIC TESTS- AC POWER SECTION BRUSHLESS GENERATOR UNITS (EXCEPT GENERATOR TYPES SD-100 THROUGH SD-200 AND SD-101 THROUGH SD-201)

PART 7 - TROUBLESHOOTING AND DIAGNOSTIC TESTING- AC POWER SECTION BRUSHLESS GENERATORS WITHOUT A STATOR EXCITATION WINDING

SAFETY RULES

1. Standby generators and related equipment should be installed, operated, serviced, tested and repaired only by qualified personnel.
2. Installation, operation, servicing and repair of this and related equipment must be accomplished in strict compliance with applicable standards, codes, laws and regulations. The manufacturer's recommendations must also be fully complied with in equipment installation, use and service.
3. The National Electric Code (NEC), Occupational Safety and Health Administration (OSHA) regulations, local industrial codes, and local inspection requirements must be complied with in equipment use and service.
4. Do not use any standby generator set until its frame and external electrically conductive parts have been properly connected to an approved electrical ground.
5. Standby generators are a source of dangerously high voltages. Comply with all safety rules to prevent extremely dangerous- possibly LETHAL- electrical shock.
6. Positively disconnect- or turn off- all sources of power voltage before attempting to test, service or repair any standby generator set or related equipment. Failure to comply with this RULE may result in extremely dangerous- possibly LETHAL- electrical shock.
7. Keep the standby generator set clean and in good condition. Promptly repair or replace all worn, damaged or defective components.
8. Wire gauge sizes of electrical wiring and cord sets must be large enough to handle the maximum electrical current to which they will be subjected.
9. Never handle any kind of electrical equipment while standing in water, while barefoot, or while hands or feet are wet. Dangerous- possibly LETHAL- electrical shock may result.
10. Never work on any standby generator set- or related equipment- while mentally or physically fatigued.
11. The engine that drives the generator set consumes oxygen and gives off DEADLY carbon monoxide gas through its exhaust system. This deadly gas, if breathed in sufficient concentrations, can cause unconsciousness or even death. Exhaust gases must be piped safely away from the generator set to a well ventilated area, where they will not accumulate and endanger people.
12. Any automatic start generator set that is installed in conjunction with an automatic controller or transfer switch with integral controller may crank and start suddenly without warning. Transfer of electrical loads to generator set output may also then occur. To prevent possible injury that might be caused by such sudden startup, always disable the automatic startup and transfer system before working on or around any generator set. This can be done by removing the 30 ampere fuse from the generator's meter and control panel. If the generator is installed in conjunction with a "GTS" type transfer switch, setting the transfer switch Safety Disconnect Switch to MANUAL will also prevent automatic startup and transfer.
13. If a generator set must be serviced while standing on metal or concrete, place insulative mats over a dry wood platform. Work on the generator only while standing on such insulative mats.
14. Practice SAFETY- by thinking before acting- and by reading the instructions in this Manual carefully.

PART 1

GENERATOR SPECIFICATIONS AND FEATURES

1.1- SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS
1.2- SPECIFICATIONS AND FEATURES- MODEL 1100 SERIES GENERATORS
1.3- MANUAL "R" LEVEL CHART
1.4- NOMINAL RESISTANCES OF ROTOR AND STATOR WINDINGS
1.5- CAPSCREW TORQUE VALUES
1.6- ELECTRICAL FORMULAE FOR AC GENERATORS
1.7- WIRE NUMBER STANDARDS
1.8- ELECTRICAL SCHEMATICS AND WIRING DIAGRAMS
1.9- INTERCONNECTION DIAGRAM- THE EARLY MODELS 6301/6919 CONTROLLER
1.10-INTERCONNECTION DIAGRAM- THE MODEL 8519 AUTOMATIC CONTROLLER

NOTE

Section 1.1, SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS, includes the wiring diagram/schematic drawing number for each specific model. These diagrams and/or schematics may be found in Section 1.8, arranged in numerical order. Section 1.2, SPECIFICATIONS AND FEATURES- MODEL 1100 SERIES GENERATORS, includes a Manual "R" Level number. Use that number in conjunction with Section 1.3, MANUAL "R" LEVEL CHART, to locate the Owner's Manual or the wiring diagram/schematic applicable to a particular generator model.

1.1- SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS

* G= Gasoline NG= Natural Gas LPG= LP Gas

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL*	WIRING DIAGRAM SCHEMATIC
7501-0	8.00	125/216	3	60	1800	993 cc	G	44244-44237
7501-1	8.00	125/216	3	60	1800	993 cc	G	46751-46752
7501-2	8.00	125/216	3	60	1800	1078cc	G	46751-46752
7501-3	8.00	125/216	3	60	1800	1078cc	G	48986-48988
7502-1	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7502-2	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7502-3	8.00	120/240	1	60	1800	1078cc	NG	44735-44725
7502-4	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7502-5	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7503-1	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7503-2	8.00	120/240	1	60	1800	1078cc	NG	46602-46603
7503-3	8.00	120/240	1	60	1800	1078cc	NG	44735-44725
7503-4	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7503-5	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7504-1	8.00	120/240	1	60	1800	993 cc	LPG	46602-46603
7504-2	8.00	120/240	1	60	1800	1078cc	LPG	46602-46603
7504-3	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7504-4	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7504-5	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7505-1	16.00	120/240	1	60	3600	993 cc	NG	46602-46616
7505-2	16.00	120/240	1	60	3600	1078cc	NG	46602-46616
7505-3	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7505-4	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7505-5	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7506-1	16.00	120/240	1	60	3600	993 cc	LPG	46602-46616
7506-2	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7506-3	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7506-4	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7506-5	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7507-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7507-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7507-3	8.00	120/240	1	60	1800	1078cc	G	44735-44725
7507-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7507-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7508-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7508-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7509-1	16.00	120/240	1	60	3600	993 cc	G	46602-46603
7509-2	16.00	120/240	1	60	3600	1078cc	G	46602-46603
7509-3	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7509-4	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7509-5	17.50	120/240	1	60	3600	1078cc	G	44725-44735
7510-1	16.00	120/240	1	60	3600	993 cc	G	46602-46603
7510-2	16.00	120/240	1	60	3600	1078cc	G	46602-46603
7510-3	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7510-4	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7510-5	17.50	120/240	1	60	3600	1078cc	G	44725-44735
7511-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603

1.1- SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS

* G= Gasoline NG= Natural Gas LPG= LP Gas

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL*	WIRING DIAGRAM SCHEMATIC
7501-0	8.00	125/216	3	60	1800	993 cc	G	44244-44237
7501-1	8.00	125/216	3	60	1800	993 cc	G	46751-46752
7501-2	8.00	125/216	3	60	1800	1078cc	G	46751-46752
7501-3	8.00	125/216	3	60	1800	1078cc	G	48986-48988
7502-1	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7502-2	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7502-3	8.00	120/240	1	60	1800	1078cc	NG	44735-44725
7502-4	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7502-5	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7503-1	8.00	120/240	1	60	1800	993 cc	NG	46602-46603
7503-2	8.00	120/240	1	60	1800	1078cc	NG	46602-46603
7503-3	8.00	120/240	1	60	1800	1078cc	NG	44735-44725
7503-4	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7503-5	8.00	120/240	1	60	1800	1078cc	NG	44725-44735
7504-1	8.00	120/240	1	60	1800	993 cc	LPG	46602-46603
7504-2	8.00	120/240	1	60	1800	1078cc	LPG	46602-46603
7504-3	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7504-4	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7504-5	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7505-1	16.00	120/240	1	60	3600	993 cc	NG	46602-46616
7505-2	16.00	120/240	1	60	3600	1078cc	NG	46602-46616
7505-3	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7505-4	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7505-5	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7506-1	16.00	120/240	1	60	3600	993 cc	LPG	46602-46616
7506-2	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7506-3	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7506-4	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7506-5	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7507-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7507-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7507-3	8.00	120/240	1	60	1800	1078cc	G	44735-44725
7507-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7507-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7508-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7508-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7508-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7509-1	16.00	120/240	1	60	3600	993 cc	G	46602-46603
7509-2	16.00	120/240	1	60	3600	1078cc	G	46602-46603
7509-3	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7509-4	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7509-5	17.50	120/240	1	60	3600	1078cc	G	44725-44735
7510-1	16.00	120/240	1	60	3600	993 cc	G	46602-46603
7510-2	16.00	120/240	1	60	3600	1078cc	G	46602-46603
7510-3	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7510-4	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7510-5	17.50	120/240	1	60	3600	1078cc	G	44725-44735
7511-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603

1.1- SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS
(Cont'd)

MODEL	WATTS	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL	WIRING DIAGRAM SCHEMATIC
7511-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7511-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7511-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7511-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7512-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7512-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7512-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7512-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7512-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7513-1	8.00	120/240	1	60	1800	993 cc	LPG	46602-46603
7513-2	8.00	120/240	1	60	1800	1078cc	LPG	46602-46603
7513-3	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7513-4	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7513-5	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7514-1	8.00	120/240	1	60	1800	993 cc	G	44060-45413
7514-2	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7514-3	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7514-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7514-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7515-1	16.00	120/240	1	60	3600	993 cc	G	46602-46603
7515-2	16.00	120/240	1	60	3600	1078cc	G	46602-46616
7515-3	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7515-4	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7515-5	17.50	120/240	1	60	3600	1078cc	G	44725-44735
7516-1	16.00	120/240	1	60	3600	993 cc	NG	46602-46603
7516-2	16.00	120/240	1	60	3600	1078cc	NG	46602-46603
7516-3	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7516-4	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7516-5	17.50	120/240	1	60	3600	1078cc	NG	44725-44735
7517-1	16.00	120/240	1	60	3600	993 cc	LPG	46602-46603
7517-2	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7517-3	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7517-4	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7517-5	17.50	120/240	1	60	3600	1078cc	LPG	44725-44735
7521-1	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7521-2	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7521-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7521-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7521-5	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7522-0	16.00	120/240	1	60	3600	993 cc	NG	44060-45410
7522-1	16.00	120/240	1	60	3600	993 cc	NG	46602-46616
7522-2	16.00	120/240	1	60	3600	1078cc	NG	46602-46616
7522-3	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7522-4	16.00	120/240	1	60	3600	1078cc	NG	44725-44735
7522-5	17.50	120/240	1	60	3600	1078cc	NG	44725-44735
7523-0	16.00	120/240	1	60	3600	993 cc	LPG	44060-45410
7523-1	16.00	120/240	1	60	3600	993 cc	LPG	46602-46616
7523-2	16.00	120/240	1	60	3600	1078cc	LPG	46602-46616
7523-3	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735
7523-4	16.00	120/240	1	60	3600	1078cc	LPG	44725-44735

1.1- SPECIFICATIONS AND FEATURES-MODEL 7500 SERIES GENERATORS (Cont'd)

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL	WIRING DIAGRAM SCHEMATIC
7523-5	17.50	120/240	1	60	3600	1078cc	LPG	44725-44735
7530-0	15.00	220/380	3	50	3000	993 cc	G	47588-47572
7530-1	15.00	220/380	3	50	3000	1078cc	G	47588-47572
7530-2	15.00	220/380	3	50	3000	1078cc	G	49640-49641
7530-3	15.00	220/380	3	50	3000	1078cc	G	49640-49641
7532-0	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7532-1	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7532-2	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7532-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7532-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7533-0	8.00	120/240	1	60	1800	993 cc	G	46602-46603
7533-1	8.00	120/240	1	60	1800	1078cc	G	46602-46603
7533-2	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7533-3	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7533-4	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7534-0	15.00	115/230	1	50	3000	993 cc	G	47855-47856
7534-1	15.00	115/230	1	50	3000	1078cc	G	47855-47856
7534-2	15.00	115/230	1	50	3000	1078cc	G	44729-44730
7534-3	15.00	115/230	1	50	3000	1078cc	G	44729-44730
7534-4	15.00	115/230	1	50	3000	1078cc	G	44729-44730
7536-0	35.00	120/240	1	60	3600	2.5 L.	G	44112-46318
7536-1	35.00	120/240	1	60	3600	2.5 L.	G	44112-46318
7536-2	35.00	120/240	1	60	3600	2.5 L.	G	50665-50666
7537-0	16.00	120/240	1	60	3600	1078cc	G	46602-46616
7537-1	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7537-2	16.00	120/240	1	60	3600	1078cc	G	44725-44735
7538-0	15.00	220/380	3	50	3000	1078cc	G	47588-47572
7538-1	15.00	220/380	3	50	3000	1078cc	G	49640-49641
7538-2	15.00	220/380	3	50	3000	1078cc	G	49640-49641
7539-0	12.50	220/380	3	50	3000	1078cc	NG	47588-47572
7539-1	15.00	220/380	3	50	3000	1078cc	NG	49640-49641
7539-2	15.00	220/380	3	50	3000	1078cc	NG	49640-49641
7540-0	12.50	220/380	3	50	3000	1078cc	NG	47588-47572
7540-1	15.00	220/380	3	50	3000	1078cc	NG	49640-49641
7540-2	15.00	220/380	3	50	3000	1078cc	NG	49640-49641
7541-0	12.50	220/380	3	50	3000	1078cc	LPG	47588-47572
7541-1	15.00	220/380	3	50	3000	1078cc	LPG	49640-49641
7541-2	15.00	220/380	3	50	3000	1078cc	LPG	49640-49641
7542-0	12.50	220/380	3	50	3000	1078cc	LPG	47588-47572
7542-1	15.00	220/380	3	50	3000	1078cc	LPG	49640-49641
7542-2	15.00	220/380	3	50	3000	1078cc	LPG	49640-49641
7543-0	15.00	115/230	1	50	3000	1078cc	G	47855-47856
7543-1	15.00	115/230	1	50	3000	1078cc	G	44729-44730
7543-2	15.00	115/230	1	50	3000	1078cc	G	44729-44730
7544-0	12.50	115/230	1	50	3000	1078cc	NG	47855-47856
7544-1	15.00	115/230	1	50	3000	1078cc	NG	44729-44730
7544-2	15.00	115/230	1	50	3000	1078cc	NG	44729-44730
7545-0	12.50	115/230	1	50	3000	1078cc	NG	47855-47856
7545-1	15.00	115/230	1	50	3000	1078cc	NG	44729-44730
7545-2	15.00	115/230	1	50	3000	1078cc	NG	44729-44730
7546-0	12.50	115/230	1	50	3000	1078cc	LPG	47855-47856

1.1- FEATURES AND SPECIFICATIONS-MODEL 7500 SERIES GENERATORS (Cont'd)

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL	WIRING DIAGRAM SCHEMATIC
7546-1	15.00	115/230	1	50	3000	1078cc	LPG	44729-44730
7546-2	15.00	115/230	1	50	3000	1078cc	LPG	44729-44730
7547-0	12.50	115/230	1	50	3000	1078cc	LPG	47855-47856
7547-1	15.00	115/230	1	50	3000	1078cc	LPG	44729-44730
7547-2	15.00	115/230	1	50	3000	1078cc	LPG	44729-44730
7548-0	15.00	120/240	1	60	1800	2.5 L.	G	44112-46318
7548-1	15.00	120/240	1	60	1800	2.5 L.	G	44112-46318
7548-2	15.00	120/240	1	60	1800	2.5 L.	G	50665-50666
7549-0	20.00	120/240	1	60	1800	2.5 L.	G	44412-46318
7549-1	20.00	120/240	1	60	1800	2.5 L.	G	44112-46318
7549-2	20.00	120/240	1	60	1800	2.5 L.	G	50665-50666
7550-0	15.00	120/240	1	60	1800	2.5 L.	NG	44112-46318
7550-1	15.00	120/240	1	60	1800	2.5 L.	NG	44112-46318
7550-2	15.00	120/240	1	60	1800	2.5 L.	NG	50665-50666
7551-0	20.00	120/240	1	60	1800	2.5 L.	NG	44112-46318
7551-1	20.00	120/240	1	60	1800	2.5 L.	NG	44112-46318
7551-2	20.00	120/240	1	60	1800	2.5 L.	NG	50665-50666
7552-0	35.00	120/240	1	60	3600	2.5 L.	NG	44112-46318
7552-1	35.00	120/240	1	60	3600	2.5 L.	NG	44112-46318
7552-2	35.00	120/240	1	60	3600	2.5 L.	NG	44112-46318
7553-0	15.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7553-1	15.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7553-2	15.00	120/240	1	60	1800	2.5 L.	LPG	50665-50666
7554-0	20.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7554-1	20.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7554-2	20.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7555-0	35.00	120/240	1	60	3600	2.5 L.	LPG	44112-46318
7555-1	35.00	120/240	1	60	3600	2.5 L.	LPG	44112-46318
7555-2	35.00	120/240	1	60	3600	2.5 L.	LPG	50665-50666
7556-0	18.00	120/208	3	60	1800	2.5 L.	G	49108-49109
7556-1	18.00	120/208	3	60	1800	2.5 L.	G	49108-49109
7556-2	18.00	120/208	3	60	1800	2.5 L.	G	51101-51102
7557-0	18.00	120/208	3	60	1800	2.5 L.	NG	49108-49109
7557-1	18.00	120/208	3	60	1800	2.5 L.	NG	49108-49109
7557-2	18.00	120/208	3	60	1800	2.5 L.	NG	51101-51102
7558-0	18.00	120/208	3	60	1800	2.5 L.	LPG	49108-49109
7558-1	18.00	120/208	3	60	1800	2.5 L.	LPG	49108-49109
7558-2	18.00	120/208	3	60	1800	2.5 L.	LPG	51101-51102
7559-0	18.00	277/480	3	60	1800	2.5 L.	G	49108-49109
7559-1	18.00	277/480	3	60	1800	2.5 L.	G	49108-49109
7559-2	18.00	277/480	3	60	1800	2.5 L.	G	51101-51102
7560-0	18.00	277/480	3	60	1800	2.5 L.	NG	49108-49109
7560-1	18.00	277/480	3	60	1800	2.5 L.	NG	49108-49109
7560-2	18.00	277/480	3	60	1800	2.5 L.	NG	51101-51102
7561-0	18.00	277/480	3	60	1800	2.5 L.	LPG	49108-49109
7561-1	18.00	277/480	3	60	1800	2.5 L.	LPG	49108-49109
7561-2	18.00	277/480	3	60	1800	2.5 L.	LPG	51101-51102
7562-0	18.00	120/208	3	60	1800	2.5 L.	G	49108-49109
7562-1	18.00	120/208	3	60	1800	2.5 L.	G	49108-49109
7562-2	18.00	120/208	3	60	1800	2.5 L.	G	51101-51102
7563-0	35.00	120/208	3	60	3600	2.5 L.	NG	49108-49109

1.1- FEATURES AND SPECIFICATIONS-MODEL 7500 SERIES GENERATORS (Cont'd)

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL	WIRING DIAGRAM SCHEMATIC
7563-1	35.00	120/208	3	60	3600	2.5 L.	NG	49108-49109
7563-2	35.00	120/208	3	60	3600	2.5 L.	NG	51101-51102
7564-0	18.00	120/208	3	60	1800	2.5 L.	NG	49108-49109
7564-1	18.00	120/208	3	60	1800	2.5 L.	NG	49108-49109
7564-2	18.00	120/208	3	60	1800	2.5 L.	NG	51101-51102
7565-0	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7565-1	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7565-2	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7566-0	35.00	120/208	3	60	3600	2.5 L.	G	49108-49109
7566-1	35.00	120/208	3	60	3600	2.5 L.	G	49108-49109
7566-2	35.00	120/208	3	60	3600	2.5 L.	G	51101-51102
7567-0	16.00	120/208	3	60	3600	1078cc	LPG	49945-49946
7567-1	16.00	120/208	3	60	3600	1078cc	LPG	49945-49946
7567-2	16.00	120/208	3	60	3600	1078cc	LPG	49945-49946
7568-0	8.00	120/240	1	60	1800	1078cc	LPG	44735-44725
7568-1	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7568-2	8.00	120/240	1	60	1800	1078cc	LPG	44725-44735
7569-0	35.00	120/240	1	60	3600	2.5 L.	G	44112-46318
7569-1	35.00	120/240	1	60	3600	2.5 L.	G	44112-46318
7569-2	35.00	120/240	1	60	3600	2.5 L.	G	50665-50666
7570-0	35.00	120/208	3	60	3600	2.5 L.	LPG	49108-49109
7570-1	35.00	120/208	3	60	3600	2.5 L.	LPG	49108-49109
7570-2	35.00	120/208	3	60	3600	2.5 L.	LPG	51101-51102
7571-0	35.00	120/240	1	60	3600	2.5 L.	NG	44112-46318
7571-1	35.00	120/240	1	60	3600	2.5 L.	NG	44112-46318
7571-2	35.00	120/240	1	60	3600	2.5 L.	NG	50665-50666
7572-0	35.00	120/208	3	60	3600	2.5 L.	G	49108-49109
7572-1	35.00	120/208	3	60	3600	2.5 L.	G	49108-49109
7572-2	35.00	120/208	3	60	3600	2.5 L.	G	51101-51102
7582-0	35.00	120/240	1	60	3600	2.5 L.	LPG	44112-46318
7582-1	35.00	120/240	1	60	3600	2.5 L.	LPG	44112-46318
7582-2	35.00	120/240	1	60	3600	2.5 L.	LPG	50665-50666
7584-0	18.00	120/208	3	60	1800	2.5 L.	LPG	49108-49109
7584-1	18.00	120/208	3	60	1800	2.5 L.	LPG	51101-51102
7585-0	18.00	120/208	3	60	1800	2.5 L.	G	51101-51102
7586-0	15.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7586-1	15.00	120/240	1	60	1800	2.5 L.	LPG	44112-46318
7586-2	15.00	120/240	1	60	1800	2.5 L.	LPG	50665-50666
7587-0	35.00	120/240	3	60	3600	2.5 L.	LPG	49108-49109
7587-1	35.00	120/240	3	60	3600	2.5 L.	LPG	51101-51102
7587-2	35.00	120/240	3	60	3600	2.5 L.	LPG	51664-51665
7588-0	35.00	120/240	3	60	3600	2.5 L.	NG	51664-51665
7589-0	35.00	120/208	3	60	3600	2.5 L.	G	49108-49109
7590-0	35.00	120/240	1	60	3600	2.5 L.	G	44112-46318
7590-1	35.00	120/240	1	60	3600	2.5 L.	G	50665-50666
7591-0	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7591-1	8.00	120/240	1	60	1800	1078cc	G	44725-44735
7592-0	18.00	120/208	3	60	1800	2.5 L.	LPG	49109-49108
7592-1	18.00	120/208	3	60	1800	2.5 L.	LPG	51101-51102
7597-0	35.00	120/208	3	60	3600	2.5 L.	NG	51101-51102
7598-0	35.00	120/240	3	60	3600	2.5 L.	NG	51101-51102

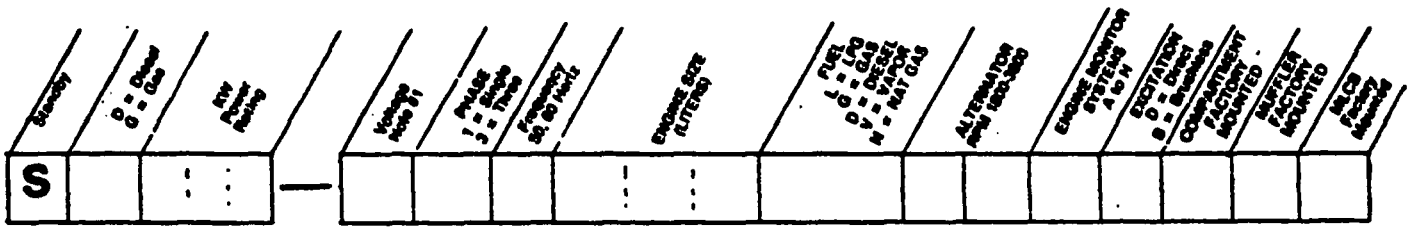
1.1- SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES GENERATORS (Cont'd)

MODEL	KW	VOLTAGE	PHASE	HERTZ	RPM	ENGINE	FUEL	WIRING DIAGRAM/ SCHEMATIC
7599-0	20.00	120/240	1	60	1800	2.5 L.	G	50665-50666
7602-0	8.00	125/216	3	60	1800	1078cc	G	46777-46778
7603-0	8.00	125/216	3	60	1800	1078cc	G	60691-60693
7604-0	8.00	120/240	1	60	1800	1078cc	NG	60691-60693
7605-0	8.00	120/240	1	60	1800	1078cc	LPG	60691-60693

1.2- SPECIFICATIONS AND FEATURES- MODEL 1100 SERIES GENERATORS

All GENERAC standby generators are assigned a **MODEL NUMBER** and a **TYPE NUMBER**. The **MODEL NUMBER** may be found on the **DATA PLATE**, which is affixed to the generator a-c connection (lower) panel.

The **TYPE NUMBER** identifies certain specifications and features of the standby generator, as shown in the following illustration. Thus, when the unit **MODEL NUMBER** is known, those specifications and features may be identified by referring to this CHART.



NOTE 1 - VOLTAGE

A	=120/240 (1 Phase)	G	=120/208 Broad Range	M	=220 Volt (1 Phase)
B	=120/208 (3 Phase) "Y" Connected	H	=240/416 Broad Range	N	=220/380 Volt (3 Phase) "Y" Connected
C	=240/416 (3 Phase) "Y" Connected	J	=120/240 Broad Range	O	=240/416 Volt (3 Phase) "Y" Connected
D	=120/240 (3 Phase) Center Tapped Delta	K	=277/480 Broad Range	P	=120/240 Volt (3 Phase) Center Tapped Delta
F	=139/240 (3 Phase) "Y" Connected	L	=139/240 Broad Range		

The CHART also lists a **MANUAL "R" LEVEL** number. Use that number in conjunction with 1.3, MANUAL "R" LEVEL CHART, to identify the specific **INSTRUCTIONS AND PARTS MANUAL** for that generator set and the various **WIRING DIAGRAMS** and **ELECTRICAL SCHEMATICS** that apply to the specific generator. Those wiring diagrams and schematics may be found starting on Page 45 of Part 1 and are arranged in numerical order by drawing number.

MODEL NUMBER	TYPE NUMBER	MANUAL "R" LEVEL
1100-0	SG036-B362.5L36CDNN	14R56444
1100-1	SG036-B362.5L36CDNN	14R56444
1101-0	SG020-A162.5L18CDNN	14R56444
1101-1	SG020-A162.5L18CDNN	14R56444
1102-0	SG036-A162.5L36CDNN	14R56444
1102-1	SG036-A162.5L36CDNN	14R56444
1102-2	SG036-A162.5L36CDNN	14R56444
1103-0	SG036-D362.5L36CDNN	14R56444
1103-1	SG036-D362.5L36CDNN	14R56444
1103-2	SG036-D362.5L36CDNN	14R56444
1104-0	SG036-B362.5N36BDNN	14R56444
1104-1	SG036-B362.5N36BDNN	14R56444
1105-0	SG070-D367.4L18CBNN	14R56435
1105-1	SG070-D367.4L18CBNN	14R58063
1106-0	SG020-B362.5L18CDNN	14R56444
1106-1	SG020-B362.5L18CDNN	14R56444
1107-0	SG070-A167.4L18CBNN	14R56435
1107-1	SG070-A167.4L18CBNN	14R58063
1107-2	SG070-A167.4L18CBNN	14R58063
1107-3	SG070-A167.4L18CBNN	14R60636
1108-0	SG070-B367.4N18CBNN	14R56435
1108-1	SG070-B367.4N18CBNN	14R58063
1108-2	SG070-B367.4N18CBNN	14R58063
1109-0	SG036-A162.5L36BDNN	14R56444
1109-1	SG036-A162.5L36BDNN	14R56444
1110-0	SG020-B362.5L18ADNN	14R56444
1110-1	SG020-B362.5L18ADNN	14R56444
1111-0	SD045-A166.4D18CBNN	14R56749
1112-0	SD020-A162.2D18CDNN	14R57746
1112-1	SD020-A162.2D18CDNN	14R57746
1113-0	SG020-B362.5L18CDNN	14R56444
1113-1	SG020-B362.5L18CDNN	14R56444
1113-2	SG020-B362.5L18CDNN	14R56444
1114-0	SG036-D362.5N36CDNN	14R56444
1114-1	SG036-D362.5N36CDNN	14R56444
1114-2	SG036-D362.5N36CDNN	14R56444
1115-0	SG050-A165.7L18CBNN	14R56435
1115-1	SG050-A165.7L18CBNN	14R58063
1115-2	SG050-A165.7L18CBNN	14R58063
1115-3	SG050-A165.7L18CBNN	14R58063
1115-4	SG050-A165.7L18CBNN	14R58063
1116-0	SG070-C367.4L18CBNN	14R56435
1116-1	SG070-C367.4L18CBNN	14R58063
1117-0	SG080-A165.7L18CBNN	14R58786
1117-1	SG080-A165.7L18CBNN	14R58786
1118-0	SG036-A162.5N36CDNN	14R56444
1118-1	SG036-A162.5N36CDNN	14R56444
1118-2	SG036-A162.5N36CDNN	14R56444
1119-0	SG036-D362.5N36BDNN	14R56444
1119-1	SG036-D362.5N36BDNN	14R56444
1120-0	SD080-B366.4D18CBNN	14R56749
1120-1	SD080-B366.4D18CBNN	14R56749
1120-2	SD080-B366.4D18CBNN	14R57965
1120-3	SD080-B366.4D18CBNN	14R57965
1120-4	SD080-B366.4D18CBNN	14R57965
1120-5	SD080-B366.4D18CBNN	14R57965
1121-0	SG036-E362.5L36CDNN	14R56444
1121-1	SG036-E362.5L36CDNN	14R56444
1122-0	SG020-D362.5N18CDNN	14R56444
1122-1	SG020-D362.5N18CDNN	14R56444
1123-0	SG070-D367.4L18ABNN	14R56435
1123-1	SG070-D367.4L18ABNN	14R58063
1124-0	SG020-A162.5N18CDNN	14R56444
1124-1	SG020-A162.5N18CDNN	14R56444
1124-2	SG020-A162.5N18CDNN	14R56444
1125-0	SG020-B362.5N18CDNN	14R56444
1125-1	SG020-B362.5N18CDNN	14R56444
1126-0	SD020-A162.2D18ADNN	14R57746
1127-0	SD020-B362.2D18CDNN	14R57746
1128-0	SG020-E362.5N18CDNN	14R56444
1129-0	SD015-D362.2D18ADNN	14R57746
1129-1	SD015-D362.2D18ADNN	14R58939
1130-0	SD096-D366.4D18CBNN	14R57995
1130-1	SD096-D366.4D18CBNN	14R57995
1131-0	SD045-B366.4D18CBNN	14R57965
1131-1	SD045-B366.4D18CBNN	14R57965
1132-0	SG070-E367.4L18ABNN	14R58063
1133-0	SD040-A156.4D15ABNN	14R58725
1133-1	SD040-A156.4D15ABNN	14R58725
1134-0	SD050-B366.4D18CBNN	14R57965
1134-1	SD050-B366.4D18CBNN	14R57965
1134-2	SD050-B366.4D18CBNN	14R57965
1135-0	SG070-A167.4N18CBNN	14R58063
1136-0	SG070-D367.4N18CBNN	14R58063
1137-0	SD045-B366.4D18BBNN	14R57965
1138-0	SD060-B366.4D18CBNN	14R57965
1139-0	SD010-A161.3D18BDNN	14R58337
1139-1	SD010-A161.3D18BDNN	14R58337
1140-0	SG035-A165.7N18CDNN	14R58564
1140-1	SG036-A165.7N18CBNN	14R58063
1141-0	SG035-B365.7N18CBNN	14R58564
1141-1	SG035-B365.7N18CBNN	14R58564
1141-2	SG036-B365.7N18CBNN	14R58564
1141-3	SG036-B365.7N18CBNN	14R58063
1142-0	SG035-A165.7L18BDNN	14R58564
1143-0	SG020-D362.5L18ADNN	14R56444
1144-0	SD060-E366.4D18ABNN	14R57965
1145-0	SG050-A165.7N18ABNN	14R58063
1146-0	SD060-A166.4D18CBNN	14R57965
1147-0	SG035-A165.7L18BDNN	14R58564
1148-0	SG080-A165.7L18ABNN	14R58786
1149-0	SG085-E365.7N18ABNN	14R58786
1150-0	SG100-D367.4N18CBNN	14R58786
1151-0	SG020-A162.5N18ADNN	14R56444
1152-0	SG085-B365.7L18CBNN	14R58786
1153-0	SG085-B365.7N18CBNN	14R58786

1153-1	SG085-B365.7N18CBNN	14R58786
1154-0	SG100-B367.4N18CBNN	14R58786
1154-1	SG100-B367.4N18CBNN	14R58786
1155-0	SG020-A162.5N18BDNN	14R56444
1155-1	SG020-A162.5N18BDNN	14R56444
1156-0	SG050-B365.7N18CBNN	14R58063
1156-1	SG050-B365.7N18CBNN	14R58063
1157-0	SG100-B367.4L18CBNN	14R58786
1158-0	SD010-B361.3D18CDNN	14R58337
1159-0	SG010-A161.3G18ADNN	14R59404
1159-1	SG010-A161.3G18ADNN	14R61645
1160-0	SG010-A161.3L18ADNN	14R59404
1161-0	SG010-A161.3L18BDNN	14R59404
1161-1	SG010-A161.3L18BDNN	14R61645
1162-0	SG010-B361.3N18BDNN	14R59404
1162-1	SG010-B361.3N18BDNN	14R61645
1163-0	SG010-B361.3N18CDNN	14R59404
1164-0	SG010-E361.3N18BDNN	14R59404
1165-0	SG020-A161.3N36BDNN	14R59404
1165-1	SG020-A161.3N36BDNN	14R59404
1166-0	SG020-B361.3L36BDNN	14R59404
1166-1	SG020-B361.3L36BDNN	14R59404
1167-0	SG036-A165.7L18CBNN	14R58564
1167-1	SG036-A165.7L18CBNN	14R58063
1168-0	SG036-B365.7L18CBNN	14R58564
1169-0	SG036-B365.7N18BBNN	14R58564
1170-0	SG050-B365.7L18CBNN	14R58063
1170-1	SG050-B365.7L18CBNN	14R58063
1171-0	SG070-B367.4L18CBNN	14R58063
1171-1	SG070-B367.4L18CBNN	14R60636
1172-0	SD020-A163.0D18ADNN	14R58206
1172-1	SD020-A163.0D18ADNN	14R58206
1173-0	SD020-B363.0D18CDNN	14R58206
1174-0	SD020-C363.0D18ADNN	14R58206
1175-0	SD020-D363.0D18ADYY	14R58206
1176-0	SD025-A163.0D18CDNN	14R59353
1177-0	SD025-E363.0D18CDNN	14R59353
1178-0	SD030-B363.0D18CBNN	14R59353
1178-1	SD030-B363.0D18CBNN	14R59353
1179-0	SD035-A163.0D18ADNN	14R59353
1180-0	SD035-E363.0D18BDYY	14R59353
1181-0	SD020-E363.0D18ADNN	14R58206
1182-0	SD035-B363.0D18CDNN	14R59353
1183-0	SD035-E363.0D18ABNN	14R59353
1184-0	SG036-A165.7L18CBYY	14R58564
1184-1	SG036-A165.7L18CBYY	14R58063
1185-0	SG036-D365.7G18CBNN	14R58564
1185-1	SG036-D365.7G18CBNN	14R58564
1186-0	SG050-E365.7L18CBNN	14R58063
1186-1	SG050-E365.7L18CBNN	14R58063
1187-0	SG070-A167.4N18CBYY	14R58063
1187-1	SG070-A167.4N18CBYY	14R58063
1188-0	SG070-B367.4N18CBYY	14R58063
1188-1	SG070-B367.4N18CBYY	14R60636
1189-0	SG100-E367.4N18CBNN	14R58786
1190-0	SD035-A163.0D18CBNN	14R59353
1191-0	SD100-D366.4D18CBNN	14R57995
1192-0	SG036-A165.7L18CDNN	
1192-1	SG036-A165.7L18CDNN	14R6000
1192-2	SG036-A165.7L18CDNN	14R61251
1192-3	SG036-A165.7L18CDNN	14R61093
1193-0	SD025-D363.0D18ADNN	14R59353
1194-0	SG010-A161.3L18CDNN	14R59404
1195-0	SD010-A161.3D18CDNN	14R58337
1196-0	SD015-B362.2D18CDYY	14R58939
1196-1	SD015-B362.2D18CDYY	14R58939
1197-0	SD030-D363.0D18CDNN	14R59353
1198-0	SG010-A161.3G18ADYY	14R59404
1199-0	SG036-B362.5G36CDNN	14R56444
1199-1	SG036-B362.5G36CDNN	14R56444
1200-0	SG036-D362.5N36CDYN	14R56444
1201-0	SG070-D367.4L18CBYY	14R58063
1202-0	SD010-A161.3D18ADNN	14R58337
1203-0	SD030-A163.0D18CBNN	14R59353
1204-0	SG020-A162.5L18CDYN	14R56444
1205-0	SG050-B365.7N18CBYY	14R58063
1206-0	SG070-E367.4N18CBNN	14R58063
1207-0	SD010-G361.3D18BDNN	14R58337
1208-0	SD020-G363.0D18BDNN	14R58206
1209-0	SD030-G363.0D18CDYN	14R59353
1210-0	SD045-B366.4D18CBYN	14R57965
1211-0	SD060-B366.4D18CBYN	14R57965
1212-0	SG010-A161.3N18BDYY	14R59404
1213-0	SG100-D367.4L18ABNN	14R58786
1214-0	SD030-J363.0D18CDYN	14R59353
1215-0	SD100-B366.4D18CBNN	14R57995
1216-0	SG010-B361.3G18BDNN	14R59404
1217-0	SG080-A165.7N18CBYY	14R58786
1218-0	SG085-E365.7N18CBNN	14R58786
1219-0	SG100-B367.4N18CBYY	14R58786
1219-1	SG100-B367.4N18CBYY	14R60637
1220-0	SD035-B363.0D18CBYY	14R59353
1221-0	SD045-B366.4D18CBYY	14R57965
1222-0	SD050-B366.4D18CBYY	14R57965
1222-1	SD050-B366.4D18CBYY	14R57965
1223-0	SD060-G366.4D18CBYY	14R57965
1223-1	SD060-G366.4D18CBYY	14R57965
1224-0	SD080-B366.4D18CBYY	14R57965
1224-1	SD080-B366.4D18CBYY	14R57965
1225-0	SG036-G365.7N18CBNN	14R58564
1225-1	SG036-G365.7N18CBNN	14R58063
1226-0	SD100-G36133D18CBNN	14R59911
1227-0	SD100-G36133D18CBYN	14R59911
1228-0	SD130-G36133D18CBNN	14R59911
1228-1	SD130-G36133D18CBNN	14R61576
1229-0	SD130-G36133D18CBYY	14R59911
1229-1	SD130-G36133D18CBYY	14R59911
1229-2	SD130-G36133D18CBYY	14R61576
1229-3	SD130-G36133D18CBYY	14R63072
1230-0	SD130-J36133D18CBNN	14R5991

1230-1	SD130-J36133D18CBNN	14R61576
1231-0	SD130-K36133D18BBNN	14R59911
1232-0	SD130-K36133D18CBNN	14R59911
1232-1	SD130-K36133D18CBNN	14R61576
1233-0	SD130-K36133D18CBYY	14R59911
1233-1	SD130-K36133D18CBYY	14R59911
1233-2	SD130-K36133D18CBYY	14R61576
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1235-0	SD035-D363.0D18CDYY	14R59353
1236-0	SD080-K366.4D18CBNN	14R57965
1236-1	SD080-K366.4D18CBNN	14R57965
1237-0	SD010-D361.3D18ADYY	14R58337
1238-0	SD020-D363.0D18ADNN	14R58206
1239-0	SD030-D363.0D18ABNN	14R59353
1240-0	SD015-A162.2D18ADYY	14R58939
1240-1	SD015-A162.2D18ADYY	14R58939
1241-0	SG020-D362.5N18CDYY	14R56444
1242-0	SD150-G36133D18CBNN	14R59911
1242-1	SD150-G36133D18CBNN	14R59911
1242-2	SD150-G36133D18CBNN	14R61576
1243-0	SG050-A165.7N18CBNN	14R58063
1244-0	SD015-D362.2D18ADYY	14R58939
1245-0	SD025-B363.0D18CDNN	14R59353
1246-0	SG036-K365.7N18CBYN	14R58564
1247-0	SD010-A161.3D18BDNY	14R58337
1248-0	SD030-G363.0D18CBNN	14R59353
1249-0	SD030-J363.0D18CBYY	14R59353
1249-1	SD030-J363.0D18CBYY	14R59353
1250-0	SD080-J366.4D18CBNN	14R57965
1251-0	SD080-J366.4D18CBYY	14R57965
1251-1	SD080-J366.4D18CBYY	14R57965
1252-0	SD100-G36133D18BBNN	14R59911
1253-0	SD100-G36133D18CBYY	14R59911
1253-1	SD100-G36133D18CBYY	14R61576
1253-2	SD100-G36133D18CBYY	14R63072
1254-0	SG010-B361.3N18BDNY	14R59404
1255-0	SG036-G365.7L18CBNN	14R58564
1255-1	SG036-G365.7L18CBNN	14R58063
1256-0	SG050-J365.7N18CBNN	14R58063
1257-0	SG070-K367.4L18CBNN	14R58063
1257-1	SG070-K367.4L18CBNN	14R60636
1258-0	SG085-G365.7N18CBNN	14R58786
1259-0	SD080-K366.4D18ABYY	14R57965
1259-1	SD080-K366.4D18ABYY	14R57965
1260-0	SD015-M152.2D15BDNN	14R58919
1261-0	SD030-K363.0D18BDYY	14R59353
1262-0	SD060-K366.4D18CBNN	14R57965
1262-1	SD060-K366.4D18CBNN	14R57965
1263-0	SG085-D365.7L18CBNN	14R58786
1264-0	SD008-M151.3D15BDNN	14R58573
1265-0	SD025-K363.0D18BDYY	14R59353
1266-0	SD050-G366.4D18CBNN	14R57965
1266-1	SD050-G366.4D18CBNN	14R57965
1267-0	SD060-K366.4D18CBYY	14R57965
1267-1	SD060-K366.4D18CBYY	14R57965
1268-0	SG020-B362.5L18CDYY	14R56444
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1269-1	SG036-D365.7N18CBNN	14R58063
1270-0	SG050-J365.7G18ABYY	14R58063
1271-0	SD100-K36133D18CBNN	14R59911
1271-1	SD100-K36133D18CBNN	14R59911
1272-0	SD150-K36133D18CBNN	14R59911
1272-1	SD150-K36133D18CBNN	14R59911
1273-0	SG050-G365.7N18CBNN	14R58063
1274-0	SD025-K363.0D18CBYY	14R59353
1274-1	SD025-K363.0D18CBYY	14R59353
1275-0	SD010-A161.3D18BDYY	14R58337
1276-0	SD015-C362.2D18CDYY	14R58939
1277-0	SD030-K363.0D18CBYY	14R59353
1277-1	SD030-K363.0D18CBYY	14R59353
1278-0	SG050-G365.7G18ABNN	14R58063
1279-0	SD015-M152.2D15ADNN	14R58919
1280-0	SG020-A162.5L18CDYY	14R56444
1281-0	SG036-A165.7N18CBYY	14R58564
1281-1	SG036-A165.7N18CBYY	14R58063
1282-0	SD015-E362.2D18CDNN	14R58939
1283-0	SD020-G363.0D18CDNN	14R58206
1284-0	SD030-L363.0D18ABYY	14R59353
1285-0	SD080-D366.4D18CBNN	14R57965
1286-0	SD080-K366.4D18CBYY	14R57965
1286-1	SD080-K366.4D18CBYY	14R57965
1287-0	SD180-K36133D18CBNN	14R59911
1287-1	SD180-K36133D18CBNN	14R59911
1287-2	SD180-K36133D18CBNN	14R61576
1288-0	SG020-A162.5N18CDYY	14R56444
1289-0	SG036-G365.7N18CBYY	14R58564
1289-1	SG036-G365.7N18CBYY	14R58063
1289-2	SG036-G365.7N18CBYY	14R62614
1290-0	SG050-K365.7N18CBNN	14R58063
1291-0	SG070-J367.4L18CBYY	14R58063
1292-0	SG100-K367.4L18CBYY	14R58786
1292-1	SG100-K367.4L18CBYY	14R60637
1293-0	SD030-B363.0D18CBYY	14R59353
1294-0	SG010-A161.3N18CDNN	14R59404
1295-0	SG070-D367.4N18CBYY	14R58063
1295-1	SG070-D367.4N18CBYY	14R60636
1296-0	SG010-D361.3G18CDNN	14R59404
1297-0	SG020-D362.5G18CDNN	14R56444
1298-0	SG036-G362.5N36CDNN	14R56444
1299-0	SG070-D367.4G18CBNN	14R58063
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1302-0	SG020-G362.5L18CDNN	14R56444
1303-0	SD045-J366.4D18CBYY	14R57965
1303-1	SD045-J366.4D18CBYY	14R57965
1304-0	SD050-K366.4D18CBYY	14R57965
1304-1	SD050-K366.4D18CBYY	14R57965
1305-0	SD060-J366.4D18CBYY	14R57965
1305-1	SD060-J366.4D18CBYY	14R57965
1306-0	SD080-A166.4D18CBNN	14R57965

1307-0	SG020-A161.3L36ADYY	14R59404
1308-0	SG100-K367.4N18CBNN	14R60637
1309-0	SD030-A163.0D18CDYY	14R59353
1310-0	SD030-G363.0D18CBYY	14R59353
1311-0	SD180-K36133D18CBYY	14R59911
1311-1	SD180-K36133D18CBYY	14R59911
1312-0	SG050-E365.7N18CBNN	14R58063
1313-0	SD060-D366.4D18CBNN	14R57965
1314-0	SD015-G362.2D18BDNY	14R58939
1315-0	SD020-G363.0D18CDYY	14R58206
1316-0	SD5.5-A160.8D18BDNY	14R60612
1317-0	SG010-D361.3L18BDNN	14R59404
1318-0	SG036-K365.7N18CBNN	14R58063
1319-0	SD020-B363.0D18ADNN	14R58206
1320-0	SD008-A151.3D15ADYY	14R58573
1321-0	SD020-A153.0D15ADYY	
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1323-0	SD030-E353.0D15ADNN	
1324-0	SD045-G366.4D18ABYY	14R57965
1325-0	SG020-B362.5N18CDYY	14R56444
1326-0	SG036-G362.5L36CDNN	14R56444
1327-0	SG070-A167.4L18CBYY	14R60636
1328-0	SG100-G367.4N18CBYY	14R60637
1328-1	SG100-G367.4N18CBYY	14R60637
1329-0	SD010-D361.3D18ADNN	14R58337
1330-0	SG020-B361.3N36BDNN	14R59404
1330-1	SG020-B361.3N36BDNN	14R61645
1331-0	SD015-A162.2D18CDYN	14R58939
1332-0	SD045-G366.4D18CBNN	14R57965
1332-1	SD045-G366.4D18CBNN	14R57965
1333-0	SD060-G366.4D18CBNN	14R57965
1333-1	SD060-G366.4D18CBNN	14R57965
1334-0	SD150-K36133D18CBYY	14R59911
1335-0	SD010-B361.3D18BDYY	14R58337
1336-0	SD015-A162.2D18CDYY	14R58939
1337-0	SD100-K366.4D18CBYY	14R57995
1337-1	SD100-K366.4D18CBYY	14R57995
1338-0	SD020-E363.0D18CDNN	14R58206
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1341-0	SD050-H366.4D18ABNN	14R57965
1342-0	SG050-A165.7G18CBYY	14R58063
1343-0	SG036-B365.7N18CBYY	14R58063
1344-0	SG036-K365.7N18CBYY	14R58063
1345-0	SG036-G365.7N18CBNY	14R58063
1345-1	SG036-G365.7N18CBNY	14R58063
1345-2	SG036-G365.7N18CBNY	14R62614
1346-0	SG020-G362.5L18CDYY	14R56444
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1350-0	SD010-B361.3D18BDNN	14R58337
1351-0	SG020-J361.3G36ADYY	14R59404
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1354-0	SD100-G366.4D18CBNN	14R57995
1355-0	SG100-G367.4N18CBNN	14R60637
1356-0	SD035-G363.0D18CBNN	14R5935
1357-0	SD5.5-A160.8D18BDNN	14R6061
1358-0	SG070-J367.4L18CBNN	14R60636
1359-0	SD030-J363.0D18CBNN	14R59353
1360-0	SD025-B363.0D18BDNN	14R59353
1361-0	SG036-B365.7N18CBYN	14R58063
1362-0	SD045-G366.4D18CBYY	14R57965
1363-0	SD030-B363.0D18BDYY	14R59353
1364-0	SD045-K366.4D18CBYY	14R57965
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1366-0	SG085-J365.7L18CBNN	14R58786
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1368-0	SG008-A161.1G18ADYY	
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1372-0	SD010-A161.3D18ADYY	14R58337
1373-0	SD050-G366.4D18CBYY	14R57965
1374-0	SD050-J366.4D18CBYY	14R57965
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1376-0	SD035-B363.0D18CBNN	14R59353
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1377-2	SD180-G36133D18CBYY	14R63072
1378-0	SG010-K361.3L18BDYY	14R59404
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1380-0	SG036-G365.7L18CBYY	14R5806
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1382-0	SG010-K361.3L18ADYY	14R59404
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1387-0	SD035-B363.0D18CDYY	14R59353
1387-1	SD035-B363.0D18CDYY	14R59353
1388-0	SD035-G363.0D18CBYY	14R59353
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1392-2	SG010-B361.3L18CDYY	14R62611
1393-0	SG010-G361.3N18CDYY	14R61645
1393-1	SG010-G361.3N18CDYY	14R61645
1393-2	SG010-G361.3N18CDYY	14R62611
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1395-2	SG020-G361.3N36CDYY	14R62611
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1397-0	SG036-B362.5L36CDYY	14R56444
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1405-0	SG100-B367.4L18CBYY	14R60637
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1406-1	SD100-K36133D18CBYY	14R61576
1407-0	SD080-K366.4D18CBYN	14R57965
1408-0	SG050-E365.7G18CBYY	14R58063
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1413-2	SG020-A161.3L36CDYY	14R62611
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1419-0	SG100-G367.4L18CBNN	14R60637
1420-0	SD020-J363.0D18CDNN	14R58206
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1423-0	SG020-K362.5N18CDYY	14R56444
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1447-0	SD5.5-E360.8D18BDYY	14R60612
1448-0	SG010-A161.3G18BDNN	14R59404
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1467-1	SD175-G36133D18CBNN	14R61576
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1469-0	SD050-A166.4D18CBYY	14R57965
1470-0	SD5.5-A160.8D18BDYY	14R60612
1471-0	SG036-A162.5L36CDYY	14R56444
1472-0	SG020-K362.5L18CDYY	14R56444
1473-0	SG036-G365.7N18BBYY	14R58063
1474-0	SG010-A161.3N18BDNN	14R59404
1474-1	SG010-A161.3N18BDNN	14R61645
1474-2	SG010-A161.3N18BDNN	14R62611
1475-0	SG010-E361.3L18BDYY	14R59404
1476-0	SG020-B362.5L18BDNN	14R56444
1477-0	SG050-G365.7L18CBYY	14R58063
1478-0	SD025-K363.0D18BDNN	14R59353
1479-0	SG010-B361.3L18BDNN	14R59404
1479-1	SG010-B361.3L18BDNN	14R61645
1480-0	SG020-A161.3L36BDNN	14R59404
1481-0	SG020-D361.3G36CDNN	14R59404
1482-0	SG036-K365.7L18CBYY	14R58063
1483-0	SG085-B365.7N18CBYY	14R58786
1484-0	SG020-B361.3N36CDNN	14R59404
1485-0	SD025-G363.0D18CDNN	14R59353
1486-0	SG050-G365.7L18CBNN	14R58063
1487-0	SG085-G365.7L18CBNN	14R58786
1488-0	SG010-G361.3N18CDNN	14R59404
1489-0	SG070-K367.4L18CBYY	14R60636
1490-0	SG070-K367.4N18CBYY	14R60636
1491-0	SG085-J365.7N18CBYY	14R58786
1492-0	SG050-D365.7L18CBYY	14R58063
1493-0	SG100-J367.4L18CBNN	14R60637
1494-0	SD060-K366.4D18ABNN	14R57965
1495-0	SG020-D361.3N36CDYY	14R59404
1496-0	SG100-D367.4N18CBYY	14R60637
1497-0	SG100-J367.4L18CBYY	14R60637

1498-0	SG010-G361.3N18BDNN	14R59404
1498-1	SG010-G361.3N18BDNN	14R61645
1498-2	SG010-G361.3N18BDNN	14R62611
1499-0	SG036-B362.5G36CDNN	14R56444
1500-0	SD100-K36133D18CBYN	14R61576
1501-0	SD015-B362.2D18BDYY	14R58939
1502-0	SD030-B363.0D18BBNN	14R59353
1503-0	SD020-D363.0D18CDYY	14R58206
1504-0	SD035-K363.0D18CDNN	14R59353
1505-0	SD050-B366.4D18ABYY	14R57965
1506-0	SD025-A163.0D18BDYY	14R59353
1507-0	SD030-K363.0D18CDYY	14R59353
1508-0	SG036-E362.5N36CDYY	14R56444
1509-0	SG010-A161.3L18CDYY	14R59404
1510-0	SG036-D362.5G36ADYY	14R56444
1511-0	SG070-G367.4N18CBNN	14R60636
1512-0	SG036-A162.5N36BDNN	14R56444
1513-0	SG036-E362.5G36ADYY	14R56444
1514-0	SD015-B362.2D18ADYY	14R58939
1515-0	SD030-G363.0D18ABYY	14R59353
1516-0	SD025-G363.0D18CBYY	14R59353
1517-0	SG010-B361.3N18BDYY	14R61645
1518-0	SD5.5-B360.8D18BDYY	14R60612
1519-0	SG010-A161.3G18AD	14R61645
1519-1	SG010-A161.3G18AD	14R62611
1520-0	SG010-G361.3L18ED	14R61645
1520-1	SG010-G361.3L18ED	14R62611
1521-0	SG020-G361.3L36ED	14R61645
1521-1	SG020-G361.3L36ED	14R62611
1522-0	SD010-K361.3D18ADYY	14R58337
1523-0	SD035-K363.0D18CBYY	14R59353
1524-0	SD080-A166.4D18CBYY	14R57965
1525-0	SD100-E366.4D18CBNN	14R57995
1526-0	SG036-B362.5N36BD	14R56444
1527-0	SG020-G362.5N18BDNN	14R56444
1528-0	SG070-K367.4N18CBNN	14R60636
1529-0	SD010-A161.3D18CDYY	14R58337
1530-0	SD030-A163.0D18ABYY	14R59353
1531-0	SG020-G361.3L36BDNN	14R61645
1532-0	SG070-A167.4L18CBYN	14R60636
1533-0	SG020-G361.3N36BDNN	14R61645
1534-0	SG010-A161.3N18BDNN	14R61644
1534-1	SG010-A161.3N18BDNN	14R62611
1534-2	SG010-A161.3N18BDNN	14R64467
1534-3	SG010-A161.3N18BDNN	
1535-0	SG010-B361.3N18BDNN	14R61645
1535-1	SG010-B361.3N18BDNN	14R62611
1536-0	SG020-G361.3N36CDNN	14R61645
1536-1	SG020-G361.3N36CDNN	14R66046
1536-2	SG020-G361.3N36CDNN	14R66343
1536-3	SG020-G361.3N36CDNN	
1537-0	SG020-G361.3N36CDYY	14R61645
1537-1	SG020-G361.3N36CDYY	14R62611
1537-2	SG020-G361.3N36CDNN	14R64467
1537-3	SG020-G361.3N36CDNN	14R66046
1537-4	SG020-G361.3N36CDYY	14R66343
1537-5	SG020-G361.3N36CDYY	14R6673
1538-0	SG050-A165.7L18CBYY	14R5806
1539-0	SG020-A161.3N36BDNN	14R61645
1539-1	SG020-A161.3N36BDNN	14R62611
1539-2	SG020-A161.3N36BDNN	
1540-0	SG036-E365.7N18CBYN	14R58063
1541-0	SG010-A161.3L18BDYY	14R61645
1541-1	SG010-A161.3L18BDYY	14R62611
1541-2	SG010-A161.3L18BDYY	
1542-0	SG020-B361.3N36CDYY	14R61645
1542-1	SG020-B361.3N36CDYY	14R62611
1542-2	SG020-B361.3N36CDYY	14R64467
1542-3	SG020-B361.3N36CDYY	14R66731
1543-0	SG036-K365.7L18CBNN	14R58063
1544-0	SD030-J363.0D18ABYY	14R59353
1545-0	SD060-J366.4D18ABYY	14R57965
1546-0	SD100-K366.4D18ABYY	
1547-0	SD130-K36133D18ABYY	14R61576
1548-0	SG020-A162.5N18CDNY	14R56444
1549-0	SG050-D365.7L18ABYY	14R58063
1550-0	SG050-K365.7G18CBYY	14R58063
1551-0	SD015-B362.2D18ADNN	14R58939
1552-0	SD020-K363.0D18CDYY	14R58206
1553-0	SG020-A162.5L18BDYY	14R56444
1554-0	SD010-A161.3D18ADNY	14R58337
1555-0	SD025-G363.0D18ABNN	14R59353
1556-0	SD030-G363.0D18ABNN	14R59356
1557-0	SD040-N356.4D15ABYY	14R58725
1558-0	SD045-G366.4D18ABNN	14R57965
1559-0	SD050-G366.4D18ABNN	14R57965
1560-0	SG010-B361.3N18BDYY	14R61645
1560-1	SG010-B361.3N18BDYY	14R62611
1561-0	SD050-G366.4D18CBYY	14R57965
1561-1	SD050-G366.4D18CBYY	14R64447
1561-2	SD050-G366.4D18CBYY	14R64447
1562-0	SD100-G36133D18CBNN	14R61576
1562-1	SD100-G36133D18CBNN	14R63072
1562-2	SD100-G36133D18CBNN	14R64465
1562-3	SD100-G36133D18CBNN	14R65467
1562-4	SD100-G36133D18CBNN	14R66148
1563-0	SD150-G36133D18CBYY	14R61576
1563-1	SD150-G36133D18CBYY	14R63072
1563-2	SD150-G36133D18CBYY	14R64465
1563-3	SD150-G36133D18CBYY	14R65467
1564-0	SG010-A161.3G18ADYY	14R61645
1564-1	SG010-A161.3G18ADYY	14R62611
1564-2	SG010-A161.3G18ADYY	14R66731
1565-0	SG020-B361.3N36BDNN	14R61645
1565-1	SG020-B361.3N36BDNN	14R62611
1566-0	SG070-G367.4N18CBNN	14R60636
1566-1	SG070-G367.4N18CBNN	14R64455
1567-0	SG010-A161.3N18BDYY	14R6164
1567-1	SG010-A161.3N18BDYY	14R6261
1567-2	SG010-A161.3N18BDYY	14R62611

1567-3	SG010-A161.3N18BDYY	14R66046
1567-4	SG010-A161.3N18BDYY	14R66343
1567-5	SG010-A161.3N18BDYY	14R66731
1568-0	SG070-G367.4L18CBYY	14R60636
1569-0	SG010-D361.3G18ADNN	14R61645
1570-0	SD025-A163.0D18ABNN	14R59353
1571-0	SD045-A166.4D18ABNN	14R57965
1572-0	SD050-A166.4D18ABNN	14R57965
1573-0	SD080-K366.4D18CBNN	14R57965
1574-0	SG010-A161.3G18ADNN	14R61645
1574-1	SG010-A161.3G18ADNN	14R62611
1574-2	SG010-A161.3G18ADNN	14R62611
1574-3	SG010-A161.3G18ADNN	14R66731
1575-0	SD010-K361.3D18CDYY	14R58337
1576-0	SD020-K363.0D18CDYY	14R58206
1576-1	SD020-K363.0D18CDYY	14R66747
1577-0	SD020-K363.0D18CDYY	14R58206
1577-1	SD020-K363.0D18CDYY	14R64461
1577-2	SD020-K363.0D18CDYY	14R66348
1577-3	SD020-K363.0D18CDYY	14R66747
1578-0	SD030-K363.0D18CDYY	14R59353
1579-0	SD050-K366.4D18CBYY	14R57965
1579-1	SD050-K366.4D18CBYY	14R64447
1580-0	SG020-A161.3N36CDYY	14R61645
1580-1	SG020-A161.3N36CDYY	14R62611
1580-2	SG020-A161.3N36CDYY	14R64467
1580-3	SG020-A161.3N36CDYY	14R66046
1580-4	SG020-A161.3N36CDYY	14R66731
1581-0	SG036-A161.3N36CDYY	14R56444
1582-0	SG036-D365.7G18CBYY	14R58063
1583-0	SG050-B365.7L18CBYY	14R58063
1583-1	SG050-B365.7L18CBYY	14R64451
1583-2	SG050-B365.7L18CBYY	14R64451
1584-0	SD025-A163.0D18ADNN	14R59353
1585-0	SD080-G366.4D18CBYY	14R57965
1585-1	SD080-G366.4D18CBYY	14R64447
1585-2	SD080-G366.4D18CBYY	14R64447
1585-3	SD080-G366.4D18CBYY	14R64447
1585-4	SD080-G366.4D18CBYY	14R66176
1585-5	SD080-G366.4D18CBYY	14R66176
1586-0	SG050-G365.7N18CBYY	14R58063
1586-1	SG050-G365.7N18CBYY	14R58063
1586-2	SG050-G365.7N18CBYY	14R62614
1586-3	SG050-G365.7N18CBYY	14R64451
1587-0	SD100-K36133D18CBYY	14R61576
1587-1	SD100-K36133D18CBYY	14R63072
1588-0	SD020-J363.0D18ADNN	14R58206
1589-0	SD030-G363.0D18CBYY	14R59353
1589-1	SD030-G363.0D18CBYY	14R66349
1589-2	SD030-G363.0D18CBYY	14R66737
1590-0	SD060-A166.4D18ABNN	14R57965
1591-0	SG050-A165.7L18CBYY	14R58063
1591-1	SG050-A165.7L18CBYY	14R62614
1592-0	SG050-A165.7N18CBYY	14R58063
1592-1	SG050-A165.7N18CBYY	14R62614
1592-2	SG050-A165.7N18CBYY	14R68032
1593-0	SG070-B367.4N18CBYY	14R60636
1594-0	SG020-B362.5N18CDNN	14R56444
1595-0	SD015-B362.2D18CDYY	14R58939
1596-0	SD030-G363.0D18CDYY	14R59353
1596-1	SD030-G363.0D18CDYY	14R64459
1596-2	SD030-G363.0D18CDYY	14R65871
1596-3	SD030-G363.0D18CDYY	14R66349
1596-4	SD030-G363.0D18CDYY	14R66737
1597-0	SD010-A161.3D18ADYY	14R58337
1598-0	SD035-K363.0D18CBYY	14R59353
1598-1	SD035-K363.0D18CBYY	14R66737
1599-0	SD045-A166.4D18ABYY	14R57965
1600-0	SG020-A161.3N36ADYY	14R61645
1600-1	SG020-A161.3N36ADYY	14R62611
1600-2	SG020-A161.3N36ADYY	14R66731
1601-0	SG020-G361.3N36BDNN	14R61645
1601-1	SG020-G361.3N36BDNN	14R66731
1602-0	SG036-A165.7L18CBNN	14R58063
1602-1	SG036-A165.7L18CBNN	14R62614
1602-2	SG036-A165.7L18CBNN	14R64451
1603-0	SD010-D361.3D18ADYY	14R58337
1604-0	SD025-H363.0D18ADNN	14R59353
1605-0	SD020-G363.0D18CDYY	14R58206
1605-1	SD020-G363.0D18CDYY	14R64461
1605-2	SD020-G363.0D18CDYY	14R64461
1605-3	SD020-G363.0D18CDYY	14R66348
1605-4	SD020-G363.0D18CDYY	14R66747
1606-0	SD020-G363.0D18CDNN	14R58206
1606-1	SD020-G363.0D18CDNN	14R64461
1606-2	SD020-G363.0D18CDNN	14R66348
1606-3	SD020-G363.0D18CDNN	14R66747
1607-0	SG020-A161.3L36CDNN	14R61645
1607-1	SG020-A161.3L36CDNN	14R62611
1608-0	SG036-B365.7N18BBYY	14R58063
1609-0	SD030-G363.0D18CBYY	14R59353
1609-1	SD030-G363.0D18CBYY	14R66349
1609-2	SD030-G363.0D18CBYY	14R66737
1610-0	SD045-K366.4D18CBYY	14R57965
1611-0	SG036-B365.7N18CBYY	14R58063
1611-1	SG036-B365.7N18CBYY	14R64451
1612-0	SD010-G361.3D18ADYY	14R58337
1613-0	SD020-A163.0D18ADNN	14R58206
1613-1	SD020-A163.0D18ADNN	14R66747
1614-0	SD020-G363.0D18ADYY	14R58206
1615-0	SD020-G363.0D18CDYY	14R58206
1615-1	SD020-G363.0D18CDYY	14R64461
1615-2	SD020-G363.0D18CDYY	14R64461
1615-3	SD020-G363.0D18CDYY	14R64461
1615-4	SD020-G363.0D18CDYY	14R66348
1615-5	SD020-G363.0D18CDYY	14R66747
1616-0	SD030-B363.0D18CDNN	14R59353
1617-0	SD045-G366.4D18ABYY	14R57965
1618-0	SD045-G366.4D18ABYY	14R57965
1618-1	SD060-G366.4D18CBNN	14R64447

1618-2	SD060-G366.4D18CBNN	14R64447
1618-3	SD060-G366.4D18CBNN	14R66349
1618-4	SD060-G366.4D18CBNN	14R66176
1619-0	SD060-J366.4D18CBNN	14R57965
1620-0	SD100-K36133D18ABYY	14R61576
1621-0	SG010-A161.3L18CDYY	14R61645
1621-1	SG010-A161.3L18CDYY	14R62611
1621-2	SG010-A161.3L18CDYY	14R64467
1621-3	SG010-A161.3L18CDYY	14R66731
1622-0	SG020-B362.5L18CDNY	14R56444
1623-0	SG036-B362.5L36CDYY	14R56444
1624-0	SD020-A163.0D18CDYY	14R58206
1624-1	SD020-A163.0D18CDYY	14R64461
1624-2	SD020-A163.0D18CDYY	14R64461
1624-3	SD020-A163.0D18CDYY	14R66747
1625-0	SD045-G366.4D18CBYY	14R57965
1625-1	SD045-G366.4D18CBYY	14R64447
1626-0	SD010-A161.3D18CDYY	14R58337
1627-0	SG070-G367.4N18CBNN	14R60636
1627-1	SG070-G367.4N18CBNN	14R64455
1627-2	SG070-G367.4N18CBNN	14R64455
1628-0	SG020-A162.5L18CDYY	14R56444
1629-0	SG036-E362.5N36CDNN	14R56444
1630-0	SD020-A163.0D18CDNN	14R58206
1631-0	SD030-N353.0D15CDYY	
1632-0	SG010-A161.3N18BDYY	14R61645
1633-0	SD010-A161.3D18ADNY	14R58337
1633-1	SD010-A161.3D18ADNY	14R61243
1634-0	SG020-G362.5G18ADYY	14R56444
1635-0	SD020-K363.0D18BDYN	14R58206
1636-0	SD030-K363.0D18BDYN	14R59353
1637-0	SG070-B367.4L18CBYY	14R60636
1637-1	SG070-B367.4L18CBYY	14R62629
1637-2	SG070-B367.4L18CBYY	14R64455
1638-0	SG036-D362.5G36ADNY	14R56444
1639-0	SD020-J363.0D18ADYY	14R58206
1640-0	SG010-B361.3N18CDNN	14R61645
1640-1	SG010-B361.3N18CDNN	14R66343
1640-2	SG010-B361.3N18CDNN	14R66731
1641-0	SG080-A165.7N18CBYN	14R58786
1642-0	SD060-G366.4D18CBYY	14R57965
1642-1	SD060-G366.4D18CBYY	14R64447
1642-2	SD060-G366.4D18CBYY	14R64447
1642-3	SD060-G366.4D18CBYY	14R66176
1643-0	SD080-K366.4D18CBYY	14R57965
1643-1	SD080-K366.4D18CBYY	14R64447
1643-2	SD080-K366.4D18CBYY	14R64447
1643-3	SD080-K366.4D18CBYY	14R64447
1643-4	SD080-K366.4D18CBYY	14R64447
1643-5	SD080-K366.4D18CBYY	14R66176
1643-6	SD080-K366.4D18CBYY	14R66176
1644-0	SG020-B361.3N36BDYY	14R61645
1644-1	SG020-B361.3N36BDYY	14R62611
1644-2	SG020-B361.3N36BDYY	14R66731
1645-0	SG036-A165.7N18CBNN	14R58063
1645-1	SG036-A165.7N18CBNN	14R62614
1645-2	SG036-A165.7N18CBNN	14R64451
1645-3	SG036-A165.7N18CBNN	14R6591
1645-4	SG036-A165.7N18CBNN	14R6803
1646-0	SD025-G363.0D18CBNN	14R59353
1647-0	SD025-G363.0D18CBYY	14R59353
1647-1	SD025-G363.0D18CBYY	14R64459
1647-2	SD025-G363.0D18CBYY	14R66737
1648-0	SD030-N353.0D15CBYN	
1649-0	SD035-D363.0D18CBYY	14R59353
1650-0	SG010-A161.3L18CDNN	14R61645
1650-1	SG010-A161.3L18CDNN	14R64467
1650-2	SG010-A161.3L18CDNN	14R66731
1651-0	SD025-A163.0D18BDYY	14R59353
1651-1	SD025-A163.0D18BDYY	14R66737
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1652-1	SD030-G363.0D18CBNN	14R65871
1652-2	SD030-G363.0D18CBNN	14R66349
1653-0	SD060-G366.4D18CBNN	14R57965
1653-1	SD060-G366.4D18CBNN	14R64447
1653-2	SD060-G366.4D18CBNN	14R64447
1653-3	SD060-G366.4D18CBNN	14R66176
1654-0	SD060-K366.4D18CBYY	14R57965
1654-1	SD060-K366.4D18CBYY	14R64447
1654-2	SD060-K366.4D18CBYY	14R64447
1654-3	SD060-K366.4D18CBYY	14R66439
1654-4	SD060-K366.4D18CBYY	14R66439
1654-5	SD060-K366.4D18CBYY	14R66176
1655-0	SD150-K36133D18CBYY	14R6157
1655-1	SD150-K36133D18CBYY	14R65461
1655-2	SD150-K36133D18CBYY	14R66148
1656-0	SG020-B362.5L18CDYY	14R56444
1657-0	SG010-A161.3L18EDNN	14R61645
1658-0	SG020-B361.3N36BDNN	14R61645
1658-1	SG020-G361.3N36BDNN	14R66046
1658-2	SG020-G361.3N36BDNN	14R66343
1659-0	SG036-J365.7L18BBNN	14R58063
1260-0	SG100-G367.4N18CBYY	14R60637
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1660-2	SG100-G367.4N18CBYY	14R65922
1661-0	SD035-D363.0D18CDNN	14R59353
1662-0	SG010-A161.3G18ADNN	14R61645
1662-1	SG010-A161.3G18ADNN	14R64467
1663-0	SG010-B361.3L18CDYY	14R61645
1663-1	SG010-B361.3L18CDYY	14R66731
1664-0	SG010-G361.3N18CDYY	14R61645
1664-1	SG010-G361.3N18CDYY	14R64467
1664-2	SG010-G361.3N18CDYY	14R66046
1664-3	SG010-G361.3N18CDYY	14R66731
1665-0	SG020-A161.3L36CDYY	14R61645
1665-1	SG020-A161.3L36CDYY	14R66731
1666-0	SG036-J365.7G18ABYY	14R58063
1667-0	SG036-K365.7N18CBNN	14R58063
1667-1	SG036-K365.7N18CBNN	14R62614
1667-2	SG036-K365.7N18CBNN	14R6445

1667-3	SG036-K365.7N18CBNN	14R64451
1667-4	SG036-K365.7N18CBNN	14R65916
1667-5	SG036-K365.7N18CBNN	14R68032
1668-0	SG085-K365.7N18CBYY	14R58786
1668-1	SG085-K365.7N18CBYY	14R64453
1669-0	SD010-J361.3D18ADYY	14R58337
1669-1	SD010-J361.3D18ADYY	14R61243
1670-0	SD025-K363.0D18CDYY	14R59353
1670-1	SD025-K363.0D18CDYY	14R66737
1671-0	SD050-K366.4D18CBNN	14R57965
1672-0	SD010-G361.3D18CDYY	14R58337
1672-1	SD010-G361.3D18CDYY	14R61243
1673-0	SD025-J363.0D18CDYY	14R59353
1674-0	SD045-G366.4D18CBNN	14R57965
1675-0	SD060-G366.4D18CBYN	14R57965
1676-0	SG020-E362.5N18BDNN	14R56444
1677-0	SG050-G365.7N18CBNN	14R58063
1677-1	SG050-G365.7N18CBNN	14R62614
1677-2	SG050-G365.7N18CBNN	14R64451
1677-3	SG050-G365.7N18CBNN	14R64451
1678-0	SG020-G362.5N18CDYY	14R56444
1679-0	SG020-K362.5N18CDNY	14R56444
1680-0	SG036-G365.7N18CBYY	14R58063
1681-0	SD010-E361.3D18CDNY	14R58337
1682-0	SD030-K363.0D18ADYY	14R59353
1683-0	SG036-G365.7N18CBYN	14R58063
1684-0	SG050-A165.7G18CBNN	14R62614
1685-0	SD080-G366.4D18CBNN	14R57965
1685-1	SD080-G366.4D18CBNN	14R66176
1686-0	SG020-G361.3N36BDYY	14R62611
1686-1	SG020-G361.3N36BDYY	14R66343
1686-2	SG020-G361.3N36BDYY	14R66731
1687-0	SG085-G365.7G18ABNY	14R58786
1688-0	SD025-K363.0D18ADYY	14R59353
1688-1	SD025-K363.0D18ADYY	14R64459
1689-0	SD5.5-A160.8D18CDNN	14R60612
1690-0	SD020-A163.0D18FDYY	14R58206
1691-0	SD020-J363.0D18CDYY	14R58206
1692-0	SD035-J363.0D18CBYY	14R59353
1692-1	SD035-J363.0D18CBYY	14R66737
1693-0	SD130-J36133D18CBYY	14R61576
1694-0	SD130-K36133D18CBNN	14R61576
1694-1	SD130-K36133D18CBNN	14R64465
1694-2	SD130-K36133D18CBNN	14R65467
1694-3	SD130-K36133D18CBNN	14R66148
1695-0	SG020-A161.3G36ADNN	14R62611
1696-0	SG020-A161.3G36ADYY	14R62611
1696-1	SG020-A161.3G36ADYY	14R66343
1697-0	SG020-G362.5N18CDYY	14R56444
1698-0	SG020-K362.5N18BDNY	14R56444
1699-0	SG070-A167.4N18CBNN	14R62614
1699-1	SG070-A167.4N18CBNN	14R64455
1700-0	SG070-K367.4N18CBNN	14R62614
1700-1	SG070-K367.4N18CBNN	14R62629
1700-2	SG070-K367.4N18CBNN	14R64455
1700-3	SG070-K367.4N18CBNN	14R64455
1701-0	SG100-K367.4L18CBNN	14R60637
1702-0	SG100-K367.4L18CBNN	14R60637
1703-0	SG100-K367.4N18CBYY	14R60637
1703-1	SG100-K367.4N18CBYY	14R64457
1703-2	SG100-K367.4N18CBYY	14R65922
1703-3	SG100-K367.4N18CBYY	14R65922
1703-4	SG100-K367.4N18CBYY	14R65922
1704-0	SD015-G363.0D18CDYN	
1705-0	SD015-K363.0D18CDYY	
1706-0	SD025-G363.0D18BBYY	14R59353
1707-0	SD020-G363.0D18CDYN	14R58206
1708-0	SD130-J36133D18CBYY	14R61576
1709-0	SD5.5-A160.8D18ADNY	14R60612
1710-0	SG020-A161.3G36ADNN	14R62611
1711-0	SG070-B367.4L18CBYY	14R62614
1712-0	SD010-A161.3D18ADYY	14R58337
1712-1	SD010-A161.3D18ADYY	14R61243
1713-0	SD030-M153.0D15BDNN	
1714-0	SG070-A167.4L18CBNN	14R62614
1714-1	SG070-A167.4L18CBNN	14R62629
1714-2	SG070-A167.4L18CBNN	14R64455
1715-0	SG070-B367.4N18CBNN	14R62614
1716-0	SG080-A165.7L18CBNN	14R58786
1717-0	SD010-J361.3D18CDYY	14R58337
1717-1	SD010-J361.3D18CDYY	14R61243
1718-0	SD025-A163.0D18ABYY	14R59353
1719-0	SD045-G366.4D18BBYY	14R57965
1720-0	SG050-J365.7L18ABNN	14R62614
1721-0	SG085-D365.7N18CBNN	14R58786
1721-1	SG085-D365.7N18CBNN	14R64453
1722-0	SD010-A161.3D18BDNY	14R58337
1722-1	SD010-A161.3D18BDNY	14R61243
1723-0	SD010-D361.3D18CDYY	14R58337
1723-1	SD010-D361.3D18CDYY	14R61243
1724-0	SD030-K363.0D18CBYY	14R59353
1724-1	SD030-K363.0D18CBYY	14R65871
1724-2	SD030-K363.0D18CBYY	14R66349
1724-3	SD030-K363.0D18CBYY	14R66737
1725-0	SD030-P353.0D15BDNN	
1726-0	SD060-J366.4D18BBNN	14R57965
1727-0	SD100-J36133D18CBNN	14R61576
1727-1	SD100-J36133D18CBNN	14R66148
1728-0	SG010-A161.3L18BDNN	14R62611
1728-1	SG010-A161.3L18BDNN	14R64467
1728-2	SG010-A161.3L18BDNN	14R66046
1728-3	SG010-A161.3L18BDNN	14R66343
1729-0	SG020-A161.3N36BDYY	14R62611
1729-1	SG020-A161.3N36BDYY	14R66731
1730-0	SG020-D361.3G36BDYY	14R62611
1731-0	SG100-G367.4N18BBYY	14R60637
1731-1	SG100-G367.4N18BBYY	14R65922
1732-0	SG056-N357.4N15CBNN	14R62614
1733-0	SG015-B362.6N18CDYY	14R62955
1733-1	SG015-B362.6N18CDYY	14R62955

1733-2	SG015-B362.6N18CDYY	14R64406
1733-3	SG015-B362.6N18CDYY	14R64469
1733-4	SG015-B362.6N18CDYY	14R66354
1733-5	SG015-B362.6N18CDYY	14R66734
1734-0	SG020-G362.6L18CDYY	14R62955
1734-1	SG020-G362.6L18CDYY	14R62955
1734-2	SG020-G362.6L18CDYY	14R64406
1734-3	SG020-G362.6L18CDYY	14R64469
1734-4	SG020-G362.6L18CDYY	14R64469
1734-5	SG020-G362.6L18CDYY	14R66354
1734-6	SG020-G362.6L18CDYY	14R66734
1735-0	SG025-B362.6N18CDYY	14R62955
1735-1	SG025-B362.6N18CDYY	14R62955
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1735-3	SG025-B362.6N18CDYY	14R64581
1735-4	SG025-B362.6N18CDYY	14R64469
1735-5	SG025-B362.6N18CDYY	14R66354
1735-6	SG025-B362.6N18CDYY	14R66734
1736-0	SG025-G362.6L18CBYY	14R62955
1736-1	SG025-G362.6L18CBYY	14R64581
1736-2	SG025-G362.6L18CBYY	14R64581
1736-3	SG025-G362.6L18CBYY	14R64469
1736-4	SG025-G362.6L18CBYY	14R66354
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1737-2	SG030-G362.6L18CDYY	14R64581
1737-3	SG030-G362.6L18CDYY	14R64469
1737-4	SG030-G362.6L18CDYY	14R66354
1737-5	SG030-G362.6L18CDYY	14R66734
1738-0	SG030-G362.6N18CBYY	14R62955
1738-1	SG030-G362.6N18CBYY	14R64581
1738-2	SG030-G362.6N18CBYY	14R64469
1738-3	SG030-G362.6N18CBYY	14R66354
1738-4	SG030-G362.6N18CBYY	14R66734
1739-0	SG036-B362.5L36BDYY	14R56444
1740-0	SG050-J365.7N18BBYY	14R62614
1740-1	SG050-J365.7N18BBYY	14R64451
1741-0	SD020-A163.0D18ADNN	14R58206
1742-0	SD020-A163.0D18ADYY	14R58206
1742-1	SD020-A163.0D18ADYY	
1743-0	SD020-B363.0D18CDNN	14R58206
1744-0	SD035-D363.0D18CDYY	14R59353
1744-1	SD035-D363.0D18CDYY	14R64459
1745-0	SG010-A161.3L18BDYY	14R62611
1745-1	SG010-A161.3L18BDYY	14R64467
1745-2	SG010-A161.3L18BDYY	14R66046
1745-3	SG010-A161.3L18BDYY	14R66343
1745-4	SG010-A161.3L18BDYY	14R66731
1746-0	SG020-K362.5N18CDYY	14R56444
1747-0	SD045-J366.4D18CBYY	14R57965
1748-0	SD050-J366.4D18CBYY	14R57965
1749-0	SD130-K36133D18CBYY	14R61576
1749-1	SD130-K36133D18CBYY	14R63072
1749-2	SD130-K36133D18CBYY	14R66148
1750-0	SG020-B361.3G36CDNY	14R62611
1751-0	SG036-E362.5L36BDNY	14R56444
1752-0	SG036-G365.7N18CBYY	14R62614
1752-1	SG036-G365.7N18CBYY	14R6445
1752-2	SG036-G365.7N18CBYY	14R64451
1753-0	SG050-G365.7N18CBYY	14R62614
1753-1	SG050-G365.7N18CBYY	14R64451
1753-2	SG050-G365.7N18CBYY	14R64451
1754-0	SG070-A167.4L18CBNN	14R62629
1755-0	SG080-A165.7N18CBNN	14R58786
1756-0	SG100-G367.4L18CBYY	14R60637
1756-1	SG100-G367.4L18CBYY	14R64457
1757-0	SD080-J366.4D18CBYY	14R57965
1758-0	SG036-B362.5L36BDYN	14R56444
1759-0	SG085-K365.7N18CBNN	14R58786
1760-0	SD025-B363.0D18CDNN	14R59353
1761-0	SD030-K363.0D18CDYY	14R59353
1761-1	SD030-K363.0D18CDYY	14R64459
1761-2	SD030-K363.0D18CDYY	14R66737
1762-0	SD100-G366.4D18CBNN	14R57995
1763-0	SG036-B362.5L36BDNY	14R56444
1764-0	SG036-G365.7N18CBNN	14R62614
1764-1	SG036-G365.7N18CBNN	14R64451
1764-2	SG036-G365.7N18CBNN	14R64451
1764-3	SG036-G365.7N18CBNN	14R65916
1764-4	SG036-G365.7N18CBNN	14R65916
1764-5	SG036-G365.7N18CBNN	14R68032
1765-0	SD060-G366.4D18BBYY	14R57965
1765-1	SD060-G366.4D18BBYY	14R6643[illegible]
1766-0	SD030-A163.0D18CBNN	14R5935[illegible]
1766-1	SD030-A163.0D18CBNN	14R66737
1767-0	SG020-B361.3L36CDYY	14R62611
1768-0	SG070-G367.4L18CBNN	14R62629
1769-0	SG070-G367.4N18BBNN	14R62629
1770-0	SD020-B363.0D18ADNN	14R58206
1771-0	SD5.5-B360.8D18BDYY	14R60612
1772-0	SG020-A162.5N18CDYY	14R56444
1773-0	SD025-B363.0D18ADNN	14R59353
1774-0	SD035-G363.0D18CBYY	14R59353
1774-1	SD035-G363.0D18CBYY	14R65871
1774-2	SD035-G363.0D18CBYY	14R66737
1775-0	SD130-K36133D18CBYY	14R61576
1775-1	SD130-K36133D18CBYY	14R63072
1775-2	SD130-K36133D18CBYY	14R64465
1775-3	SD130-K36133D18CBYY	14R64465
1775-4	SD130-K36133D18CBYY	14R65467
1775-5	SD130-K36133D18CBYY	14R66148
1776-0	SG020-G362.5N18CDNY	14R56444
1777-0	SG020-J362.5L18BDYY	14R56444
1778-0	SG036-A165.7N18CBYN	14R62614
1779-0	SD025-B363.0D18BDYN	14R59353
1780-0	SG020-K362.5G18CDYY	14R56444
1781-0	SG036-B362.5N36CDNY	14R56444
1782-0	SG070-A167.4N18CBYY	14R62629
1783-0	SD025-B363.0D18BDNN	14R593[illegible]
1784-0	SG020-G362.5N18BDYY	14R5644[illegible]

1785-0	SD050-G366.4D18CBNN	14R57965
1786-0	SD080-B366.4D18CBNN	14R57965
1787-0	SD130-G36133D18CBNN	14R61576
1787-1	SD130-G36133D18CBNN	14R63072
1787-2	SD130-G36133D18CBNN	14R65467
1787-3	SD130-G36133D18CBNN	14R66148
1788-0	SG070-K367.4N18CBYY	14R62629
1788-1	SG070-K367.4N18CBYY	14R64455
1789-0	SD020-G363.0D18BDNN	14R58206
1789-1	SD020-G363.0D18BDNN	14R64461
1790-0	SD080-G366.4D18BBNN	14R57965
1791-0	SD150-K36133D18CBNN	14R61576
1791-1	SD150-K36133D18CBNN	14R63072
1791-2	SD150-K36133D18CBNN	14R64465
1791-3	SD150-K36133D18CBNN	14R66148
1792-0	SG010-A161.3N18CDNN	14R62611
1793-0	SG010-B361.3N18CDYY	14R62611
1793-1	SG010-B361.3N18CDYY	14R66731
1794-0	SG020-D362.5L18CDNN	14R56444
1795-0	SG036-K365.7L18BBNN	14R62614
1796-0	SG100-G367.4N18CBYY	14R60637
1796-1	SG100-G367.4N18CBYY	14R64457
1796-2	SG100-H367.4N18CBYY	14R65922
1797-0	SD025-J363.0D18CDNN	14R59353
1798-0	SD030-J363.0D18CDYY	14R59353
1799-0	SD050-K366.4D18CBYY	14R57965
1800-0	SD100-G36133D18CBYY	14R61576
1800-1	SD100-G36133D18CBYY	14R63072
1800-2	SD100-G36133D18CBYY	14R64465
1800-3	SD100-G36133D18CBYY	14R66148
1801-0	SD100-J36133D18BBYY	14R61576
1802-0	SG085-G365.7N18CBYY	14R58786
1802-1	SG085-G365.7N18CBYY	14R64453
1803-0	SG100-J367.4N18CBNN	14R60637
1804-0	SD025-G363.0D18BBNN	14R59353
1805-0	SG010-K361.3N18CDNN	14R62611
1806-0	SG020-B361.3N36CDNN	14R62611
1806-1	SG020-B361.3N36CDNN	14R66731
1807-0	SG020-K361.3N36CDYY	14R62611
1807-1	SG020-K361.3N36CDYY	14R64467
1807-2	SG020-K361.3N36CDYY	14R66046
1807-3	SG020-K361.3N36CDYY	14R66731
1808-0	SG036-D362.5N36CDNY	14R56444
1809-0	SG036-D365.7N18CBYY	14R62614
1810-0	SG050-J365.7G18CBYY	14R62614
1811-0	SG070-G367.4L18CBYY	14R62629
1811-1	SG070-G367.4L18CBYY	14R64455
1812-0	SD035-B363.0D18BBYY	14R59353
1813-0	SD5.5-A160.8D18BDNY	14R60612
1814-0	SG036-A162.5L36CDYY	14R56444
1815-0	SD080-G366.4D18CBNN	14R57965
1815-1	SD080-G366.4D18CBNN	14R64447
1815-2	SD080-G366.4D18CBNN	14R64447
1815-3	SD080-G366.4D18CBNN	14R64447
1815-4	SD080-G366.4D18CBNN	14R66176
1816-0	SD035-J363.0D18CDYY	14R59353
1817-0	SD020-K363.0D18CDNN	14R58206
1817-1	SD020-K363.0D18CDNN	
1818-0	SD025-G363.0D18CBNN	14R59353
1818-1	SD025-G363.0D18CBNN	14R65871
1818-2	SD025-G363.0D18CBNN	14R66349
1819-0	SG010-G361.3N18CDNN	14R62611
1819-1	SG010-G361.3N18CDNN	14R66731
1820-0	SG020-A162.5N18BDYY	14R56444
1821-0	SD010-K361.3D18CDYY	14R61243
1822-0	SD020-B363.0D18CDYY	14R58206
1822-1	SD020-B363.0D18CDYY	14R66747
1823-0	SG020-D361.3L36CDYY	14R62611
1824-0	SG036-B362.5N36CDYY	14R56444
1825-0	SG010-A161.3N18BDNN	14R62611
1825-1	SG010-A161.3N18BDNN	14R66343
1825-2	SG010-A161.3N18BDNN	14R66731
1826-0	SG100-J367.4L18ABNN	14R60637
1826-1	SG100-J367.4L18ABNN	14R65922
1827-0	SD100-K36133D18CBNN	14R61576
1827-1	SD100-K36133D18CBNN	14R65467
1827-2	SD100-K36133D18CBNN	14R66148
1828-0	SG020-B361.3L36DDNY	14R62611
1829-0	SG020-G362.5G18CDYY	14R56444
1830-0	SG036-J365.7L18CBNN	14R62614
1831-0	SD030-G363.0D18ADYY	14R59353
1832-0	SD100-K36133D18CBYY	14R61576
1832-1	SD100-K36133D18CBYY	14R63072
1832-2	SD100-K36133D18CBYY	14R64465
1832-3	SD100-K36133D18CBYY	14R65467
1832-4	SD100-K36133D18CBYY	14R66148
1833-0	SD150-K36133D18CBYY	14R61576
1833-1	SD150-K36133D18CBYY	14R64465
1833-2	SD150-K36133D18CBYY	14R65467
1833-3	SD150-K36133D18CBYY	14R65467
1833-4	SD150-K36133D18CBYY	14R66148
1834-0	SG020-D361.3N36ADNN	14R62611
1835-0	SG020-D361.3N36BDYY	14R62611
1836-0	SG020-K362.5L18CDYY	14R56444
1837-0	SG050-A165.7L18CBNN	14R62614
1838-0	SG085-G365.7N18CBNN	14R58786
1839-0	SG100-K367.4L18CBYY	14R60637
1839-1	SG100-K367.4L18CBYY	14R64457
1839-2	SG100-K367.4L18CBYY	14R65922
1840-0	SG010-A161.3N18CDYY	14R62611
1840-1	SG010-A161.3N18CDYY	14R66046
1840-2	SG010-A161.3N18CDYY	14R66343
1840-3	SG010-A161.3N18CDYY	14R66731
1841-0	SG020-B361.3L36BDNN	14R62611
1841-1	SG020-B361.3L36BDNN	14R64467
1842-0	SG020-D361.3G36ADYY	14R62611
1843-0	SG050-K365.7N18CBYY	14R62614
1843-1	SG050-K365.7N18CBYY	14R64451
1844-0	SG070-G367.4L18CBYY	14R62629
1844-1	SG070-G367.4L18CBYY	14R64455

1845-0	SG036-B362.5N36CDNN	14R56444
1846-0	SG050-A165.7G18ABYY	14R62614
1847-0	SG100-K367.4N18CBNN	14R60637
1847-1	SG100-K367.4N18CBNN	14R64457
1847-2	SG100-K367.4N18CBNN	14R65922
1848-0	SD010-G361.3D18BDYY	14R61243
1849-0	SD025-G363.0D18BBYY	14R59353
1850-0	SD040-P356.4D15ABNN	14R58725
1851-0	SG020-A162.5G18ADYY	14R56444
1852-0	SG036-A165.7N18CBYY	14R62614
1852-1	SG036-A165.7N18CBYY	14R64451
1852-2	SG036-A165.7N18CBYY	14R68032
1853-0	SD030-J363.0D18CBYY	14R59353
1853-1	SD030-J363.0D18CBYY	14R66737
1854-0	SG010-A161.3N18CDNN	14R62611
1854-1	SG010-A161.3N18CDNN	14R66343
1854-2	SG010-A161.3N18CDNN	14R66731
1855-0	SG020-D361.3G36ADYY	14R62611
1856-0	SG080-A165.7L18CBYY	14R58786
1857-0	SD025-D363.0D18ADNN	14R59353
1858-0	SD045-G366.4D18CBNN	14R57965
1859-0	SG085-K365.7N18CBYY	14R58786
1860-0	SD025-G363.0D18CDYY	14R59353
1861-0	SD050-J366.4D18ABYY	14R57965
1862-0	SG010-J361.3L18BDYY	14R62611
1863-0	SG020-B362.6L18CDNN	14R62955
1863-1	SG020-B362.6L18CDNN	14R66734
1864-0	SG070-K367.4G18ABYY	14R62629
1865-0	SD025-K363.0D18CBYY	14R59353
1865-1	SD025-K363.0D18CBYY	14R64459
1865-2	SD025-K363.0D18CBYY	14R65871
1865-3	SD025-K363.0D18CBYY	14R66737
1866-0	SG020-K362.5G18CDNY	14R56444
1867-0	SG036-A165.7L18CBYY	14R62614
1867-1	SG036-A165.7L18CBYY	14R64451
1868-0	SG010-G361.3N18DNNY	14R62611
1869-0	SG020-B362.5N18BDNY	14R56444
1870-0	SG020-B362.5N18BDYY	14R56444
1871-0	SD060-A166.4D18CBYY	14R57965
1871-1	SD060-A166.4D18CBYY	14R64447
1872-0	SG036-B362.5G36ADNY	14R56444
1873-0	SG100-D367.4L18CBYY	14R60637
1874-0	SG020-B361.3N36CDNN	14R62611
1875-0	SD035-B363.0D18CBYY	14R59353
1876-0	SD060-K366.4D18CBYY	14R57965
1876-1	SD060-K366.4D18CBYY	14R64447
1876-2	SD060-K366.4D18CBYY	14R64447
1876-3	SD060-K366.4D18CBYY	14R66439
1876-4	SD060-K366.4D18CBYY	14R66176
1877-0	SG020-B361.3N36CDYY	14R62611
1877-1	SG020-B361.3N36CDYY	14R66731
1878-0	SG020-B362.6N18BDNN	14R62955
1879-0	SG020-B362.6N18BDYY	14R62955
1880-0	SD030-K363.0D18BBYY	14R59353
1881-0	SD100-G36133D18BBNN	14R63072
1882-0	SD130-G36133D18CBNN	14R63072
1882-1	SD130-G36133D18CBNN	14R66148
1883-0	SG020-G362.6N18CDNN	14R6295
1884-0	SG020-G362.6N18CDYY	14R6295
1884-1	SG020-G362.6N18CDYY	14R66734
1885-0	SD010-A161.3D18CDYY	14R61243
1886-0	SD010-D361.3D18CDNN	14R61243
1887-0	SD045-G366.4D18CBYN	14R57965
1888-0	SD045-K366.4D18CBNN	14R57965
1889-0	SD050-G366.4D18BBYY	14R57965
1890-0	SD100-K36133D18BBYY	14R63072
1891-0	SG020-K362.6N18CDYY	14R62955
1891-1	SG020-K362.6N18CDYY	14R66734
1892-0	SG036-A165.7L18CBYN	14R62614
1893-0	SG036-A165.7L18CBYY	14R62614
1893-1	SG036-A165.7L18CBYY	14R64451
1893-2	SG036-A165.7L18CBYY	14R64451
1894-0	SD010-A161.3D18BDYY	14R61243
1895-0	SD010-A161.3D18BDYY	14R61243
1896-0	SG036-A165.7N18CBYY	14R62614
1896-1	SG036-A165.7N18CBYY	14R64451
1896-2	SG036-A165.7N18CBYY	14R64451
1897-0	SG050-A165.7N18CBYY	14R62614
1897-1	SG050-A165.7N18CBYY	14R64451
1898-0	SG050-G365.7N18BBYY	14R62614
1898-1	SG050-G365.7N18BBYY	14R64451
1899-0	SG070-B367.4N18CBYY	14R62629
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1901-0	SD035-G363.0D18BDYY	14R5935
1902-0	SD5.5-B360.8D18ADNY	14R60612
1903-0	SG020-D361.3L36BDNN	14R62611
1904-0	SG030-G362.6N18BDYY	
1904-1	SG030-G362.6N18BDYY	14R64469
1905-0	SD180-K36133D18CBYN	14R63072
1906-0	SD180-K36133D18CBYY	14R63072
1906-1	SD180-K36133D18CBYY	14R64465
1907-0	SD035-A163.0D18CDYY	14R59353
1907-1	SD035-A163.0D18CDYY	14R66737
1908-0	SD100-J36133D18CBNN	14R63072
1909-0	SG015-G362.6N18BDNN	14R62955
1910-0	SG025-A162.6L18CDYY	14R62955
1910-1	SG025-A162.6L18CDYY	14R64581
1911-0	SG010-G361.3L18BDYY	14R62611
1911-1	SG010-G361.3L18BDYY	14R66343
1912-0	SG020-B362.6N18BDNN	14R62955
1913-0	SG020-B362.6N18BDYY	14R62955
1914-0	SG036-G365.7N18CBNN	14R62614
1914-1	SG036-G365.7N18CBNN	14R64451
1914-2	SG036-G365.7N18CBNN	14R64451
1915-0	SD130-G36133D18CBYY	14R63072
1915-1	SD130-G36133D18CBYY	14R64465
1916-0	SD150-K36133D18CBNN	14R63072
1916-1	SD150-K36133D18CBNN	14R66148
1917-0	SD180-G36133D18CBYY	14R6307
1917-1	SD180-G36133D18CBYY	14R6446

1917-2	SD180-G36133D18CBYY	14R66148
1918-0	SD045-A166.4D18BBYY	14R57965
1919-0	SD080-B366.4D18CBYY	14R57965
1920-0	SG085-D365.7N18CBYY	14R58786
1921-0	SG070-G367.4N18CBYY	14R62629
1921-1	SG070-G367.4N18CBYY	14R64455
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1922-0	SG100-D367.4L18CBYY	14R60637
1922-1	SG100-D367.4L18CBYY	14R64457
1923-0	SD035-B363.0D18ABNN	14R59353
1924-0	SD060-D366.4D18CBYY	14R57965
1925-0	SG015-A162.6N18CDYY	14R62955
1926-0	SG020-B361.3N36ADNN	14R62611
1927-0	SD020-J363.0D18CDYY	14R58206
1927-1	SD020-J363.0D18CDYY	14R64461
1928-0	SD025-K363.0D18CDNN	14R59353
1929-0	SD180-G36133D18CBYY	14R63072
1929-1	SD180-G36133D18CBYY	14R66148
1930-0	SG020-G362.6N18CDNN	14R62955
1930-1	SG020-G362.6N18CDNN	14R64406
1930-2	SG020-G362.6N18CDNN	14R64469
1930-3	SG020-G362.6N18CDNN	14R66734
1931-0	SG070-A167.4N18CBYY	14R62629
1932-0	SG080-A165.7N18BBNY	14R58786
1933-0	SD010-A161.3D18CDYY	14R61243
1934-0	SG020-G362.6L18CDNN	14R62955
1934-1	SG020-G362.6L18CDNN	14R66734
1935-0	SD025-A163.0D18ADNN	14R59353
1936-0	SD030-A163.0D18ADNN	14R59353
1937-0	SD035-A163.0D18CDNN	14R59353
1937-1	SD035-A163.0D18CDNN	14R64459
1937-2	SD035-A163.0D18CDNN	14R66349
1938-0	SD035-D363.0D18CDNN	14R59353
1939-0	SD050-G366.4D18CBYY	14R57965
1939-1	SD050-G366.4D18CBYY	14R64447
1940-0	SD020-M153.0D15ADYY	
1941-0	SG020-A162.6N18CDNN	14R62955
1941-1	SG020-A162.6N18CDNN	14R66734
1942-0	SG020-B361.3G36BDNN	14R62611
1943-0	SG030-G362.6N18CDYY	14R62955
1943-1	SG030-G362.6N18CDYY	14R64469
1943-2	SG030-G362.6N18CDYY	14R66354
1943-3	SG030-G362.6N18CDYY	14R66734
1944-0	SG050-K365.7G18CBYY	14R62614
1945-0	SG070-J367.4G18CBNN	14R62629
1946-0	SG020-E361.3N36CDNN	14R62611
1947-0	SD010-B361.3D18BDYY	14R61243
1948-0	SD030-G363.0D18BDYY	14R59353
1949-0	SG015-K362.6N18CDNN	14R62955
1949-1	SG015-K362.6N18CDNN	14R66734
1950-0	SG030-G362.6N18CDYY	14R62955
1950-1	SG030-G362.6N18CDYY	14R64469
1950-2	SG030-G362.6N18CDYY	14R66354
1950-3	SG030-G362.6N18CDYY	14R66734
1951-0	SG070-K367.4N18CBYN	14R62629
1952-0	SD015-M153.0D15ADNN	
1953-0	SD015-N353.0D15ADNN	
1954-0	SD020-K363.0D18BDYY	14R58206
1955-0	SD045-A166.4D18CBYY	14R57965
1955-1	SD045-A166.4D18CBYY	14R64447
1956-0	SD060-K366.4D18CBNN	14R57965
1957-0	SG020-B361.3L36CDYY	14R62611
1958-0	SG020-B361.3N36ADNN	14R62611
1959-0	SG050-K365.7L18CBNN	14R62614
1960-0	SG050-G365.7N18CBNN	14R62614
1960-1	SG050-G365.7N18CBNN	14R64451
1961-0	SD060-B366.4D18CBNN	14R57965
1962-0	SG015-K362.6N18BDYY	14R62955
1963-0	SG020-B361.3L36BDYY	14R62611
1963-1	SG020-B361.3L36BDYY	14R66343
1964-0	SG050-G365.7N18BBNN	14R62614
1965-0	SG100-K367.4N18BBYY	14R60637
1965-1	SG100-K367.4N18BBYY	14R64457
1966-0	SD050-J366.4D18CBNN	14R57965
1967-0	SG020-G362.6L18CDNY	14R62955
1968-0	SG020-K362.6N18CBYY	14R62955
1969-0	SD020-A163.0D18BDNN	14R58206
1969-1	SD020-A163.0D18BDNN	
1970-0	SG025-K362.6N18CBYY	14R62955
1970-1	SG025-K362.6N18CBYY	14R66734
1971-0	SD025-E363.0D18CDNN	14R59353
1972-0	SD030-B363.0D18BDYN	14R59353
1973-0	SD030-M153.0D15ADNN	
1974-0	SG015-A162.6N18CDYY	14R62955
1974-1	SG015-A162.6N18CDYY	14R64406
1974-2	SG015-A162.6N18CDYY	14R64469
1974-3	SG015-A162.6N18CDYY	14R66734
1975-0	SG036-D365.7L18CBYY	14R62614
1975-1	SG036-D365.7L18CBYY	14R64451
1976-0	SD020-J363.0D18BDNN	14R58206
1977-0	SD030-G363.0D18CBNN	14R59353
1977-1	SD030-G363.0D18CBNN	14R64459
1977-2	SD030-G363.0D18CBNN	14R65871
1977-3	SD030-G363.0D18CBNN	14R66349
1977-4	SD030-G363.0D18CBNN	14R66737
1978-0	SD010-A161.3D18BDNN	14R61243
1979-0	SD045-G366.4D18ABYN	14R57965
1980-0	SD100-G36133D18CBYY	14R63072
1980-1	SD100-G36133D18CBYY	14R64465
1981-0	SD180-K36133D18CBNN	14R63072
1981-1	SD180-K36133D18CBNN	14R65467
1981-2	SD180-K36133D18CBNN	14R66148
1982-0	SG020-G361.3N36BDNN	14R62611
1982-1	SG020-G361.3N36BDNN	14R64467
1983-0	SD100-G366.4D18BBYY	14R57995
1984-0	SG020-A162.6N18ADNN	14R62955
1984-1	SG020-A162.6N18ADNN	14R64406
1985-0	SG036-K365.7N18CBYY	14R62614
1985-1	SG036-K365.7N18CBYY	14R64451
1985-2	SG036-K365.7N18CBYY	14R64451

1986-0	SG100-G367.4N18CBNN	14R60637
1986-1	SG100-G367.4N18CBNN	14R65922
1987-0	SG020-G362.6N18BDNN	14R62955
1988-0	SD035-K363.0D18CBYY	14R59353
1988-1	SD035-K363.0D18CBYY	14R64459
1988-2	SD035-K363.0D18CBYY	14R66737
1989-0	SG010-G361.3L18ADNN	14R62611
1989-1	SG010-G361.3L18ADNN	14R64467
1990-0	SG020-G361.3L36ADNN	14R62611
1990-1	SG020-G361.3L36ADNN	14R64467
1991-0	SG020-K362.5G18ADYY	
1992-0	SG070-G367.4N18CBYY	14R62629
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1993-0	SG070-K367.4N18CBYY	14R62629
1993-1	SG070-K367.4N18CBYY	14R64455
1994-0	SG080-A165.7N18BBYY	14R58786
1994-1	SG080-A165.7N18BBYY	14R64453
1995-0	SD150-G36133D18CBNN	14R63072
1995-1	SD150-G36133D18CBNN	14R65467
1995-2	SD150-G36133D18CBNN	14R66148
1996-0	SG020-A161.3G36ADYY	14R62611
1997-0	SG020-A162.6N18CDYY	
1998-0	SG020-G361.3L36BDNN	14R62611
1998-1	SG020-G361.3L36BDNN	14R64467
1999-0	SG020-G362.6N18BDYY	14R62955
1999-1	SG020-G362.6N18BDYY	14R64469
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2000-2	SG020-G362.6N18CDYY	14R62955
2000-3	SG020-G362.6N18CDYY	14R66734
2001-0	SG020-J361.3G36ADYY	14R62611
2001-1	SG020-J361.3G36ADYY	14R66343
2002-0	SG020-K362.6N18BDNN	14R62955
2003-0	SG030-A162.6L18CBNN	
2003-1	SG030-A162.6L18CBNN	14R64469
2004-0	SG030-K362.6N18CDNN	
2004-1	SG030-K362.6N18CDNN	14R66734
2005-0	SD010-K361.3D18ADYY	14R61243
2006-0	SD025-A163.0D18ABNN	14R59353
2007-0	SD020-A163.0D18CDNN	14R58206
2007-1	SD020-A163.0D18CDNN	14R64461
2007-2	SD020-A163.0D18CDNN	14R66348
2007-3	SD020-A163.0D18CDNN	14R66348
2008-0	SG036-J365.7N18CBNN	14R62614
2008-1	SG036-J365.7N18CBNN	14R64451
2009-0	SG050-K365.7N18CBNN	14R62614
2010-0	SG036-K365.7N18BBNN	14R62614
2011-0	SD010-A161.3D18BDNY	14R61243
2012-0	SD020-A163.0D18BDNN	14R58206
2012-1	SD020-A163.0D18BDNN	14R66747
2013-0	SD020-A163.0D18BDYN	14R58206
2014-0	SD020-J363.0D18BDNN	14R58206
2015-0	SD025-J363.0D18BDNN	14R59353
2016-0	SD030-J363.0D18BDNN	14R59353
2017-0	SD035-J363.0D18BDNN	14R59353
2018-0	SD025-A163.0D18CDYY	14R59353
2019-0	SD025-K363.0D18CDYY	14R59353
2020-0	SD035-K363.0D18CBYY	14R5935
2020-1	SD035-K363.0D18CBYY	14R6587
2020-2	SD035-K363.0D18CBYY	14R66737
2021-0	SD080-K366.4D18CBYY	14R57965
2021-1	SD080-K366.4D18CBYY	14R64447
2021-2	SD080-K366.4D18CBYY	14R66176
2022-0	SG020-A162.6L18BDNN	14R62955
2023-0	SG020-A162.6N18CDNN	14R62955
2023-1	SG020-A162.6N18CDNN	14R66734
2024-0	SG020-G362.6N18BDYY	14R62955
2024-1	SG020-G362.6N18BDYY	14R64406
2025-0	SG036-D362.5G36ADYY	14R56444
2026-0	SG036-E362.5G36ADNN	14R56444
2027-0	SG036-E362.5G36ADNN	14R56444
2028-0	SG100-G367.4N18BBNN	14R60637
2029-0	SD020-B363.0D18BDNN	14R58206
2030-0	SD080-G366.4D18BBYY	14R57965
2031-0	SG015-G362.6N18CDNN	14R62955
2031-1	SG015-G362.6N18CDNN	14R64469
2031-2	SG015-G362.6N18CDNN	14R66734
2032-0	SG030-A162.6N18CDNN	14R62955
2032-1	SG030-A162.6N18CDNN	14R66734
2033-0	SG030-J362.6L18BDNN	14R62955
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2034-1	SG050-A165.7L18CBYY	14R64451
2035-0	SG030-G362.6N18CBNN	14R62955
2035-1	SG030-G362.6N18CBNN	14R6446
2035-2	SG030-G362.6N18CBNN	14R6635
2035-3	SG030-G362.6N18CBNN	14R66734
2036-0	SD045-K366.4N18CBYY	14R57965
2037-0	SD130-G36133D18CBYY	14R63072
2037-1	SD130-G36133D18CBYY	14R64465
2037-2	SD130-G36133D18CBYY	14R66148
2038-0	SG050-B365.7N18CBNN	14R62614
2038-1	SG050-B365.7N18CBNN	14R64451
2039-0	SG070-G367.4N18BBNN	14R62629
2040-0	SG070-K367.4N18BBYY	14R62629
2041-0	SG085-G365.7N18BBYY	14R58786
2042-0	SD020-A163.0D18CDYY	14R58206
2042-1	SD020-A163.0D18CDYY	14R64461
2042-2	SD020-A163.0D18CDYY	14R66747
2043-0	SD025-A163.0D18BBYY	14R59353
2043-1	SD025-A163.0D18BBYY	14R66737
2044-0	SG010-A161.3N18CDYY	14R62611
2045-0	SG025-A162.6L18BDNN	14R64581
2046-0	SG025-A162.6L18CBNN	14R62955
2046-1	SG025-A162.6L18CBNN	14R64469
2047-0	SG025-A162.6N18BBNN	14R64581
2048-0	SG070-K367.4N18BBYY	14R62629
2049-0	SG020-A161.3N36CDNN	14R62611
2049-1	SG020-A161.3N36CDNN	14R66343
2049-2	SG020-A161.3N36CDNN	14R6673
2050-0	SD180-K36133D18CBYY	14R6307

2050-1	SD180-K36133D18CBYY	14R64465
2050-2	SD180-K36133D18CBYY	14R65467
2050-3	SD180-K36133D18CBYY	14R66148
2051-0	SG025-A162.6L18CDNN	14R64581
2052-0	SG025-A162.6N18CDNN	14R64581
2053-0	SG030-A162.6N18CBNN	
2053-1	SG030-A162.6N18CBNN	14R64469
2053-2	SG030-A162.6N18CBNN	14R66734
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2055-0	SG050-A165.7N18CBNN	14R62614
2055-1	SG050-A165.7N18CBNN	14R64451
2056-0	SG100-K367.4N18CBNN	14R60637
2056-1	SG100-K367.4N18CBNN	14R64457
2056-2	SG100-K367.4N18CBNN	14R65922
2057-0	SD025-A163.0D18ADYY	14R59353
2057-1	SD025-A163.0D18ADYY	14R66349
2057-2	SD025-A163.0D18ADYY	14R66737
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2058-1	SG050-G365.7L18CBNN	14R64451
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2060-1	SG070-G367.4L18CBNN	14R64455
2061-0	SG070-H367.4N18CBNN	14R62629
2062-0	SG100-J367.4L18CBNN	14R60637
2063-0	SD020-K363.0D18ADNN	14R58206
2064-0	SG050-A165.7N18CBNN	14R62614
2065-0	SD035-A163.0D18BDNN	14R59353
2066-0	SG025-A162.6N18CDYY	14R64581
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2067-1	SG050-J365.7N18CBYY	14R64451
2068-0	SG050-K365.7G18CBYY	14R62614
2069-0	SG085-G365.7N18CBYY	14R58786
2070-0	SG100-G367.4N18CBNN	14R60637
2070-1	SG100-G367.4N18CBNN	14R64457
2070-2	SG100-G367.4N18CBNN	14R65922
2071-0	SD180-G36133D18CBNN	14R63072
2071-1	SD180-G36133D18CBNN	14R65467
2071-2	SD180-G36133D18CBNN	14R66148
2072-0	SG025-A162.6L18CDNN	14R64581
2072-1	SG025-A162.6L18CDNN	14R66734
2073-0	SG050-K365.7N18BBYY	14R62614
2073-1	SG050-K365.7N18BBYY	14R64451
2073-2	SG050-K365.7N18BBYY	14R64451
2074-0	SD030-A163.0D18CBYY	14R59353
2074-1	SD030-A163.0D18CBYY	14R66349
2075-0	SG020-J362.6N18ADNN	14R64406
2076-0	SD025-J363.0D18BDYY	14R59353
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2078-0	SG036-K365.7G18CBYY	14R62614
2079-0	SG070-G367.4G18CBYY	14R62629
2080-0	SG070-G367.4L18BBNN	14R62629
2081-0	SD050-B366.4D18CBNN	14R57965
2082-0	SG070-G367.4N18BBNN	14R62629
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2084-0	SD130-J36133D18CBNN	14R64465
2085-0	SG010-G361.3N18BDYY	14R64467
2086-0	SG015-A162.6N18BDYY	14R64469
2086-1	SG015-A162.6N18BDYY	14R66354
2086-2	SG015-A162.6N18BDYY	14R66734
2087-0	SG030-G362.6N18CDNN	14R64469
2087-1	SG030-G362.6N18CDNN	14R66354
2087-2	SG030-G362.6N18CDNN	14R66734
2088-0	SG050-G365.7G18ABYY	14R64451
2089-0	SG070-K367.4N18ABNN	14R64455
2090-0	SG080-A165.7N18BBYY	14R64453
2091-0	SG010-G361.3N18CDYY	14R64467
2091-1	SG010-G361.3N18CDYY	14R66046
2091-2	SG010-G361.3N18CDYY	14R66343
2092-0	SG015-K362.6N18BDNN	14R64469
2092-1	SG015-K362.6N18BDNN	14R66734
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2093-1	SG050-J365.7L18CBYY	14R64451
2094-0	SD035-A163.0D18BDYY	14R64459
2095-0	SD100-G36133D18CBNN	14R64465
2095-1	SD100-G36133D18CBNN	14R65467
2095-2	SD100-G36133D18CBNN	14R66148
2096-0	SD080-K366.4D18CBNN	14R64447
2096-1	SD080-K366.4D18CBNN	14R66176
2097-0	SG015-A162.6L18CDNN	14R64469
2097-1	SG015-A162.6L18CDNN	14R66354
2098-0	SG045-G365.7L18CDNN	
2099-0	SD100-J36133D18CBYY	14R64465
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2101-0	SG036-K365.7N18ABYY	14R64451
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2103-0	SD025-C363.0D18ADYY	14R64459
2104-0	SD025-H363.0D18ABYY	14R64459
2105-0	SG036-J365.7G18ABYY	14R64451
2106-0	SG020-A161.3N36CDNN	14R64467
2107-0	SG020-G361.3G36ADYY	14R64467
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2108-1	SG025-G362.6N18BDYY	14R66734
2109-0	SG030-A162.6N18BDYY	14R64469
2109-1	SG030-A162.6N18BDYY	14R66734
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2111-1	SD020-G363.0D18BDYY	14R64461
2112-0	SD060-K366.4D18BBYY	14R64447
2112-1	SD060-K366.4D18BBYY	14R66176
2113-0	SG030-K362.6L18CDYY	14R64469
2114-0	SD020-B363.0D18CDYY	14R64461
2114-1	SD020-B363.0D18CDYY	14R64461
2114-2	SD020-B363.0D18CDYY	14R66348
2114-3	SD020-B363.0D18CDYY	14R66747
2115-0	SD035-B363.0D18CDYY	14R64459
2115-1	SD035-B363.0D18CDYY	14R64459

2115-2	SD035-B363.0D18CDYY	14R64459
2115-3	SD035-B363.0D18CDYY	14R65871
2115-4	SD035-B363.0D18CDYY	14R66349
2116-0	SD035-G363.0D18CBYY	14R64459
2116-1	SD035-G363.0D18CBYY	14R64459
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2116-3	SD035-G363.0D18CBYY	14R65871
2116-4	SD035-G363.0D18CBYY	14R66349
2117-0	SD040-G364.0D18CBYY	14R65329
2117-1	SD040-G364.0D18CBYY	14R66146
2117-2	SD040-G364.0D18CBYY	14R66740
2118-0	SD050-G364.0D18CBYY	14R65329
2118-1	SD050-G364.0D18CBYY	14R65329
2118-2	SD050-G364.0D18CBYY	14R65329
2118-3	SD050-G364.0D18CBYY	14R66146
2118-4	SD050-G364.0D18CBYY	14R66740
2119-0	SD060-G366.4D18CBYY	14R64447
2119-1	SD060-G366.4D18CBYY	14R64447
2119-2	SD060-G366.4D18CBYY	14R66176
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2120-1	SD080-G366.4D18CBYY	14R64447
2120-2	SD080-G366.4D18CBYY	14R66176
2121-0	SD100-G366.4D18CBYY	14R64449
2122-0	SG010-B361.3L18CDYY	14R64467
2122-1	SG010-B361.3L18CDYY	14R66046
2122-2	SG010-B361.3L18CDYY	14R66343
2123-0	SG020-A161.3L36CDYY	14R64467
2123-1	SG020-A161.3L36CDYY	14R66046
2124-0	SG020-G361.3N36CDYY	14R64467
2124-1	SG020-G361.3N36DCYY	14R66046
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2126-0	SG085-B365.7L18CBYY	14R64453
2127-0	SG100-B367.4L18CBYY	14R64457
2128-0	SD045-A166.4D18CBNN	14R64447
2129-0	SD050-A164.0D18CBYY	14R65329
2129-1	SD050-A164.0D18CBYY	14R65329
2129-2	SD050-A164.0D18CBYY	14R66740
2130-0	SD050-K364.0D18CBYN	14R65329
2131-0	SG020-A162.6L18CBNN	14R64469
2132-0	SG020-G361.3N36BDYY	14R64467
2133-0	SG030-K362.6N18CBYY	14R64469
2133-1	SG030-K362.6N18CBYY	14R66354
2133-2	SG030-K362.6N18CBYY	14R66734
2134-0	SG030-K362.6N18CBNN	14R64469
2134-1	SG030-K362.6N18CBNN	14R66354
2134-2	SG030-K362.6N18CBNN	14R66734
2134-3	SG030-K362.6N18CBNN	14R66734
2135-0	SG020-A161.3N36BDYY	14R64467
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2136-1	SG030-A162.6L18CDYY	14R66734
2136-2	SG030-A162.6L18CDYY	14R66734
2137-0	SG030-L362.6N18CBYY	14R64469
2138-0	SD025-J363.0D18CBNN	14R64459
2139-0	SG085-J365.7L18CBNN	14R64453
2140-0	SD050-K366.4D18CBYN	14R64447
2141-0	SD201-K36133D18CBYY	14R65637
2141-1	SD201-K36133D18CBYY	14R6615(
2141-2	SD201-K36133D18CBYY	14R66151
2141-3	SD201-K36133D18CBYY	14R66151
2141-4	SD201-K36133D18CBYY	14R68630
2142-0	SG070-G367.4G18CBYN	14R64455
2143-0	SD040-A164.0D18ABNN	14R65329
2144-0	SG030-A162.6N18BBNN	14R64469
2145-0	SG030-A162.6L18BDNN	14R64469
2145-1	SG030-A162.6L18BDNN	14R66354
2145-2	SG030-A162.6L18BDNN	14R66734
2146-0	SD101-G36133D18CBNN	14R65637
2146-1	SD101-G36133D18CBNN	14R66151
2146-2	SD101-G36133D18CBNN	14R66151
2146-3	SD101-G36133D18CBNN	14R66151
2147-0	SD131-G36133D18CBNN	14R65637
2147-1	SD131-G36133D18CBNN	14R66151
2147-2	SD131-G36133D18CBNN	14R66151
2147-3	SD131-G36133D18CBNN	14R66151
2147-4	SD131-G36133D18CBNN	14R66151
2148-0	SD151-G36133D18CBNN	14R65637
2149-0	SD151-G36133D18CBYY	14R65637
2149-1	SD151-G36133D18CBYY	14R66151
2150-0	SD151-G36133D18CBYY	14R65637
2150-1	SD151-G36133D18CBYY	14R66151
2151-0	SD181-G36133D18CBNN	14R65637
2152-0	SD181-G36133D18CBYY	14R65637
2152-1	SD181-G36133D18CBYY	14R6615(
2153-0	SD181-K36133D18CBYY	14R65637
2154-0	SD200-K36133D18CBYY	14R65467
2154-1	SD200-K36133D18CBYY	14R66148
2154-2	SD200-K36133D18CBYY	14R66148
2154-3	SD200-K36133D18CBYY	14R66148
2155-0	SD201-G36133D18CBYY	14R65637
2155-1	SD201-G36133D18CBYY	14R66151
2155-2	SD201-G36133D18CBYY	14R66151
2156-0	SD030-G363.0D18CDYY	14R64459
2157-0	SD050-G366.4D18CBNN	14R64447
2158-0	SG015-G362.6L18ADNN	14R64469
2159-0	SG015-G362.6L18BDYY	14R64469
2160-0	SG030-G362.6L18CBYY	14R64469
2160-1	SG030-G362.6L18CBYY	14R66354
2160-2	SG030-G362.6L18CBYY	14R66734
2161-0	SG030-K362.6L18CBNN	14R64469
2162-0	SG050-A165.7L18BBNN	14R64451
2163-0	SD035-G363.0D18CDYY	14R64459
2163-1	SD035-G363.0D18CDYY	14R66737
2164-0	SD035-J363.0D18ABYY	14R64459
2165-0	SD035-K363.0D18CDYY	14R64459
2166-0	SG015-A162.6L18BBNN	14R64469
2167-0	SG020-G361.3L36BDYY	14R64467
2168-0	SG025-A162.6L18CBYY	14R64469
2168-1	SG025-A162.6L18CBYY	14R6635
2168-2	SG025-A162.6L18CBYY	14R6673

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2169-1	SG030-J362.6L18CBNN	14R64469
2170-0	SD100-G366.4D18CBYY	14R64449
2170-1	SD100-G366.4D18CBYY	14R64449
2170-2	SD100-G366.4D18CBYY	14R67503
2171-0	SD035-D363.0D18CBYY	14R64459
2172-0	SD040-A164.0D18CBYY	14R65329
2172-1	SD040-A164.0D18CBYY	14R66740
2173-0	SG015-B362.6N18CDNN	14R64469
2173-1	SG015-B362.6N18CDNN	14R66734
2174-0	SD050-G364.0D18CBNN	14R65329
2174-1	SD050-G364.0D18CBNN	14R66146
2174-2	SD050-G364.0D18CBNN	14R66740
2175-0	SD080-J366.4D18CBNN	14R64447
2176-0	SD131-K36133D18CBNN	14R65637
2176-1	SD131-K36133D18CBNN	14R66151
2176-2	SD131-K36133D18CBNN	14R66151
2177-0	SG010-K361.3N18BDYY	14R64467
2178-0	SD181-K36133D18CBNN	14R65637
2179-0	SD030-K363.0D18CDNN	14R64459
2179-1	SD030-K363.0D18CDNN	14R66737
2180-0	SD050-K364.0D18CBYY	14R65329
2180-1	SD050-K364.0D18CBYY	14R65329
2180-2	SD050-K364.0D18CBYY	14R65329
2180-3	SD050-K364.0D18CBYY	14R66146
2180-4	SD050-K364.0D18CBYY	14R66740
2181-0	SD101-K36133D18BBNN	14R65637
2182-0	SD131-K36133D18CBYY	14R65637
2182-1	SD131-K36133D18CBYY	14R66151
2182-2	SD131-K36133D18CBYY	14R68630
2183-0	SG015-A162.6N18BBNN	14R64469
2184-0	SG015-B362.6N18BDYY	14R64469
2185-0	SG020-A162.6N18CDYY	14R64469
2186-0	SG025-A162.6L18BBNN	14R64469
2187-0	SD020-J363.0D18ADYY	14R64461
2188-0	SD050-K364.0D18BBYY	14R65329
2188-1	SD050-K364.0D18BBYY	14R65329
2189-0	SG050-K365.7L18CBYY	14R64451
2190-0	SG080-A165.7N18ABYY	14R64453
2191-0	SG085-K365.7N18BBYY	14R64453
2192-0	SD131-K36133D18CBYY	14R65637
2193-0	SD151-K36133D18CBYY	14R65637
2193-1	SD151-K36133D18CBYY	14R66151
2194-0	SG030-G362.6N18CBYY	14R64469
2195-0	SG015-A162.6N18BBYY	14R64469
2196-0	SG015-G362.6N18CDYY	14R64469
2196-1	SG015-G362.6N18CDYY	14R66734
2197-0	SG030-J362.6N18CBNN	14R64469
2197-1	SG030-J362.6N18CBNN	14R66734
2197-2	SG030-J362.6N18CBNN	14R66734
2198-0	SD010-A161.3D18ADYN	14R61243
2199-0	SD080-K366.4D18CBYN	14R64447
2200-0	SD100-K366.4D18CBYY	14R64449
2201-0	SG025-G362.6N18BDNN	14R64469
2201-1	SG025-G362.6N18BDNN	14R66734
2202-0	SG036-J365.7N18CBNN	14R64451
2202-1	SG035-J365.7N18CBNN	14R64451
2203-0	SG050-G365.7L18CBYY	14R64451
2204-0	SG050-K365.7N18CBYY	14R64451
2205-0	SD020-G363.0D18BDNN	14R64461
2206-0	SG030-B362.6N18CBYY	14R64469
2207-0	SG030-K362.6N18BDYY	14R64469
2208-0	SG085-B365.7N18CBYY	14R64453
2209-0	SD015-G363.0D18CBNN	
2210-0	SD015-G363.0D18CBYY	
2211-0	SD010-K361.3D18BDYN	14R61243
2212-0	SD020-B363.0D18BDYY	14R64461
2213-0	SG025-B362.6N18CBYY	14R64469
2213-1	SG025-B362.6N18CBYY	14R66734
2214-0	SG030-A162.6L18CBNN	14R64469
2214-1	SG030-A162.6L18CBNN	14R66354
2215-0	SD025-J363.0D18CBYY	14R65871
2215-1	SD025-J363.0D18CBYY	14R66349
2215-2	SD025-J363.0D18CBYY	14R66737
2216-0	SD030-B363.0D18CBYY	14R65871
2216-1	SD030-B363.0D18CBYY	14R66349
2217-0	SD030-J363.0D18ADYY	14R65871
2218-0	SD045-J366.4D18CBNN	14R64447
2218-1	SD045-J366.4D18CBNN	14R64447
2219-0	SD050-A164.0D18CBNN	14R65329
2219-1	SD050-A164.0D18CBNN	14R66740
2220-0	SD050-D364.0D18CBYY	14R65329
2220-1	SD050-D364.0D18CBYY	14R66740
2221-0	SD050-K364.0D18CBYY	14R65329
2221-1	SD050-K364.0D18CBYY	14R65329
2221-2	SD050-K364.0D18CBYY	14R66740
2222-0	SD060-J366.4D18CBNN	14R64447
2222-1	SD060-J366.4D18CBNN	14R64447
2222-2	SD060-J366.4D18CBNN	14R66439
2223-0	SD130-K36133D18ABYY	14R65467
2223-1	SD130-K36133D18ABYY	14R66148
2224-0	SD151-K36133D18BBYN	14R65367
2225-0	SG015-A162.6N18BDNN	14R64469
2225-1	SG015-A162.6N18BDNN	14R66734
2226-0	SG015-G362.6N18CDYY	14R64469
2226-1	SG015-G362.6N18CDYY	14R66354
2227-0	SG020-G361.3L36CDYY	14R64467
2227-1	SG020-G361.3L36CDYY	14R66046
2227-2	SG020-G361.3L36CDYY	14R66731
2228-0	SG025-A162.6L18CDYY	14R64469
2229-0	SG036-J365.7G18CBYY	14R64451
2229-1	SG036-J365.7G18CBYY	14R64451
2230-0	SG030-B362.6N18BDYY	14R64469
2230-1	SG030-B362.6N18BDYY	14R66354
2231-0	SG036-D365.7G18CBYY	14R64451
2232-0	SG025-G362.6N18CBNN	14R64469
2232-1	SG025-G362.6N18CBNN	14R66354
2232-2	SG025-G362.6N18CBNN	14R66734
2233-0	SD010-K361.3D18BDYY	14R61243
2234-0	SG025-A162.6L18BDYY	14R64469

2234-1	SG025-A162.6L18BDYY	14R66354
2235-0	SD030-D363.0D18ADYY	14R65871
2235-1	SD030-D363.0D18ADYY	14R66349
2236-0	SD030-K363.0D18CBNN	14R65871
2236-1	SD030-K363.0D18CBNN	14R66737
2237-0	SD050-J364.0D18CBYY	14R65329
2237-1	SD050-J364.0D18CBYY	14R65329
2237-2	SD050-J364.0D18CBYY	14R66740
2238-0	SD025-K363.0D18BBYY	14R65871
2238-1	SD025-K363.0D18BBYY	14R66349
2239-0	SD035-K363.0D18ABYY	14R65871
2239-1	SD035-K363.0D18ABYY	14R66349
2240-0	SD050-K364.0D18CBNN	14R65329
2240-1	SD050-K364.0D18CBNN	14R66740
2241-0	SD080-K366.4D18ABYY	14R64447
2241-1	SD080-K366.4D18ABYY	14R64447
2241-2	SD080-K366.4D18ABYY	14R66176
2242-0	SG050-A165.7N18BBYY	14R64451
2242-1	SG050-A165.7N18BBYY	14R64451
2243-0	SG025-G362.6N18CBYY	14R64469
2243-1	SG025-G362.6N18CBYY	14R66354
2243-2	SG025-G362.6N18CBYY	14R66734
2244-0	SG036-D365.7N18CBNN	14R64451
2245-0	SG036-K365.7L18ABYY	14R64451
2246-0	SG050-J365.7N18CBNN	14R64451
2247-0	SG070-K367.4L18CBYY	14R64455
2248-0	SG100-K367.4N18CBYY	14R64457
2248-1	SG100-K367.4N18CBYY	14R65922
2249-0	SG020-J362.6N18BDNN	14R64469
2249-1	SG020-J362.6N18BDNN	14R66354
2250-0	SG020-K361.3N36BDYY	14R66046
2250-1	SG020-K361.3N36BDYY	14R66343
2250-2	SG020-K361.3N36BDYY	14R66731
2251-0	SG100-K367.4N18BBYN	14R64457
2252-0	SD050-G366.4D18BBNN	14R64447
2253-0	SD150-G36133D18CBYY	14R65467
2253-1	SD150-G36133D18CBYY	14R66148
2254-0	SG015-A162.6N18BBYY	14R64469
2254-1	SG015-A162.6N18BBYY	14R66354
2254-2	SG015-A162.6N18BBYY	14R66734
2255-0	SG020-A161.3N36BDNN	14R66046
2255-1	SG020-A161.3N36BDNN	14R66343
2256-0	SG025-D362.6N18CBNN	14R64469
2256-1	SG025-D362.6N18CBNN	14R66354
2257-0	SG030-G362.6L18CDYY	14R64469
2257-1	SG030-G362.6L18CDYY	14R66354
2258-0	SG085-K365.7L18CBYY	14R64453
2259-0	SG100-G367.4L18CBYY	14R64457
2259-1	SG100-G367.4L18CBYY	14R65922
2260-0	SG030-A162.6L18CDNN	14R64469
2260-1	SG030-A162.6L18CDNN	14R66354
2261-0	SD030-A163.0D18CDNN	14R65871
2261-1	SD030-A163.0D18CDNN	14R66349
2262-0	SG020-A161.3L36BDNN	14R66046
2262-2	SG020-A161.3L36BDNN	14R66731
2263-0	SG020-A161.3L36BDYY	14R66046
2263-1	SG020-A161.3L36BDYY	14R6634[illegible]
2263-2	SG020-A161.3L36BDYY	14R6673[illegible]
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2264-1	SG030-G362.6L18CBNN	14R66354
2265-0	SG036-G365.7L18BBYY	14R64451
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2267-0	SD035-A163.0D18ABYY	14R65871
2267-1	SD035-A163.0D18ABYY	14R66349
2268-0	SD025-J363.0D18ABYY	14R66349
2268-1	SD025-J363.0D18ABYY	14R66737
2269-0	SD050-D364.0D18CBYY	14R65329
2270-0	SG030-A162.6N18BBNN	14R66354
2271-0	SG030-A162.6N18BBYN	14R66354
2272-0	SG050-B365.7N18BBYY	14R64451
2273-0	SD030-D363.0D18CDYY	14R66349
2274-0	SD050-G364.0D18BBNN	14R66146
2275-0	SG015-A162.6N18BDYY	14R66354
2275-1	SG015-A162.6N18BDYY	14R66734
2276-0	SG050-D365.7L18BBNN	14R64451
2277-0	SG100-K367.4N18ABNN	14R64457
2278-0	SG015-B362.6L18CBYY	14R66354
2278-1	SG015-B362.6L18CBYY	14R66734
2279-0	SG020-A161.3L18CDYY	14R66343
2280-0	SG020-B361.3N18CDYY	14R66343
2281-0	SG020-G362.6N18CBYY	14R66354
2281-1	SG020-G362.6N18CBYY	14R6673[illegible]
2282-0	SG025-K362.6N18CBYY	14R6635[illegible]
2283-0	SD025-G363.0D18CDYY	14R66349
2284-0	SD030-K363.0D18BDYY	14R66349
2284-1	SD030-K363.0D18BDYY	14R66737
2285-0	SD020-K363.0D18BBNN	14R66348
2286-0	SD025-J363.0D18CBNN	14R66349
2287-0	SD020-G363.0D18CBNN	14R66348
2287-1	SD020-G363.0D18CBNN	14R66747
2288-0	SD020-K363.0D18CBYY	14R66348
2289-0	SD030-K363.0D18CBYY	14R66349
2289-1	SD030-K363.0D18CBYY	14R66737
2290-0	SD050-B364.0D18CBYY	14R66146
2290-1	SD050-B364.0D18CBYY	14R66740
2291-0	SD080-K366.4D18BBYY	14R64447
2292-0	SG015-B362.6G18ADYY	14R66354
2293-0	SG025-A162.6N18BDYY	14R66354
2294-0	SG030-A162.6N18CBNN	14R66354
2294-1	SG030-A162.6N18CBNN	14R66734
2295-0	SG030-G362.6N18BDNN	14R66354
2296-0	SG036-G365.7N18BBYY	14R64451
2297-0	SG036-G365.7N18BBYY	14R64451
2298-0	SG020-A161.3L36ADNN	14R66343
2299-0	SD020-G363.0D18CBYY	14R66348
2299-1	SD020-G363.0D18CBYY	14R66747
2300-0	SG025-G362.6L18CDYY	14R66354

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2303-0	SG020-A161.3G36CDNN	14R66343
2304-0	SG020-A162.6L18BBNN	14R66354
2305-0	SG020-A162.6N18CBNN	14R66354
2306-0	SG030-J362.6N18CBYY	14R66354
2307-0	SD130-G36133D18BBNN	14R66148
2308-0	SG020-A162.6G18ADYY	14R66354
2309-0	SD020-K363.0D18ABYY	14R66348
2310-0	SD040-K364.0D18ABYY	14R66146
2311-0	SD020-D363.0D18CBNN	14R66348
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2318-0	SG050-D365.7L18CBYY	14R64451
2319-0	SD040-K364.0D18CBNN	14R66146
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2324-1	SG030-D362.6N18CBNN	14R66734
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2327-0	SG100-J367.4N18CBYY	14R64457
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2329-0	SD035-K363.0D18ABYY	14R66737
2330-0	SD050-B364.0D18BBYY	14R66740
2331-0	SD100-K36133D18BBNN	14R66148
2332-0	SD200-G36133D18CBYY	14R66148
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2337-0	SD101-K36133D18CBYY	14R66151
2337-1	SD101-K36133D18CBYY	14R66151
2337-2	SD101-K36133D18CBYY	14R66151
2337-3	SD101-K36133D18CBYY	14R68630
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2340-0	SG050-B365.7N18CBYY	14R64451
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2341-1	SG075-J365.7N18CBNN	14R65918
2341-2	SG075-J365.7N18CBNN	14R68034
2342-0	SG020-D362.6N18CDNN	14R66734
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2345-1	SG075-K365.7N18CBNN	14R65918
2345-2	SG075-K365.7N18CBNN	14R68034
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2353-1	SD080-K366.4D18ABYY	14R66176
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2355-0	SG015-K362.6N18BBNN	14R66734
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2357-0	SG021-A162.6N18BBNN	14R66603
2358-0	SG036-K365.7L18CBYY	14R64451
2359-0	SG036-J365.7N18CBYY	14R64451
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2364-0	SG030-B362.6L18BBYY	14R66734
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2367-0	SD030-B363.0D18CBNN	14R66737
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2371-0	SG030-K362.6N18CDNN	14R66734
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2373-1	SG075-K365.7N18CBYY	14R68034
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2380-1	SD201-K36133D18CBNN	14R66151
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2386-0	SD181-K36133D18CBYY	14R66151
2386-1	SD181-K36133D18CBYY	14R68630
2387-0	SG050-G365.7N18BBNY	14R64451
2388-0	SG075-G365.7N18CBYY	14R65918
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2389-0	SD020-K363.0D18CBNN	14R66747
2390-0	SD025-K363.0D18ABYY	14R66737
2391-0	SD050-D364.0D18CBNN	14R66740
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2393-0	SD181-K36133D18CBNN	14R66151
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2403-0	SD030-B363.0D18BDNN	14R66737
2404-0	SD100-J366.4D18CBNN	14R64449
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2408-0	SG036-J365.7N18CBNY	14R64451
2409-0	SG050-B365.7N18CBNN	14R64451
2410-0	SD100-G366.4D18CBNN	14R64449
2410-1	SD100-G366.4D18CBNN	14R67503
2410-2	SD100-G366.4D18CBNN	14R67503
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2411-1	SG070-G367.4G18CBYN	14R65920
2412-0	SD100-D366.4D18CBNN	14R64449
2413-0	SD020-A163.0D18CBYY	14R66747
2414-0	SD020-K363.0D18CBYY	14R66747
2415-0	SD040-K364.0D18ABYY	14R66740
2416-0	SD050-K364.0D18ABYY	14R66740
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2418-0	SD020-A163.0D18CBNN	14R66747
2419-0	SD040-G364.0D18BBYY	14R66740
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2422-0	SG060-G367.4N18CBNN	14R65920
2423-0	SG100-G367.4N18BBYY	14R65922
2423-1	SG100-G367.4N18BBYY	14R65922
2424-0	SG025-G362.6L18CBYY	14R66734
2425-0	SG031-G362.6L18CBNN	14R66603
2426-0	SG100-G367.4L18CBNN	14R65922
2427-0	SD025-A163.0D18CBNN	14R66737
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2429-1	SD131-G36133D18CBYY	14R68630
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2433-1	SG036-A165.7N18BBNN	14R68032
2434-0	SG080-A165.7L18CBYY	14R65918
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2436-0	SG060-K367.4N18CBYY	14R65920
2437-0	SG065-G367.4L18CBYY	14R65920
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2439-0	SG065-K367.4L18CBYY	14R65920
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2441-0	SG020-K361.3N36BDNN	14R66731
2442-0	SG036-J365.7L18CBYY	14R64451
2443-0	SG020-K362.6L18CDYY	14R66734
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2445-0	SD010-J361.3D18ADYN	14R6124
2446-0	SD020-D363.0D18ADYY	14R66747
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2469-0	SG025-D362.6N18CBYY	14R66734
2470-0	SG075-G365.7N18CBNN	14R6591
2470-1	SG075-G365.7N18CBNN	14R68034
2471-0	SG020-A161.3G36CDYY	14R66731
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2473-0	SG100-J367.4N18ABNN	14R65922
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2475-0	SD101-G36133D18CBNN	14R66151
2476-0	SD010-G361.3D18CDYN	14R61243
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2478-0	SD040-G364.0D18CBNN	14R66740
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2483-0	SG080-A165.7L18CBNN	14R65918
2484-0	SD020-K363.0D18BDNN	14R66747
2485-0	SD020-J363.0D18BBYY	14R66747
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2489-0	SD130-K36133D18BBYY	14R66148
2490-0	SG030-J362.6N18BDYY	14R66734
2491-0	SD025-D363.0D18CDYY	14R66737
2492-0	SG015-G362.6N18BDNN	14R66734
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2493-1	SG036-A165.7N18BBYY	14R6803
2494-0	SG036-G365.7N18BBNN	14R6445

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2496-0	SD080-A166.4D18CBNN	14R66176
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3093-0	SG020-J362.6N18CBYY	14R66734
3094-0	SD010-G361.3D18CDNN	14R61243
3095-0	SD020-G363.0D18BBYY	14R66747
3096-0	SD040-A164.0D18BBYY	14R66740
3097-0	SG030-K362.6N18BBYY	14R66734
3098-0	SD050-K364.0D18ABYY	14R66740
3099-0	SG030-K362.6N18CDYY	14R66734

3100-0	SG045-A165.7N18ABNN	14R68032
3101-0	SG045-B365.7N18CBYY	14R68032
3102-0	SG020-K362.6N18CBNN	14R66734
3103-0	SD050-A164.0D18BBYY	14R66740
3104-0	SG045-A165.7N18ABYY	14R68032
3105-0	SG060-G367.4N18BBYY	14R65920
3106-0	SG065-A167.4L18CBNN	14R65920
3107-0	SG010-K361.3G18ADNN	14R66731
3108-0	SG020-G362.6G18ADYY	14R66734
3109-0	SG020-A162.6N18CBYY	14R66734
3110-0	SD025-D363.0D18CBNN	14R66737
3111-0	SD025-D363.0D18ADYY	14R66737
3112-0	SD025-D363.0D18ADYY	14R66737
3113-0	SG065-A167.4L18BBNN	14R65920
3114-0	SD100-J366.4D18CBNN	14R67503
3115-0	SG015-A162.6L18BDYY	14R66734
3116-0	SG075-J365.7N18CBNN	14R68034
3117-0	SG025-A162.6N18CBYY	14R66734
3118-0	SG036-D365.7G18ABYY	14R68032
3119-0	SD020-A163.0D18CXNN	14R66747
3120-0	SD020-G363.0D18CXNN	14R66747
3121-0	SD020-K363.0D18CXNN	14R66747
3122-0	SD025-A163.0D18CXNN	14R66737
3123-0	SD025-G363.0D18CXNN	14R66737
3124-0	SD025-K363.0D18CXNN	14R66737
3125-0	SD030-A163.0D18CXNN	14R66737
3126-0	SD030-G363.0D18CXNN	14R66737
3127-0	SD030-K363.0D18CXNN	14R66737
3128-0	SD035-A163.0D18CXNN	14R66737
3129-0	SD035-G363.0D18CXNN	14R66737
3130-0	SD035-K363.0D18CXNN	14R66737
3131-0	SD040-A164.0D18CBNN	14R66740
3132-0	SD040-G364.0D18CBNN	14R66740
3133-0	SD040-K364.0D18CBNN	14R66740
3134-0	SD050-A164.0D18CBNN	14R66740
3135-0	SD050-G364.0D18CBNN	14R66740
3136-0	SD050-K364.0D18CBNN	14R66740
3137-0	SD060-G366.4D18CBNN	14R66176
3138-0	SD060-K366.4D18CBNN	14R66176
3139-0	SD080-G366.4D18CBNN	14R66176
3140-0	SD080-K366.4D18CBNN	14R66176
3141-0	SD100-K366.4D18CBYY	14R67503
3142-0	SD101-G36133D18CBNN	14R68630
3143-0	SD101-K36133D18CBNN	14R68630
3144-0	SD131-G36133D18CBNN	14R68630
3145-0	SD131-K36133D18CBNN	14R68630
3146-0	SD151-G36133D18CBNN	14R68630
3147-0	SD151-K36133D18CBNN	14R68630
3148-0	SD181-G36133D18CBNN	14R68630
3149-0	SD181-K36133D18CBNN	14R68630
3150-0	SD201-G36133D18CBNN	14R68630
3151-0	SD201-K36133D18CBNN	14R68630
3152-0	SG010-A161.3G18CDNN	14R66731
3153-0	SG010-G361.3G18CDNN	14R66731
3154-0	SG010-K361.3G18CDNN	14R66731
3155-0	SG015-A162.6G18CXNN	14R66734
3156-0	SG015-G362.6G18CXNN	14R66734
3157-0	SG015-K362.6G18CXNN	14R6673
3158-0	SG020-A161.3G36CDNN	14R6673
3159-0	SG020-A162.6X18CXNN	14R66734
3160-0	SG020-G361.3X36CDNN	14R66731
3161-0	SG020-G362.6X18CXNN	14R66734
3162-0	SG020-K361.3X36CDNN	14R66731
3163-0	SG020-K362.6X18CXNN	14R66734
3164-0	SG025-A162.6X18CXNN	14R66734
3165-0	SG025-G362.6X18CXNN	14R66734
3166-0	SG025-K362.6X18CXNN	14R66734
3167-0	SG030-A162.6X18CXNN	14R66734
3168-0	SG030-G362.6X18CXNN	14R66734
3169-0	SG030-K362.6X18CXNN	14R66734
3170-0	SG036-A165.7X18CBNN	14R68032
3171-0	SG036-G365.7X18CBNN	14R68032
3172-0	SG036-K365.7X18CBNN	14R68032
3173-0	SG045-A165.7X18CBNN	14R68032
3174-0	SG045-G365.7X18CBNN	14R68032
3175-0	SG045-K365.7X18CBNN	14R68032
3176-0	SG065-A167.4X18CBNN	14R65920
3177-0	SG065-G367.4X18CBNN	14R65920
3178-0	SG065-K367.4X18CBNN	14R65920
3179-0	SG080-K365.7X18CBYY	14R68034
3180-0	SG100-K367.4X18CBYY	14R65922
3181-0	SG015-K362.6N18CBNN	14R66734
3182-0	SG030-A162.6N18CBYY	14R66734
3183-0	SD100-K366.4D18CBNN	14R6750
3184-0	SG045-K365.7L18CBYY	14R6803
3185-0	SG010-G361.3N18CDNN	14R66731
3186-0	SG060-J367.4N18CBYY	14R65920
3187-0	SG060-J367.4N18CBYY	14R65920
3188-0	SG045-K365.7L18CBNN	14R68032
3189-0	SG016-G362.6N18CDNN	14R66603
3190-0	SG045-A165.7L18CBNN	14R68032
3191-0	SD030-B363.0D18CDYY	14R66737
3192-0	SD030-J363.0D18CBNN	14R66737
3193-0	SG015-A162.6N18CBYY	14R66734
3194-0	SG020-B362.6N18CDYY	14R66734
3195-0	SG025-B362.6L18CDYY	14R66734
3196-0	SG030-K362.6N18BBNN	14R66734
3197-0	SG045-G365.7N18BBNN	14R68032
3198-0	SG050-A165.7G18CBYY	14R68032
3199-0	SD200-K36133D18CBYN	14R66148
3200-0	SD201-K36133D18CBYN	14R68630
3201-0	SG021-K362.6N18CBNN	14R66603
3202-0	SG036-K365.7N18BBNN	14R68032
3203-0	SG045-D365.7L18BBYY	14R68032
3204-0	SG060-A167.4N18CBYY	14R65920
3205-0	SD020-D363.0D18CDYY	14R66747
3206-0	SG015-A162.6N18CDNN	14R66734
3207-0	SG020-K362.6N18BBNN	14R66734
3208-0	SG030-K362.6N18BBNN	14R6673
3209-0	SD025-K363.0D18CBNN	14R6673

3210-0	SD020-A163.0D18CBNN	14R66747
3211-0	SD050-D364.0D18ABYY	14R66740
3212-0	SD050-G364.0D18CBNN	14R66740
3213-0	SD101-G36133D18CBYY	14R68630
3214-0	SG015-G362.6N18BBNN	14R66734
3215-0	SG020-G362.6N18BBNN	14R66734
3216-0	SD040-A164.0D18BBYY	14R66740
3217-0	SD010-A162.2D18CBYY	14R66649
3218-0	SD010-A162.2D18CBNN	14R66649
3219-0	SD010-G362.2D18CBNN	14R66649
3220-0	SD010-K362.2D18CBNN	14R66649
3221-0	SD012-A162.2D18CBNN	14R66649
3222-0	SD012-G362.2D18CBNN	14R66649
3223-0	SD012-K362.2D18CBNN	14R66649
3224-0	SD015-A162.2D18CBNN	14R66649
3225-0	SD015-G362.2D18CBNN	14R66649
3226-0	SD015-K362.2D18CBNN	14R66649
3227-0	SD017-A162.2D18CBNN	14R66649
3228-0	SD017-G362.2D18CBNN	14R66649
3229-0	SD017-K362.2D18CBNN	14R66649
3230-0	SD060-A166.4D18BBYY	14R66176
3231-0	SG020-G362.6G18CDYY	14R66734
3232-0	SG025-A162.6N18BDNN	14R66734
3233-0	SD010-A162.2D18CDYY	14R66649

1.3- MANUAL "R" LEVEL CHART

Use this CHART in conjunction with 1.2, SPECIFICATIONS AND FEATURES- MODEL 1100 SERIES GENERATORS, to locate Instructions and Parts Manuals part numbers and electrical schematics/wiring diagrams for specific standby generator models. The CHART may be used as follows:-

a. In 1.2, find the specific MODEL NUMBER of the applicable standby generator set. Locate the MANUAL "R" LEVEL for that MODEL NUMBER in the CHART.
b. Find the desired MANUAL "R" LEVEL in this CHART, as well as the correct INSTRUCTIONS AND PARTS MANUAL PART NUMBER and the drawing number for applicable electrical schematics/wiring diagrams.

1= CONTROL PANEL WIRING DIAGRAM
2= GENERATOR WIRING DIAGRAM
3= ENGINE WIRING DIAGRAM
4= SCHEMATIC- GENERATOR RECONNECTION
5= A-C POWER SCHEMATIC
6= D-C CONTROL SCHEMATIC

MANUAL "R" LEVEL	INSTRUCTION MANUAL	WIRING DIAGRAMS			SCHEMATICS		
		1	2	3	4	5	6
14R56435	56436	55988	55989	55990		56469	
14R56444	56445	55988	56468	55990		56469	
14R56749	57151	56704	56468	56759		58920	
14R57746	56863	56704	56468	58921		58920	
14R57965	57966	56704	55989	61717		58920	
14R57995	58735	56704	55989	56759		58920	
14R58063	58064	55988	55989	55990		56469	
14R58206	58207	56704	56468	58921		58920	
14R58337	58084	58218 58391	58219	57217	58394	58394	58393
14R58564	58769	55988	55989	55990		56469	
14R58573	58576	58218 58391	58219	58217	58394	58392	58393
14R58725	58719	56704	56468	56759		58920	
14R58786	59323	55988	55989	55990		56469	
14R58919	58925	56704	56468	58921		58920	
14R58939	58940	56704	56468	58921		58920	
14R59353	59382	56704	56468	58921 60804		58920	
14R59404	59405	55988	56468	59417		56469	
14R59911	60146	56704	60370	56759		58920	
14R60006	59497	59499	56468	55990		59490	
14R60612	60622	58218 58391	58219		58394	58392	58393
14R60636	60638	55988	55989	55990		56469	
14R60637	60639	55988	55989	55990		56469	
14R61093	61094	61384	61307	61381		61390	
14R61243	63446	63438	56468	58217		62322	
14R61251 14R61354	61252	59499	56468	55990		59490	
14R61576	61575	56704	61594	61717		58920	
14R61645	61985	62323	62302 62321	62301 62320		61984 62322	

MANUAL "R" LEVEL	INSTRUCTION MANUAL	WIRING DIAGRAMS			SCHEMATICS		
		1	2	3	4	5	6
14R62611	62610	62323	62302 62321	62301 62320		61984 62322	
14R62614	62612	55988	55989	55990		56469	
14R62629	62613	55988	55989	55990		56469	
14R62955	62981	62323	62302 62321	63485 63486		62322 63203	
14R63072	63073	56704	61594	61717		58920	
14R64406	64407	62323	62302 62321	63485 63486		63203 62322	
14R64447	64448	64813 64390 64391	64444	64812		64488	
14R64449	64450	64813 64390 64391	64444	64812		64488	
14R64451	64452	64392 64390 64391	64444	64487		64486	
14R64453	64454	64392 64390 64391	64444	64487		64486	
14R64455	64456	64392 64390 64391	64444	64487		64486	
14R64457	64458	64392 64391 64390	64444	64487		64486	
14R64459	64460	64390 64391 64813	64444	60804 65085		64488	
14R64461	64462	64390 64391 64813	64444	60804 65085		64488	
14R64465	64466	64390 64391 64813	64822	64812		64488	
14R64467	64468	64392 64391 64390	64444	54485		64486	
14R64469	64470	64392 64390 64391	64444	64483		64486	
14R64581	64592	62323	62302 62321	63485 63486		62322 63203	
14R64590	64591	62323	62302 62321	63485 63486		62322 63203	
14R65329	65330	64813 64390 64391	65365	65369		64488	
14R65467	65468	64813 64390 64391	64822	64812		64488	

MANUAL "R" LEVEL	INSTRUCTION MANUAL	WIRING DIAGRAMS			SCHEMATICS		
		1	2	3	4	5	6
14R65637	65638	64813 64390 64391	64822	64812		64488	
14R65871	65872	64813 64390 64391	65365	65085 60804		64488	
14R65916	65917	64390 64391 64392	65365	64487		64486	
14R65918	65918	64390 64391 64392	64487 64822			64486	
14R65920	65921	64390 64391 64392	65365	64487		64486	
14R65922	65923	64390 64391 64392		64487		64486	
14R66046	66047	64392 64390 64391	64444	64485		64486	
14R66146	66147	64390 64391 64813	65365	66145		66144	66563
14R66148	66149	64813 64390 64391	64822	66144		66145	66563
14R66151	66152	64390 64391 64813	64822	66144		66145	66563
14R66176							
14R66343	66344	64392 64391 64390	64444	64485		64486	66563
14R66348	66351	64390 64391 64813	64444	60804 65085		64488	66563
14R66349	66350	64390 64391 64813		60804 65085		64488	66563
14R66350	66351	64390 64391 64813	64444	60804 65085		64488	66563
14R66354	66355	64390 64391 64392	64444	64483		64486	66563
14R66439	66440	64390 64391 64813	64444	64483		64486	
14R66603	66604	64390 64391 64392	64444	64483		64486	

MANUAL "R" LEVEL	INSTRUCTION MANUAL	WIRING DIAGRAMS			SCHEMATICS		
		1	2	3	4	5	6
14R66649	66650	64390 64391 64813	64444	68440		64488	
14R66731	66732	64390 64391	64444	64485		64486	
14R66734	66735	64390 64391 64392	64444	64483		64486	
14R66737	66738	64390 64391 64813	60804	65085		64488	
14R66740	66741	64390 64391 64813	65365	66145		66144	
14R66747	66754	64390 64391 64813	64444	65085		64488	
14R67503	67504	64390 64813 64391	64444	67021		66144	
14R68032	68033	64390 64391 64392	65365	64487		64486	
14R68034	68035	64390 64391 64392	64822	64487		64486	
14R68630	68631	64390 64391 64813	64822	67021		66144	

1.4- NOMINAL RESISTANCE VALUES FOR ROTOR AND STATOR WINDINGS

KW	FIELD POLES	PHASE	*** TYPE	ROTOR PART NO.	OHMS	STATOR PART NO.	**** TYPE	1	2	3
5.5	4	1	B	B57473	4.6	58313	A	0.27	1.90	
5.5	4	3	B	B57473	4.6	60096	B	0.38	0.76	3.40
10.0	4	1	B	A57473	5.6	57836	A	0.11	1.43	
10.0	4	3	B	A57473	5.6	58071	B	0.15	0.30	1.40
10.0	4	3	B	A57473	5.6	59820*	C	0.30	1.25	
15.0	4	1	B	57738	5.1	57739	A	0.07	0.83	
15.0	4	3	B	57738	5.1	57740	B	0.83	0.17	0.97
15.0	4	3	B	57738	5.1	57743**	C	0.16	1.10	
15.0	4	1	S	A63215	13.7	63265	A	0.07	0.40	
20.0	2	1	B	58970	8.5	61922A 61921A*	A			
20.0	2	3	B	58970	8.5	58975A	B	0.07	0.14	0.45
20.0	4	1	B	57726	6.5	49923	A	0.06	0.85	
20.0	4	3	B	57726	6.5	57727	B	0.08	0.11	0.85
25.0	4	1	B	59507	6.5	59509	A	0.06	0.42	
25.0	4	3	B	59851	6.5	59508*	B	0.07	0.15	1.00
30.0	4	1	B	59368	7.8	59375	A	0.04	0.54	
30.0	4	3	B	59368	7.8	59376	B	0.04	0.10	0.77
30.0	4	3	B	59368	7.8	59858*	C	0.09	0.72	0.87
30.0	4	1	S	59516	7.8	59375	A	0.04	0.37	
30.0	4	3	S	59516	7.8	59376	B	0.04	1.00	0.37
30.0	4	3	S	59516	7.8	59858*	C	0.09	0.42	
35.0	4	1	B	59368	7.8	59375	A	0.04	0.54	
35.0	4	3	B	59368	7.8	59376	B	0.04	0.10	0.77
35.0	4	3	B	59368	7.8	59858*	C	0.09	0.72	0.87
35.0	4	1	S	59516	7.8	59375	A	0.04	0.37	
35.0	4	3	S	59516	7.8	59376	B	0.04	1.00	0.37
35.0	4	3	S	59516	7.8	59858*	C	0.09	0.42	
36.0	2	1	B	A49908	8.0	49918	A	0.02	0.50	
36.0	2	1	B	A49908	8.0	49921	B	0.03	0.05	0.40
36.0	4	1	S	58583	7.8	58580	A	0.04	0.18	
36.0	4	3	S	58583	7.8	58774	B	0.04	0.08	1.80
36.0	4	3	S	58583	7.8	60513*	C	0.09	0.42	
40.0	4	1	S	53606	9.0	55494	A	0.01	0.20	
40.0	4	3	S	53606	9.0	55493	B	0.02	0.04	0.13
40.0	4	3	S	53606	9.0	57958*	C	0.05	0.20	
50.0	4	1	S	53606	9.0	55494	A	0.01	0.20	
50.0	4	3	S	53606	9.0	55493	B	0.02	0.04	0.13
50.0	4	3	S	53606	9.0	57958*	C	0.05	0.20	
60.0	4	1	S	53605	13.1	55481	A	0.01	0.14	
60.0	4	3	S	57657	14.3	57957*	C	0.02	0.20	
70.0	4	1	S	53605	13.1	55481	A	0.01	0.14	
70.0	4	3	S	57657	14.3	57957*	C	0.02	0.20	
80.0	4	3	S	57657	14.3	57656	B	0.01	0.02	0.22
80.0	4	3	S	57657	14.3	57957*	C	0.02	0.20	
85.0	4	3	S	57657	14.3	57656	B	0.01	0.02	0.22
85.0	4	3	S	57657	14.3	57957*	C	0.02	0.20	
100	4	3	S	57992	10.4	57993	C	0.02	0.29	
100	4	3	S	59828	11.4	59827*	C	0.01	0.25	
100	4	3	S	**	9.3	**		NOTE 1		
112	4	3	S	57992	10.4	57993	C	0.02	0.29	

KW	FIELD POLES	PHASE	TYPE	ROTOR PART NO.	OHM	STATOR PART NO.	TYPE	1	2	3
112	4	3	S	59828	11.4	59827*	C	0.01	0.25	
130	4	3	S	**	1.05	**	D	NOTE	1	
150	4	3	S	**	1.15	**	D	NOTE	1	
180	4	3	S	**	1.33	**	D	NOTE	1	

* 12-Wire Reconnectable "Broad-Range" Unit
** Contact Generac Corporation
*** B= Brush Type Unit, S= Brushless Type
**** Stator "A", Column 1 (AC Power) across Wires 11-22, 33-44
Stator "A", Column 2 (DPE) across Wires 2-6
Stator "B", Column 1 (AC Power) across Wires S1-S4, S7-S10
Stator "B", Column 2 (AC Power) across Wires S2-S5, S3-S6, S8-S11, S9-S12
Stator "B", Column 3 (DPE) across Wires 2-6
Stator "C", Column 1 is all "S" windings- Column 2 (DPE) across Wires 2-6
Stator "D" units have no DPE Windings (See NOTE 1)

NOTE 1:- Stator "S" winding resistances as follows:-
100 KW Units- 0.07 Ohms 130 KW Units- 0.06 Ohms
150 KW Units- 0.04 Ohms 180 KW Units- 0.04 Ohms

1.5- CAPSCREW TORQUE VALUES

Capscrew Diameter and Ultimate Tensile Strength (PSI) [4]	To 1/2 - 69,000 PSI To 3/4 - 64,000 PSI To 1 - 55,000 PSI			To 3/4 - 120,000 PSI To 1 - 115,000 PSI			150,000 PSI		
SAE Grade Number	1 or 2			5			8		
Capscrew Head Markings									
Capscrew Body Size (Inches) - (Thread)	Torque Ft-Lb (N-m)			Torque Ft-Lb (N-m)			Torque Ft-Lb (N-m)		
	Dry [1]	Oiled [2]	Plated [3]	Dry [1]	Oiled [2]	Plated [3]	Dry [1]	Oiled [2]	Plated [3]
1/4 - 20	5 (7)	4.5 (6)	4 (5)	8 (11)	7 (9)	6 (8)	12 (16)	11 (15)	10 (14)
- 28	6 (8)	5.4 (7)	4.8 (6)	10 (14)	9 (12)	8 (11)	14 (19)	13 (18)	11 (15)
5/16 - 18	11 (15)	10 (14)	9 (12)	17 (23)	15 (20)	14 (19)	24 (33)	22 (30)	19 (26)
- 24	13 (18)	12 (16)	10 (14)	19 (26)	17 (23)	15 (20)	27 (37)	24 (33)	22 (30)
3/8 - 16	18 (24)	16 (22)	14 (19)	31 (42)	28 (38)	25 (34)	44 (60)	40 (54)	35 (47)
- 24	20 (27)	18 (24)	16 (22)	35 (47)	32 (43)	28 (38)	49 (66)	44 (60)	39 (53)
7/16 - 14	28 (38)	25 (34)	22 (30)	49 (66)	44 (60)	39 (53)	70 (95)	63 (85)	56 (76)
- 20	30 (41)	27 (37)	24 (33)	55 (75)	50 (68)	44 (60)	78 (106)	70 (95)	62 (84)
1/2 - 13	39 (53)	35 (47)	31 (42)	75 (102)	68 (92)	60 (81)	105 (142)	95 (129)	84 (114)
- 20	41 (56)	37 (50)	33 (45)	85 (115)	77 (104)	68 (92)	120 (163)	108 (146)	96 (130)
9/16 - 12	51 (69)	46 (62)	41 (56)	110 (149)	99 (134)	88 (119)	155 (210)	140 (190)	124 (168)
- 18	55 (75)	50 (68)	44 (60)	120 (163)	108 (146)	96 (130)	170 (230)	153 (207)	136 (184)
5/8 - 11	83 (113)	75 (102)	66 (89)	150 (203)	135 (183)	120 (163)	210 (285)	189 (256)	168 (228)
- 18	95 (129)	86 (117)	76 (103)	170 (230)	153 (207)	136 (184)	240 (325)	216 (293)	192 (260)
3/4 - 10	105 (142)	95 (130)	84 (114)	270 (366)	243 (329)	216 (293)	375 (508)	338 (458)	300 (407)
- 16	115 (156)	104 (141)	92 (125)	295 (400)	266 (361)	236 (320)	420 (569)	378 (513)	336 (456)
7/8 - 9	160 (217)	144 (195)	128 (174)	395 (535)	356 (483)	316 (428)	605 (820)	545 (739)	484 (656)
- 14	175 (237)	158 (214)	140 (190)	435 (590)	392 (531)	348 (472)	675 (915)	608 (824)	540 (732)
1 - 8	235 (319)	212 (287)	188 (255)	590 (800)	531 (720)	472 (640)	910 (1234)	819 (1110)	728 (987)
- 14	250 (339)	225 (305)	200 (271)	660 (895)	594 (805)	528 (716)	990 (1342)	891 (1208)	792 (1074)

NOTES:
1. Based on use of clean, dry threads.
2. Torque reduced by 10% when engine oil is used as a lubricant.
3. Torque reduced by 20% if new plated capscrews are used.
4. Capscrews threaded into aluminum may require reductions in torque of 30% or more.

1.6- ELECTRICAL FORMULAE FOR AC GENERATORS

DESIRED DATA	SINGLE PHASE	THREE PHASE
Kilo-Volt-Amperes (KVA)	$\frac{\text{Volts} \times \text{Amperes}}{1000}$	$\frac{1.73 \times \text{Volts} \times \text{Amperes}}{1000}$
Kilowatts (KW)	$\frac{\text{Volts} \times \text{Amperes} \times \text{P.F.}}{1000}$	$\frac{1.73 \times \text{Volts} \times \text{Amperes} \times \text{P.F.}}{1000}$
Power Factor (P.F.)	$\frac{\text{KW}}{\text{KVA}}$	$\frac{\text{KW}}{\text{KVA}}$
Amperes (When KW is known)	$\frac{\text{KW} \times 1000}{\text{Volts} \times \text{P.F.}}$	$\frac{\text{KW} \times 1000}{1.73 \times}$
Amperes (When KVA is known)	$\frac{\text{KVA} \times 1000}{\text{Volts}}$	$\frac{\text{KVA} \times 1000}{1.73 \times \text{Volts}}$
Required Horsepower of Prime Mover	$\frac{\text{KW}}{\text{Generator Efficiency} \times 0.746}$	
AC Frequency (Hertz)	$\frac{\text{Number of Poles} \times \text{RPM}}{120}$	
Revolutions per Minute (RPM)	$\frac{\text{Hertz} \times 120}{\text{Number of Poles}}$	
Voltage Regulation (In Percent)	$\frac{\text{No-Load Voltage} - \text{Full Load Voltage} \times 100}{\text{Full Load Voltage}}$	
Speed Regulation (In Percent)	$\frac{\text{No-Load RPM} - \text{Full Load RPM} \times 100}{\text{Ful Load RPM}}$	

1.7- WIRE NUMBER STANDARDS

WIRE NUMBER	FUNCTION
00	Neutral line for generator 3-phase AC power output
0	Frame Ground
1	Negative (-) side of DC circuit to Revolving Field
2	Stator Excitation Winding output to Voltage Regulator
3	Positive (+) side of DC circuit to Revolving Field when variable gain Voltage Regulator is used
4	Positive (+) side of DC circuit to Revolving Field when V/F or DPE Regulator is used
5	Stator Excitation (DPE) Winding output
6	Stator Excitation (DPE) Winding output
7	Stator Excitation (DPE) lead (Tap)
8	Stator Excitation (DPE) lead (Second Tap)
9	+12 VDC to Ignition Coil
10	AC Power NEUTRAL lead (Tractor Driven generators)
11	Generator Stator AC power output lead
12	Choke solenoid wire (water-cooled)- Ignition Coil wire (Air-Cooled)
13	Positive (+) battery cable
13A	Battery Charge Ammeter lead
13R	Battery lead to Engine DC Alternator Voltage Regulator
14	+12 Volts DC with generator unit running only
15	+12 Volts DC Battery voltage (Fused)
16	+12 Volts DC while cranking only
17	Lead is grounded for manual engine cranking
18	Lead is grounded for manually stopping the engine
19	Low oil pressure shutdown lead to diesel engine fuel solenoid
20	Fused AC power output
21	Generator AC power output lead- after the circuit breaker
22	Generator AC power output
23	Transfer Switch control lead (on 9-wire interconnections)
24	Center contact for High/Low Bias Switch and DPE (Welders)
25	Ignition Stator Trigger coil output (SXL Engine)
26	Return line for AC portion of Bias Rectifier (Welders)
27	Bias (Common)
28	Bias (Low)
29	Bias (High)
30	Fused AC Power
31	Generator AC power output (after the circuit breaker)
32	Generator AC Power output
33	Generator AC power output
34	Sensing lead for Welder Voltage Regulator
35	Sensing lead for Welder Voltage Regulator
36	Sensing lead for Welder Voltage Regulator
37	Welder unit auxiliary AC power (while welding)
38	Welder unit auxiliary AC power (while welding)
39	Choke heater lead (units with Generac automatic choke)
40	Fused AC power
41	AC Power
42	AC Power
43	AC Power
44	AC Power

1.7- WIRE NUMBER STANDARDS (Cont'd)

WIRE NUMBER	FUNCTION
45	Welder unit +DC Choke output
46	Welder unit -DC Diode output
47	Welder unit choke lead
48	Engine DC Alternator field lead
49	Engine DC Alternator field lead
50	Welder unit WELD Winding output
51	Welder unit diode lead (AC)
52	Welder unit diode lead (AC)
53	Welder unit diode le.d (AC)
54	Trickle Charger Ammeter lead
55	Generator Stator battery charge winding output
56	Generator battery charge winding output (through Circuit Breaker
57	Current Transformer lead (1-Phase units)
58	Current Transformer lead (2-Phase units)
59	Current Transformer lead (3-Phase units)
60	Welder unit Stator WELD winding output
61	Welder unit Remote Control jack
62	Welder unit current adjusting resistor (Wiper and Common)
63	Welder unit current adjusting resistor (Free end)
64	Line Voltmeter lead
65	Line Voltmeter lead
66	Generator Stator Battery Charge Winding lead
67	Phase Selector Switch to panel Ammeter
68	Coolant Temperature Sensor to panel Gauge
69	Engine Oil Pressure Sensor to panel gauge
70	Welder unit Stator WELD Winding output
71	Engine Running signal to automatic start controller
77	Generator Stator Battery Charge winding output
78	Stator Battery Charge Winding output through Circuit Breaker
79	RPM Sensor lead
81	Automatic Idle Control lead
82	Automatic Idle Control lead
83	Automatic Idle Control lead
84	Automatic Idle Control lead
85	High Coolant Temperature Sensor Switch Lead
86	Low Oil Pressure Switch lead
89	Voltage Adjust lead to Voltage Regulator
90	Choke Solenoid lead (On units with Generac automatic Choke)
91	Choke Solenoid lead (On units with Generac automatic Choke)
92	Battery Trickle Charger/Engine Coolant Heater lead
93	Same as 92
94	Lead to Low Oil Pressure Indicator lamp
95	High Coolant Temperature Indicator lamp
96	Overcrank Indicator Lamp
97	Overspeed Indicator Lamp
98	RPM Sensor Loss Indicator Lamp
99	Generator Stator Lead (Center Tap)
100	Latch/Crank circuit board Annunciator Horn (+12 VDC when an automatic shutdown due to an annunciated fault occurs)

1.7- WIRE NUMBER STANDARDS (Cont'd)

WIRE NUMBER	FUNCTION
107	Transfer Switch Position Contacts lead
108	Transfer Switch position contacts
110	Transfer Switch Position contacts
116	Transfer Switch Motor lead- First Tap Primary Transformer
117	Transfer Switch Motor lead- Second Tap Primary Transformer
118	Transfer Switch Motor lead- Third Tap Primary Transformer
119	Transfer Switch Motor lead- Fourth Tap Primary Transformer
120	Transfer Switch Motor lead- Fifth tap Primary Transformer
121	Transfer Switch Motor lead- Tap Selector Primary Transformer
122	Transfer Switch Motor lead- Primary Transformer Common
123	Transfer Switch Motor lead- Fused Secondary
124	Transfer Switch Motor lead- Fused Secondary
125	Transfer Switch Motor lead- Unfused Secondary
126	Transfer Switch Motor lead- Unfused secondary
127	Transfer Switch Normally-Closed (NC) Contacts
128	Transfer Switch Normally-Closed (NC) Contacts
129	Panel Frequency Meter Positive (+) lead
130	+DC Battery lead (Before BCM Shunt)
131	Overspeed Shutdown lead
132	RPM Sensor Loss shutdown lead
133	Engine Crank Signal (From Latch/Crank to DC Control circuit board
134	Crank Limit signal (output signal to Transfer Switch)
135	Engine OFF Signal from Latch/Crank circuit board (+12VDC)
136	Automatic start signal (grounds to crank engine)
137	Option "C" Engine Monitor Panel TEST switch lead
138	Option "C" Engine Monitopr panel RESET switch lead
139	Panel Frequency Meter negative (-) lead
140	Sensing Transformer Secondary lead- Common
141	Sensing Transformer Secondary Voltage Divider Resistor (200V)
142	Sensing Transformer Secondary Voltage Divider Resistor (230V)
143	Sensing Transformer Secondary Voltage Divider Resistor (400V)
144	Sensing Transformer Secondary Voltage Divider Resistor (460V)
145	Sensing Transformer Secondary Voltage Divider Resistor (575V)
146	Sensing Transformer- Voltage Divider Resistor Selector
147	Transfer Switch Position Indicator Lamp- Emergency
148	Transfer Switch Position Indicator Lamp- Normal
149	Fuel Filter Contact Line
150	Diesel engine PRE-HEAT line
151	Tractor Driven Generator Boost winding
152	Same as 151
153	Boost Circuit
154	Boost Circuit
155	Sensing Transformer line
156	Sensing Transformer line
157	Idle Control Solenoid interlock line
158	BYPASS Switch line
159	Engine Governor power lead
160	Actuator Power for electronic isochronous governor
161	Actuator Power for electronic isochronous governor
162	Throttle Positioner lead

1.7- WIRE NUMBER STANDARDS (Cont'd)

WIRE NUMBER	FUNCTION
163	Throttle Positioner lead
164	Throttle Positioner lead
165	Throttle Positioner lead
166	Diode protected 12 Volts DC
167	Switched 12 Volts DC
168	Electronic Governor 12 Volts DC
169	Electronic Governor 12 Volts DC
170	7-Day Exercise circuit board disable lead
171	Latch/Crank circuit board annunciator dialer lead (+12VDC when system failure occurs)
172	Run lead
173	Secondary 1-Phase Sensing Transformer
174	Option 2 Position Switch AUTO lead
175	Option 2 Position Switch MAN lead
176	Engine Indication light lead
177	2-Wire Start System
178	2-Wire start system
179	AC Generator Field
180	AC Generator Field
181	AC Generator Field
182	Switched Sensing input to Transfer switch Logic circuit board
183	Switched 2-Wire start system
184	Fused AC load power
185	Low Voltage AC (Transfer Switch 7-Day Exerciser circuit board timing inpput voltage)
186	Line Fail Indicator lamp on Transfer Switch
187	Time Delay Neutral Position lead on "Y"-Type GTS Transfer Switch
188	Time Delay Neutral Position lead on "Y"-Type GTS Transfer Switch
189	Time Delay Neutral Position lead on "Y"-Type GTS Transfer Switch
190	Alarm Control Relay
191	Generator sensing (Low Voltage)
192	Generator Sensing (Low Voltage)
193	Time Delay Neutral Relay Control lead
194	+12 VDC Relay Control (GTS Transfer Switch)
195	Circuit Board interconnection lead (GTS Transfer Switch)
196	Circuit Board interconnection lead (GTS Transfer Switch)
197	Circuit Board interconnection lead (GTS Transfer Switch)
198	Circuit Board interconnection lead (GTS Transfer Switch)
199	Circuit Board interconnection lead (GTS Transfer Switch)
200	Circuit Board interconnection lead (GTS Transfer Switch)
201	Circuit Board interconnection lead (GTS Transfer Switch)
202	Circuit Board interconnection lead (GTS Transfer Switch)
203	Circuit Board interconnection lead (GTS Transfer Switch)
204	Current Transformer Common lead (GTS Transfer Switch)
205	Transfer switch operation- Unfused Secondary
206	Transfer Switch operation- Unfused Secondary
207	Transfer switch operation- Unfused Secondary
208	Transfer switch operation- Unfused Secondary

1.7- WIRE NUMBER STANDARDS (Cont'd)

WIRE NUMBER	FUNCTION
209	Normally-Closed (NC) Alarm Contact (2-Wire Latch/Crank circuit board)
210	Comon Alarm Contact (2-Wire Latch/Crank circuit board)
211	Normally-Open (NO) Alarm Contact (2-Wire Start Latch/Crank circuit board)
212	Filter Indicator
213	3-Wire Start COMMON lead (GTS Transfer Switch)
214	Transfer Switch operation ("M"-Type GTS Transfer Switch)
215	Transfer Switch operation ("M"-Type GTS Transfer Switch)
216	Transfer Switch operation ("M"-Type GTS Transfer Switch)
217	Switched 3-Wire COMMON (GTS Transfer Switch)
218	+24VDC Battery voltage to Circuit Breaker (Upper Control Panel)
219	+24VDC Battery voltage from circuit breaker to relay (Upper Control panel)
223	Latch/Crank to DC Control circuit board (Automatic stop- +12VDC to stop)
500	Low Coolant Temperature Pre-Alarm Lamp (Optional Annunciator panel)
501	Low Oil Pressure Pre-Alarm lamp (Optional Annunciator Panel)
502	Low Fuel Alarm lamp- +12VDC at 20% fuel load (Optional Annunciator Panel)
503	Auto/Off/Manual Switch OFF lamp (Optional Annunciator panel)
504	High Battery Voltage Alarm lamp (Optional Annunciator Panel)
505	Low Battery Voltage alarm lamp (Optional Annunciator Panel)
506	High Coolant Temperature Pre-Alarm Lamp (Optional Anunciator Panel)
507	High Oil Temperature Shutdown
508	High Oil Temperature Pre-Alarm
509	Low Fuel Alarm
510	Line OK Signal (+12VDC)
511	Remote Annunciator Auxiliary Contacts (N.O.)

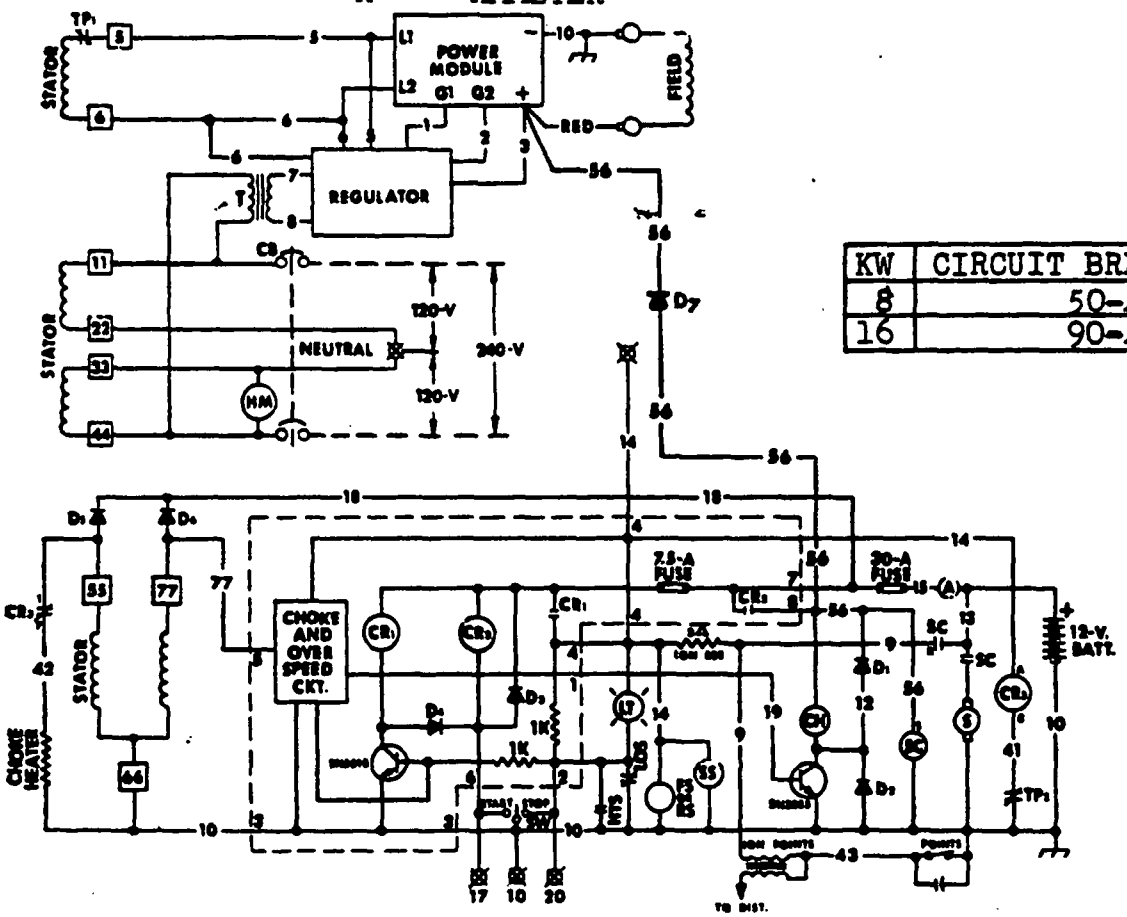
SECTION 1.8

WIRING DIAGRAMS/ELECTRICAL SCHEMATICS

All Wiring Diagrams and Electrical Schematics are arranged in numerical order. To locate the Wiring Diagram and/or Schematic for a particular Generator Model, refer to Section 1.1 (SPECIFICATIONS AND FEATURES- MODEL 7500 SERIES) or Section 1.2 (SPECIFICATIONS AND FEATURES- MODEL 1100 SERIES). The Model 7500 series chart includes the applicable Wiring Diagram/Schematic for each model. The Model 1100 series chart includes a Manual "R" Level number which can be used to locate Wiring Diagram/Schematic numbers in Section 1.3 (MANUAL "R" LEVEL CHART).

LEGEND

CB - CIRCUIT BREAKER
T - VOLTAGE SENSING TRANSFORMER
TP_1 - STATOR THERMAL PROTECTOR
TP_2 - CHOKE THERMOSTAT
CR - CONTROL RELAY
HTS - HIGH WATER TEMPERATURE SWITCH
LOS - LOW OIL SWITCH
HM - HOUR METER
CH - CHOKE SOLENOID
SC - STARTER CONTACTOR
S - STARTER MOTOR
SW - START-STOP SWITCH
D - DIODE
- SCREW TERMINAL
SS - SHUTTER SOLENOID
LT - LOW OIL PRESSURE AND HIGH WATER TEMPERATURE INDICATOR LIGHT
FS - FUEL SOLENOID (Used with gasoline system only)
RS - REGULATOR SOLENOID (Used with L.P.G. or Natural Gas Only)
A - AMMETER

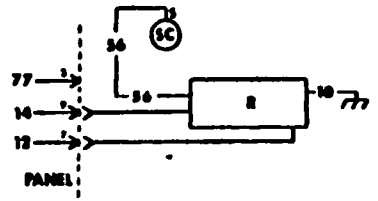


KW	CIRCUIT BREAKER (CB)
8	50-A.
16	90-A.

SCHEMATIC
44060

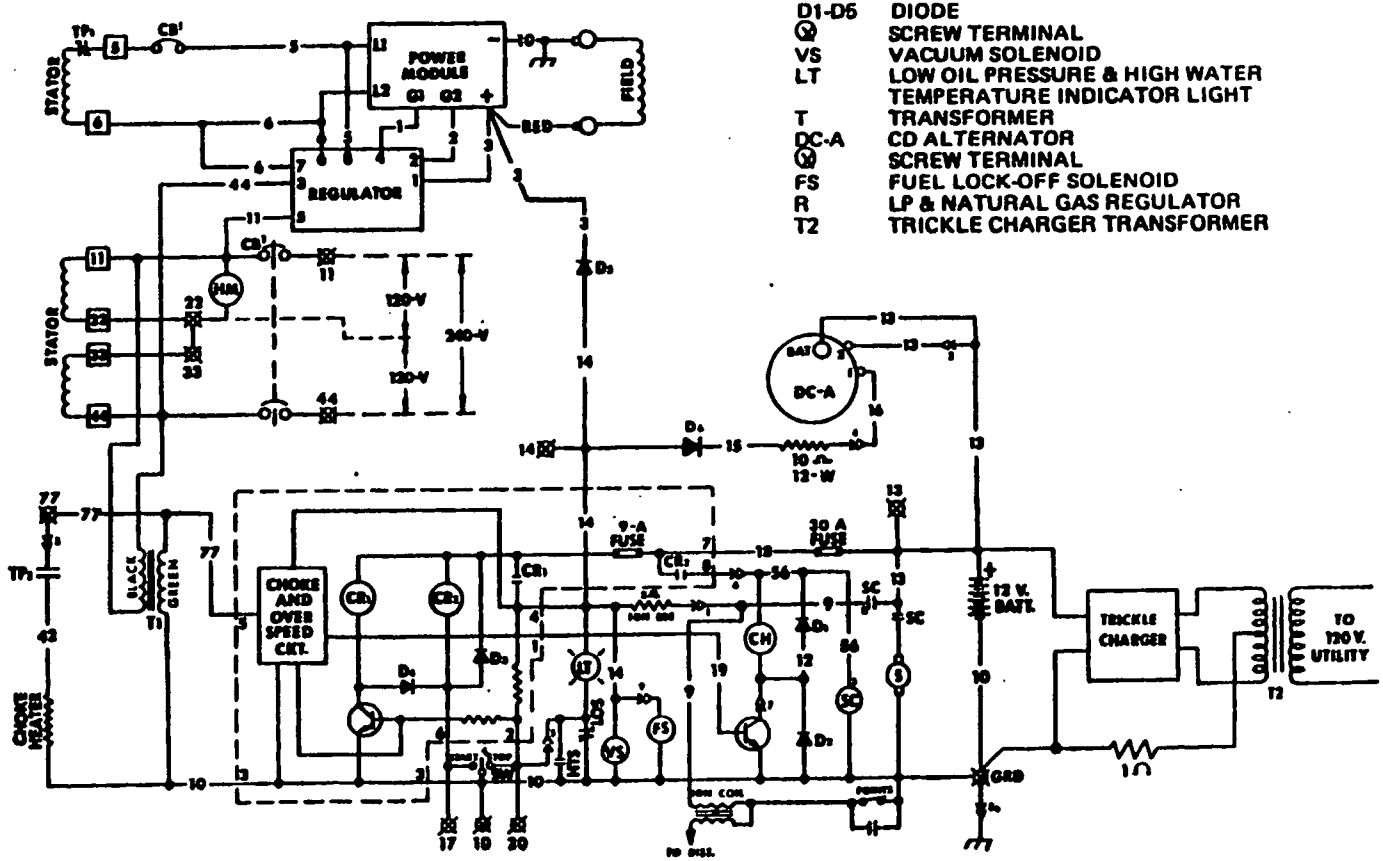
120V./240V			
KW	CB1	CB2	RPM
15	5-A	70-A	1800
20	6-A	100-A	1800
25	8-A	125-A	1800
35	6-A	175-A	3600
35	-A	175-A	1800
50	-A	225-A	1800
65	-A	275-A	1800

FUEL LOCK-OFF SOLENOID' CHOKE THERMOSTAT, CHOKE SOLENOID, OR CHOKE HEATER ARE NOT USED.

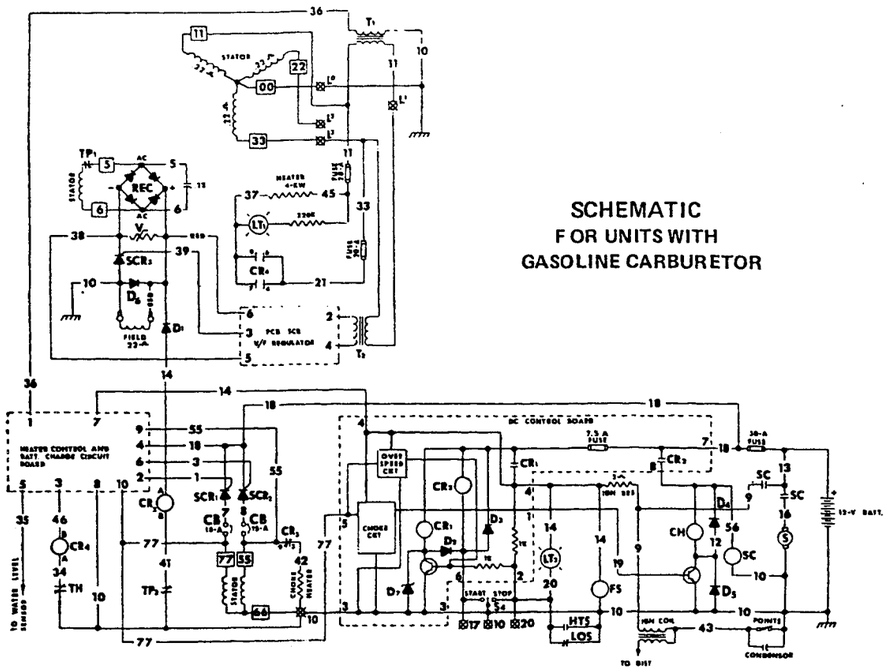


SCHEMATIC OF LP AND NATURAL GAS ONLY

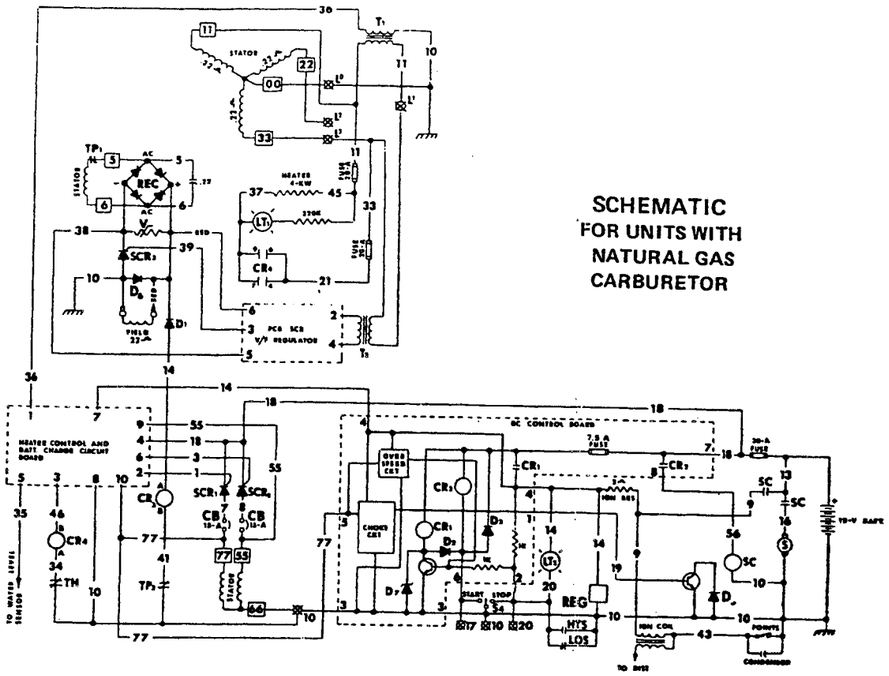
CB	CIRCUIT BREAKER
T1	VOLTAGE SENSING TRANSFORMER
TP1	STATOR THERMAL PROTECTOR
TP2	CHOKE THERMOSTAT
CR	CONTROL RELAY
HTS	HIGH WATER TEMPERATURE SWITCH
LOS	LOW OIL SWITCH
HM	HOUR METER
CH	CHOKE SOLENOID
SC	STARTER CONTACTOR
S	STARTER MOTOR
SW	START/STOP SWITCH
D1-D5	DIODE
	SCREW TERMINAL
VS	VACUUM SOLENOID
LT	LOW OIL PRESSURE & HIGH WATER TEMPERATURE INDICATOR LIGHT
T	TRANSFORMER
DC-A	CD ALTERNATOR
	SCREW TERMINAL
FS	FUEL LOCK-OFF SOLENOID
R	LP & NATURAL GAS REGULATOR
T2	TRICKLE CHARGER TRANSFORMER



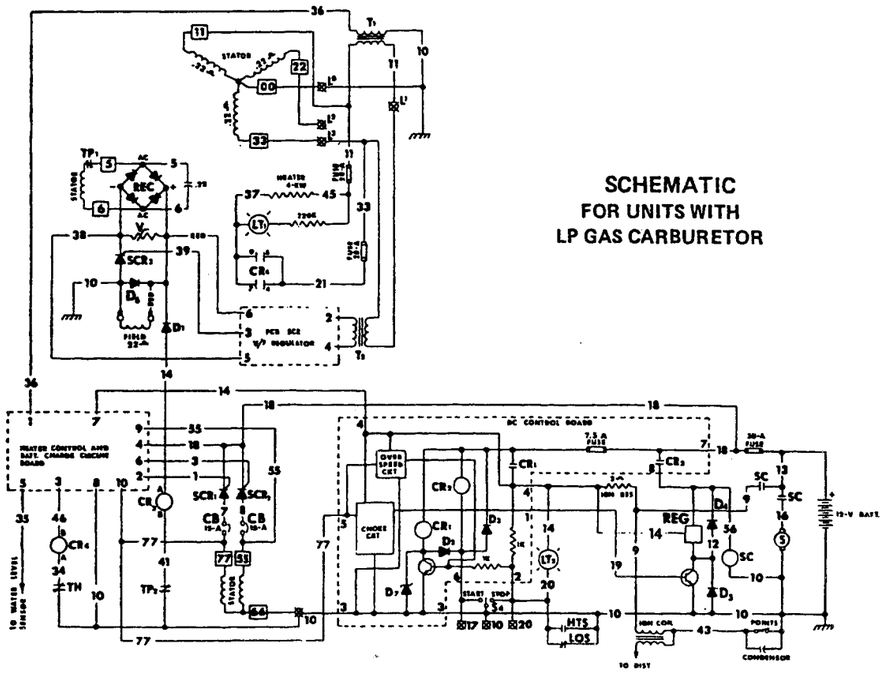
SCHEMATIC 44112



SCHEMATIC
FOR UNITS WITH
GASOLINE CARBURETOR



SCHEMATIC
FOR UNITS WITH
NATURAL GAS
CARBURETOR



SCHEMATIC
FOR UNITS WITH
LP GAS CARBURETOR

LEGEND

CB - CIRCUIT BREAKER
CH - CHOKE SOLENOID
CR - CONTROL RELAY
D^1 - D^6 - DIODE
D^7 - ZENER DIODE
FS - FUEL LOCK-OFF SOLENOID
HTS - HIGH TEMP. SWITCH
LT^1 - HEATER POWER LIGHT
LT^2 - LIGHT-HIGH TEMP., LOW OIL
LOS - LOW OIL SWITCH
REC - FIELD RECTIFIER
S - STARTER MOTOR
SC - STARTER CONTACTOR
SCR - SILICON CONTROLLED RECTIFIER
S^4 - START-STOP SWITCH
TH - THERMOSTAT
T^1 - CURRENT SENSING TRANSFORMER
T^2 - VOLTAGE SENSING TRANSFORMER
TP^1 - STATOR THERMAL PROTECTOR
TP^2 - CHOKE THERMOSTAT
V - VARISTOR
⊠ - SCREW TERMINAL

TERMINAL	VOLTS
L^0 to L^1 -	125
L^0 to L^2 -	125
L^0 to L^3 -	125
L^1 to L^2 -	216
L^2 to L^3 -	216
L^3 to L^1 -	216

SCHEMATIC
44237

WATER COOLED MANIFOLD
LO SWITCH
HT SWITCH
THERMOSTAT HOUSING
KLIXON ON INTAKE MANIFOLD
IGN. COIL
DISTRIBUTOR
IGN. RES.
STARTER
TO +12-V. BATTERY
TO 125/216-V. 3ϕ AC LOAD
STATOR
ROTOR
TO REMOTE START/STOP SWITCH
STOP
START
20-A.
RED
CR_3
CR_4

WIRING DIAGRAM
44244

FUEL LOCK-OFF SOLENOID
IGN. RESISTOR
STARTER
CHOKE

GASOLINE CARBURETOR

STARTER
IGN. RESISTOR
REGULATOR

NOT USED REMOVE FROM CONTROL PANEL

LP GAS CARBURETOR

STARTER
NOT USED REMOVE
IGN. RESISTOR
REGULATOR

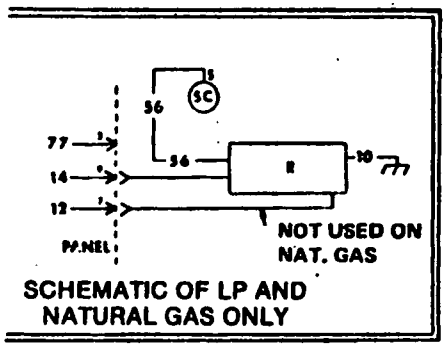
NOT USED REMOVE FROM CONTROL PANEL

NATURAL GAS CARBURETOR

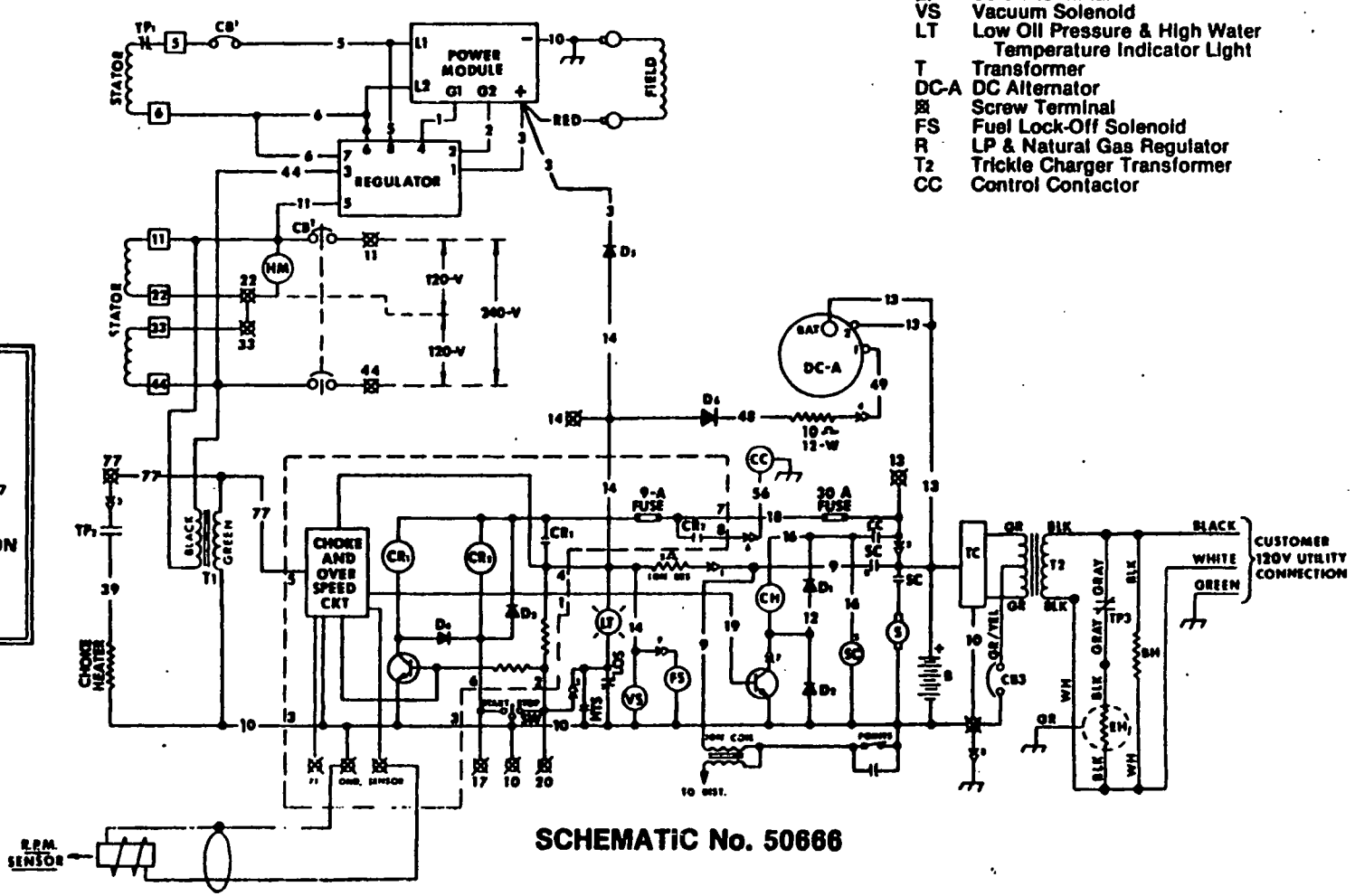
120V./240V.			
KW	CB¹	CB²	RPM
15	5 -A	70-A	1800
20	6 -A	100-A	1800
25	8-A	125-A	1800
35	6-A	175-A	3600
35	-A	175-A	1800
50	-A	225-A	1800
65	-A	275-A	1800

LEGEND

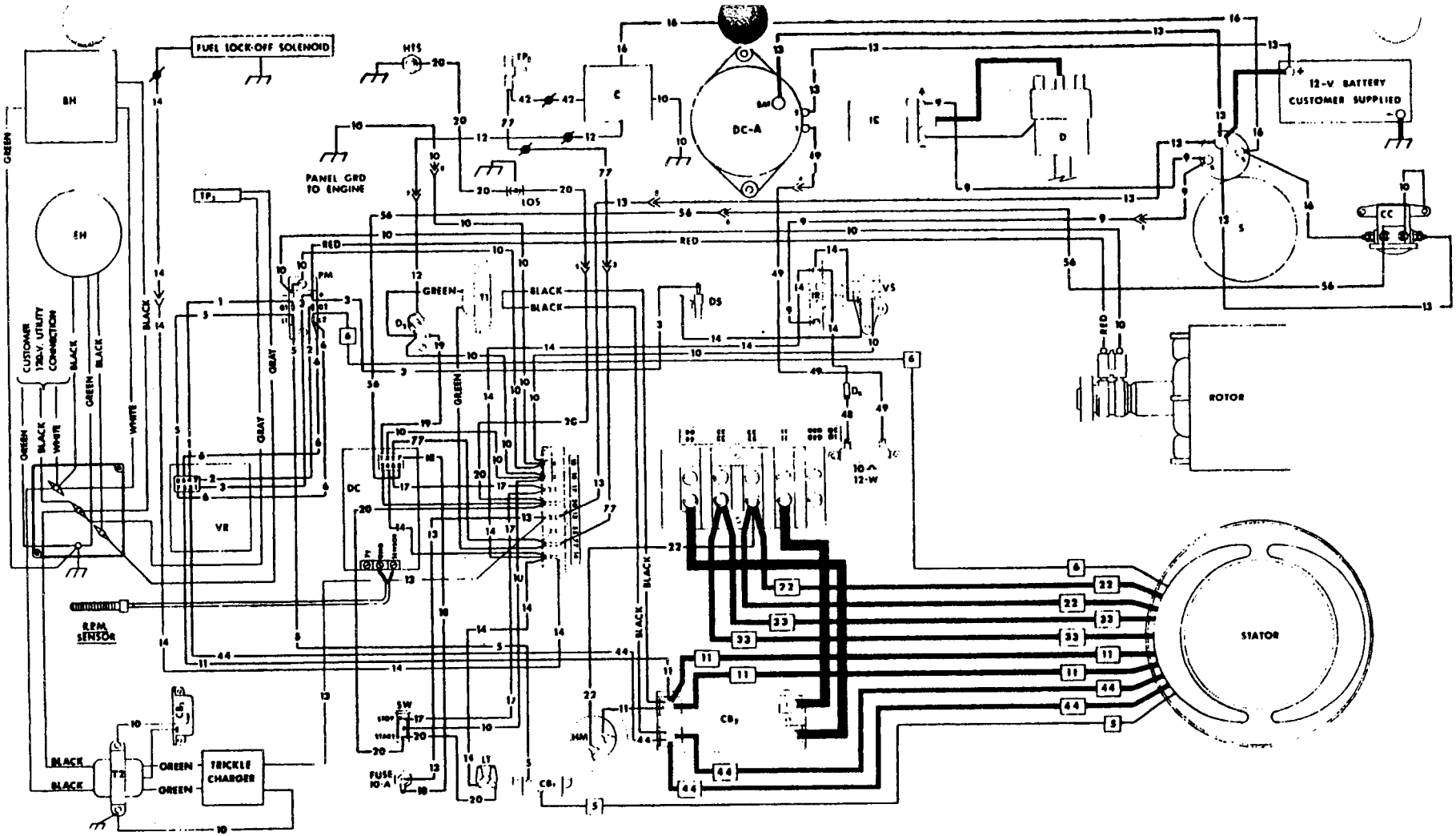
BH	Battery Heater
EH	Engine Heater
TP3	Thermostat (Water Heater)
CB	Circuit Breaker
T1	Voltage Sensing Transformer
TP1	Stator Thermal Protector
TP2	Choke Thermostat
CR	Control Relay
HTS	High Water Temperature Switch
LOS	Low Oil Switch
HM	Hour Meter
CH	Choke Solenoid
SC	Starter Contactor
S	Starter Motor
SW	Start/Stop Switch
D1-D5	Diode
⊠	Screw terminal
VS	Vacuum Solenoid
LT	Low Oil Pressure & High Water Temperature Indicator Light
T	Transformer
DC-A	DC Alternator
⊠	Screw Terminal
FS	Fuel Lock-Off Solenoid
R	LP & Natural Gas Regulator
T2	Trickle Charger Transformer
CC	Control Contactor



SCHEMATIC OF LP AND NATURAL GAS ONLY



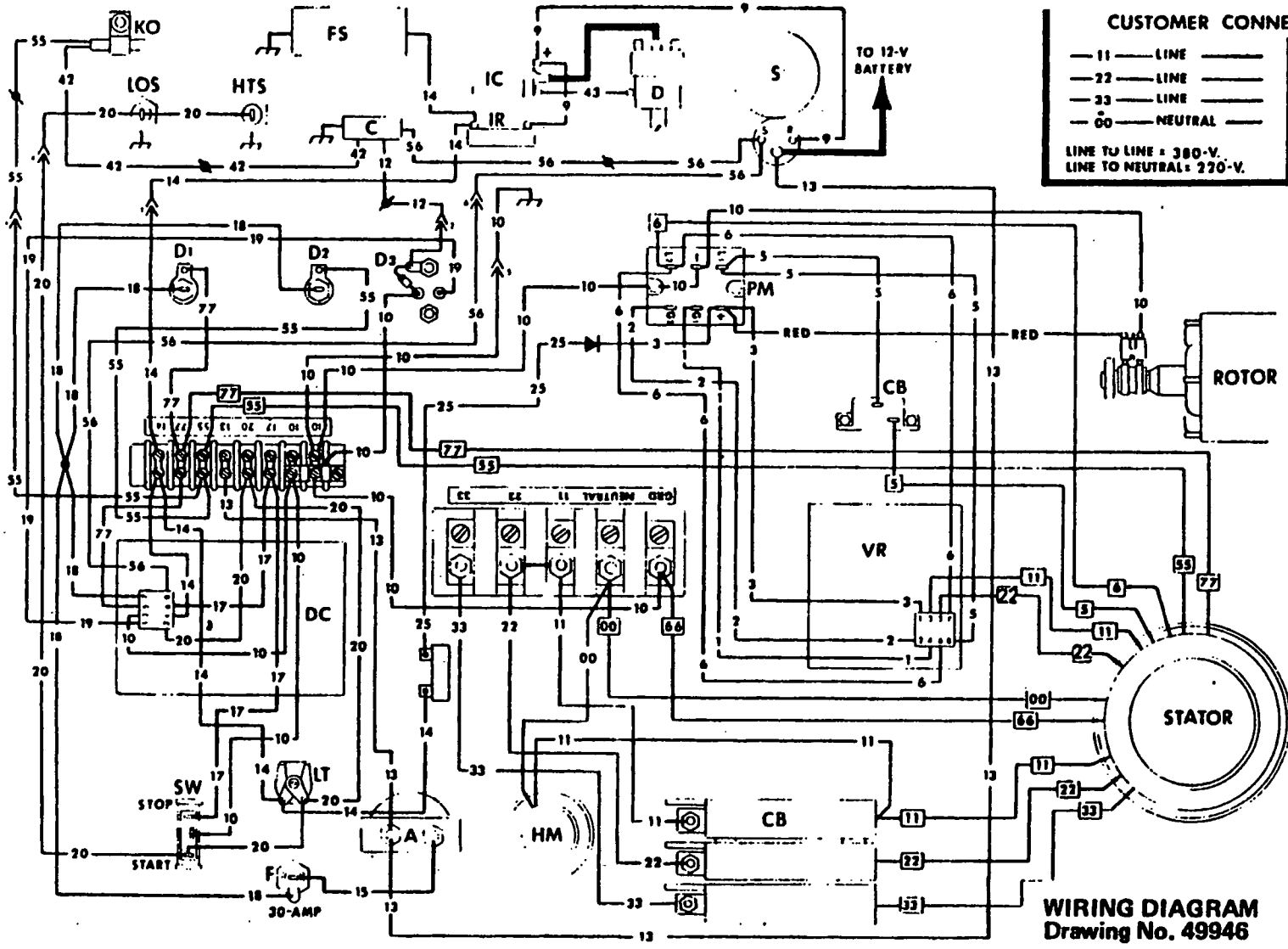
SCHEMATIC No. 50666



WIRING DIAGRAM No. 50665

LEGEND

CB	Circuit Breaker
T_1	Voltage Sensing Transformer
TP_2	Choke Thermostat
CR	Control Relay
HTS	High Water Temperature Switch
LOS	Low Oil Switch
HM	Hour Meter
CH	Choke Solenoid
SC	Starter Contactor
S	Starter Motor
SW	Start/Stop Switch
D_1-D_5	Diode
⊠	Screw Terminal
VS	VacuumSolenoid
LT	Low Oil Pressure & High Water Temperature Indicator Light
DC-A	DC Alternator
GRD	Dround
FS	Fuel Lock-Off Solenoid
T_2	Trickle Charger Transformer
TC	Trickle Charger PC Board
CC	Control Contactor
PM	Power Module
IC	Ignition Coil
EH	Engine Heater
BH	Battery Heater
TP(3)	Thermostat (Water Heater)



CUSTOMER CONNECTIONS

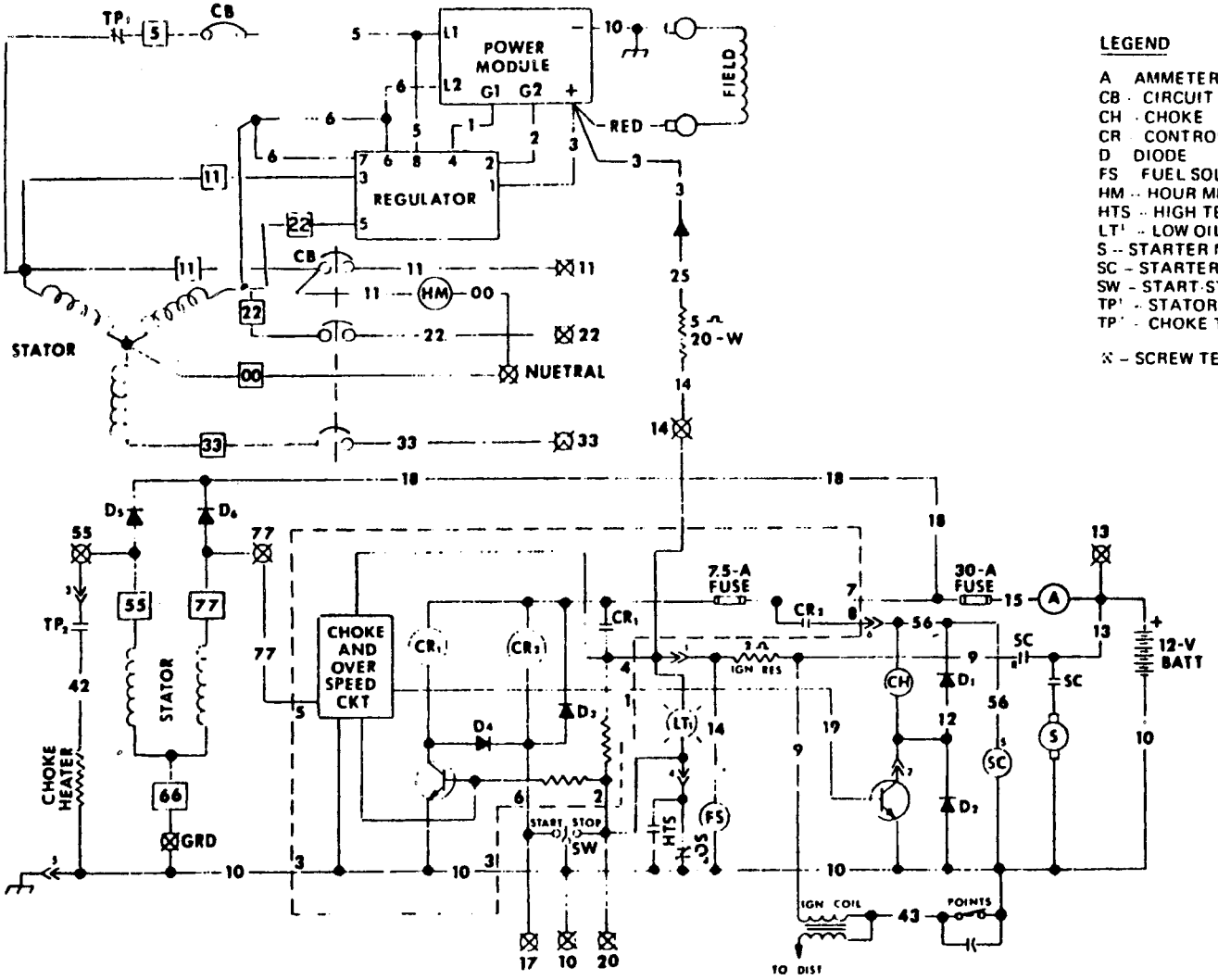
11 — LINE	10
22 — LINE	17
33 — LINE	20
00 — NEUTRAL	TO REMOTE START/STOP SWITCH

LINE TO LINE = 380-V.
LINE TO NEUTRAL = 220-V.

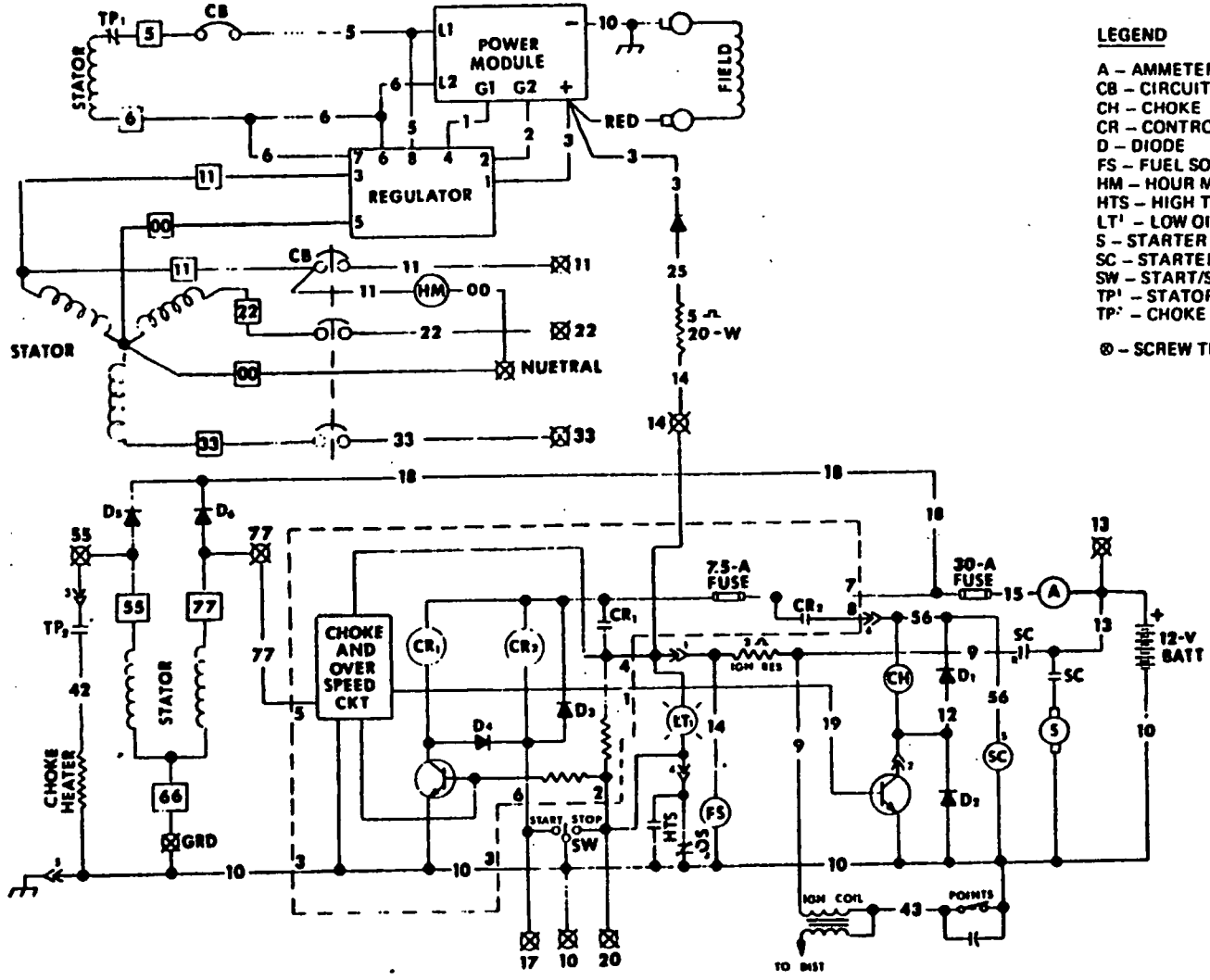
WIRING DIAGRAM
Drawing No. 49946

LEGEND

A AMMETER
C CHOKE
CB CIRCUIT BREAKER
D DISTRIBUTOR
D1, D2, D3 DIODE
DC DC CIRCUIT BOARD
F FUSE
FS FUEL LOCK OFF SOLENOID
IC IGN. COIL
IR IGN. RESISTOR
KO KLIXON ON INTAKE MANIFOLD
HM HOUR METER
HTS HIGH TEMP SWITCH
LOS LOW OIL SWITCH
LT LIGHT LOW OIL HIGH TEMP
PM POWER MODULE
S STARTER
SW START STOP SWITCH
VR VOLTAGE REGULATOR CIRCUIT BOARD



SCHEMATIC
Drawing No. 49945

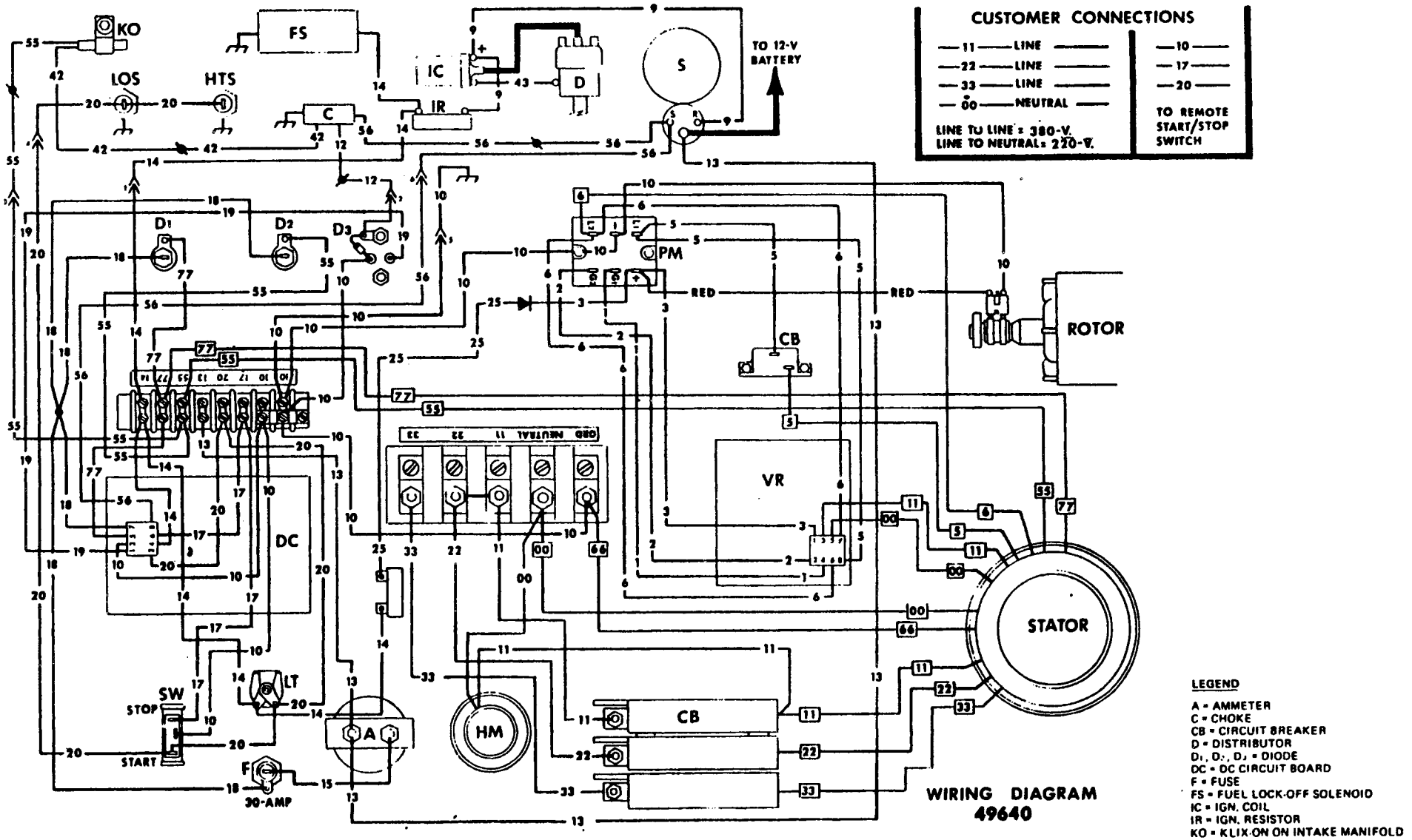


LEGEND

A – AMMETER
CB – CIRCUIT BREAKER
CH – CHOKE
CR – CONTROL RELAY
D – DIODE
FS – FUEL SOLENOID
HM – HOUR METER
HTS – HIGH TEMP. SWITCH
LT¹ – LOW OIL HIGH TEMP. LIGHT
S – STARTER MOTOR
SC – STARTER CONTACTOR
SW – START/STOP SWITCH
TP¹ – STATOR THERMAL PROTECTOR
TP² – CHOKE THERMOSTAT

⊗ – SCREW TERMINAL

SCHEMATIC
49641

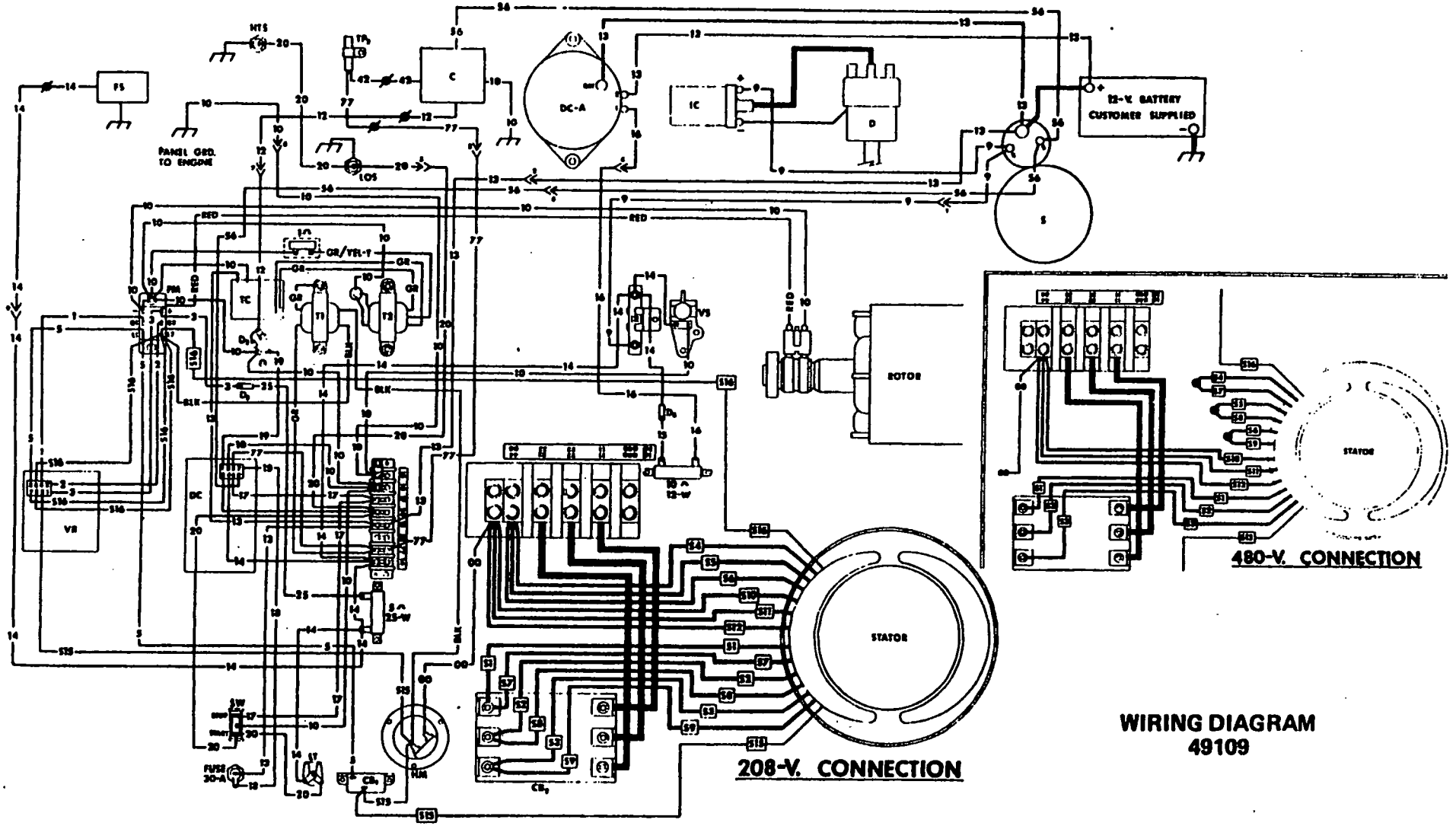


LEGEND

A = AMMETER
C = CHOKE
CB = CIRCUIT BREAKER
D = DISTRIBUTOR
D1, D2, D3 = DIODE
DC = DC CIRCUIT BOARD
F = FUSE
FS = FUEL LOCK-OFF SOLENOID
IC = IGN. COIL
IR = IGN. RESISTOR
KO = KLIX-ON ON INTAKE MANIFOLD
HM = HOUR METER
HTS = HIGH TEMP. SWITCH
LOS = LOW OIL SWITCH
LT = LIGHT LOW OIL HIGH TEMP.
PM = POWER MODULE
S = STARTER
SW = START/STOP SWITCH
VR = VOLTAGE REGULATOR CIRCUIT BOARD

CB - CIRCUIT BREAKER
T1 - VOLTAGE SENSING TRANSFORMER
TP2 - CHOKE THERMOSTAT
HTS - HIGH WATER TEMPERATURE SWITCH
LOS - LOW OIL SWITCH
HM - HOUR METER
C - CHOKE
S - STARTER MOTOR

SW - START/STOP SWITCH
D2-D5 - DIODE
VS - VACUUM SOLENOID
LT - LOW OIL PRESSURE & HIGH WATER TEMPERATURE INDICATOR LIGHT.
DC-A-DC ALTERNATOR
FS - FUEL LOCK-OFF SOLENOID
T2 - TRICKLE CHARGER TRANSFORMER
TC - TRICKLE CHARGER PC BOARD



WIRING DIAGRAM
49109

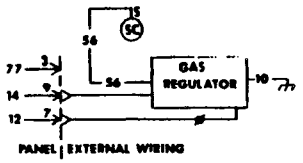
LINE TO LINE 208V. 480V.
LINE TO NEUT 120V. 277V.
T(1) – LINE A
T(2) – LINE B
T(3) – LINE C
T(4) – NUETRAL

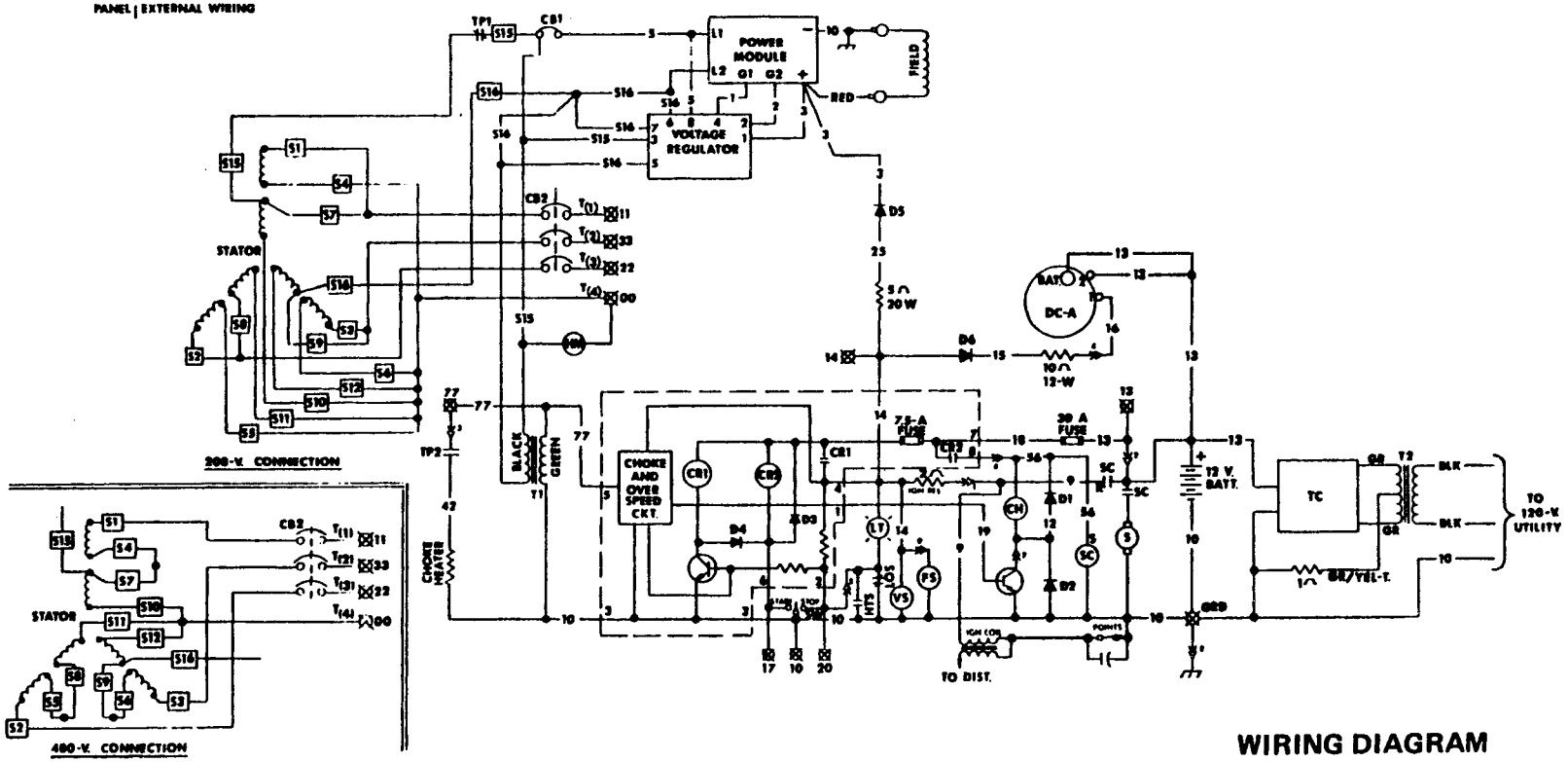
NOTE:
DO NOT USE FUEL LOCK-OFF SOLENOID, CHOKE THERMOSTAT, CHOKE SOLENOID, OR CHOKE HEATER WITH NATURAL OR LP GAS UNITS.

VOLTAGE		208 V.	480 V.	RPM
KVA	CB1	CB2	CB2	
18.75	7-A	60-A	30-A	1800
25.00	-A	70-A	40-A	1800
31.25	-A	100-A	50-A	1800
43.75	7-A	125-A	60-A	1800
43.75	7-A	125-A	60-A	3600
62.50	-A	175-A	100-A	1800
81.25	-A	225-A	125-A	1800

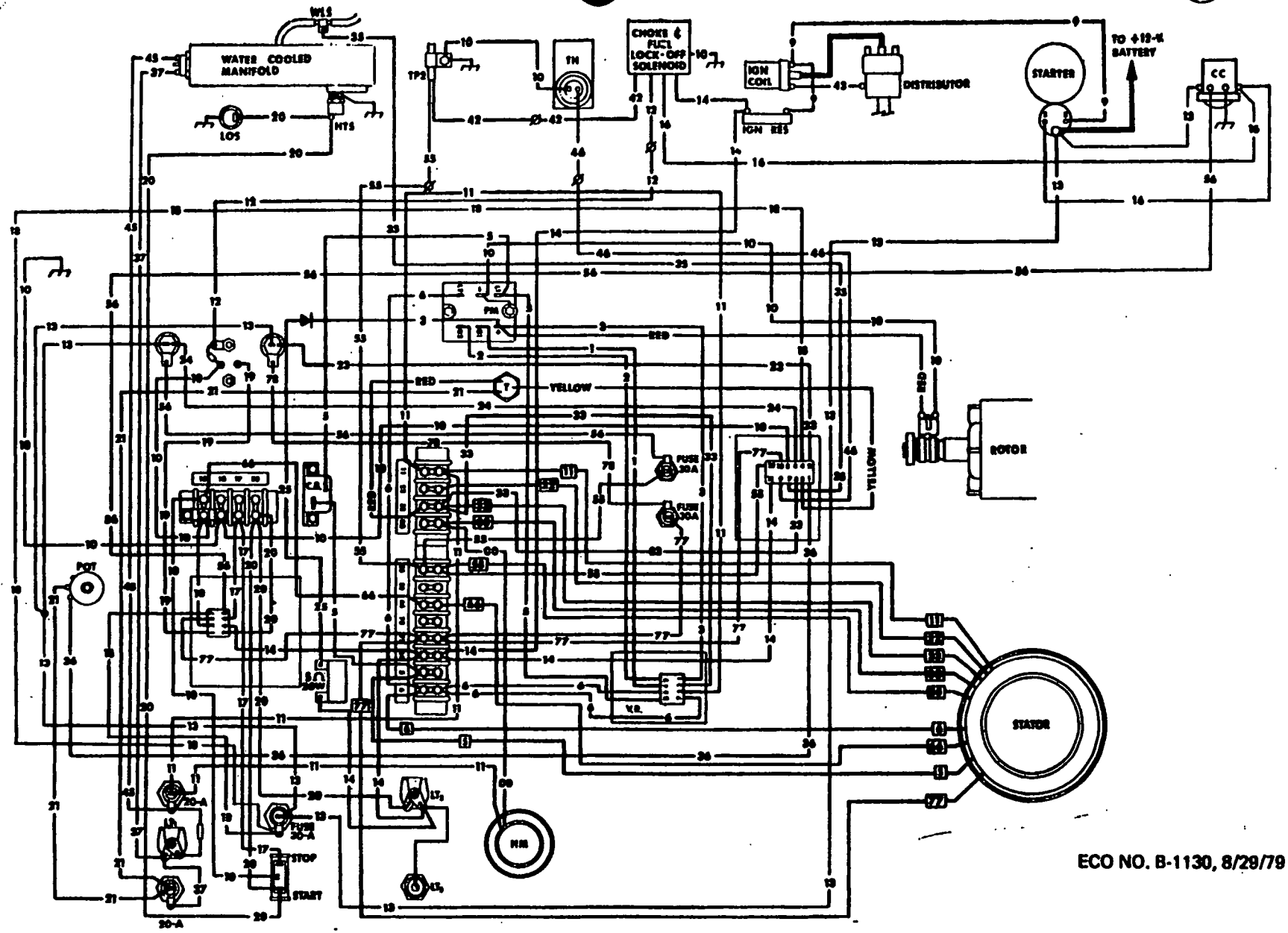
CB - CIRCUIT BREAKER
T1- VOLTAGE SENSING TRANSFORMER
TP2 - CHOKE THERMOSTAT
HTS - HIGH WATER TEMPERATURE SWITCH
LOS - LOW OIL SWITCH
HM - HOUR METER
C - CHOKE
S - STARTER MOTOR
SW - START/STOP SWITCH
D2-D5 - DIODE
VS - VACUUM SOLENOID
LT – LOW OIL PRESSURE & HIGH WATER TEMPERATURE INDICATOR LIGHT.
DC-A-DC ALTERNATOR
FS - FUEL LOCK-OFF SOLENOID
T2 - TRICKLE CHARGER TRANSFORMER
TC - TRICKLE CHARGER PC BOARD

WIRING FOR NATURAL AND LP GAS ONLY





WIRING DIAGRAM
49108

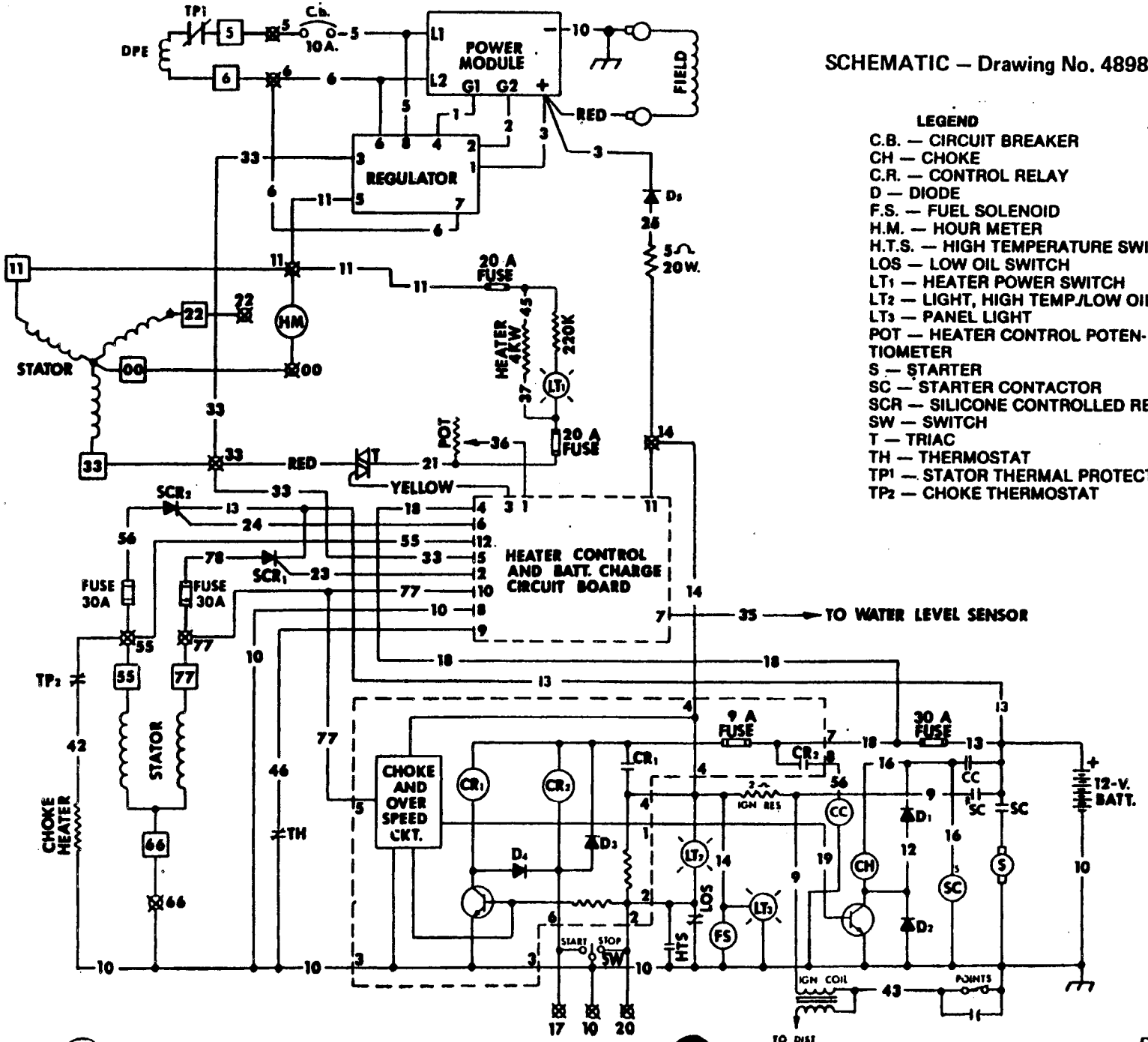


ECO NO. B-1130, 8/29/79

LEGEND

C.B. — CIRCUIT BREAKER
H.M. — HOUR METER
H.T.S. — HIGH TEMP. SWITCH
LOS — LOW OIL SWITCH
PM — POWER MODULE
T — TRIAC
LT_1 — HEAT POWER LIGHT
LT_2 — LIGHT-HIGH TEMP./LOW OIL
LT_3 — PANEL LIGHT
POT — POTENTIOMETER
V.R. — VOLTAGE REGULATOR
TH — THERMOSTAT
TP_2 — CHOKE THERMOSTAT
WLS — WATER LEVEL SENSOR

WIRING DIAGRAM — Drawing No. 48988



SCHEMATIC – Drawing No. 48986

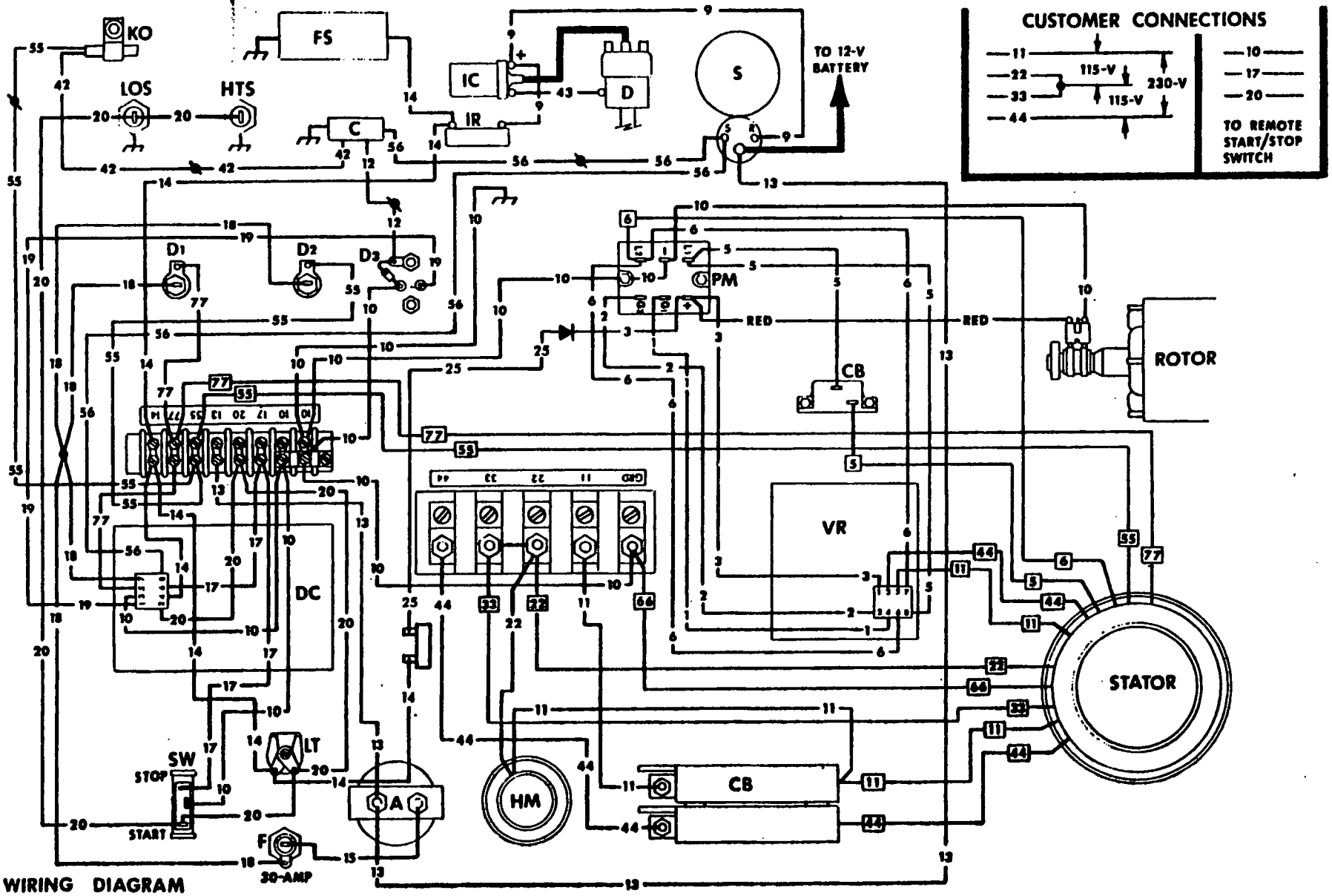
LEGEND

C.B. — CIRCUIT BREAKER
CH — CHOKE
C.R. — CONTROL RELAY
D — DIODE
F.S. — FUEL SOLENOID
H.M. — HOUR METER
H.T.S. — HIGH TEMPERATURE SWITCH
LOS — LOW OIL SWITCH
LT1 — HEATER POWER SWITCH
LT2 — LIGHT, HIGH TEMP./LOW OIL
LT3 — PANEL LIGHT
POT — HEATER CONTROL POTENTIOMETER
S — STARTER
SC — STARTER CONTACTOR
SCR — SILICONE CONTROLLED RECTIFIER
SW — SWITCH
T — TRIAC
TH — THERMOSTAT
TP1 — STATOR THERMAL PROTECTOR
TP2 — CHOKE THERMOSTAT

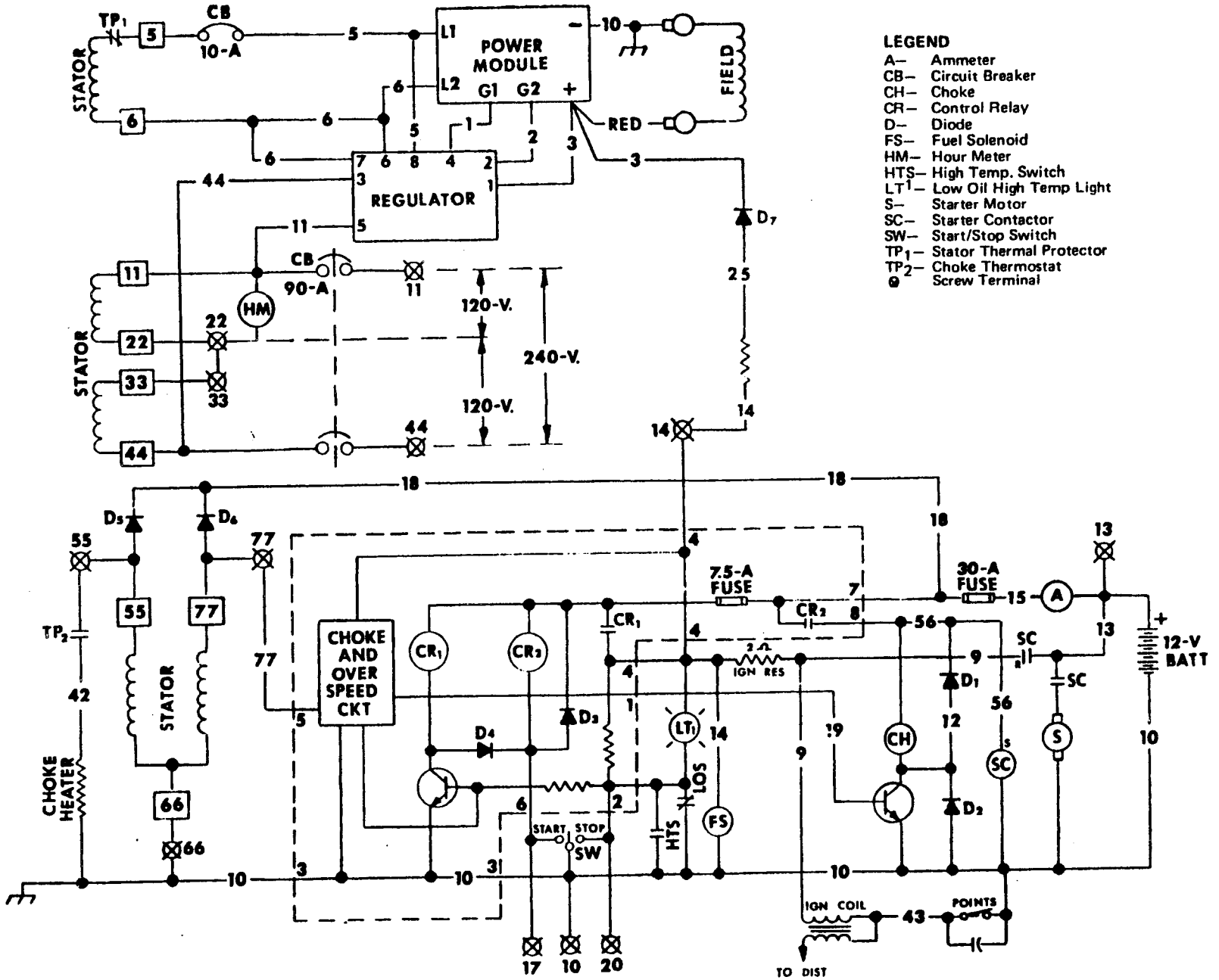
ECO NO. B-113 '79

LEGEND

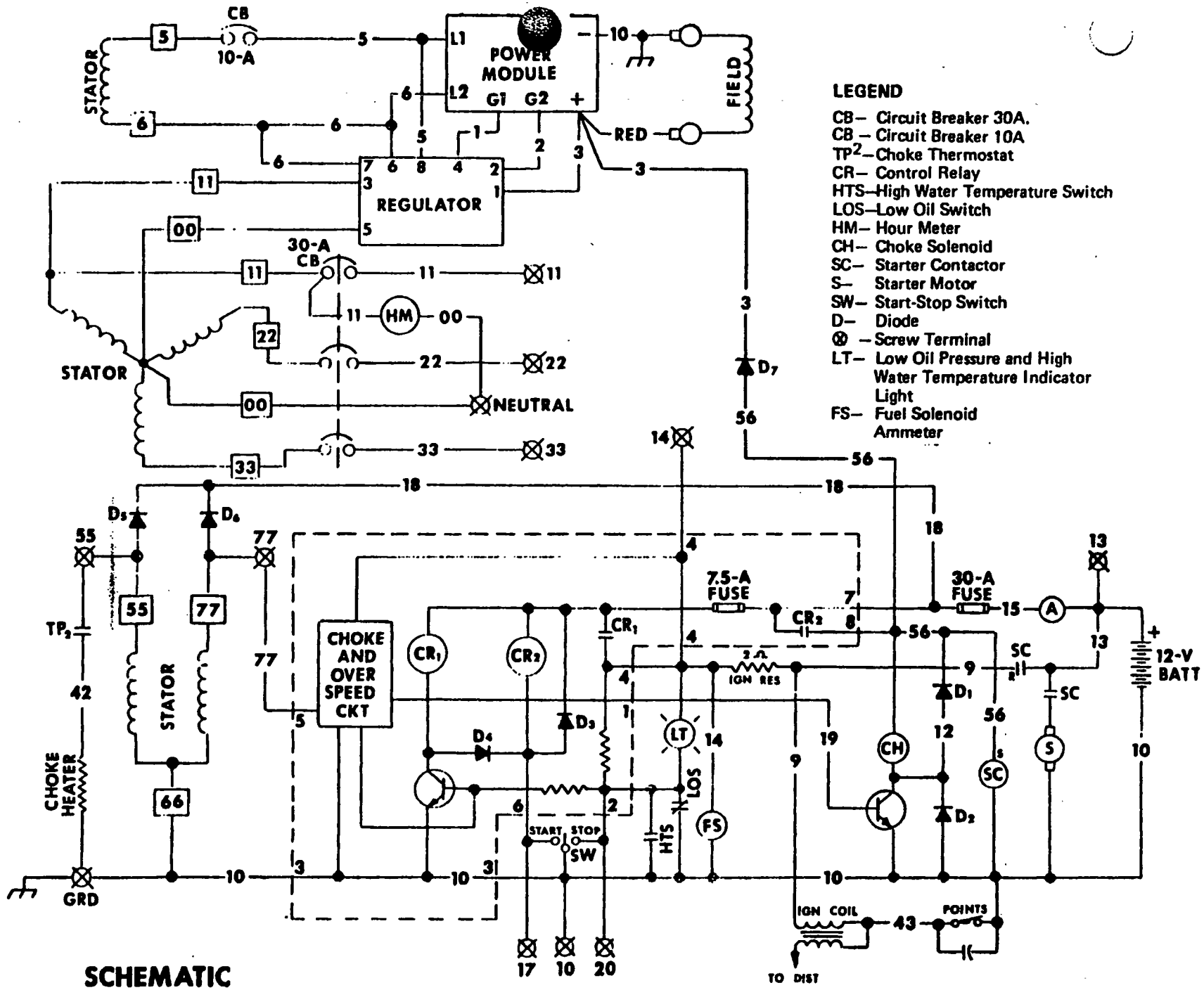
A–	Ammeter	KO–	Klixon On Intake Manifold
C–	Choke	HM–	Hour Meter
CB–	Circuit Breaker	HTS–	High Temp; Switch
D–	Distributor	LOS–	Low Oil Switch
D_1,D_2,D_3–	Diode	LT–	Light Low Oil High Temp.
DC–	DC Circuit Board	PM–	Power Module
F–	Fuse	S–	Starter
FS–	Fuel Lock-off Solenoid	SW–	Start/Stop Switch
IC–	Ign. Coil	VR–	Voltage Regulator Circuit Board
IR–	Ign. Resistor		



WIRING DIAGRAM



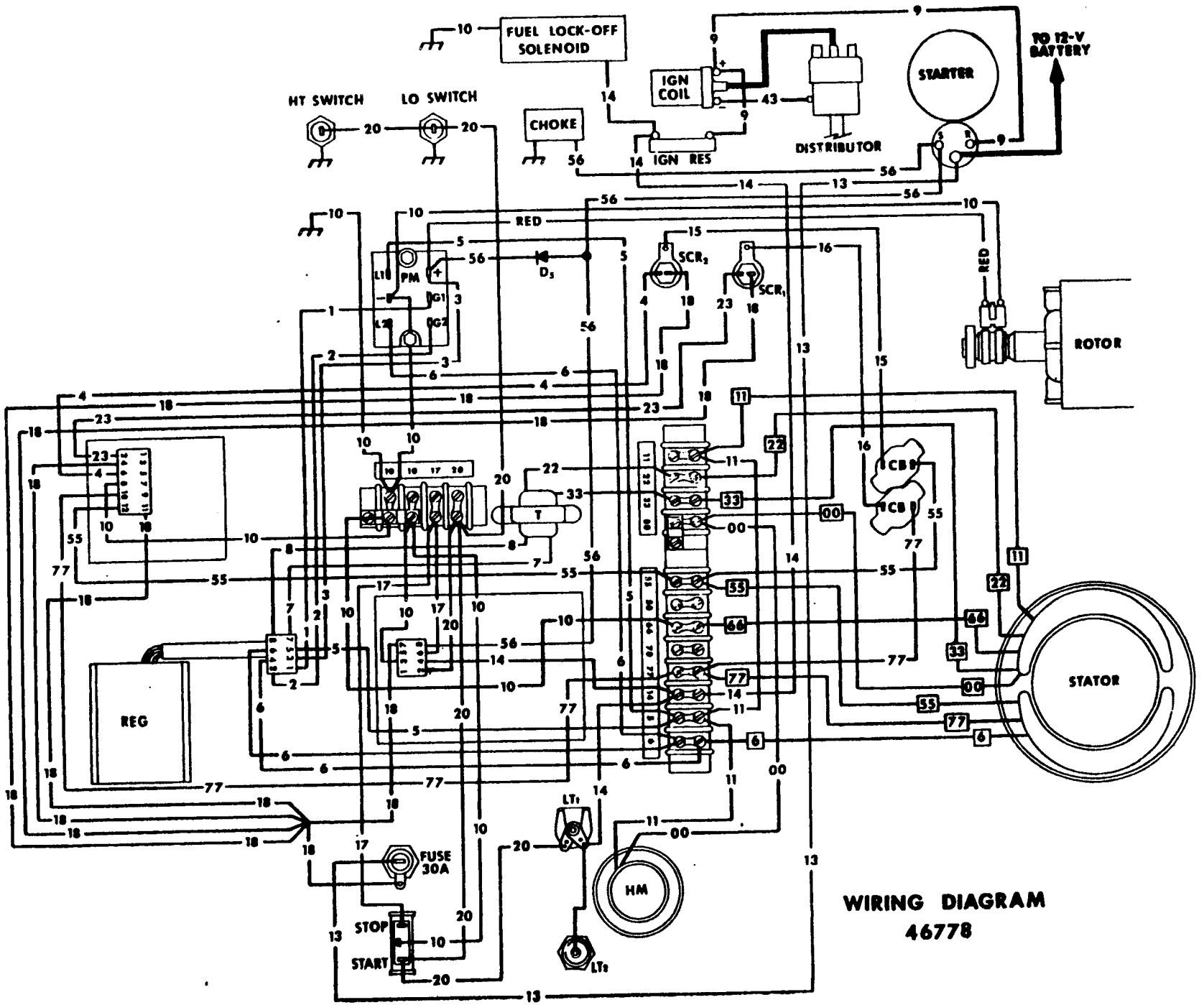
SCHEMATIC
47855



LEGEND

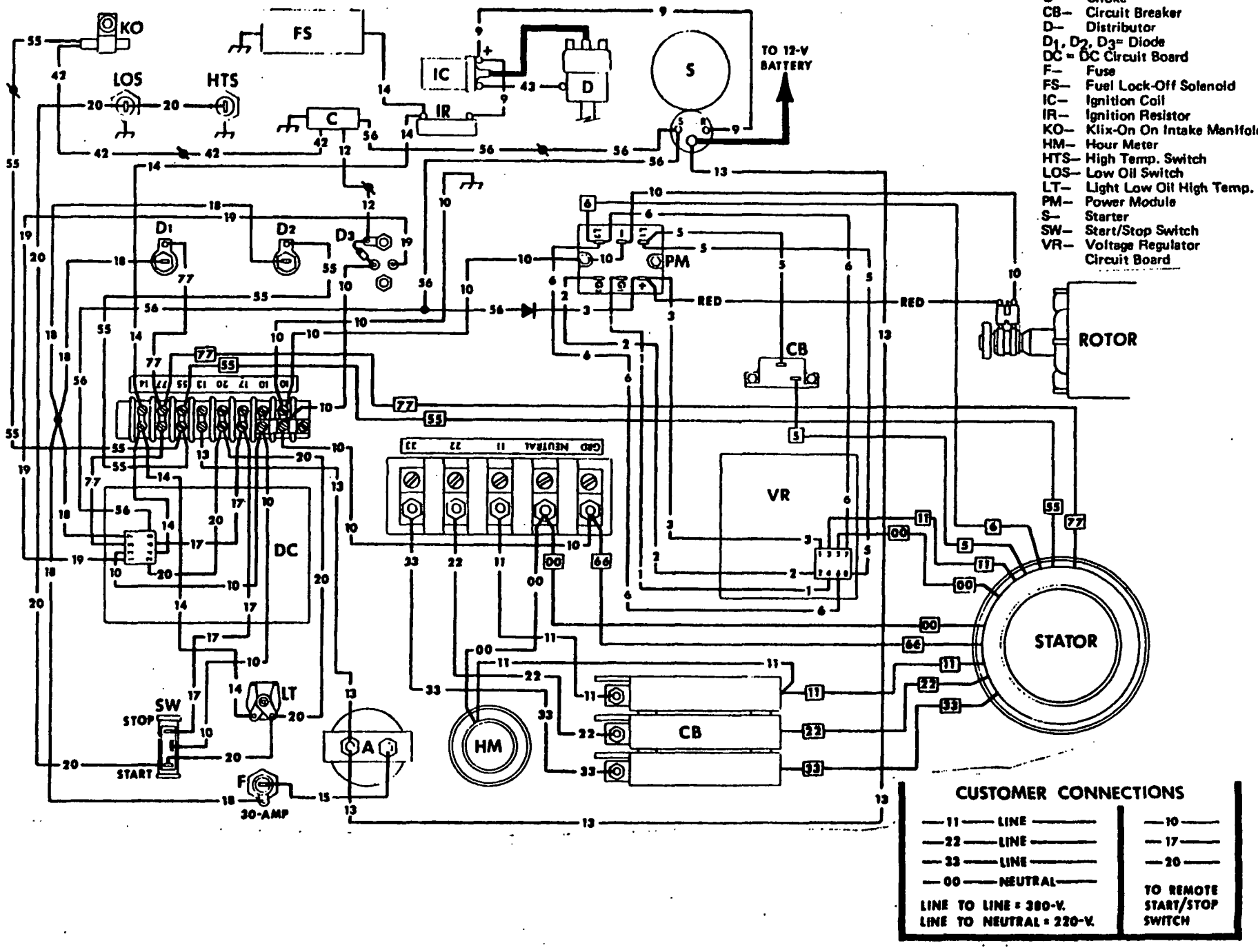
CB– Circuit Breaker 30A.
CB – Circuit Breaker 10A
TP2–Choke Thermostat
CR– Control Relay
HTS–High Water Temperature Switch
LOS–Low Oil Switch
HM– Hour Meter
CH– Choke Solenoid
SC– Starter Contactor
S– Starter Motor
SW– Start-Stop Switch
D– Diode
⊗ – Screw Terminal
LT– Low Oil Pressure and High Water Temperature Indicator Light
FS– Fuel Solenoid Ammeter

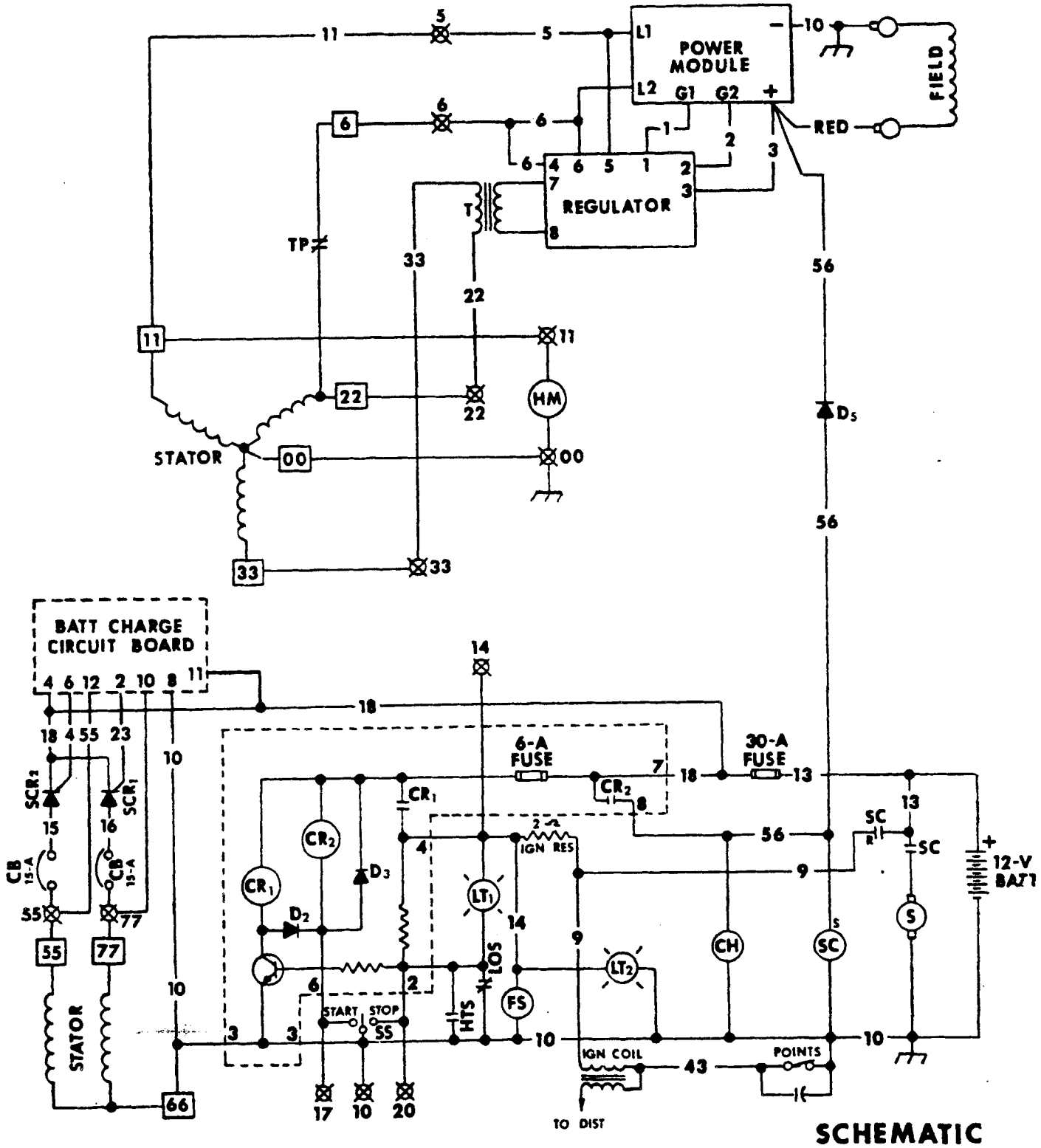
SCHEMATIC
47588


FUEL LOCK-OFF SOLENOID
IGN COIL
STARTER
TO 12-V BATTERY
HT SWITCH
LO SWITCH
CHOKE
IGN RES
DISTRIBUTOR
RED
ROTOR
PM
SCR2
SCR1
REG
STATOR
FUSE 30A
STOP
START
HM
WIRING DIAGRAM
46778

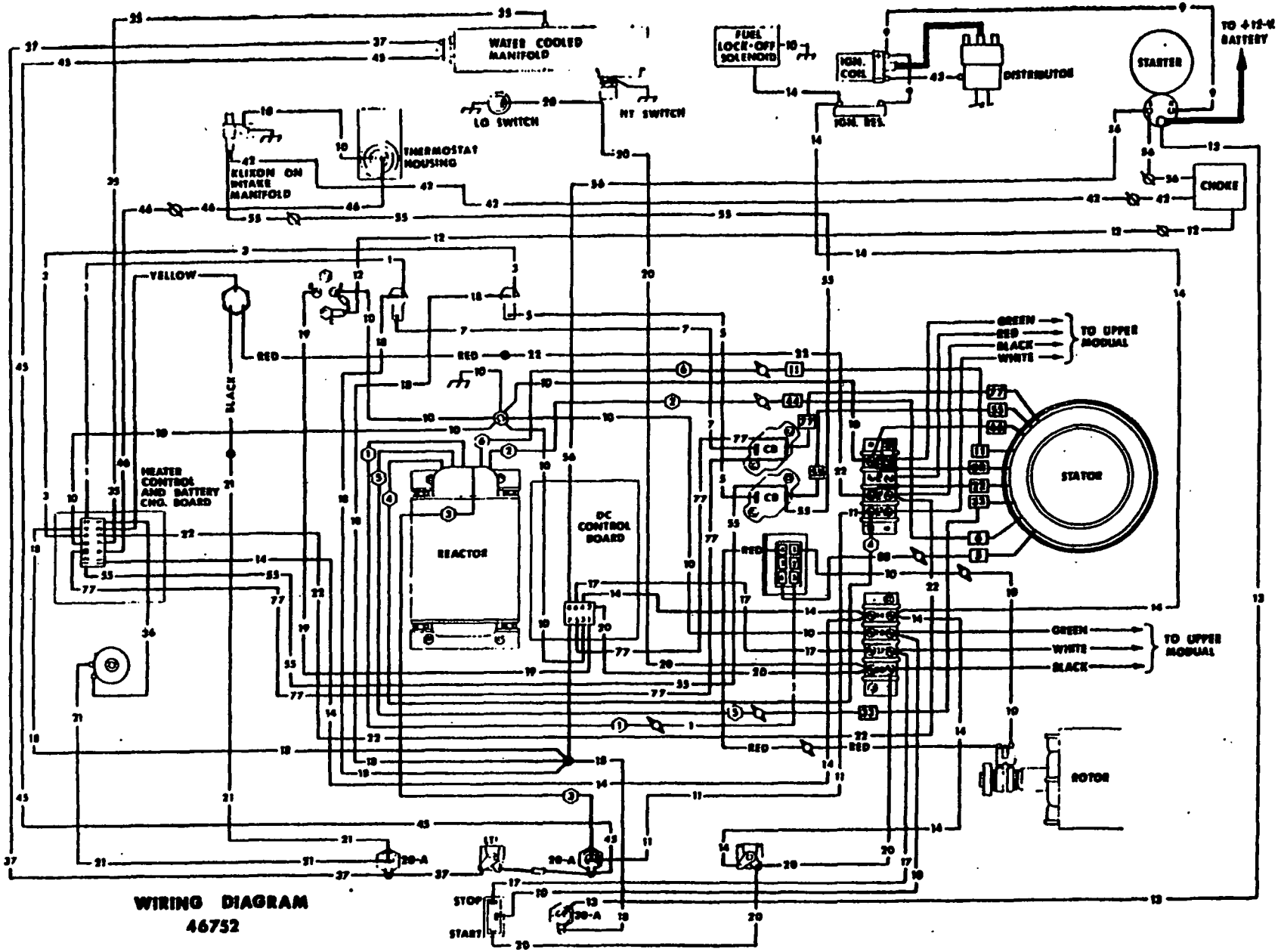
WIRING DIAGRAM

47572

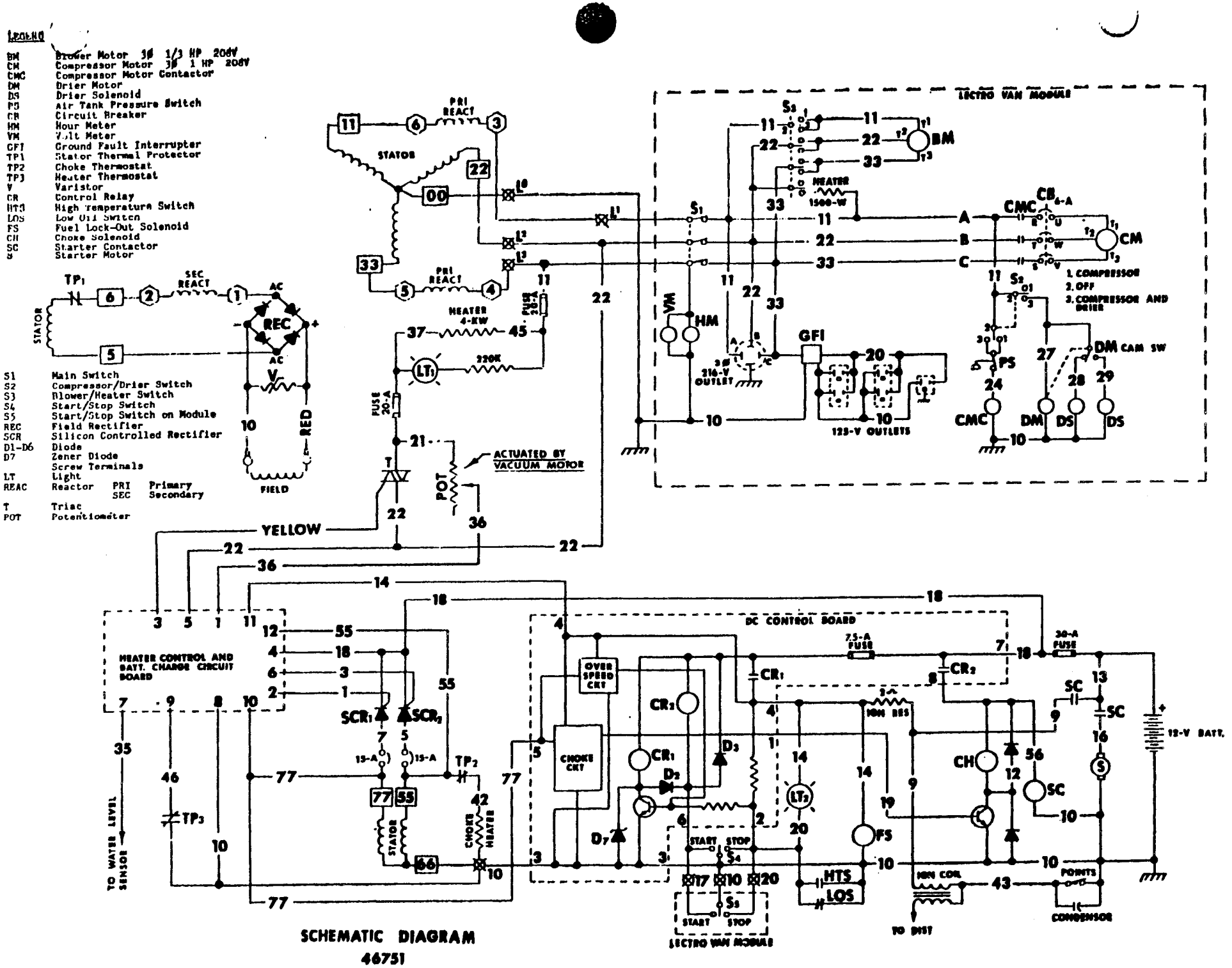




SCHEMATIC
46777



WIRING DIAGRAM
46752

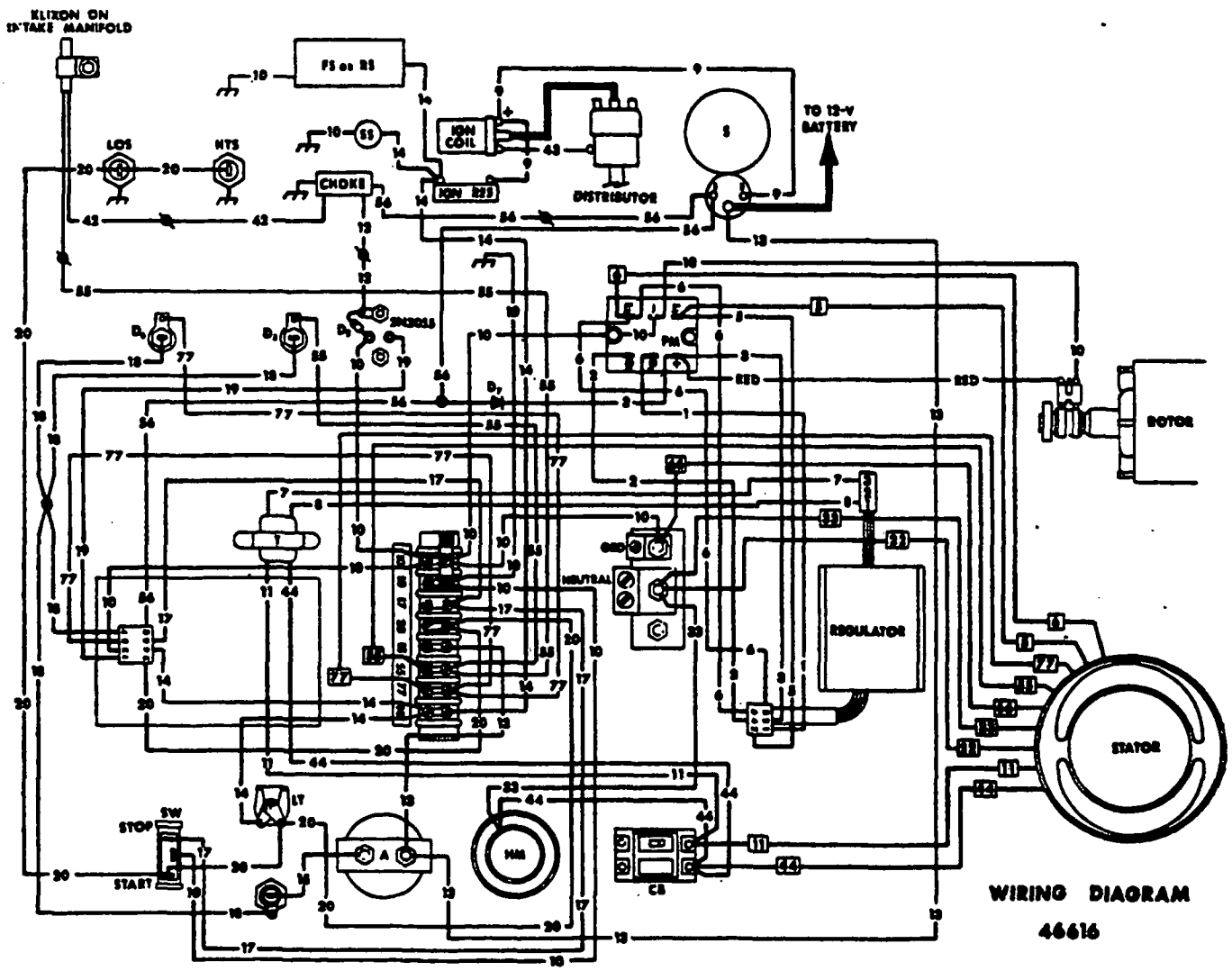


SCHEMATIC DIAGRAM

46751

LEGEND

A	-	AMMETER
D	-	DIODE
HM	-	HOUR METER
LT	-	PANEL LIGHT
T	-	VOLTAGE SENSING TRANSFORMER
LOS	-	LOW OIL SWITCH
S	-	STARTER MOTOR
CB	-	CIRCUIT BREAKER
FS	-	FUEL LOCK-OFF SOLENOID
HTS	-	HIGH TEMP. SWITCH
SW	-	START-STOP SWITCH
PM	-	POWER MODULE

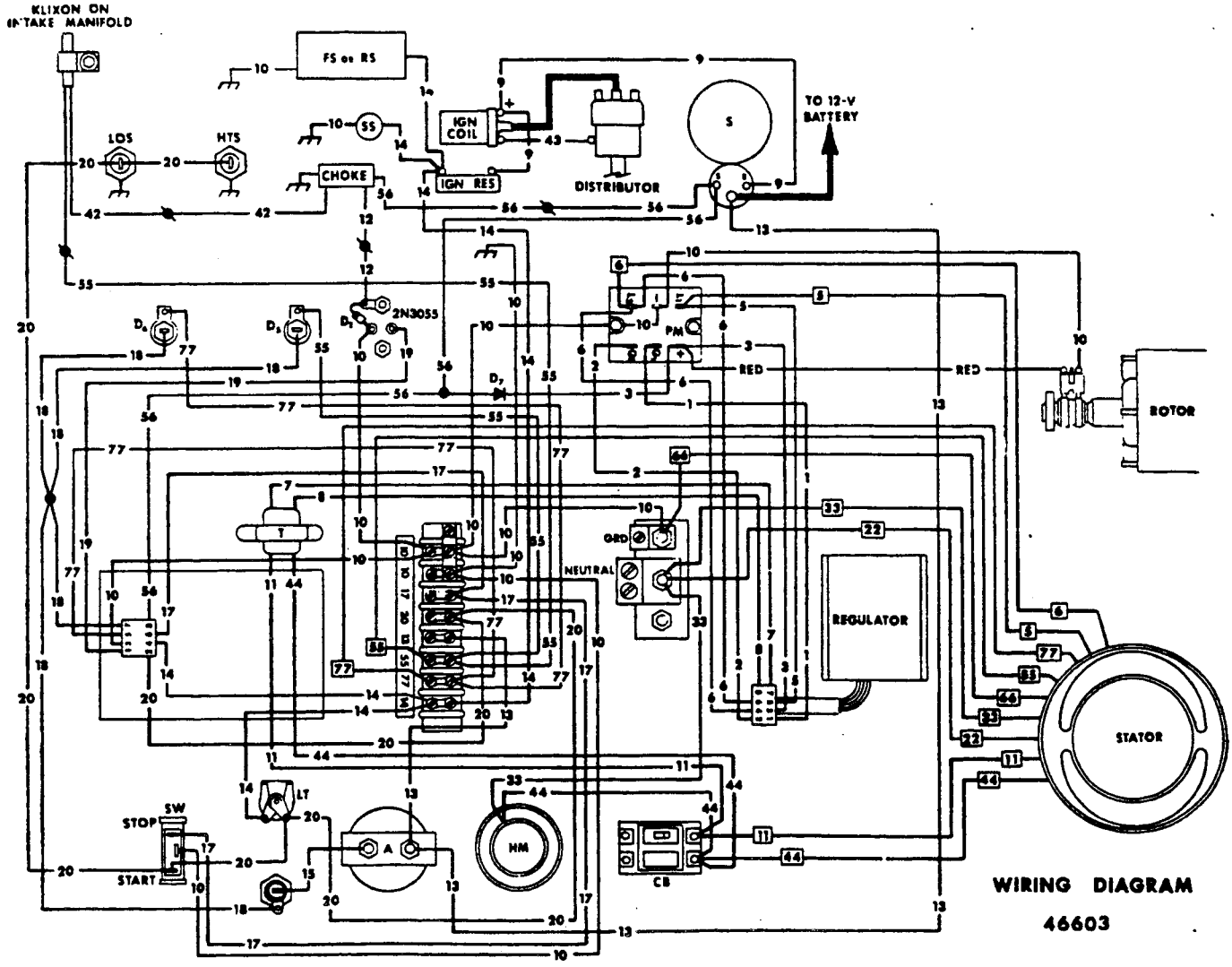


WIRING DIAGRAM

46616

LEGEND

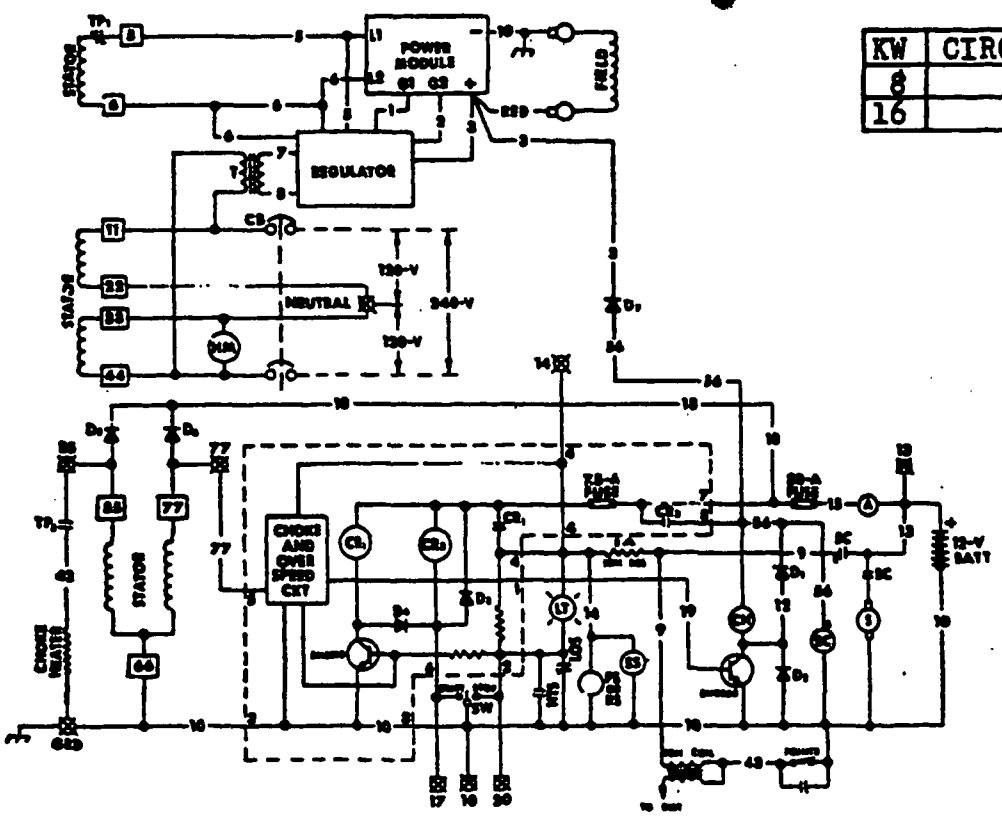
CB - CIRCUIT BREAKER
T - VOLTAGE SENSING TRANSFORMER
HTS - HIGH WATER TEMPERATURE SWITCH
LOS - LOW OIL SWITCH
HM - HOUR METER
S - STARTER MOTOR
SW - START-STOP SWITCH
D - DIODE
LT - LOW OIL PRESSURE AND HIGH WATER TEMPERATURE INDICATOR LIGHT
FS - FUEL SOLENOID (Used with gasoline system only)
RS - REGULATOR SOLENOID (Used with L.P.G. or Natural Gas Only)
A - AMMETER
PM - POWER MODULE



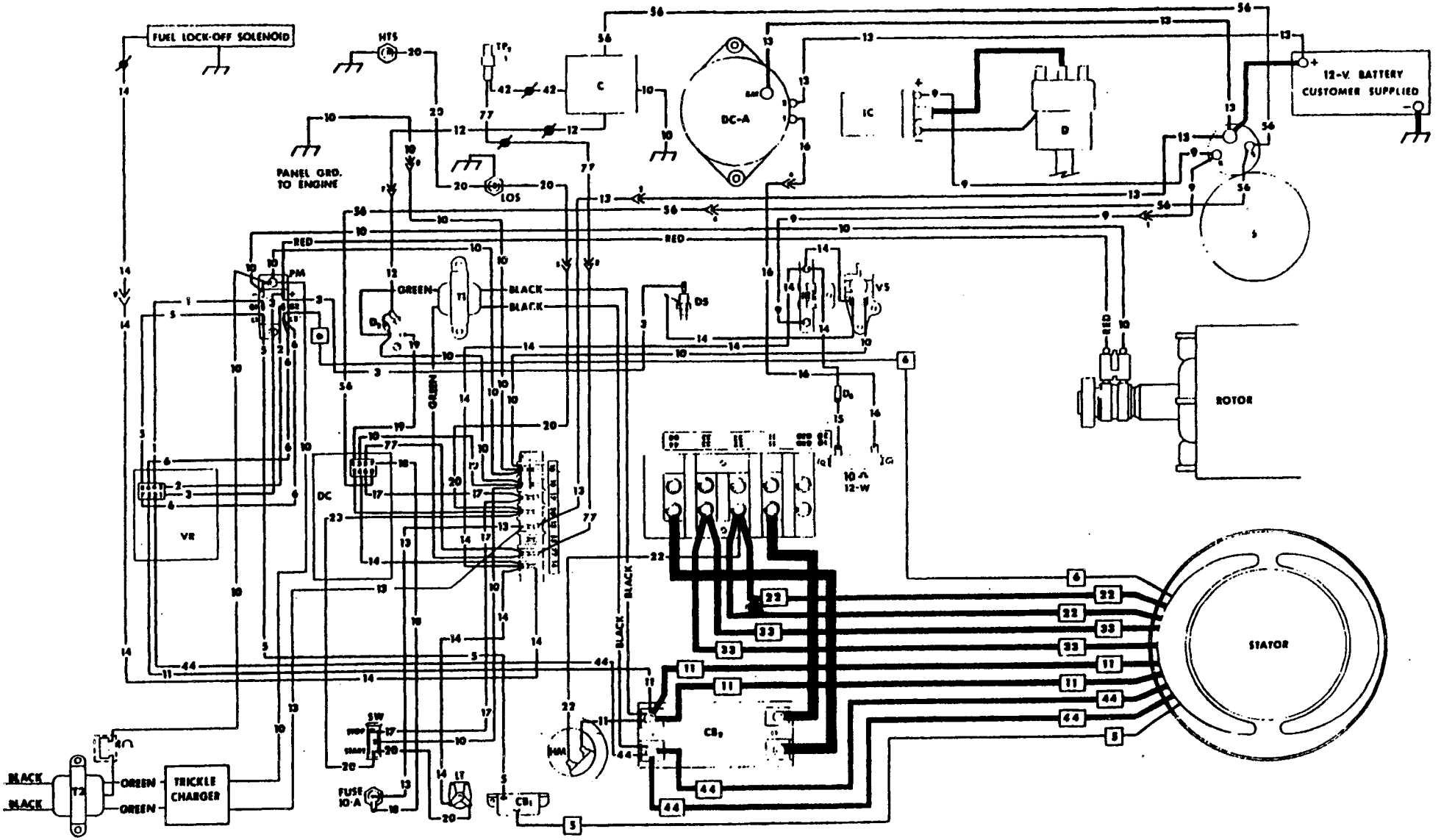
LEGEND

CB - CIRCUIT BREAKER
T - VOLTAGE SENSING TRANSFORMER
TP^1 - STATOR THERMAL PROTECTOR
TP^2 - CHOKE THERMOSTAT
CR - CONTROL RELAY
HTS - HIGH WATER TEMPERATURE SWITCH
LOS - LOW OIL SWITCH
HM - HOUR METER
CH - CHOKE SOLENOID
SC - STARTER CONTACTOR
S - STARTER MOTOR
SW - START-STOP SWITCH
D - DIODE
- SCREW TERMINAL
SS - SHUTTER SOLENOID
LT - LOW OIL PRESSURE AND HIGH WATER TEMPERATURE INDICATOR LIGHT
FS - FUEL SOLENOID (Used with gasoline system only)
RS - REGULATOR SOLENOID (Used with L.P.G. or Natural Gas Only)
A - AMMETER

KW	CIRCUIT BREAKER (CB)
8	50-A.
16	90-A.



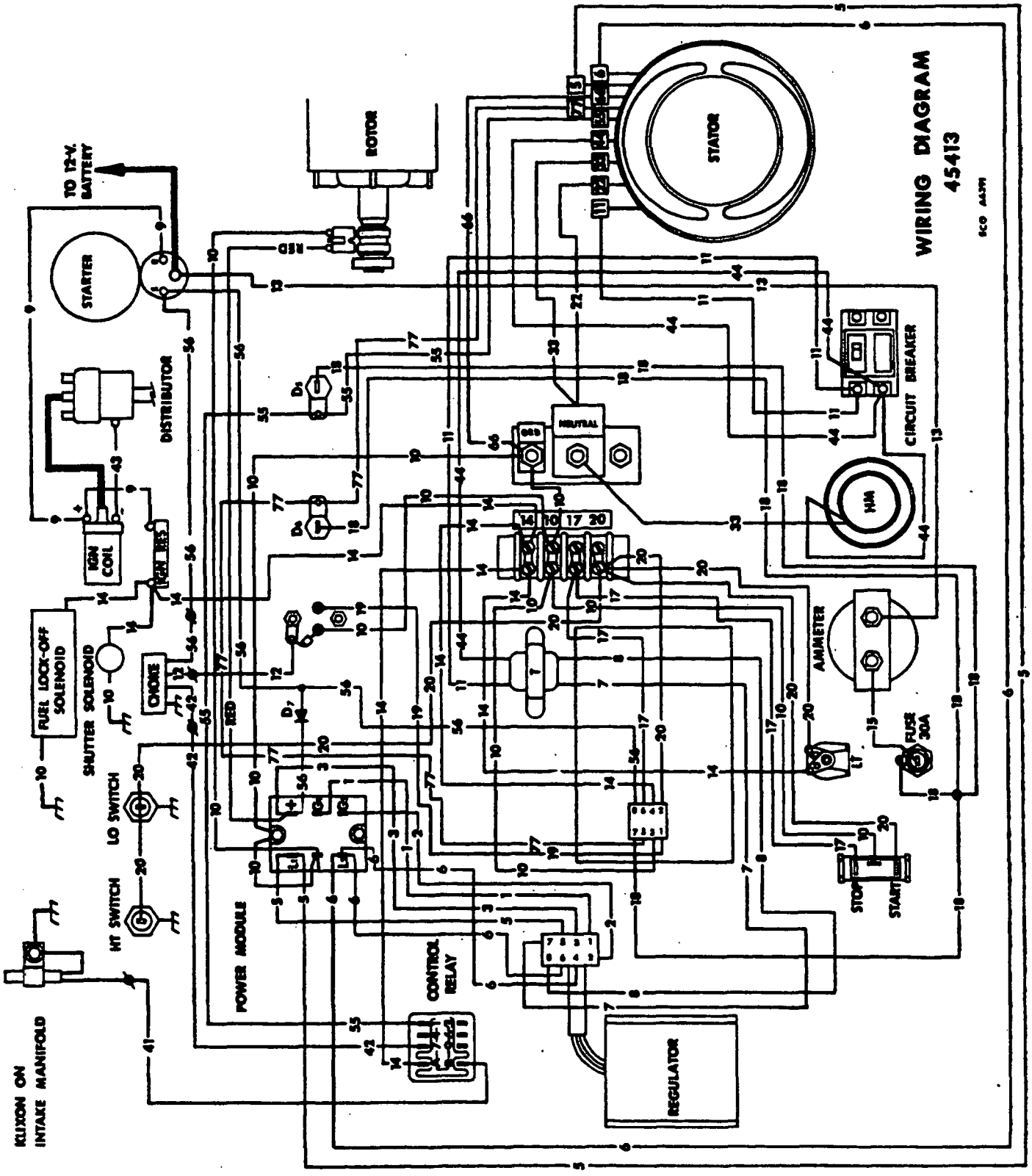
SCHEMATIC
46602

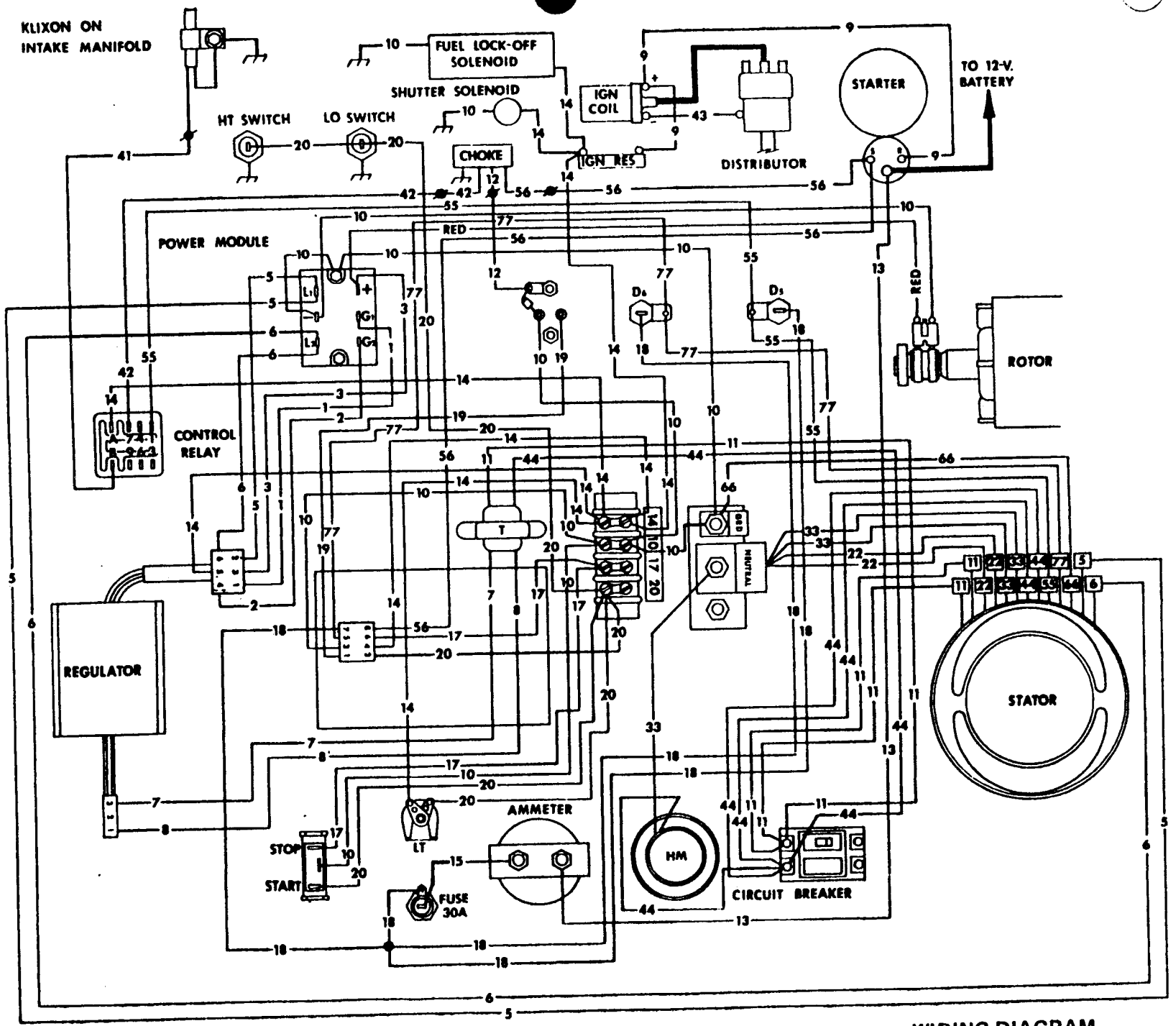


WIRING DIAGRAM
Drawing No. 46318

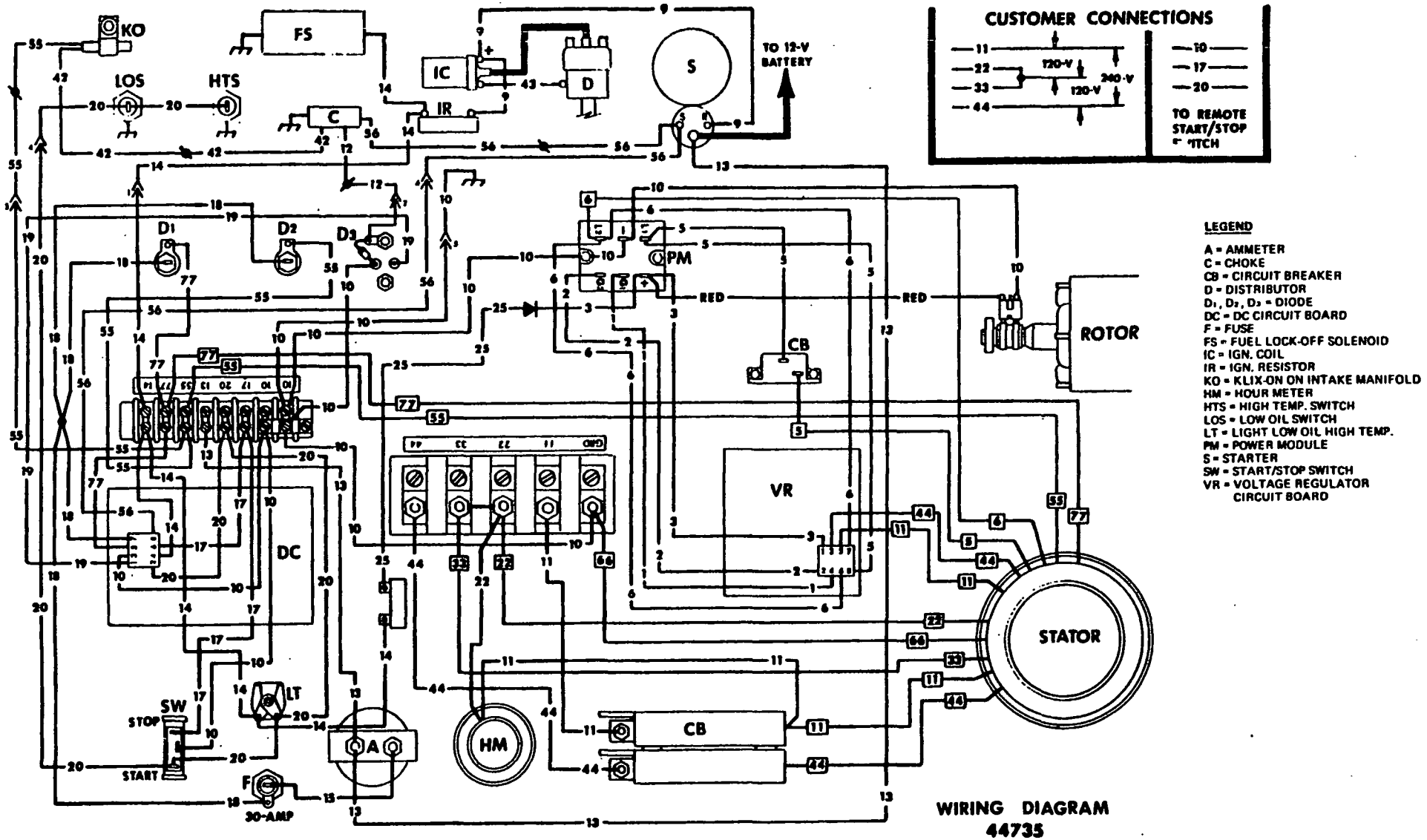
LEGEND

A - AMMETER
D - DIODE
HM - HOUR METER
LT - PANEL LIGHT
T - VOLTAGE SENSING TRANSFORMER





WIRING DIAGRAM
45410

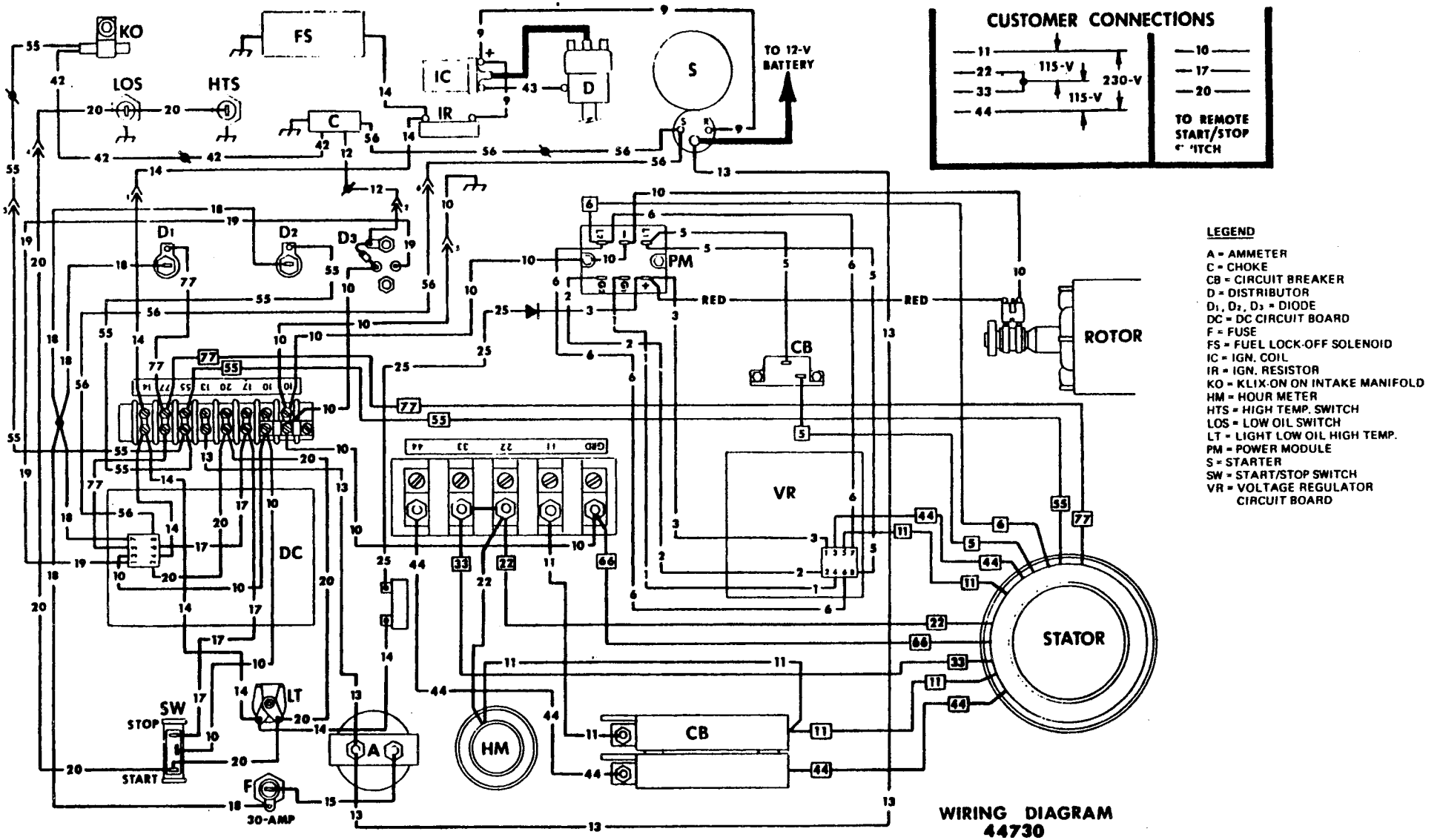


LEGEND

A = AMMETER
C = CHOKE
CB = CIRCUIT BREAKER
D = DISTRIBUTOR
D_1, D_2, D_3 = DIODE
DC = DC CIRCUIT BOARD
F = FUSE
FS = FUEL LOCK-OFF SOLENOID
IC = IGN. COIL
IR = IGN. RESISTOR
KO = KLIX-ON ON INTAKE MANIFOLD
HM = HOUR METER
HTS = HIGH TEMP. SWITCH
LOS = LOW OIL SWITCH
LT = LIGHT LOW OIL HIGH TEMP.
PM = POWER MODULE
S = STARTER
SW = START/STOP SWITCH
VR = VOLTAGE REGULATOR CIRCUIT BOARD

WIRING DIAGRAM
44735

KW	CIRCUIT BREAKER (CB)
8	50-A.
16	90-A.

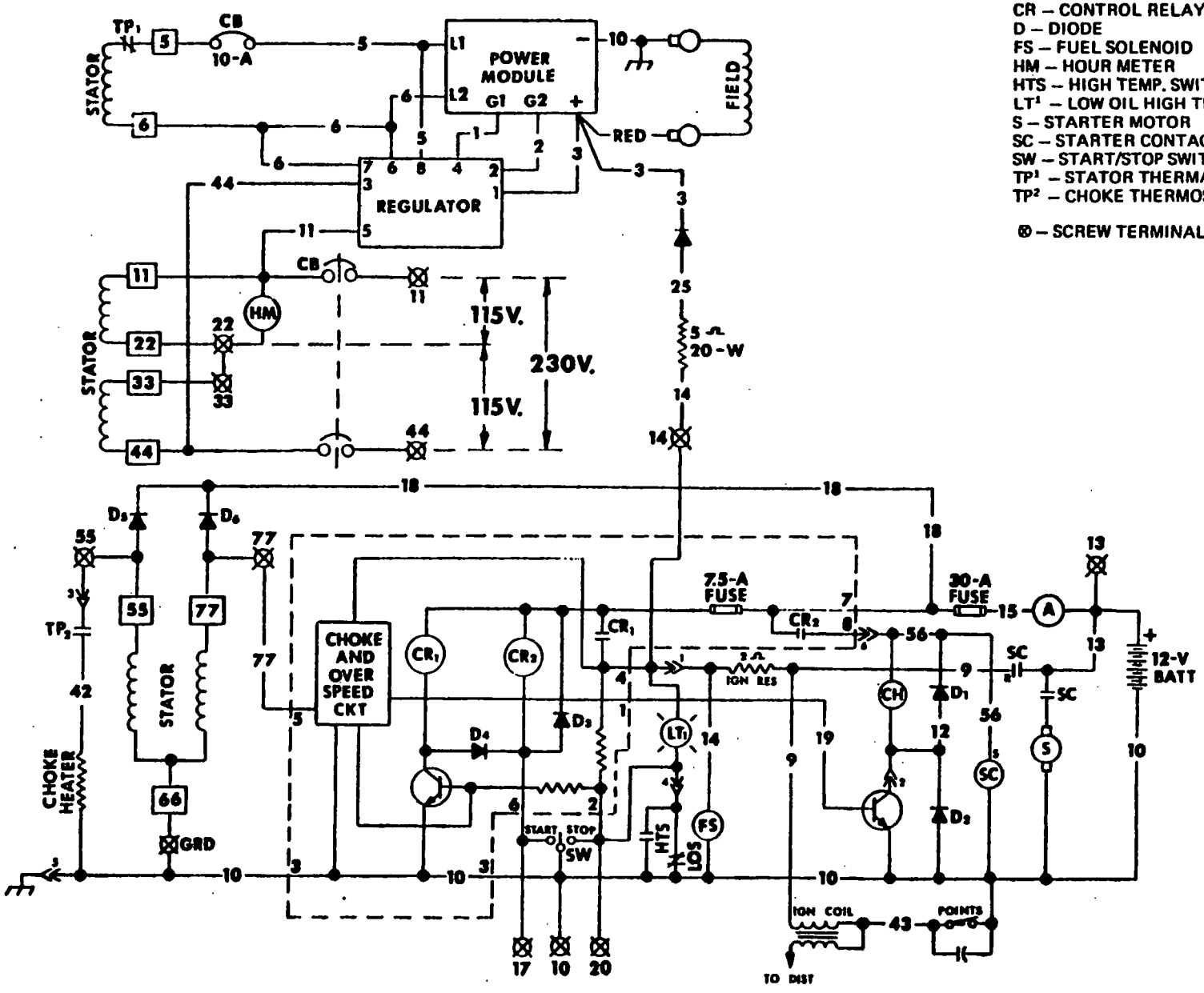


WIRING DIAGRAM
44730

LEGEND

A – AMMETER
CB – CIRCUIT BREAKER
CH – CHOKE
CR – CONTROL RELAY
D – DIODE
FS – FUEL SOLENOID
HM – HOUR METER
HTS – HIGH TEMP. SWITCH
LT¹ – LOW OIL HIGH TEMP. LIGHT
S – STARTER MOTOR
SC – STARTER CONTACTOR
SW – START/STOP SWITCH
TP¹ – STATOR THERMAL PROTECTOR
TP² – CHOKE THERMOSTAT

⊗ – SCREW TERMINAL



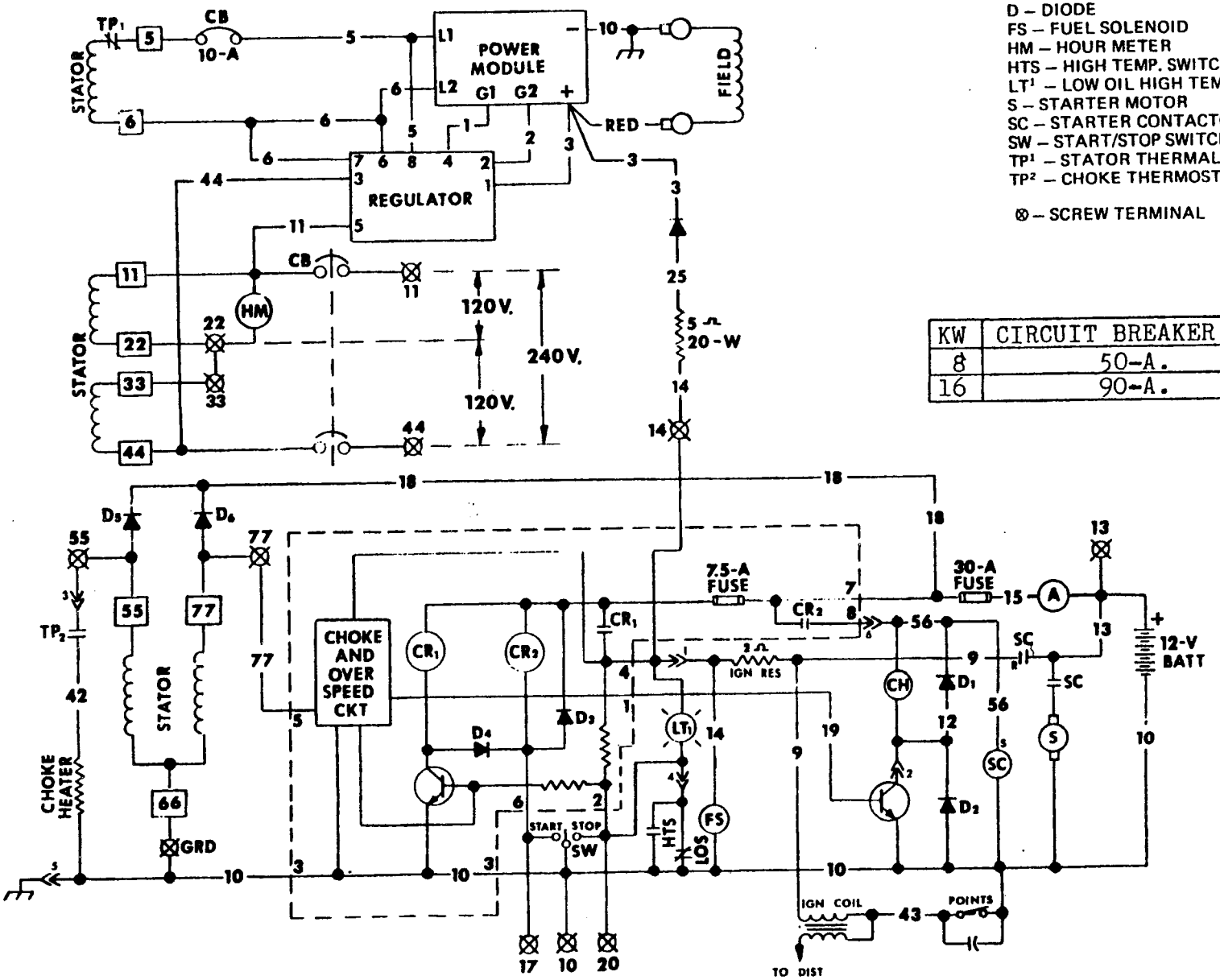
SCHEMATIC
44729

LEGEND

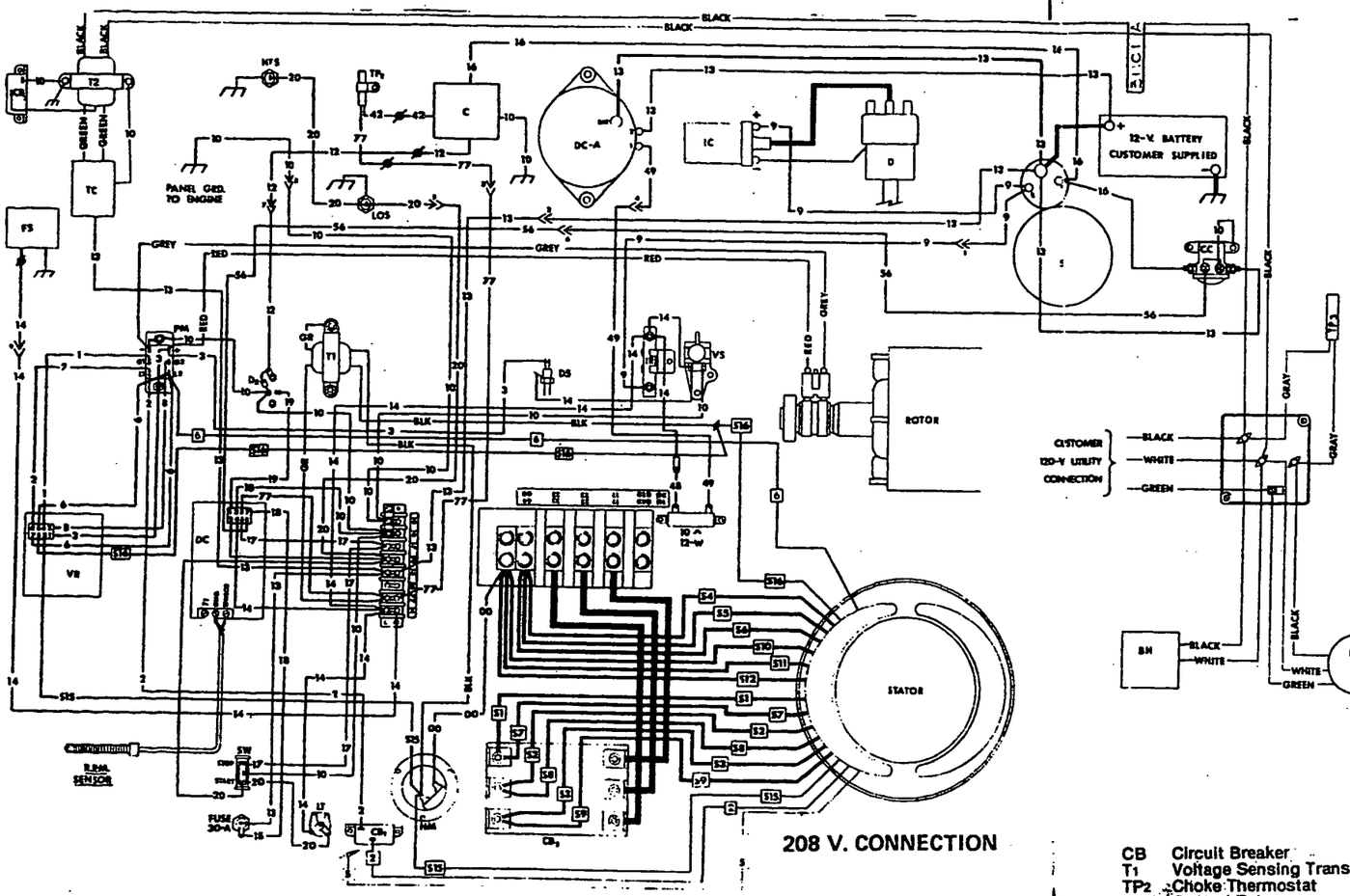
A – AMMETER
CB – CIRCUIT BREAKER
CH – CHOKE
CR – CONTROL RELAY
D – DIODE
FS – FUEL SOLENOID
HM – HOUR METER
HTS – HIGH TEMP. SWITCH
LT¹ – LOW OIL HIGH TEMP. LIGHT
S – STARTER MOTOR
SC – STARTER CONTACTOR
SW – START/STOP SWITCH
TP¹ – STATOR THERMAL PROTECTOR
TP² – CHOKE THERMOSTAT

⊗ – SCREW TERMINAL

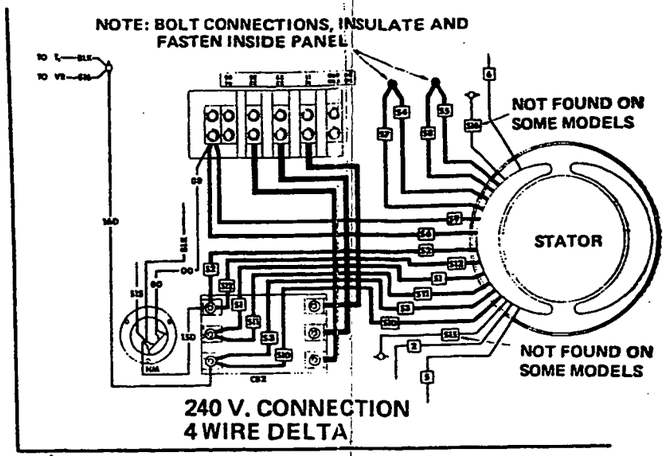
KW	CIRCUIT BREAKER (CB)
8	50-A.
16	90-A.



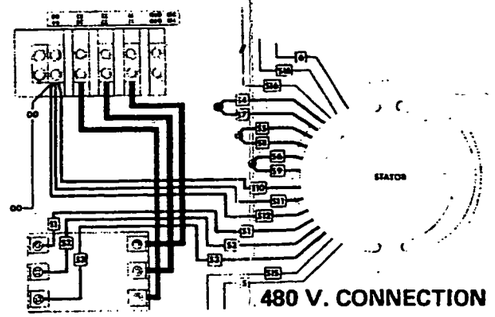
SCHEMATIC
44725



208 V. CONNECTION



240 V. CONNECTION
4 WIRE DELTA



480 V. CONNECTION

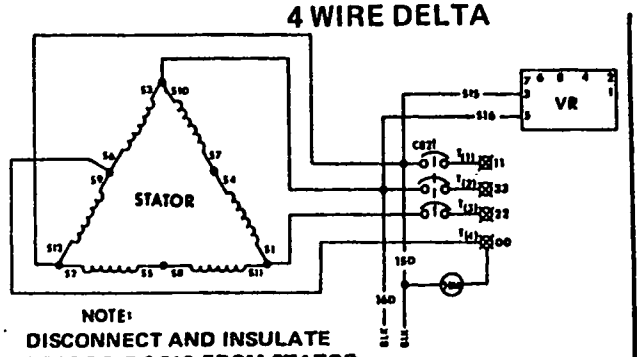
WIRING DIAGRAM No. 51101

LEGEND

CB	Circuit Breaker
T_1	Voltage Sensing Transformer
TP_2	Choke Thermostat
CR	Control Relay
HTS	High Water Temperature Switch
LOS	Low Oil Switch
HM	Hour Meter
CH	Choke Solenoid
SC	Starter Contactor
S	Starter Motor
SW	Start/Stop Switch
D_1-D_2	Diodes
⊠	Screw Terminal
VS	Vacuum Solenoid
LT	Low Oil Pressure & High Water Temperature Indicator Light
T_1	Transformer
DC-A	DC Alternator
⊠	Screw Terminal
FS	Fuel Lock-Off Solenoid
T_2	Trickle Charger Transformer
CC	Control Contactor
PM	Power Module
IC	Ignition Coil
EH	Engine Heater
BH	Battery Heater
TP_3	Thermostat (Water Heater)

LINE TO LINE	208V.	480V.	240V.
LINE TO NEUT.	120V.	277V.	*120V.
T(1) -LINE A	WYE	WYE	DELTA
T(2) -LINE B			
T(3) - LINE C		* 11-N, 33-N } ONLY	
T(4) - NUETRAL			

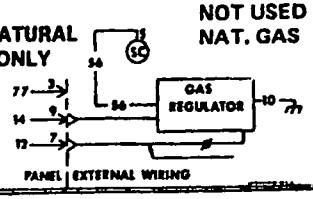
240 V. CONNECTION 4 WIRE DELTA

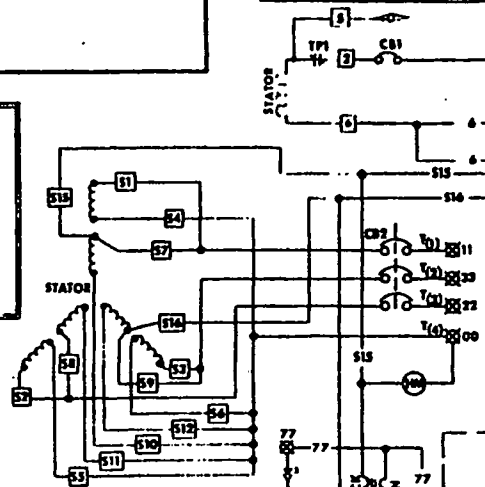


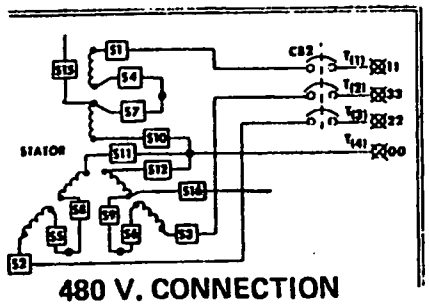
VOLTAGE		208 V.	480 V.	RPM
KVA	CB1	CB2	CB2	
22.50	7-A	60-A	30-A	1800
25.00	-A	70-A	40-A	1800
31.25	-A	100-A	50-A	1800
43.75	7-A	125-A	60-A	1800
43.75	7-A	125-A	60-A	3600
62.50	-A	175-A	100-A	1800
81.25	-A	225-A	125-A	1800

WIRING FOR NATURAL AND L.P. GAS ONLY

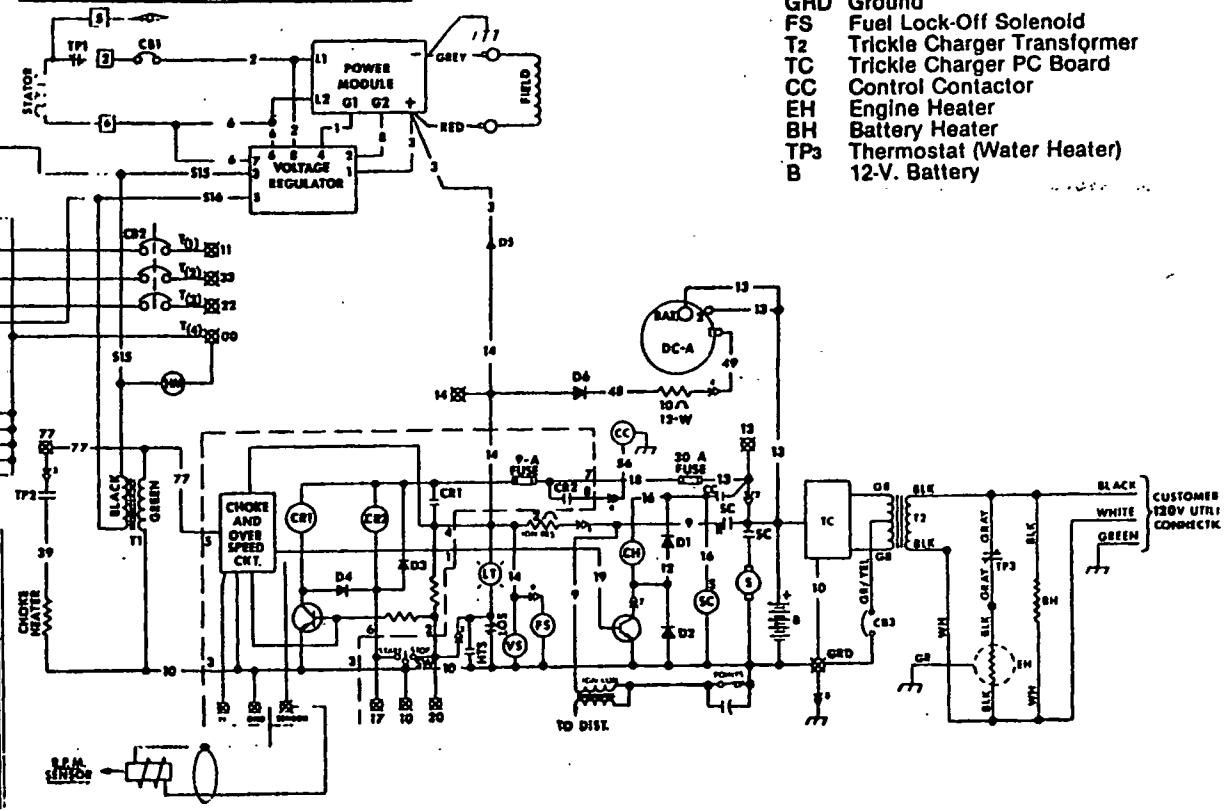
NOT USED ON NAT. GAS







480 V. CONNECTION



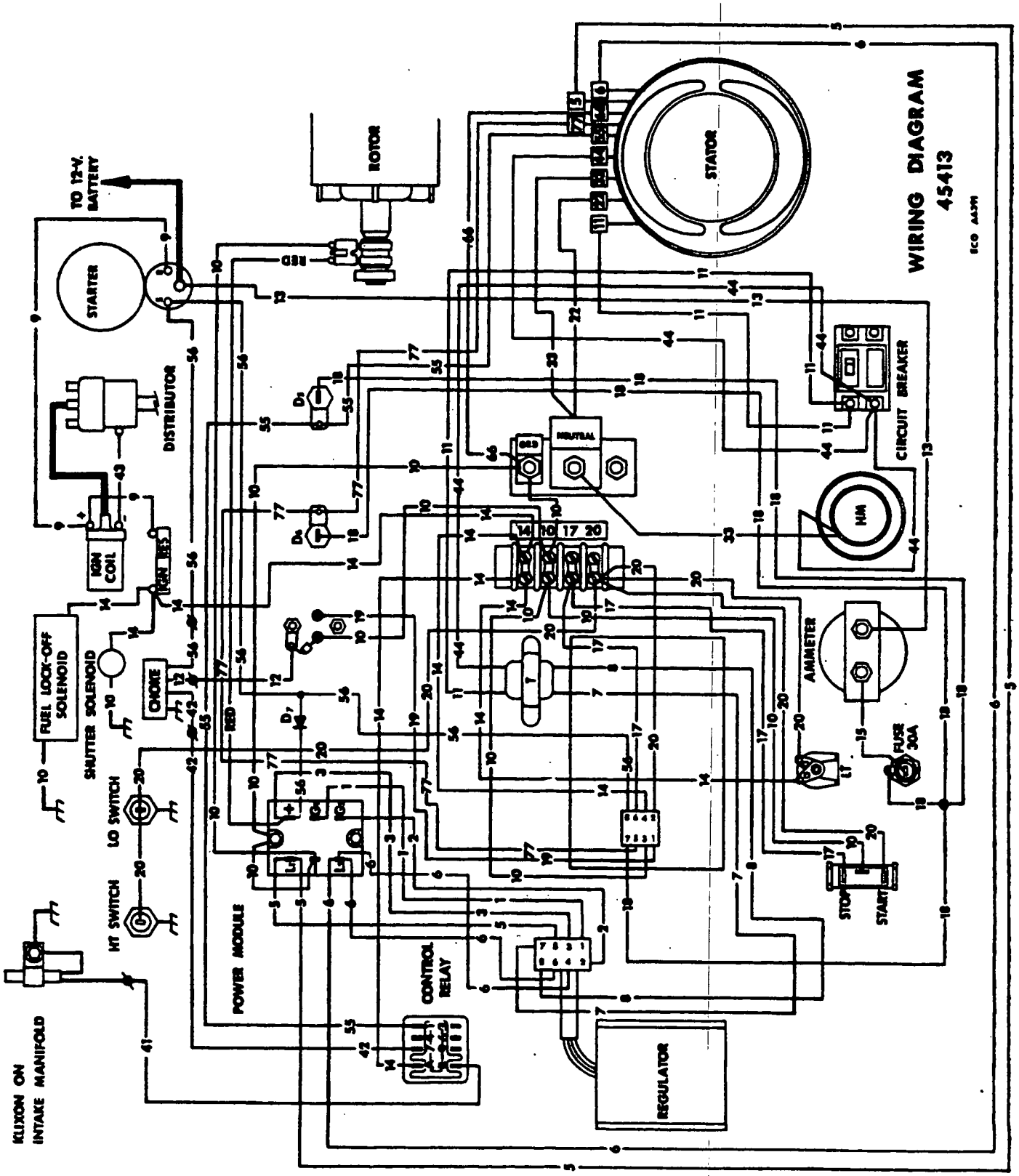
LEGEND

CB	Circuit Breaker
T_1	Voltage Sensing Transformer
TP_1	Stator Thermal Protector
TP_2	Choke Thermostat
CR	Control Relay
HTS	High Water Temperature Switch
LOS	Low Oil Switch
HM	Hour Meter
CH	Choke Solenoid
SC	Starter Contactor
S	Starter Motor
SW	Start/Stop Switch
D_1-D_5	Diode
⊠	Screw Terminal
VS	Vacuum Solenoid
LT	Low Oil Pressure & High Water Temperature Indicator Light
DC-A	DC Alternator
GRD	Ground
FS	Fuel Lock-Off Solenoid
T_2	Trickle Charger Transformer
TC	Trickle Charger PC Board
CC	Control Contactor
EH	Engine Heater
BH	Battery Heater
TP_3	Thermostat (Water Heater)
B	12-V. Battery

SCHEMATIC No. 51102

LEGEND

A - AMMETER
D - DIODE
HM - HOUR METER
LT - PANEL LIGHT
T - VOLTAGE SENSING TRANSFORMER



ALTERNATE ROTARY SWITCH

LEGEND

A	=	AMMETER
BCA	=	BATTERY CHARGE AMMETER
BR	=	BREAKER RELAY*
CB1	=	CIRCUIT BREAKER- FIELD
D	=	DIODE
F	=	FUSE
G1	=	GAUGE- WATER TEMPERATURE
G2	=	GAUGE- OIL PRESSURE
HM	=	HOURMETER
HZ	=	FREQUENCY METER
L1	=	LIGHT- LOW OIL PRESSURE
L2	=	LIGHT- HIGH COOLANT TEMPERATURE
L3	=	LIGHT- OVERCRANK
L4	=	LIGHT- OVERSPEED
L5	=	LIGHT- RPM SENSOR LOSS
L6	=	LIGHT- PANEL
R1	=	RESISTOR- 10 Ohm, 12 Watt
R2	=	RESISTOR- FIELD BOOST
R3	=	POTENTIOMETER 10K, 2W (Voltage Adjust)
RS	=	ROTARY SWITCH
SW1	=	SWITCH- START/STOP
SW2	=	SWITCH- TEST
SW3	=	SWITCH- RESET
TB	=	TERMINAL BLOCK
V	=	VOLTMETER
VR	=	VOLTAGE REGULATOR

* Used on units without Main Circuit Breaker. On Units with Main Circuit Breaker, connect Wire 160 to 29, 163 to 162, cut and insulate Wires 14 and 161.

NOTE:- R2 JUMPER USED ON 1800 RPM UNITS ONLY 20 KW, 15 KW,

TO CONNECTION BOX

TO ENGINE

DC CONT. BAD

CLEAR PLASTIC INSULATOR

RPM SENSOR

OPTION A

ENGINE MONITOR PANEL

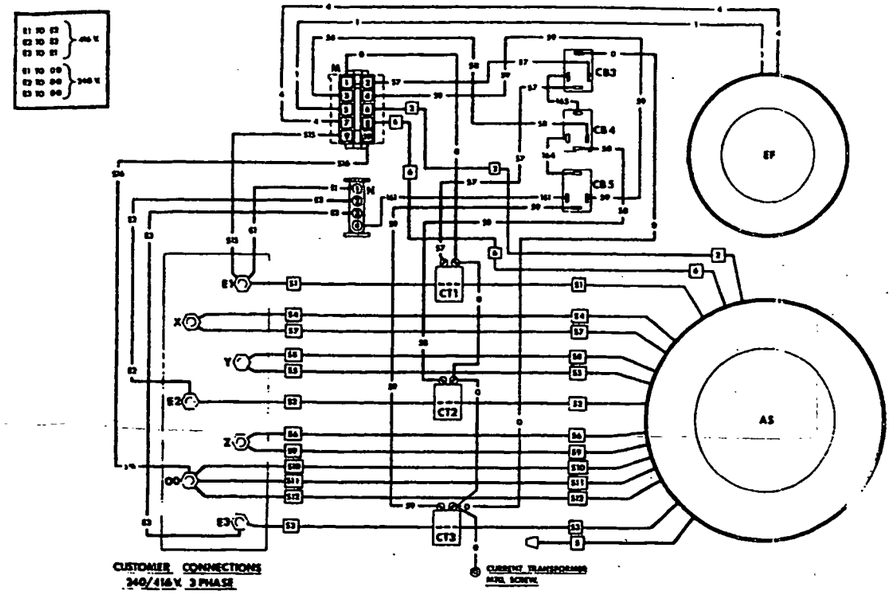
OPTION "B"

LATCH CRANK P.C. BOARD

OPTION C

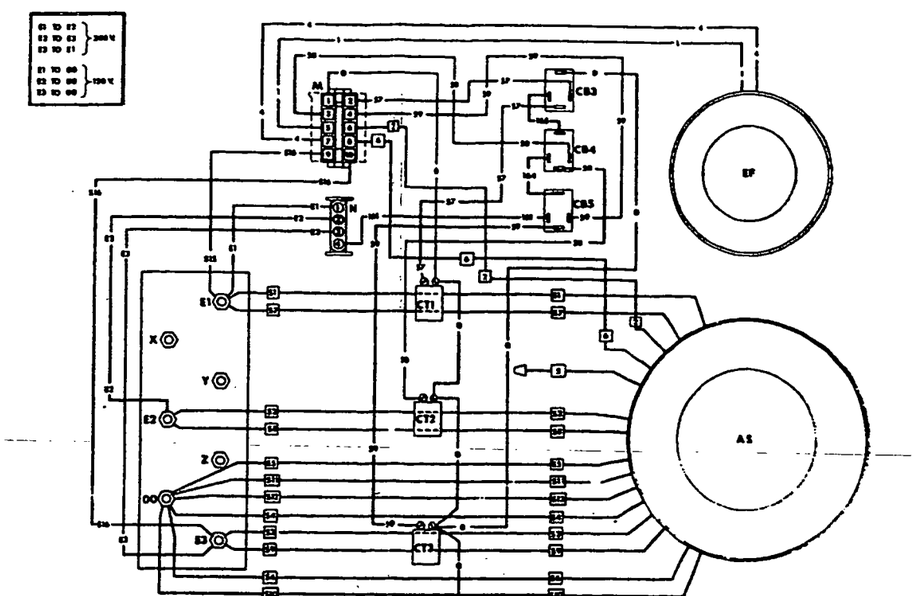
LATCH/CRANK PC BOARD

CONTROL PANEL WIRING DIAGRAM - GAS
Drawing Number 55988
Revised - 4/19/83



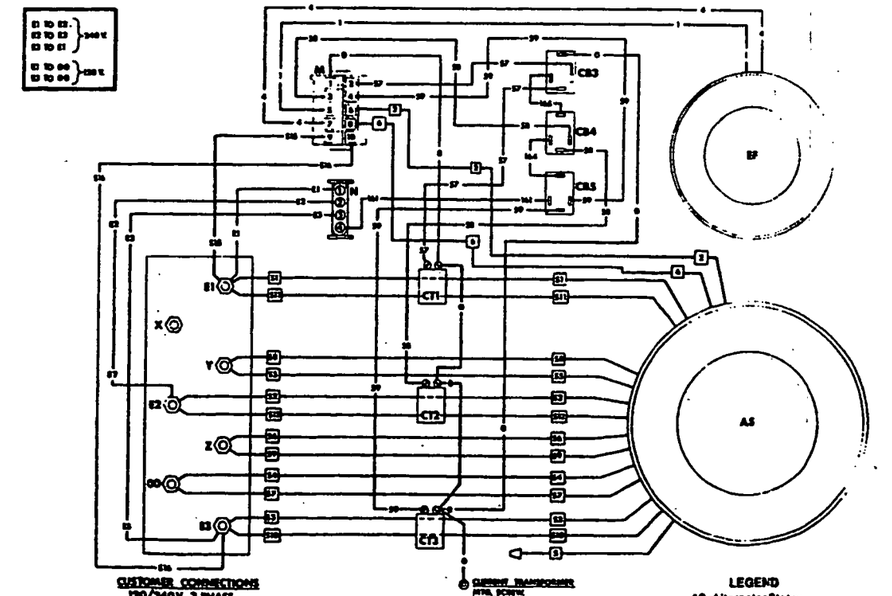
CUSTOMER CONNECTIONS
240/416 V. 3 PHASE

CURRENT TRANSFORMER
MTR. SCRN'L



CUSTOMER CONNECTIONS
120/208 V. 3 PHASE

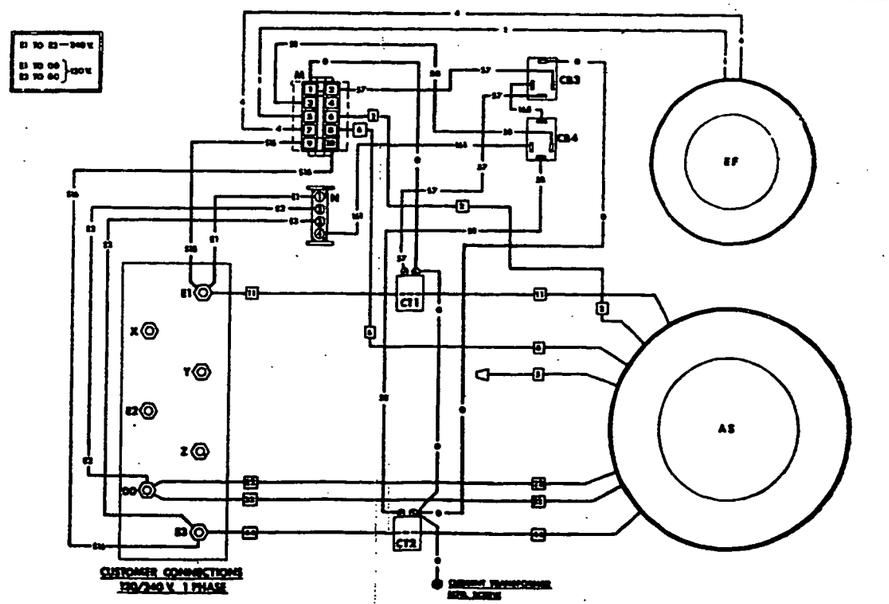
CURRENT TRANSFORMER
MTR. SCRN'L



CUSTOMER CONNECTIONS
120/240 V. 3 PHASE

CURRENT TRANSFORMER
MTR. SCRN'L

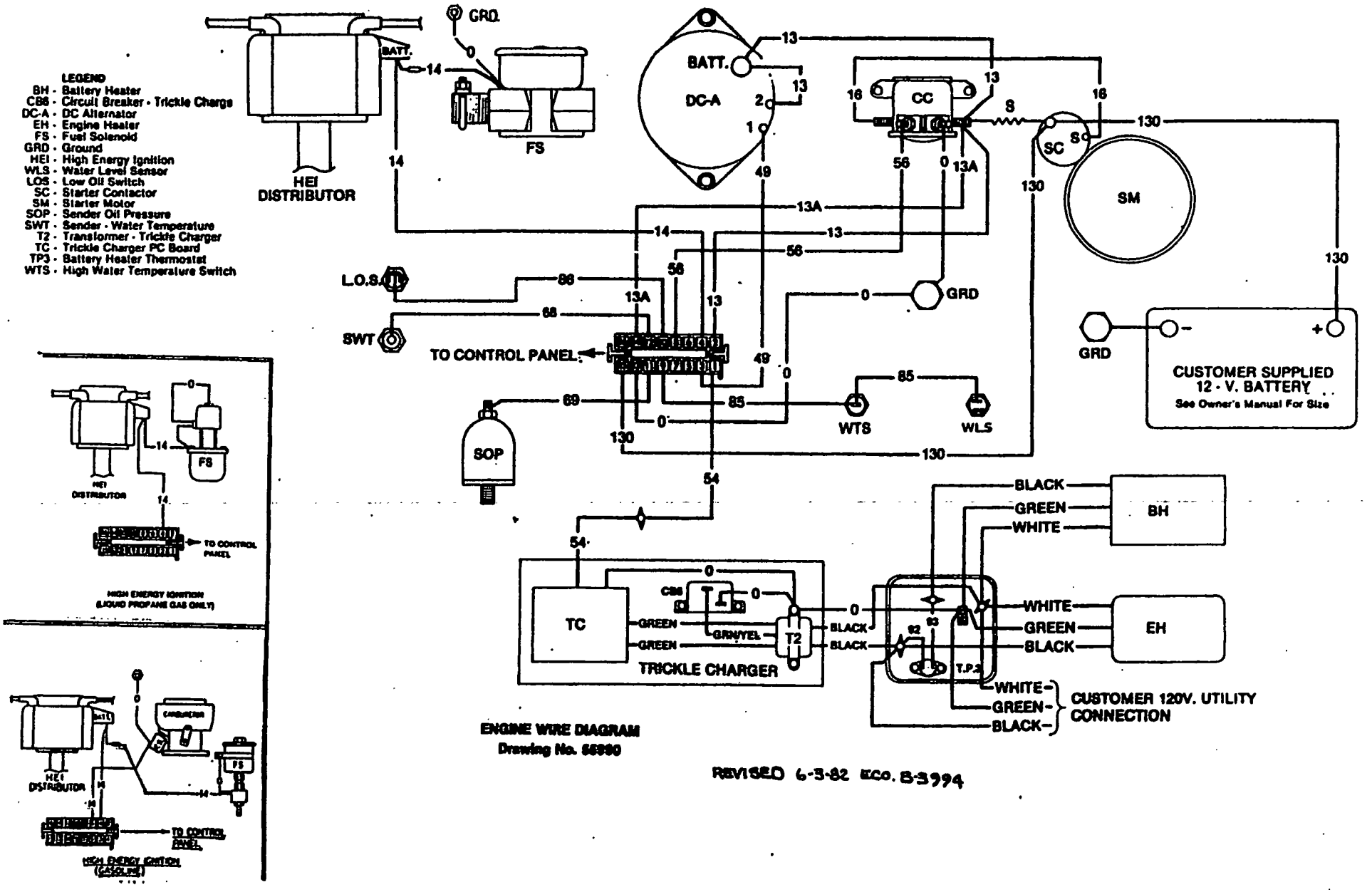
LEGEND
AS -Alternator Stator
CB3 -Circuit Breaker - Line/DPE
CB4 -Circuit Breaker - Line/DPE
CB5 -Circuit Breaker - Line/DPE
CT -Current Transformer
EF -Exciter Field



CUSTOMER CONNECTIONS
120/240 V. 1 PHASE

CURRENT TRANSFORMER
MTR. SCRN'L

Drawing No. 55989

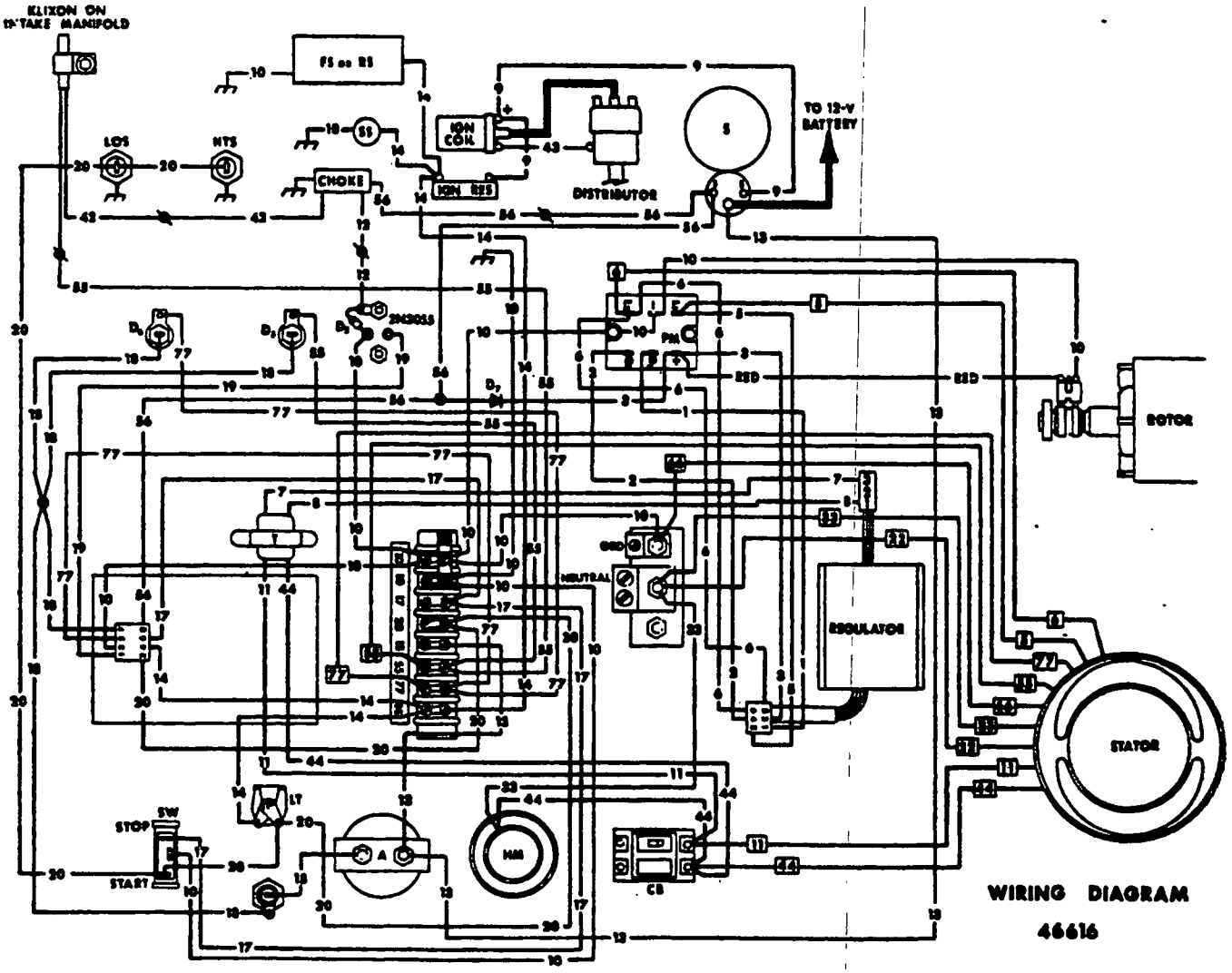


ENGINE WIRE DIAGRAM
Drawing No. 66990

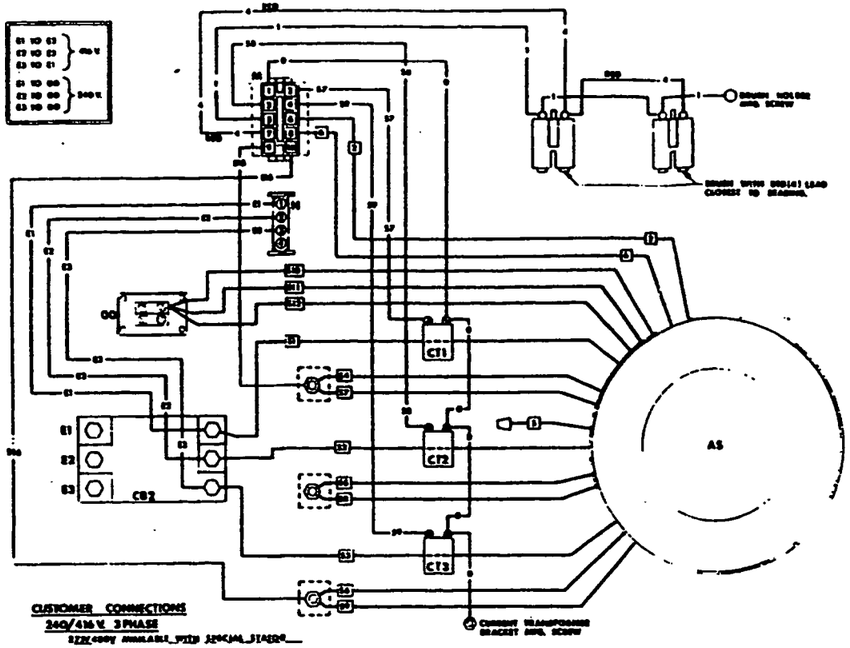
REVISED 6-3-82 ECO. B-3994

LEGEND

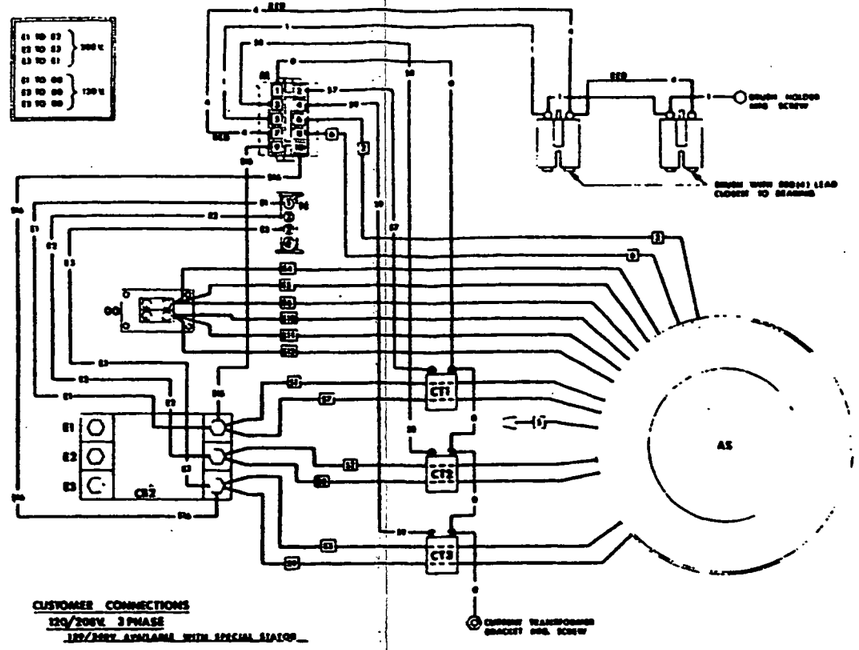
A - AMMETER
D - DIODE
HM - HOUR METER
LT - PANEL LIGHT
T - VOLTAGE SENSING TRANSFORMER
LOS - LOW OIL SWITCH
S - STARTER MOTOR
CB - CIRCUIT BREAKER
FS - FUEL LOCK-OFF SOLENOID
HTS - HIGH TEMP. SWITCH
SW - START-STOP SWITCH
PM - POWER MODULE



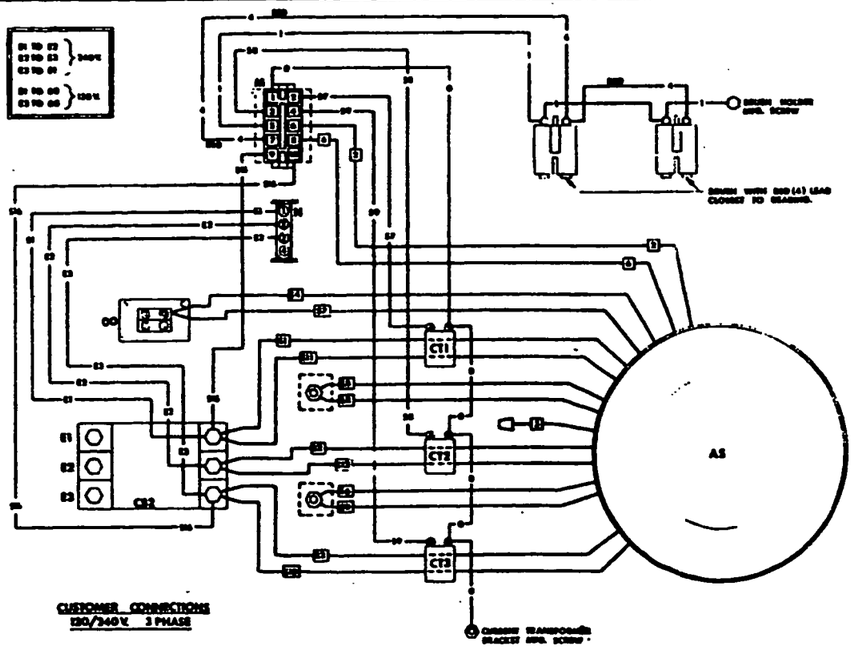
WIRING DIAGRAM
46616



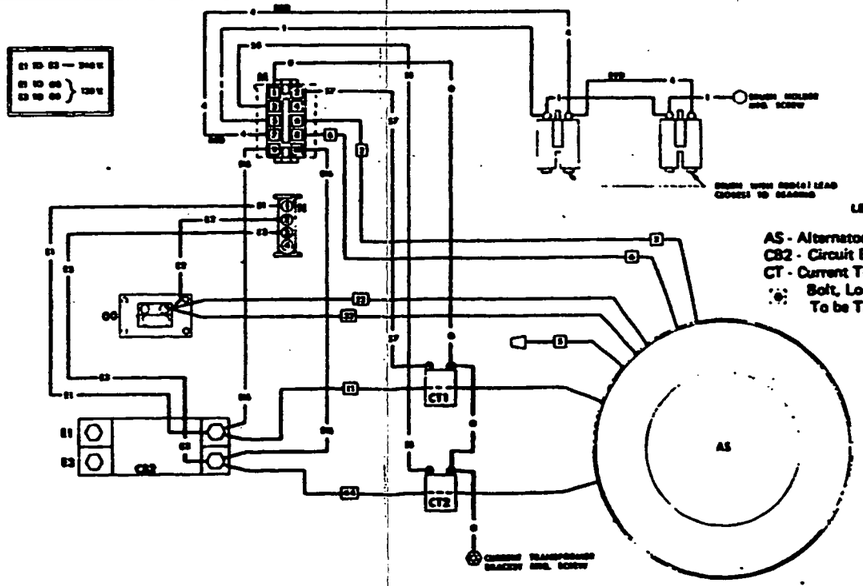
CUSTOMER CONNECTIONS
240/416 V. 3 PHASE
277/480V AVAILABLE WITH SPECIAL STATOR



CUSTOMER CONNECTIONS
120/208V. 3 PHASE
120/240V AVAILABLE WITH SPECIAL STATOR



CUSTOMER CONNECTIONS
120/240 V. 3 PHASE



LEGEND

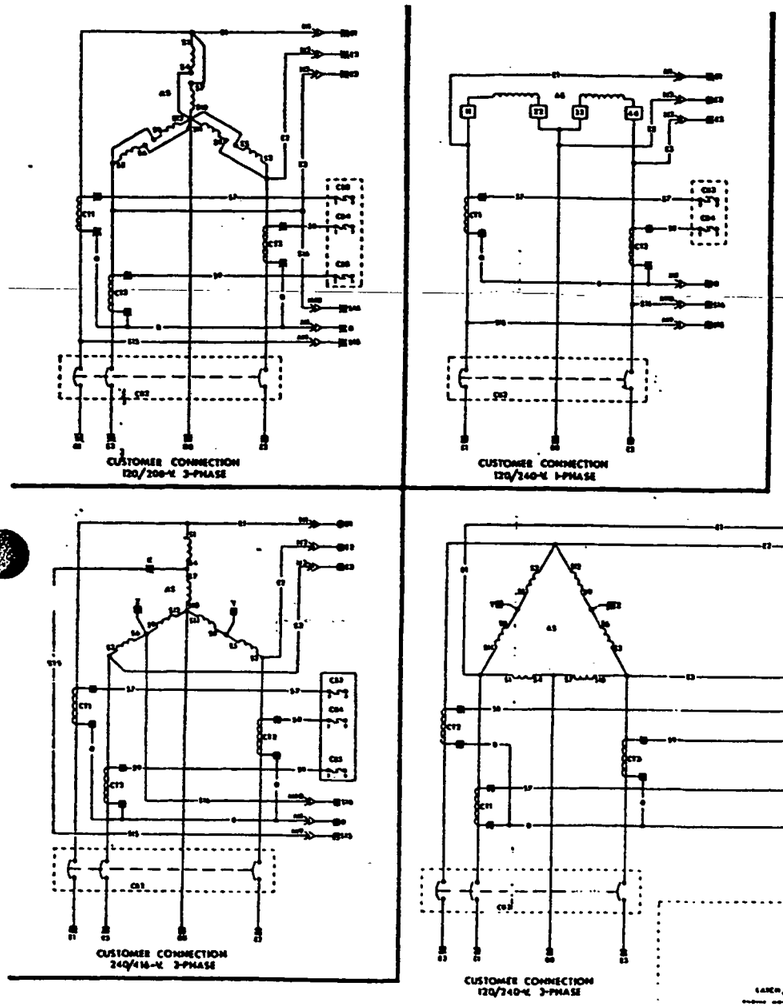
AS - Alternator Stator
CB2 - Circuit Breaker
CT - Current Transformer
Bolt, Lockwasher, & Nut To be Tape Insulated

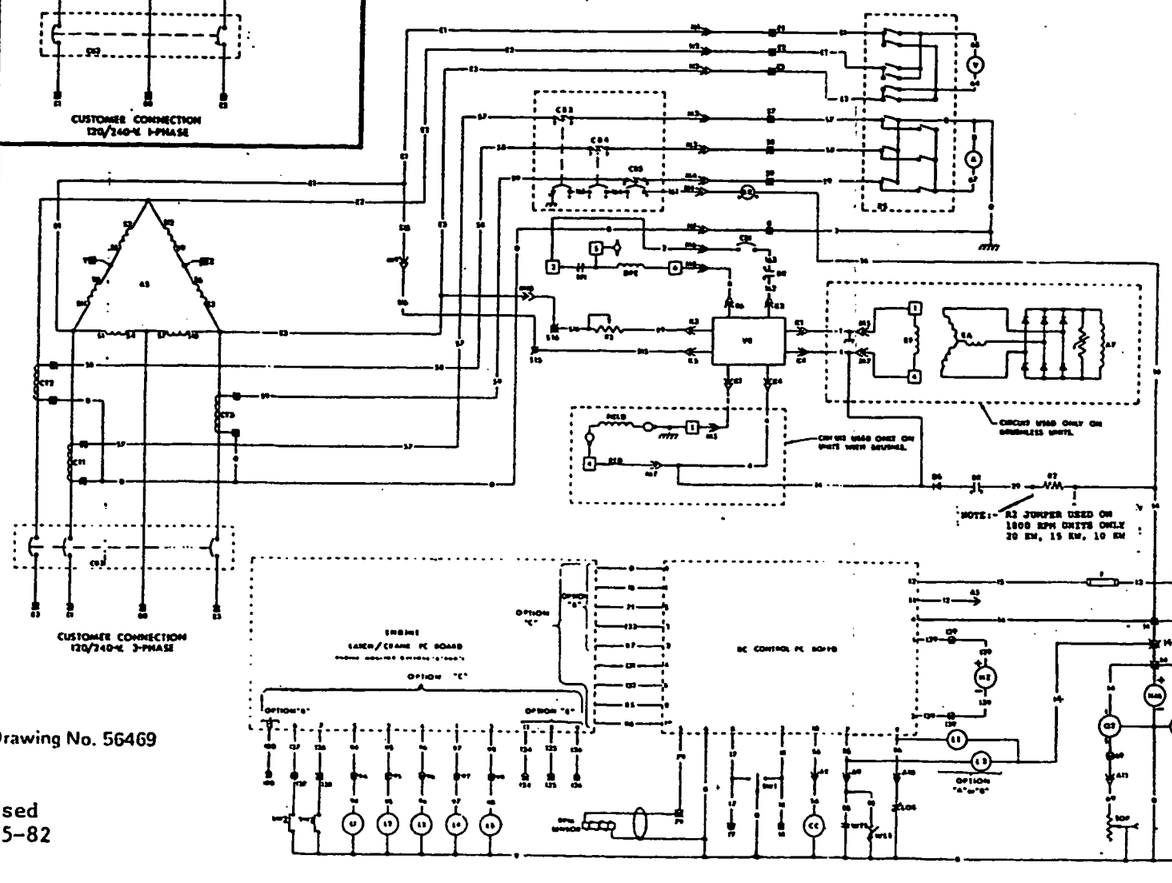
CUSTOMER CONNECTIONS
120/240V. 1 PHASE

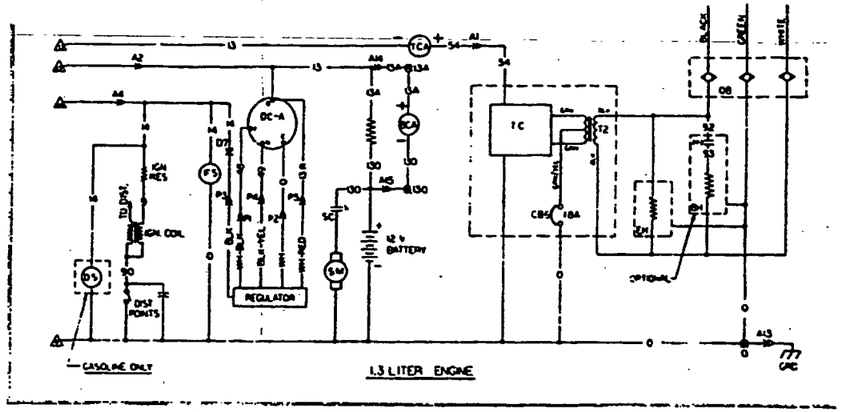
WIRING DIAGRAM
Drawing No. E6468

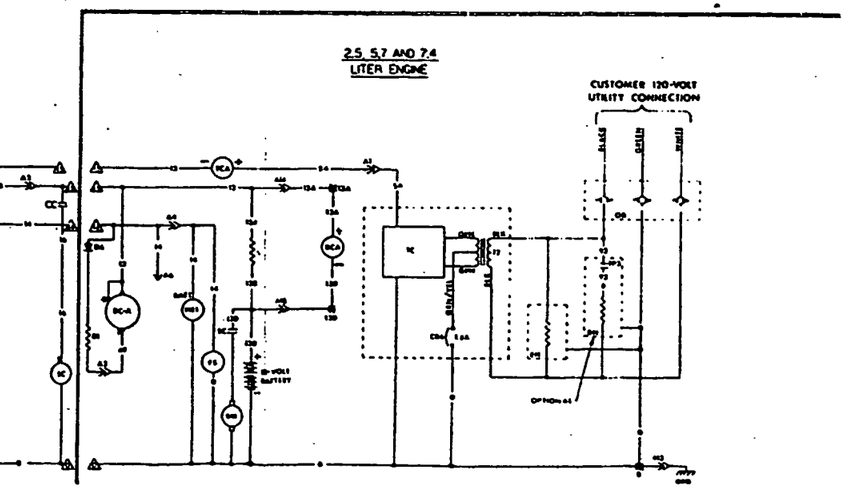
LEGEND

- A - Ammeter
- AF - Alternator Field
- AS - Alternator Stator
- BCA - Battery Charge Ammeter
- BH - Battery Heater
- BR - Breaker relay (Used on Units without CB2)
- CB1 - Circuit Breaker - Field
- CB2 - Circuit Breaker - Main (Optional on Units Exceeding 36KW)
- CB3 - Circuit Breaker - Line/DPE } Used on Units without CB2
- CB4 - Circuit Breaker - Line/DPE }
- CB5 - Circuit Breaker - Line/DPE
- CB6 - Circuit Breaker - Trickle Charger
- CC - Control Contactor
- CH - Choke Heater
- CS - Choke Solenoid
- CT - Current Transformer
- D - Diode
- DC-A - DC Alternator
- DPE - Displaced Phase Excitation
- DS - Anti-Diesel Solenoid
- EA - Exciter Armature
- EF - Exciter Field
- EH - Engine Heater
- F - Fuse 30-Amp
- FS - Fuel Solenoid
- G1 - Guage - Water Temperature
- G2 - Gauge - Oil Pressure
- GRD - Ground
- HEI - High Energy Ignition
- HM - Hour Meter
- HTS - High Temperature Switch
- HZ - Frequency Meter
- L1 - Light - Low Oil Pressure
- L2 - Light - High Coolant Temperature
- L3 - Light - Over Crank
- L4 - Light - Over Speed
- L5 - Light - RPM Sensor Loss
- LOS - Low Oil Switch
- OB - Outlet Box
- R1 - Resistor 10-OHM 12-Watt
- R2 - Resister - Field Boost
- R3 - Potentiometer 10K-OHM 2-Watt (Voltage Adjust)
- RS - Rotary Switch
- S - Shunt
- SC - Starter Contactor
- SM - Starter Motor
- SOP - Sender Oil Pressure
- SW1 - Switch - Start/Stop
- SW2 - Switch - Test
- SW3 - Switch - Reset
- SWT - Sender - Water Temperature
- T1 - Transformer - Voltage Sensing
- T2 - Transformer - Trickle Charger
- TC - Trickle Charger PC Board
- TCA - Trickle Charger Ammeter
- TP1 - Stator Thermal Protector
- TP2 - Choke Thermostat
- TP3 - Battery Heater Thermostat
- V - Voltmeter
- VR - Voltage Regulator
- WTS - High Water Temperature Switch
- ⊠ Screw Terminal
- ◇ Wire Nut



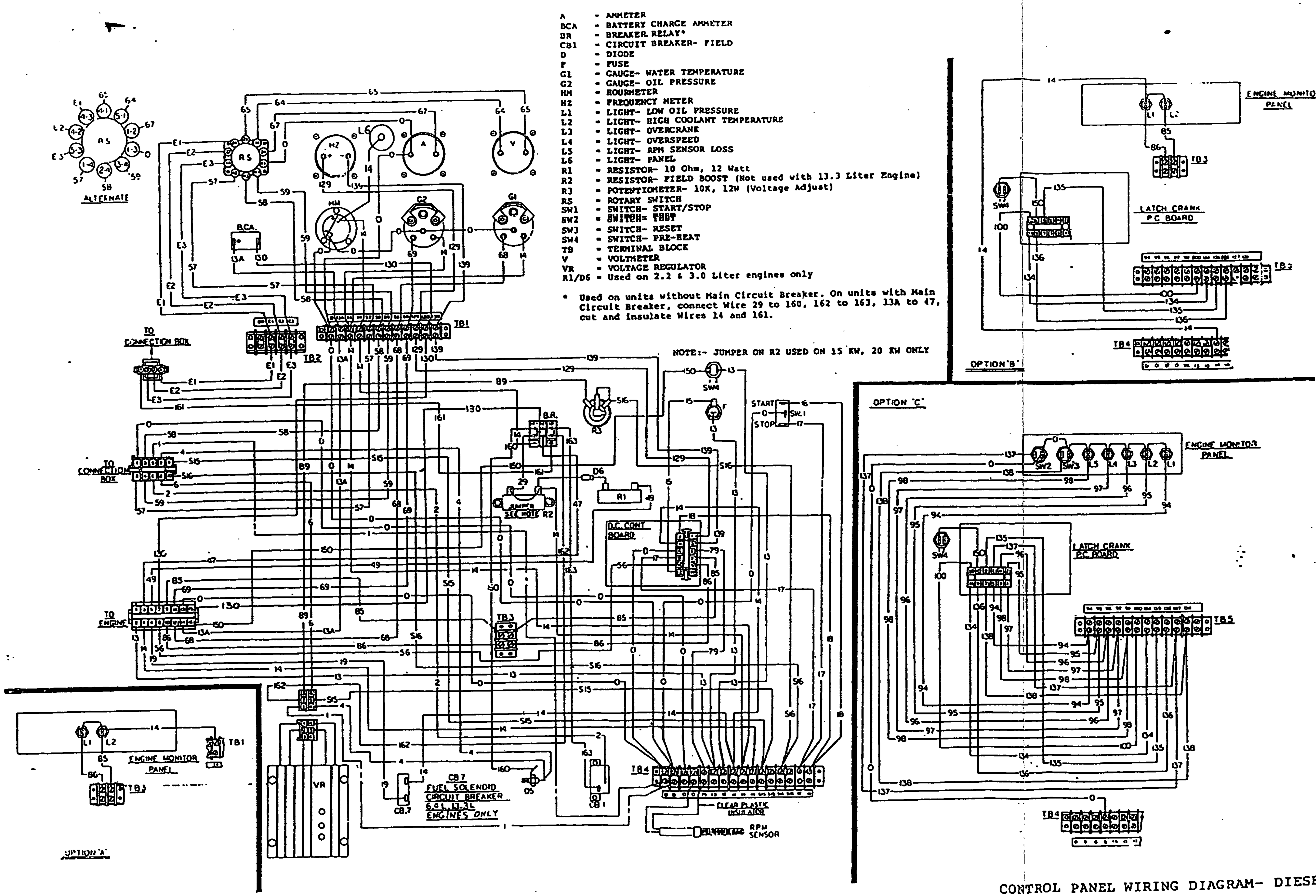






SCHEMATIC Drawing No. 56469

Revised
10-25-82



A - AMMETER
BCA - BATTERY CHARGE AMMETER
BR - BREAKER RELAY*
CB1 - CIRCUIT BREAKER- FIELD
D - DIODE
F - FUSE
G1 - GAUGE- WATER TEMPERATURE
G2 - GAUGE- OIL PRESSURE
HM - HOURMETER
HZ - FREQUENCY METER
L1 - LIGHT- LOW OIL PRESSURE
L2 - LIGHT- HIGH COOLANT TEMPERATURE
L3 - LIGHT- OVERCRANK
L4 - LIGHT- OVERSPEED
L5 - LIGHT- RPM SENSOR LOSS
L6 - LIGHT- PANEL
R1 - RESISTOR- 10 Ohm, 12 Watt
R2 - RESISTOR- FIELD BOOST (Not used with 13.3 Liter Engine)
R3 - POTENTIOMETER- 10K, 12W (Voltage Adjust)
RS - ROTARY SWITCH
SW1 - SWITCH- START/STOP
SW2 - SWITCH- TEST
SW3 - SWITCH- RESET
SW4 - SWITCH- PRE-HEAT
TB - TERMINAL BLOCK
V - VOLTMETER
VR - VOLTAGE REGULATOR
R1/D6 - Used on 2.2 & 3.0 Liter engines only

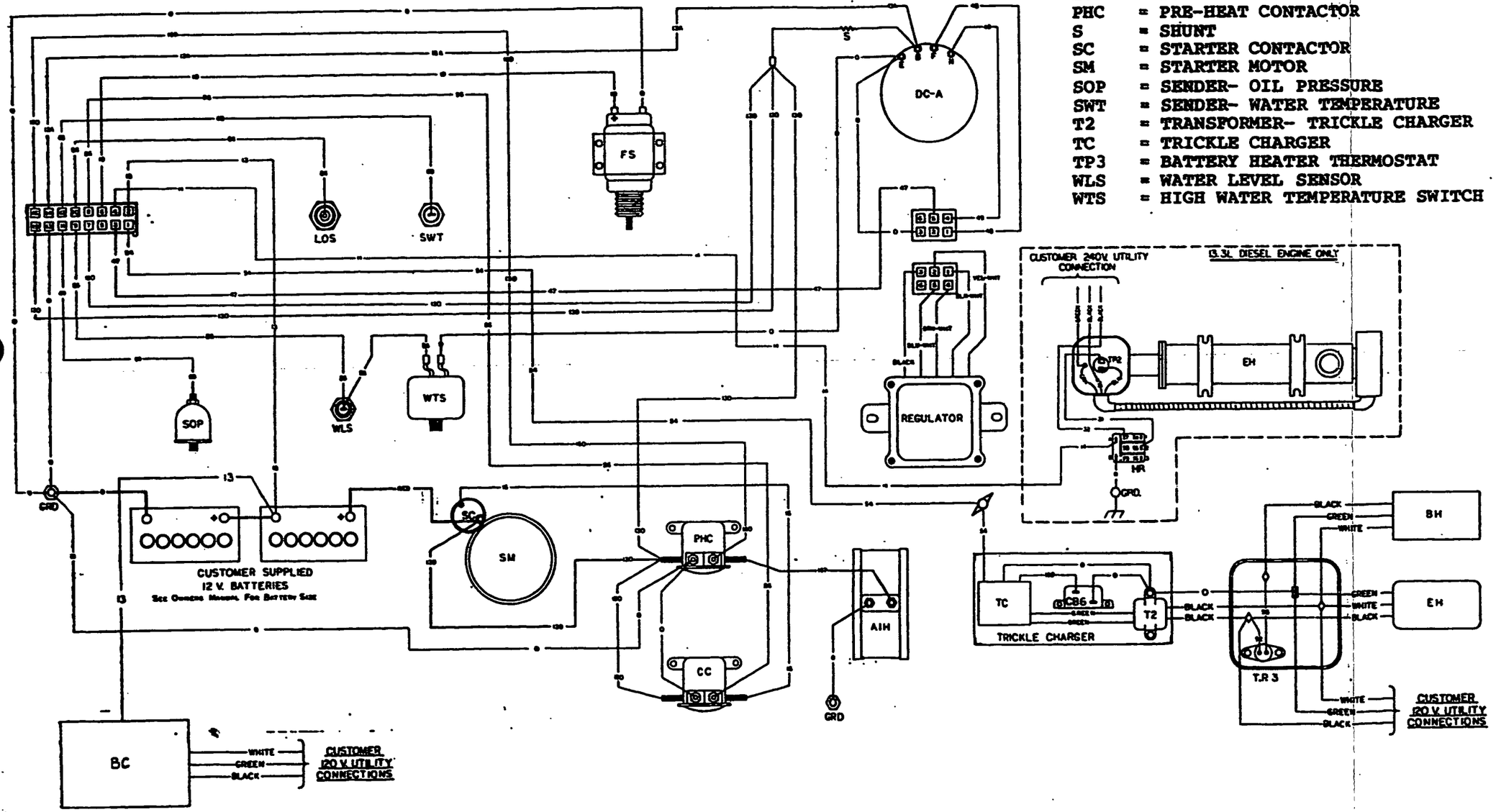
* Used on units without Main Circuit Breaker. On units with Main Circuit Breaker, connect Wire 29 to 160, 162 to 163, 13A to 47, cut and insulate Wires 14 and 161.

NOTE:- JUMPER ON R2 USED ON 15 KW, 20 KW ONLY

CONTROL PANEL WIRING DIAGRAM- DIESEL
Drawing Number 56704
Revised- 6-27-83

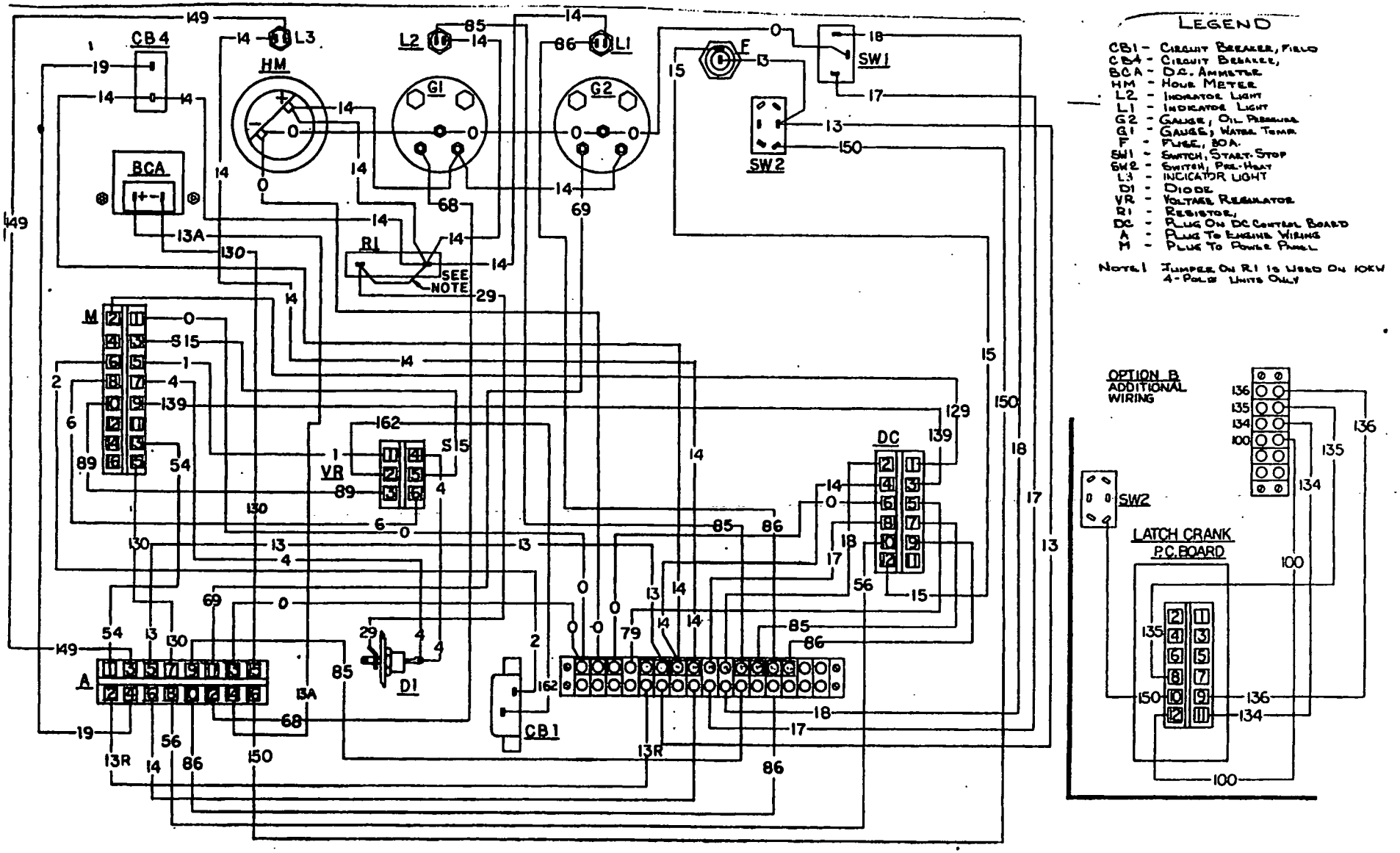
LEGEND

AIH = AIR INTAKE HEATER
BC = BATTERY CHARGER- 2 AMP
BH = BATTERY HEATER
CB = CIRCUIT BREAKER
CC = CONTROL CONTACTOR
DC-A = DC ALTERNATOR
EH = ENGINE HEATER
FS = FUEL SOLENOID
GRD = GROUND
HR = ENGINE HEATER RELAY
LOS = LOW OIL SWITCH
PHC = PRE-HEAT CONTACTOR
S = SHUNT
SC = STARTER CONTACTOR
SM = STARTER MOTOR
SOP = SENDER- OIL PRESSURE
SWT = SENDER- WATER TEMPERATURE
T2 = TRANSFORMER- TRICKLE CHARGER
TC = TRICKLE CHARGER
TP3 = BATTERY HEATER THERMOSTAT
WLS = WATER LEVEL SENSOR
WTS = HIGH WATER TEMPERATURE SWITCH



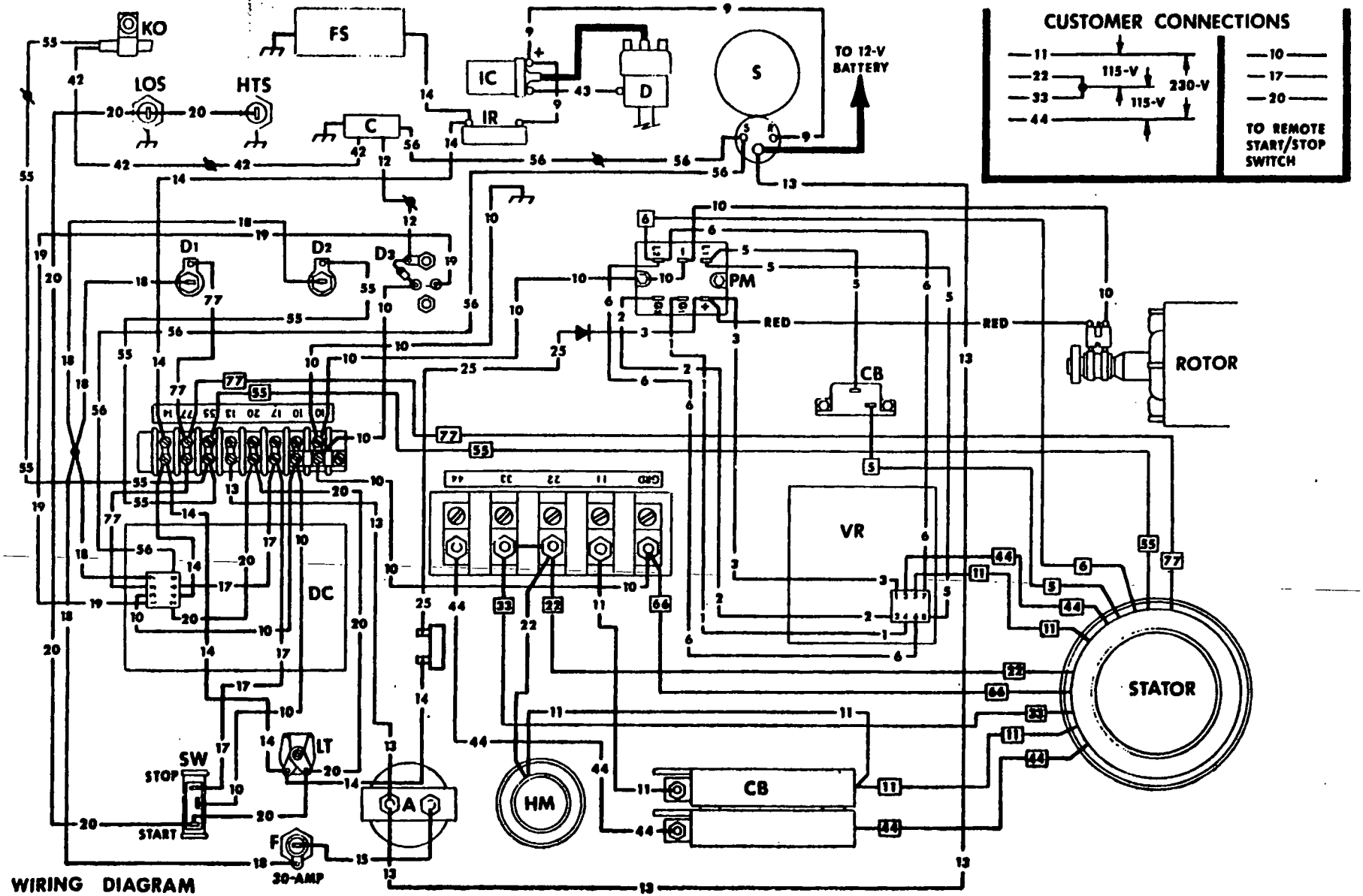
ENGINE WIRING DIAGRAM
Drawing Number 56759
Revised- 4/20/83

WIRING DIAGRAM-UPPER PANEL
Drawing No. 58218
ECO #B-3725A 1/82



LEGEND

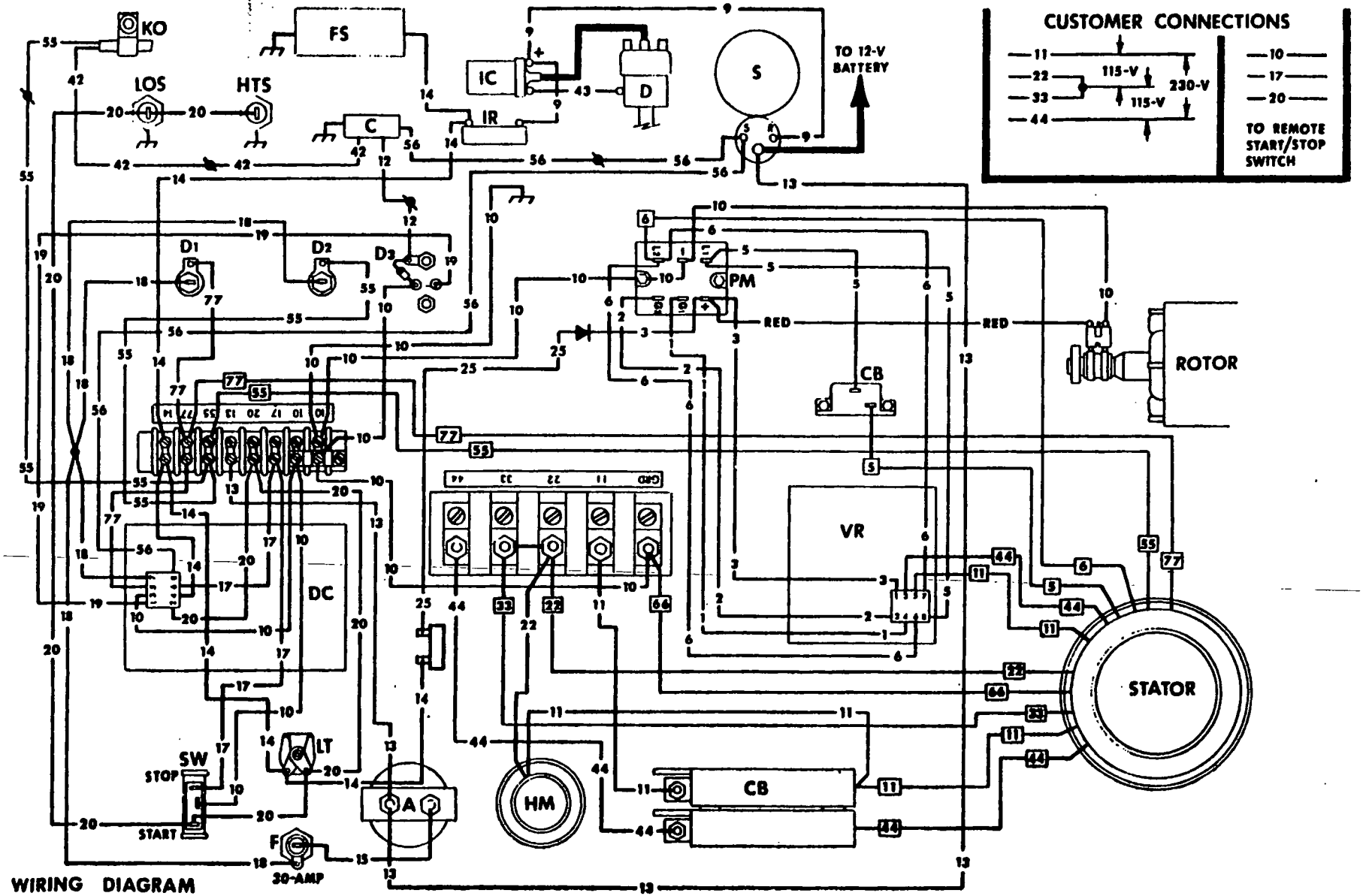
A–	Ammeter	KO–	Klixon On Intake Manifold
C–	Choke	HM–	Hour Meter
CB–	Circuit Breaker	HTS–	High Temp; Switch
D–	Distributor	LOS–	Low Oil Switch
$D_1.D_2.D_3$–	Diode	LT–	Light Low Oil High Temp.
DC–	DC Circuit Board	PM–	Power Module
F–	Fuse	S–	Starter
FS–	Fuel Lock-off Solenoid	SW–	Start/Stop Switch
IC–	Ign. Coil	VR–	Voltage Regulator Circuit Board
IR–	Ign. Resistor		



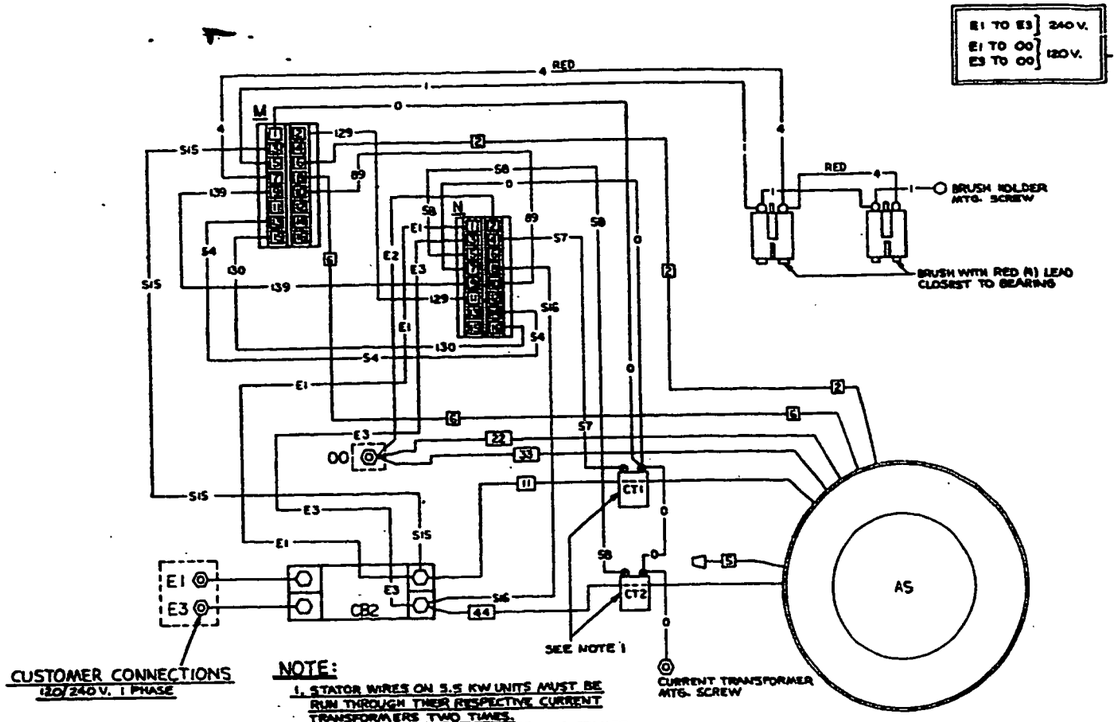
WIRING DIAGRAM

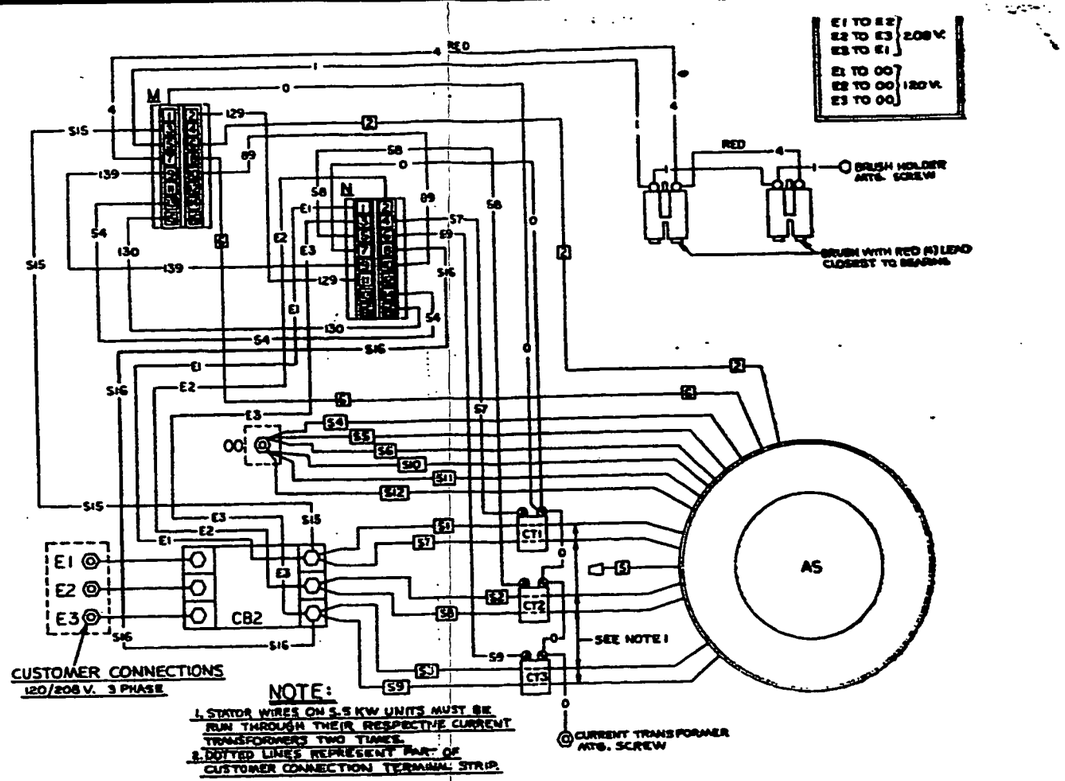
LEGEND

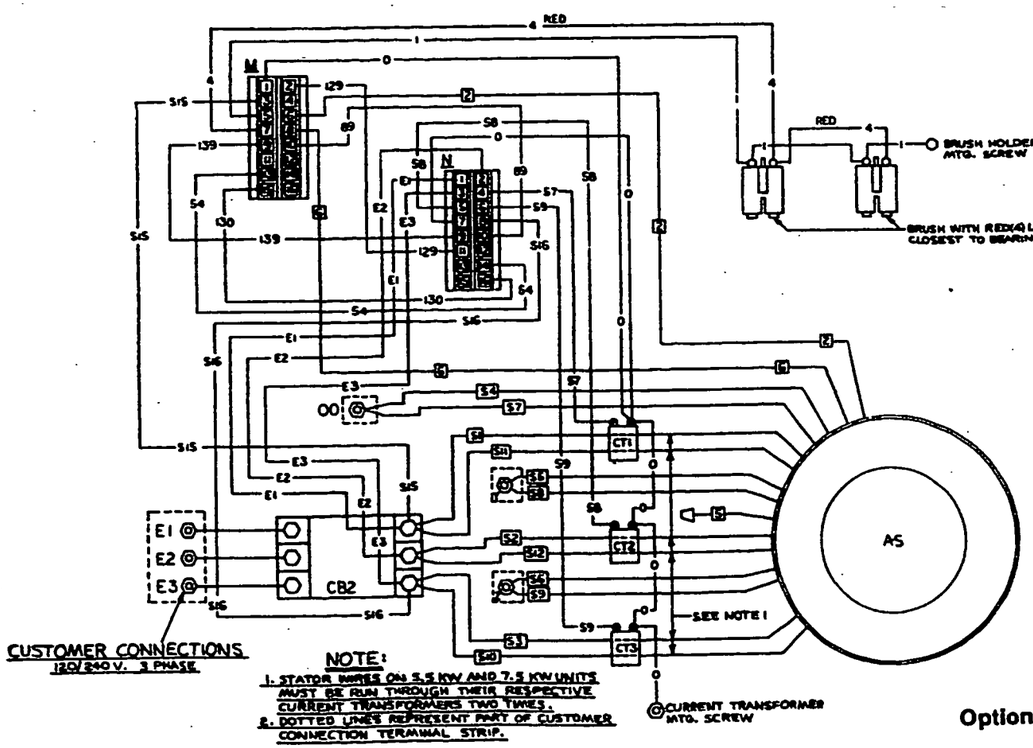
A–	Ammeter	KO–	Klixon On Intake Manifold
C–	Choke	HM–	Hour Meter
CB–	Circuit Breaker	HTS–	High Temp; Switch
D–	Distributor	LOS–	Low Oil Switch
$D_1.D_2.D_3$–	Diode	LT–	Light Low Oil High Temp.
DC–	DC Circuit Board	PM–	Power Module
F–	Fuse	S–	Starter
FS–	Fuel Lock-off Solenoid	SW–	Start/Stop Switch
IC–	Ign. Coil	VR–	Voltage Regulator Circuit Board
IR–	Ign. Resistor		

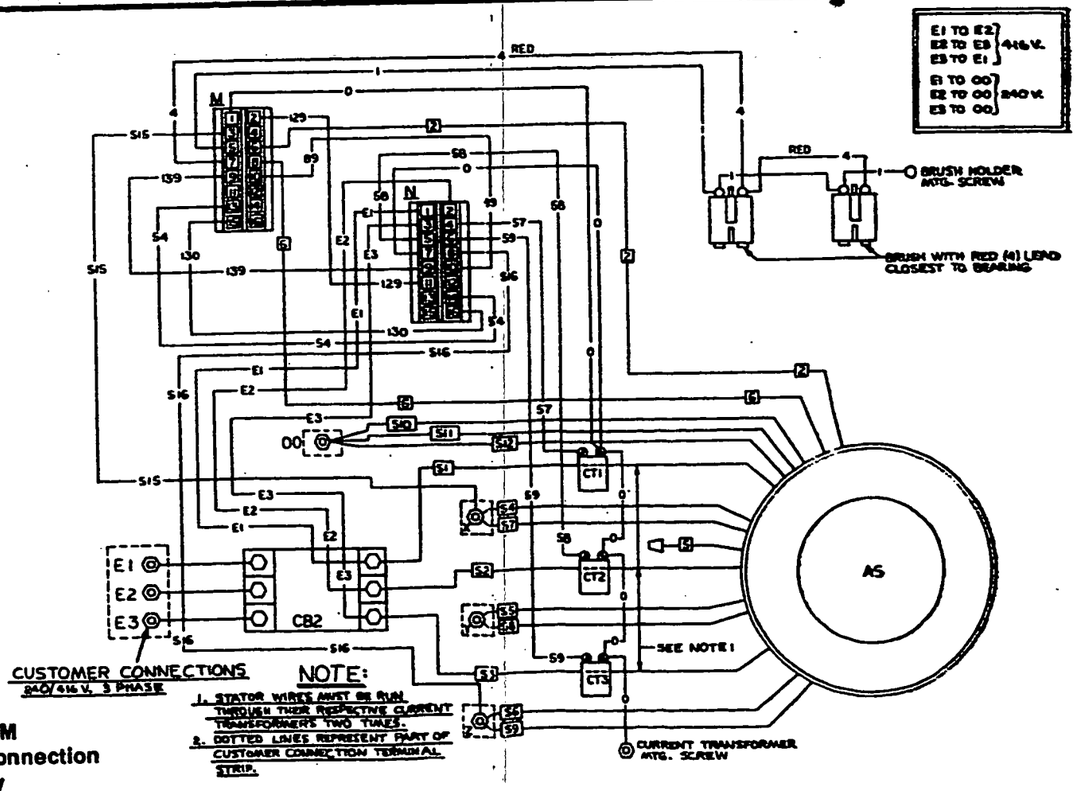


WIRING DIAGRAM

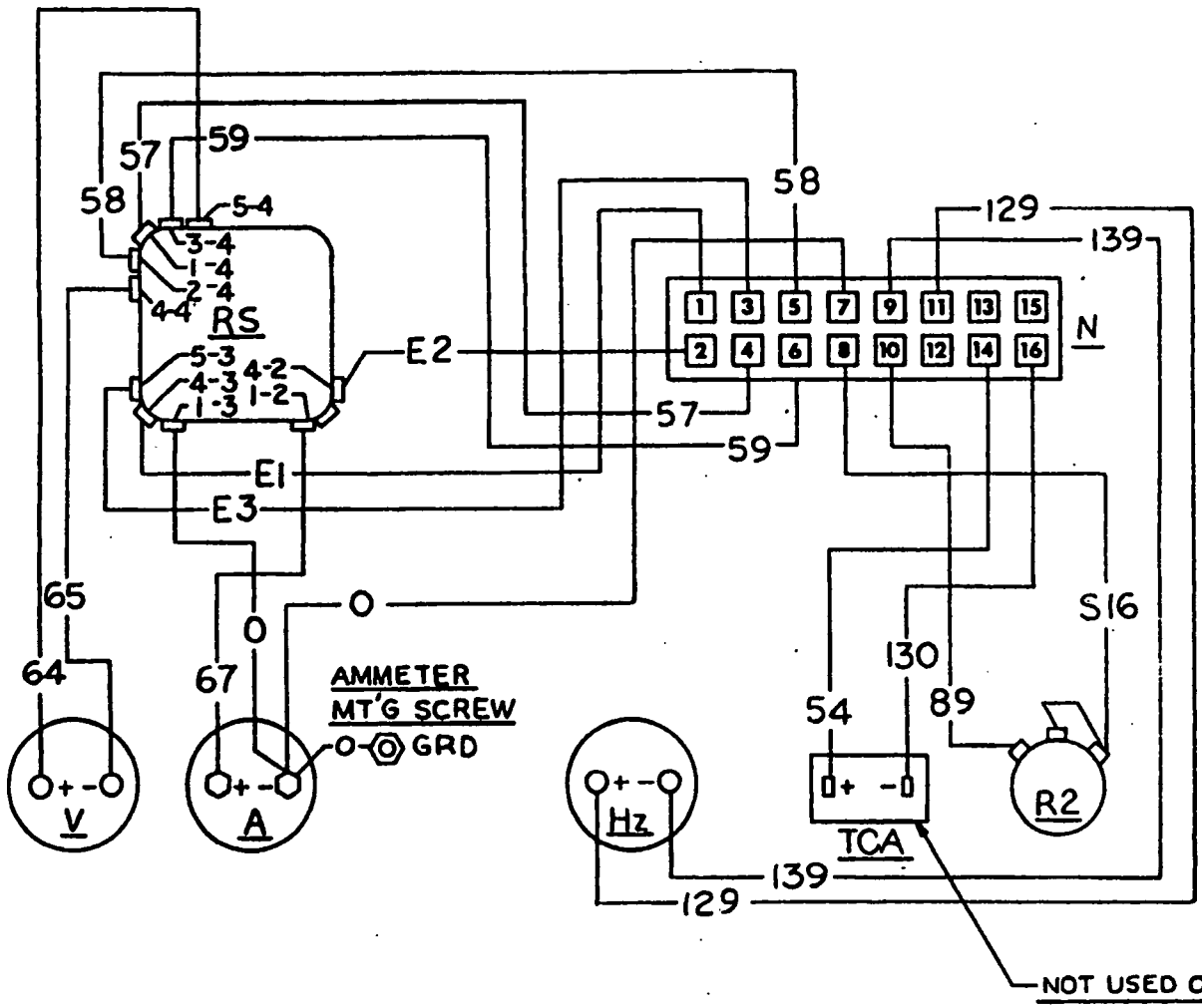








WIRING DIAGRAM
Optional Alternator Reconnection
10 KW Standby
Drawing No. 58219

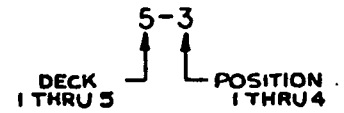


LEGEND

RS - ROTARY SWITCH
V - VOLTMETER
A - AMMETER
Hz - FREQUENCY METER
TCA - TRICKLE CHARGE AMMETER
R2 - POTENTIOMETER
GRD - GROUND
N - LOWER/FRONT PANEL CONNECTOR

NOTE:

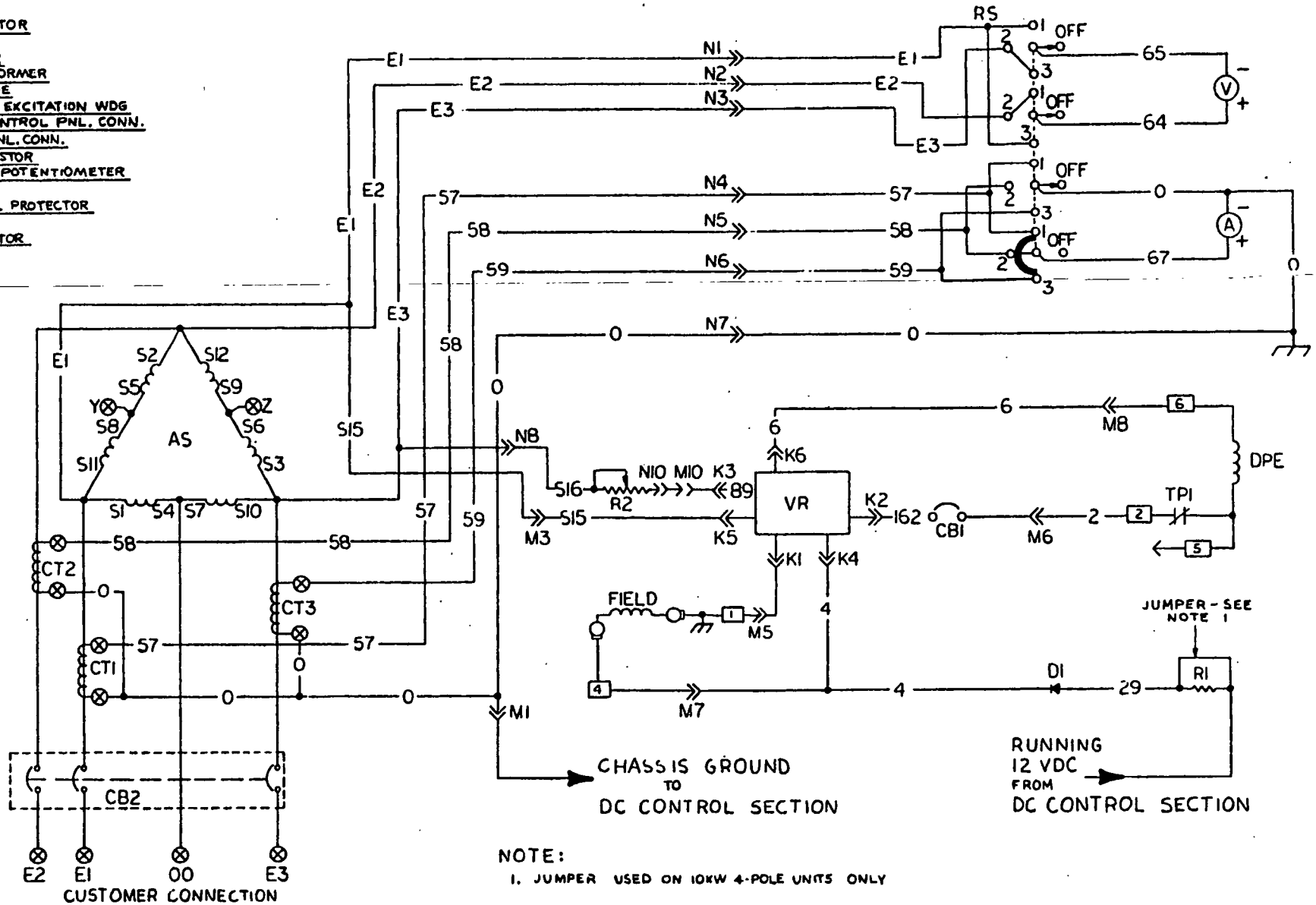
ROTARY SWITCH CONNECTION GUIDE EXAMPLE:



[redacted]

LEGEND

A - AMMETER
AS - ALTERNATOR STATOR
BR - BREAKER RELAY
CB - CIRCUIT BREAKER
CT - CURRENT TRANSFORMER
DI - FIELD BOOST DIODE
DPE - DISPLACED PHASE EXCITATION WDG
M - UPPER/LOWER CONTROL PNL. CONN.
N - LOWER/FRONT PNL. CONN.
R1 - FIELD BOOST RESISTOR
R2 - VOLTAGE ADJUST POTENTIOMETER
RS - ROTARY SWITCH
TPI - STATOR THERMAL PROTECTOR
V - VOLTMETER
VR - VOLTAGE REGULATOR

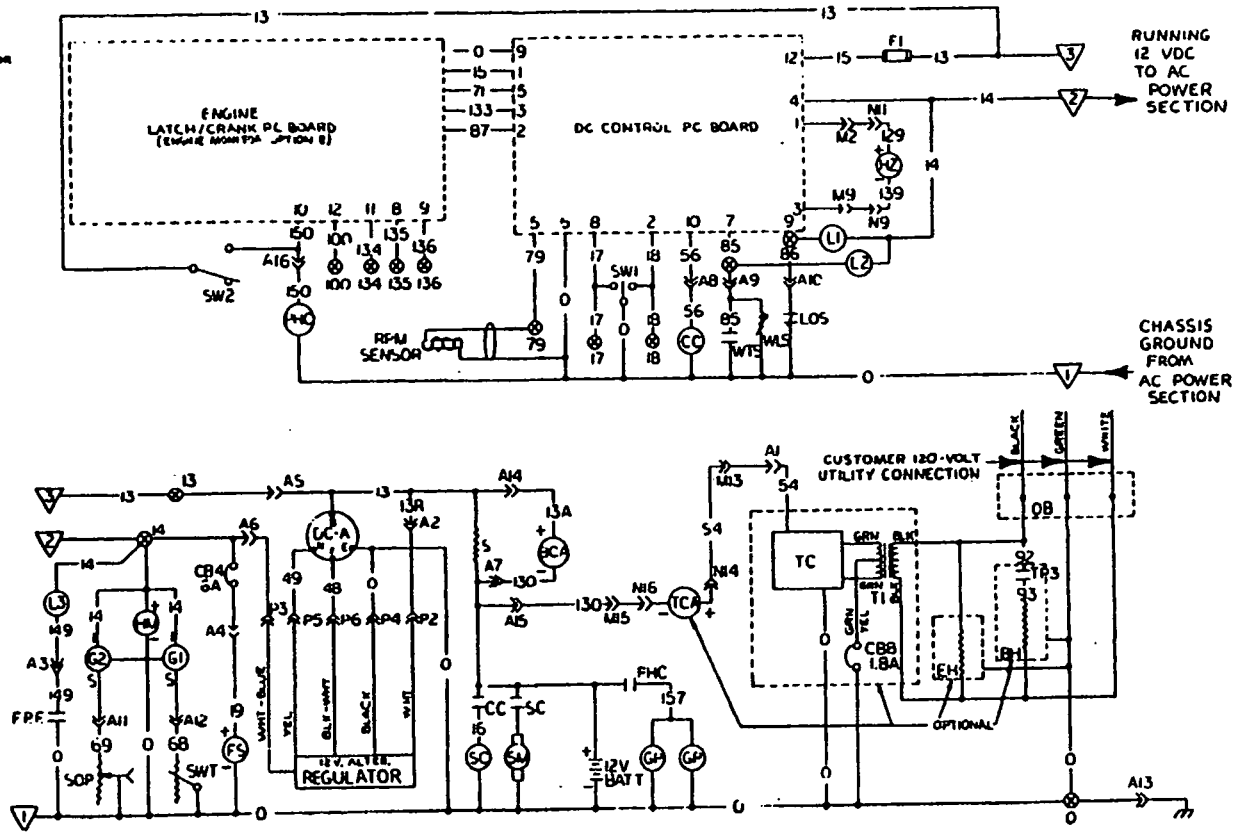


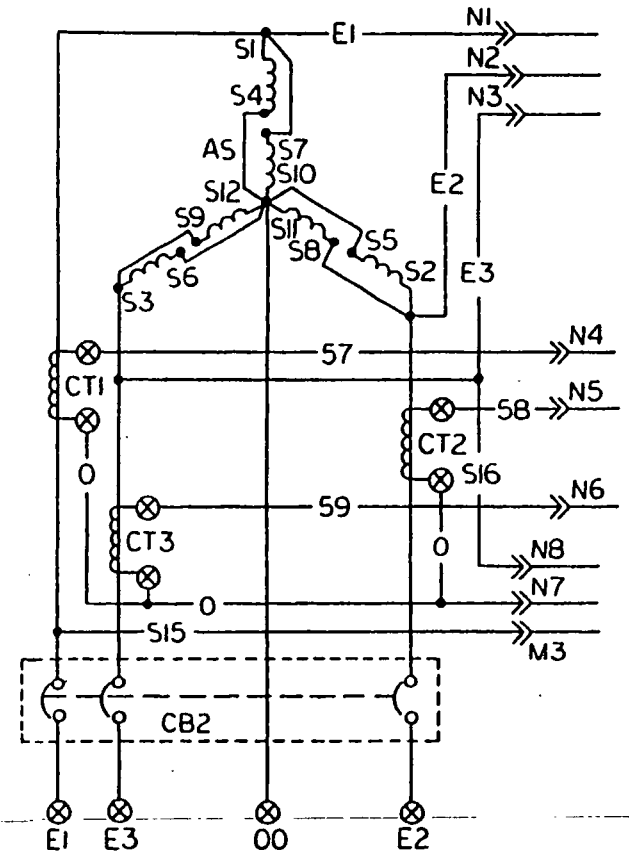
NOTE:
1. JUMPER USED ON 10KW 4-POLE UNITS ONLY

DC CONTROL SCHEMATIC
Drawing No. 58393
ECO #B-3725-A 1/82

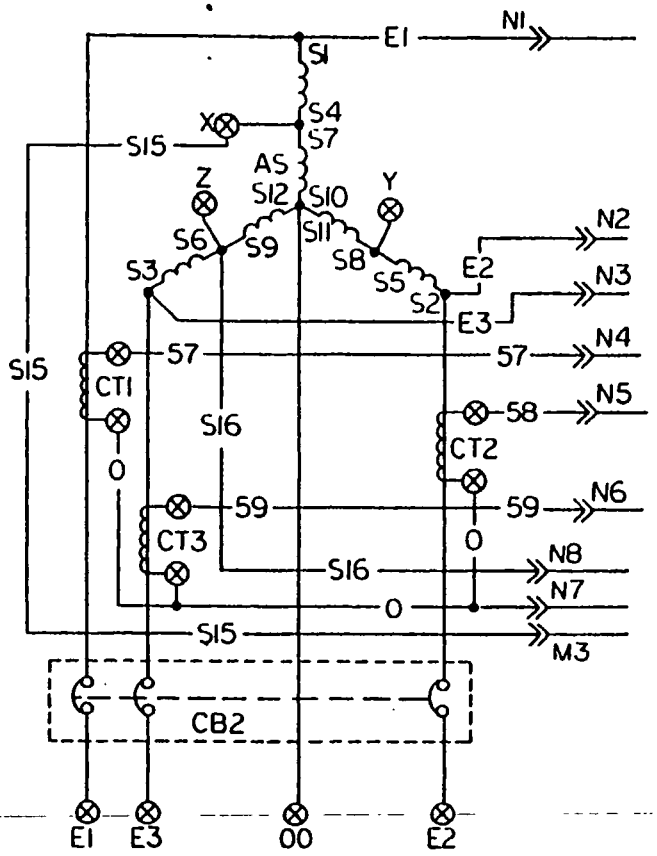
LEGEND

A – ENGINE/UPPER CONTROL PANEL CONNECTOR
BCA – BATTERY CHARGE AMMETER
BH – BATTERY HEATER
CB – CIRCUIT BREAKER
CC – CONTROL CONTACTOR
DCA – DC ALTERNATOR
EH – ENGINE HEATER
FI – FUSE 80A
FS – FUEL SOLENOID
GI – GAUGE/WATER TEMPERATURE
G2 – GAUGE/OIL PRESSURE
GP – GLOW PLUG
HM – HOUR METER
HZ – FREQUENCY METER
LI – LOW OIL PRESSURE LIGHT
L2 – HIGH WATER TEMPERATURE LIGHT
LOS – LOW OIL SWITCH
M – UPPER/LOWER CONTROL PANEL CONNECTOR
N – LOWER FRONT PANEL CONNECTOR
P – DC ALTER REGAL CONNECTOR
PHC – PREHEAT CONTACTOR
SC – STARTER CONTACTOR
SOP – SENDER/OIL PRESSURE
SM – STARTER MOTOR
SWT – SWITCH/WATER TEMPERATURE
SW1 – SWITCH/START-STOP
SW2 – SWITCH/PREHEAT
TCA – TRICKLE CHARGE AMMETER
TC – TRICKLE CHARGER
WLS – WATER LEVEL SENSOR
WTS – WATER TEMPERATURE SWITCH
T1 – TRICKLE CHARGER TRANSFORMER
TP2 – BATTERY HEATER THERMAL SWITCH
⊗ – TERMINAL BOARD POINT
F.P.F – FUEL PUMP FILTER
L3 – CLEAN FUEL PUMP FILTER



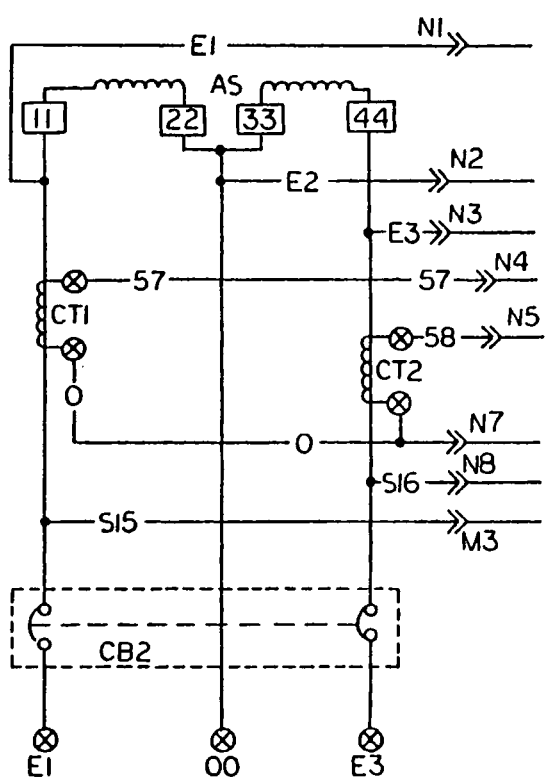


CUSTOMER CONNECTION
120/208-V. 3-PHASE



CUSTOMER CONNECTION
240/416-V. 3-PHASE

ALTERNATE RECONNECTION SCHEMES WITH
3 PHASE ALTERNATOR



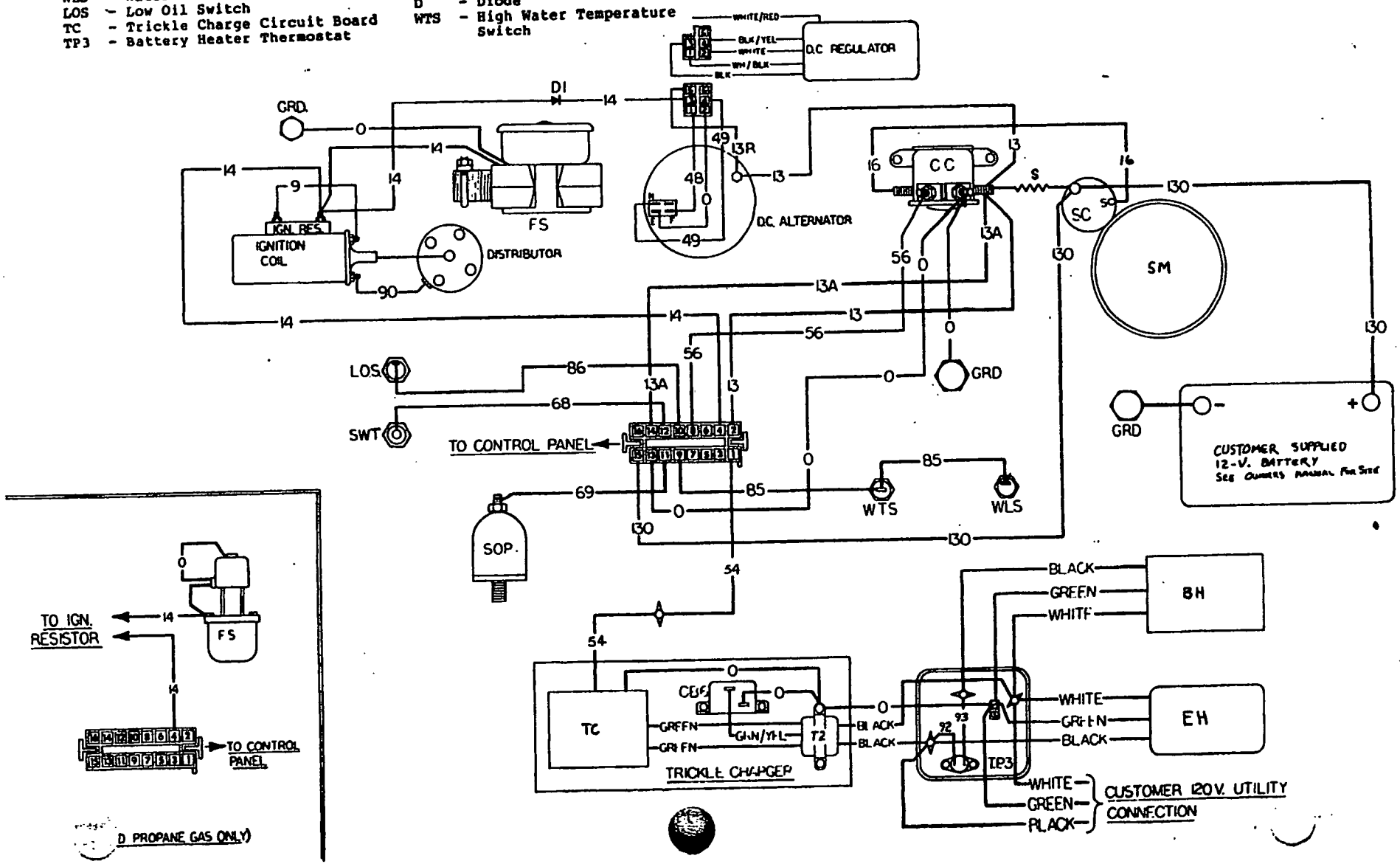
CUSTOMER CONNECTION
120/240-V. 1-PHASE

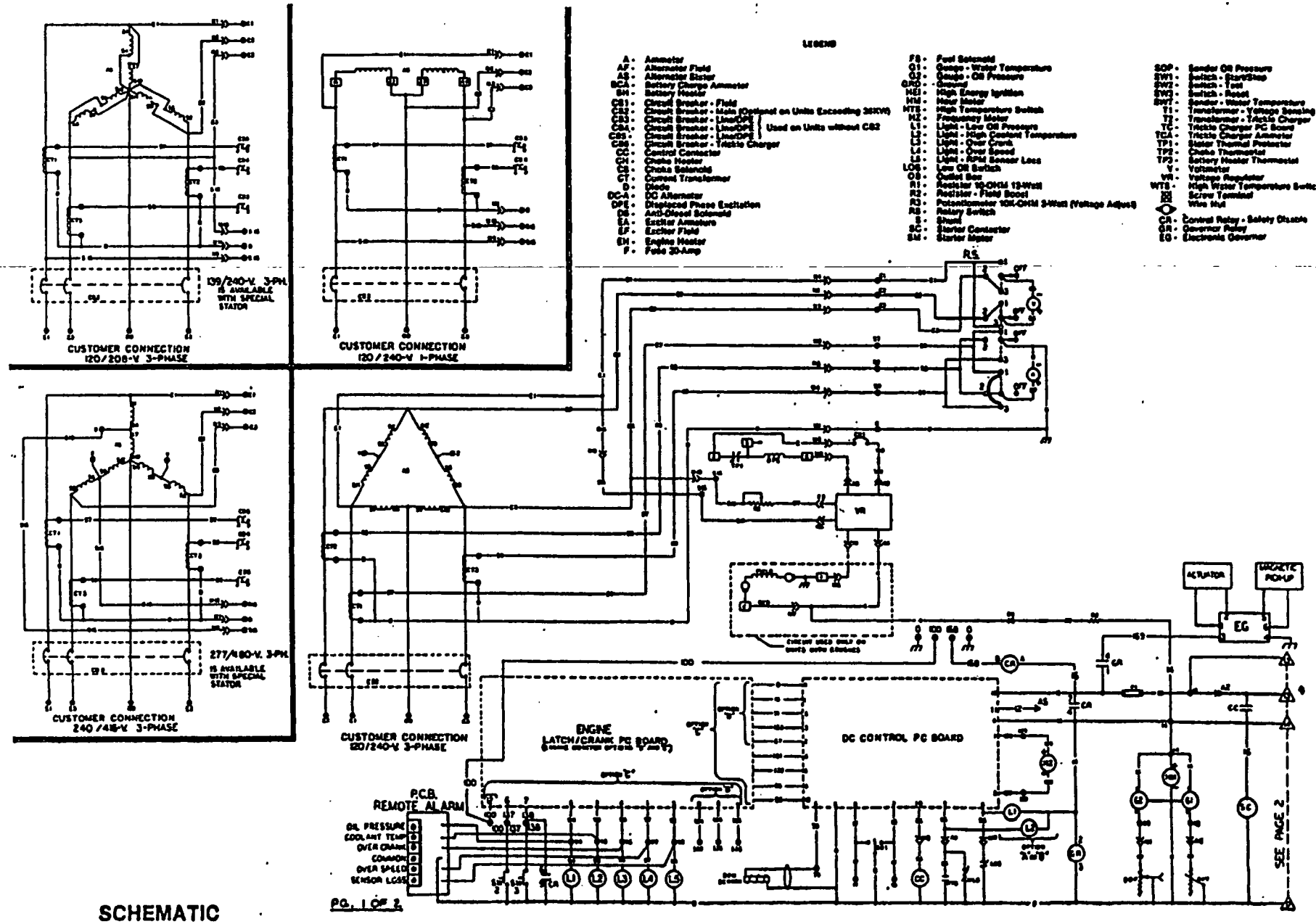
SINGLE PHASE ALTERNATOR
CONNECTION SCHEME

ENGINE WIRING DIAGRAM
Drawing Number 59417

LEGEND

BH - Battery Heater
CB-6 - Trickle Charge Circuit Breaker
DC-A - DC Alternator
EH - Engine Heater
FS - Fuel Solenoid
GRD - Ground
WLS - Water Level Sensor
LOS - Low Oil Switch
TC - Trickle Charge Circuit Board
TP3 - Battery Heater Thermostat
SC - Starter Contactor
SM - Starter Motor
SOP - Oil Pressure Sender
SWT - Water Temperature Sender
T2 - Trickle Charge Transformer
D - Diode
WTS - High Water Temperature Switch

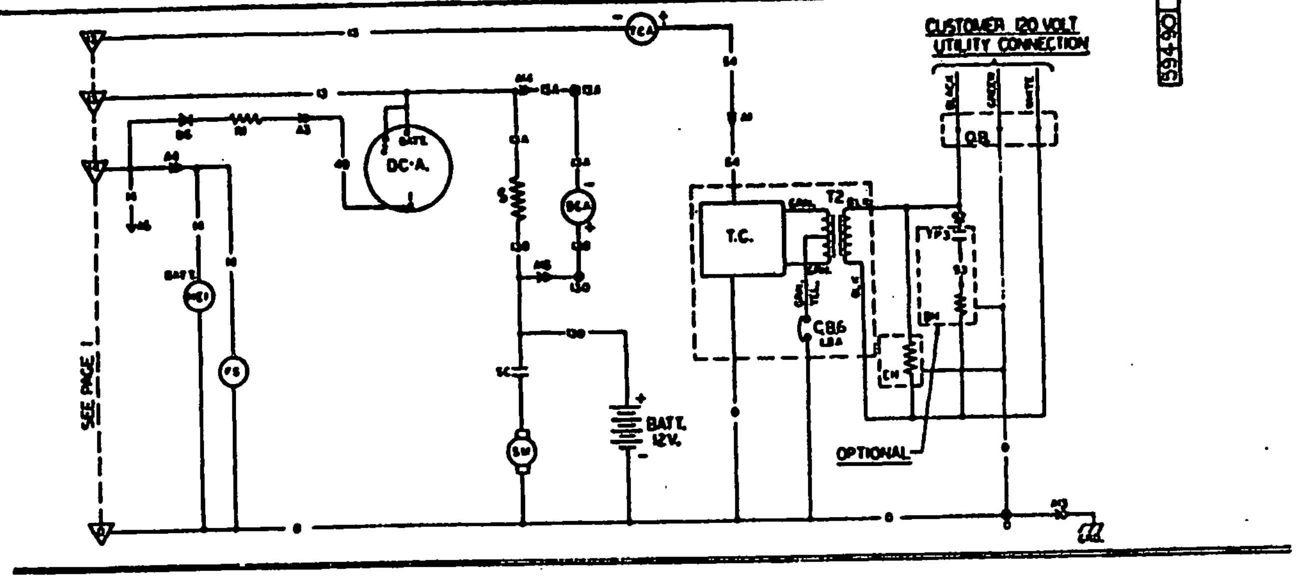




SCHEMATIC
Drawing No. 59490

PAGE 1 OF 2

ENGINE SCHEMATIC



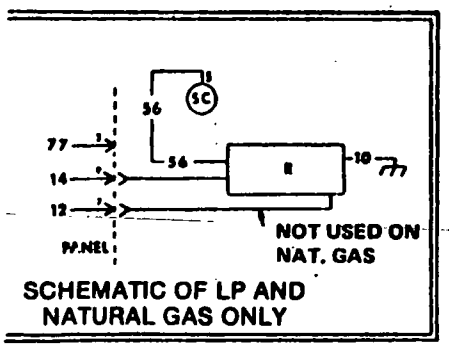
PAGE 2 OF 2

ENGINE SCHEMATIC	
GENERAC CORP.	D 59490

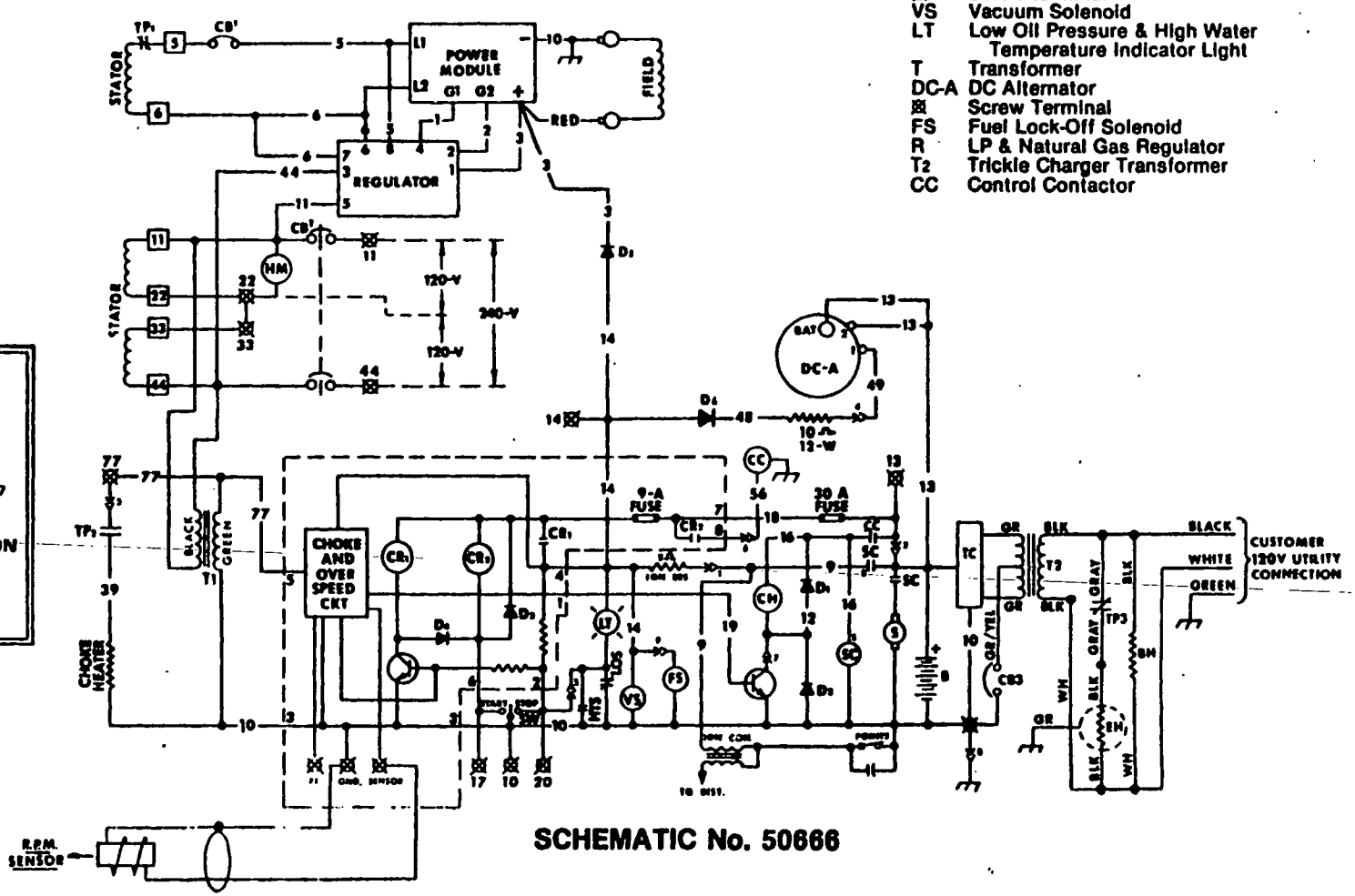
120V./240V.			
KW	CB¹	CB²	RPM
15	5-A	70-A	1800
20	6-A	100-A	1800
25	8-A	125-A	1800
35	6-A	175-A	3600
35	-A	175-A	1800
50	-A	225-A	1800
65	-A	275-A	1800

LEGEND

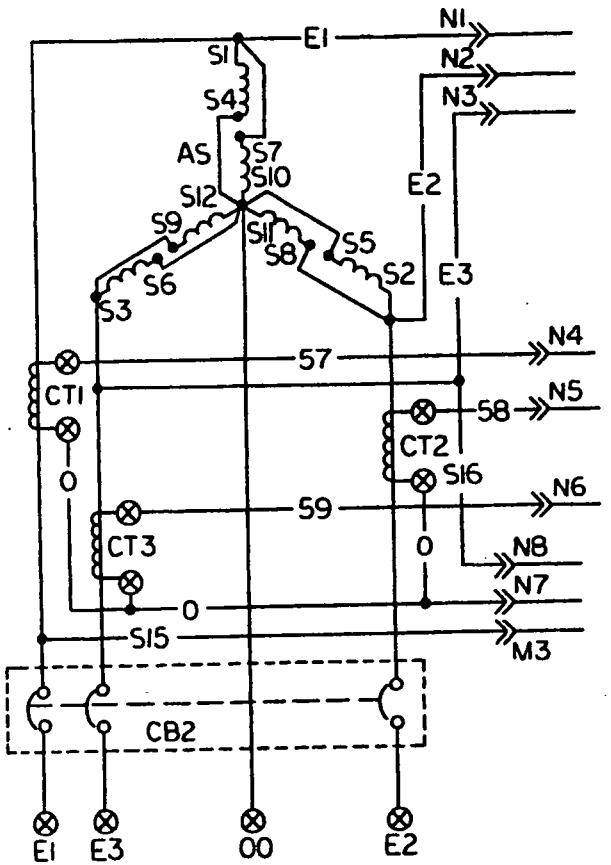
BH	Battery Heater
EH	Engine Heater
TP3	Thermostat (Water Heater)
CB	Circuit Breaker
T1	Voltage Sensing Transformer
TP1	Stator Thermal Protector
TP2	Choke Thermostat
CR	Control Relay
HTS	High Water Temperature Switch
LOS	Low Oil Switch
HM	Hour Meter
CH	Choke Solenoid
SC	Starter Contactor
S	Starter Motor
SW	Start/Stop Switch
D1-D5	Diode
⊠	Screw terminal
VS	Vacuum Solenoid
LT	Low Oil Pressure & High Water Temperature Indicator Light
T	Transformer
DC-A	DC Alternator
⊠	Screw Terminal
FS	Fuel Lock-Off Solenoid
R	LP & Natural Gas Regulator
T2	Trickle Charger Transformer
CC	Control Contactor



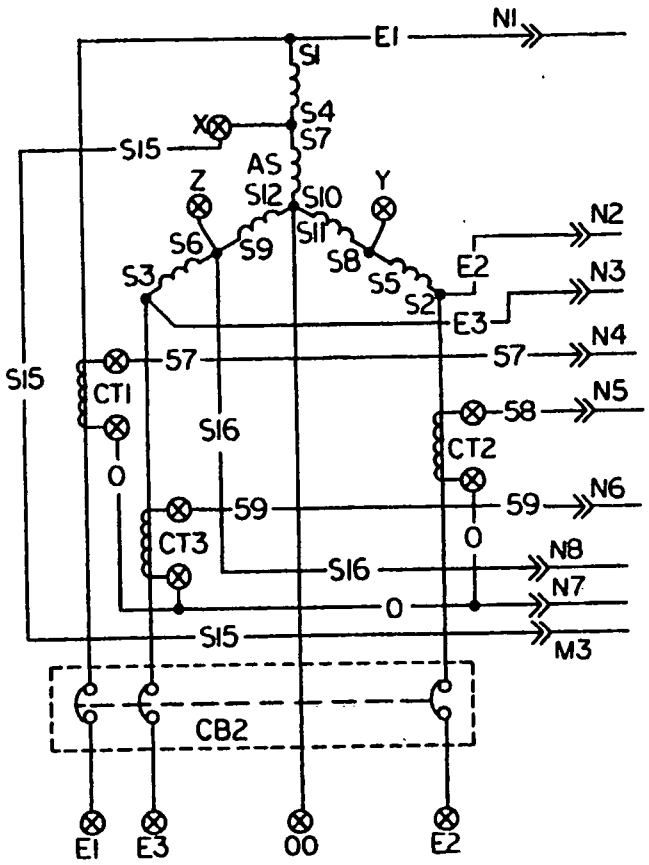
SCHEMATIC OF LP AND NATURAL GAS ONLY



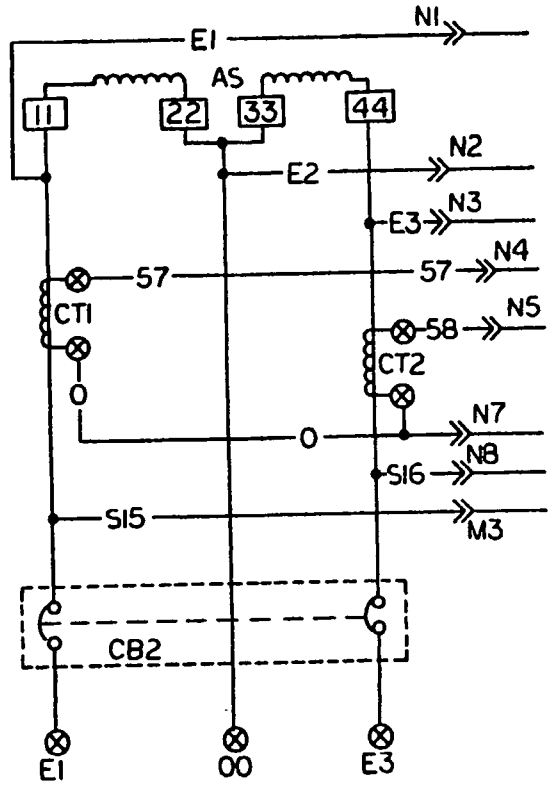
SCHEMATIC No. 50666



CUSTOMER CONNECTION
120/208-V. 3-PHASE



CUSTOMER CONNECTION
240/416-V. 3-PHASE

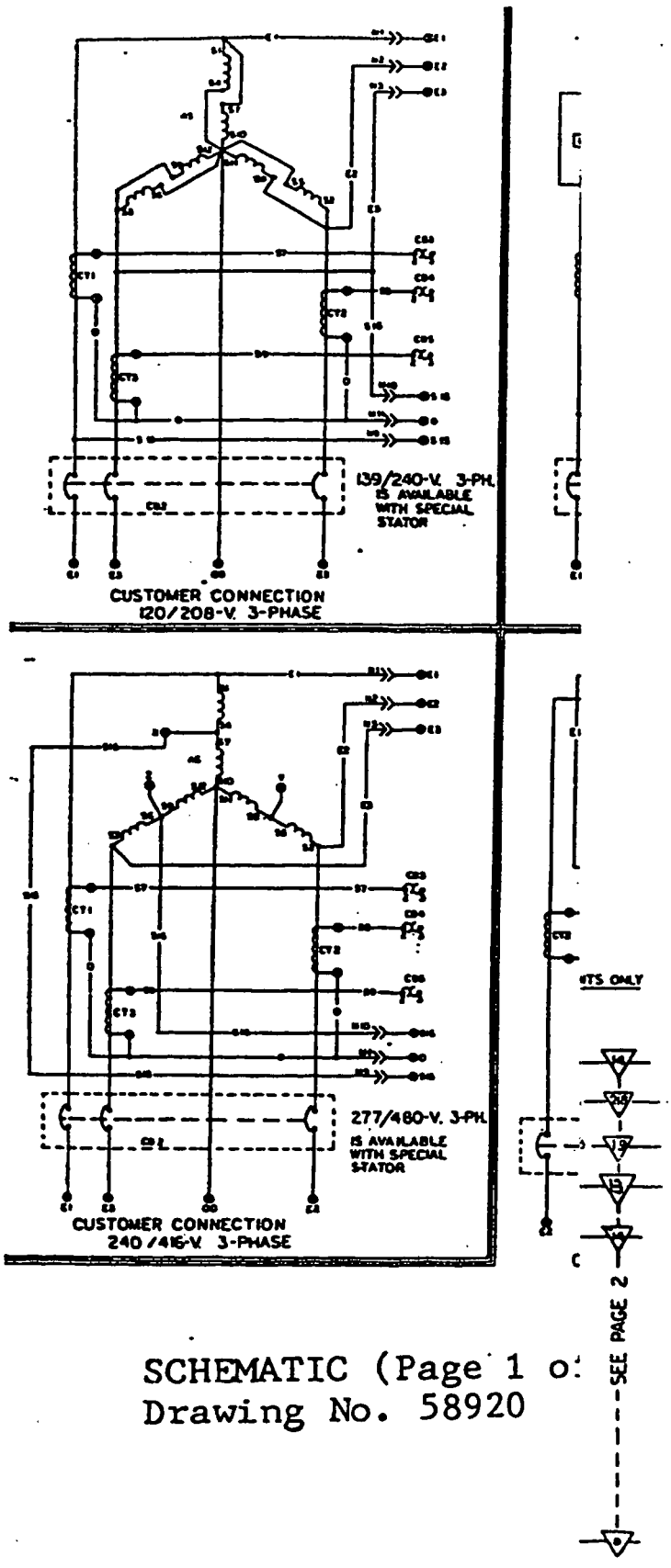


CUSTOMER CONNECTION
120/240-V. 1-PHASE

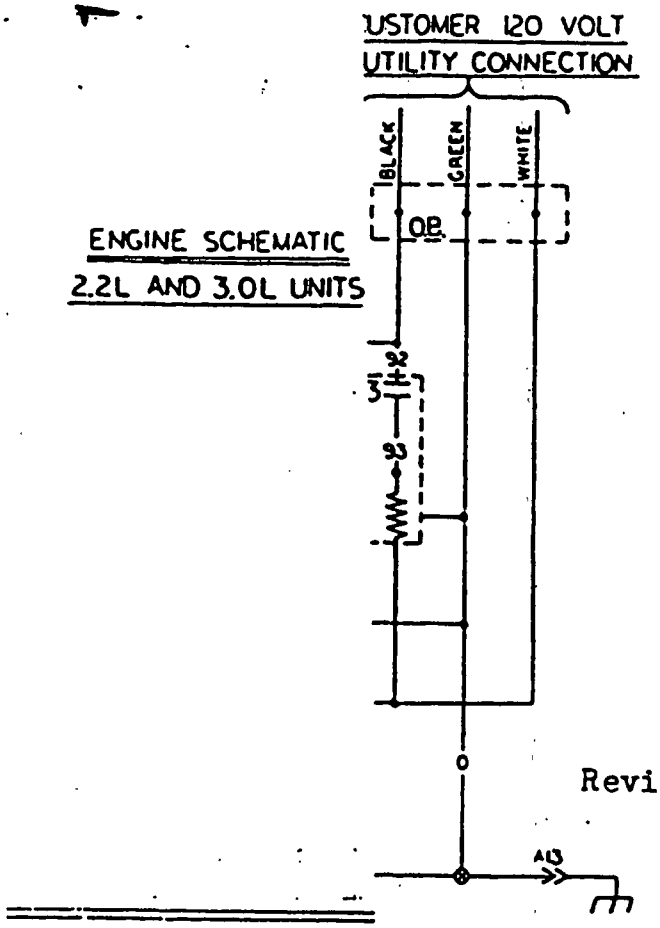
ALTERNATE RECONNECTION SCHEMES WITH
3 PHASE ALTERNATOR

SINGLE PHASE ALTERNATOR
CONNECTION SCHEME

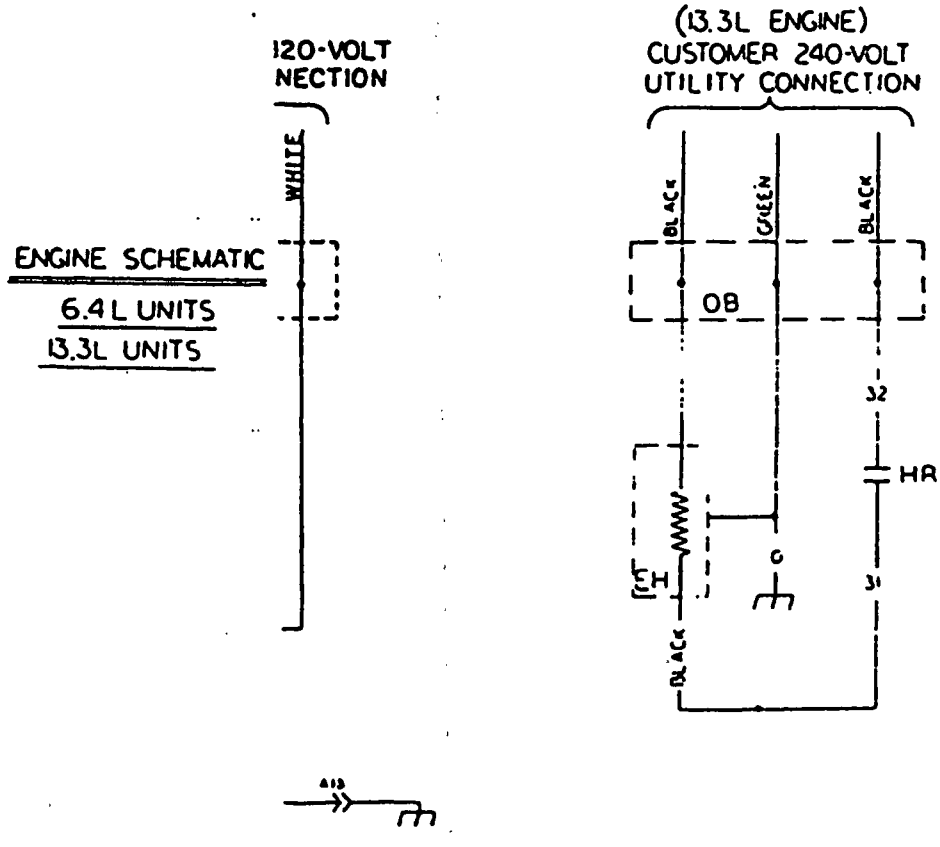
[redacted]



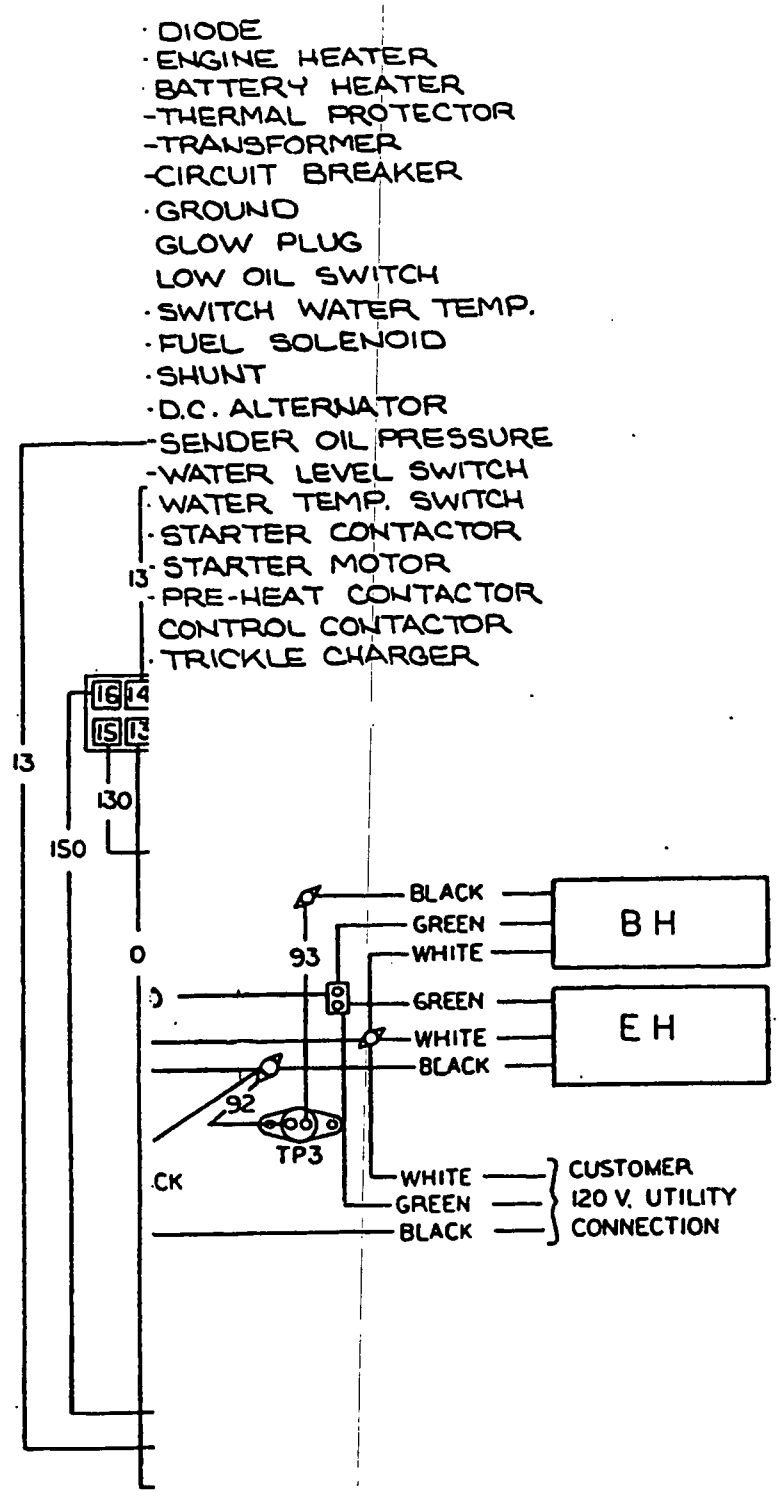
SCHEMATIC (Page 1 o:
Drawing No. 58920



Revised 2/20/84 (ECO #B-4767)



ELECTRICAL SCHEMATIC
Drawing Number 58920 (Page 2 of 2)
Revised-

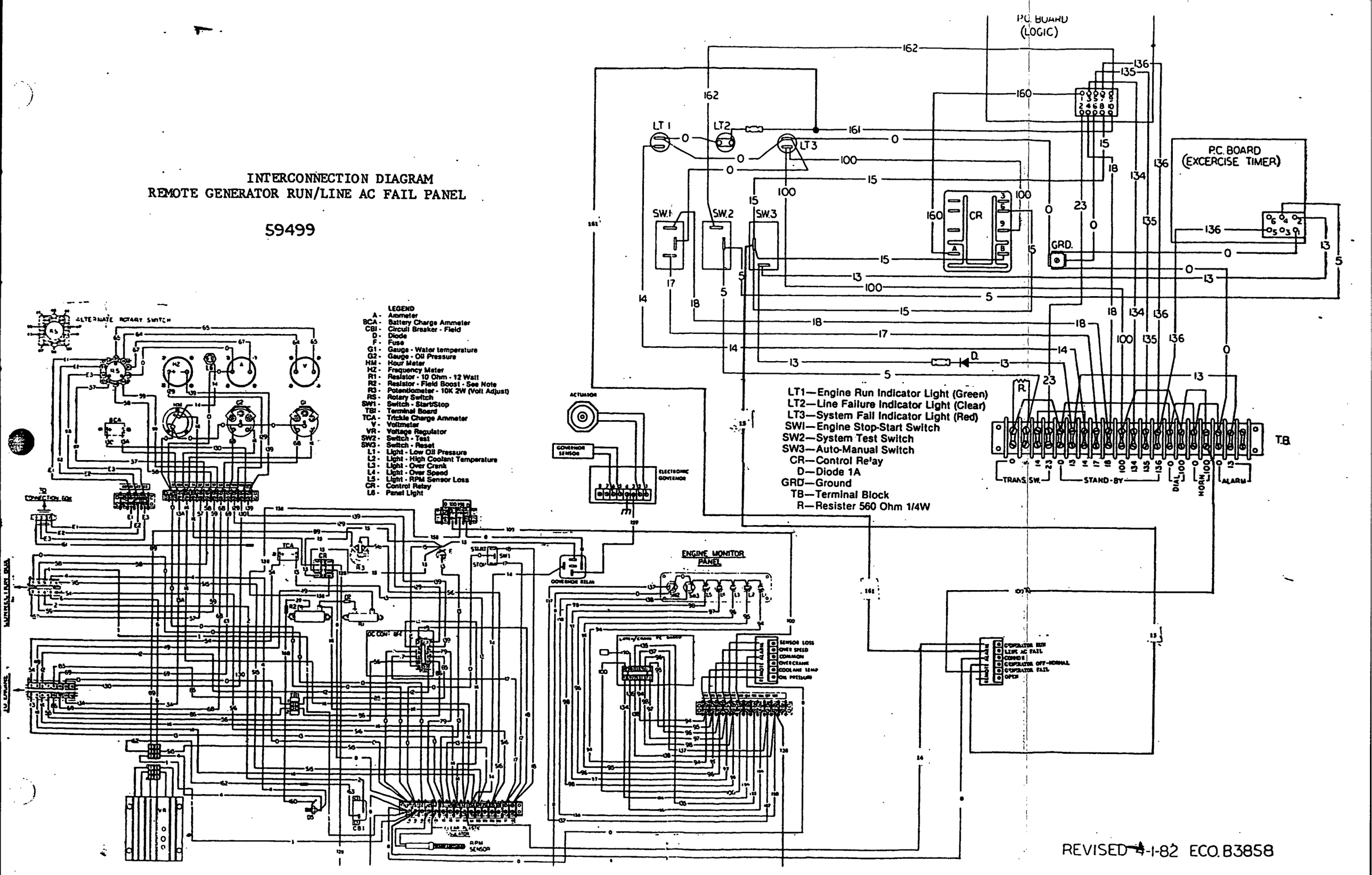


ɜINE WIRING DIAGRAM
Drawing No. 58921

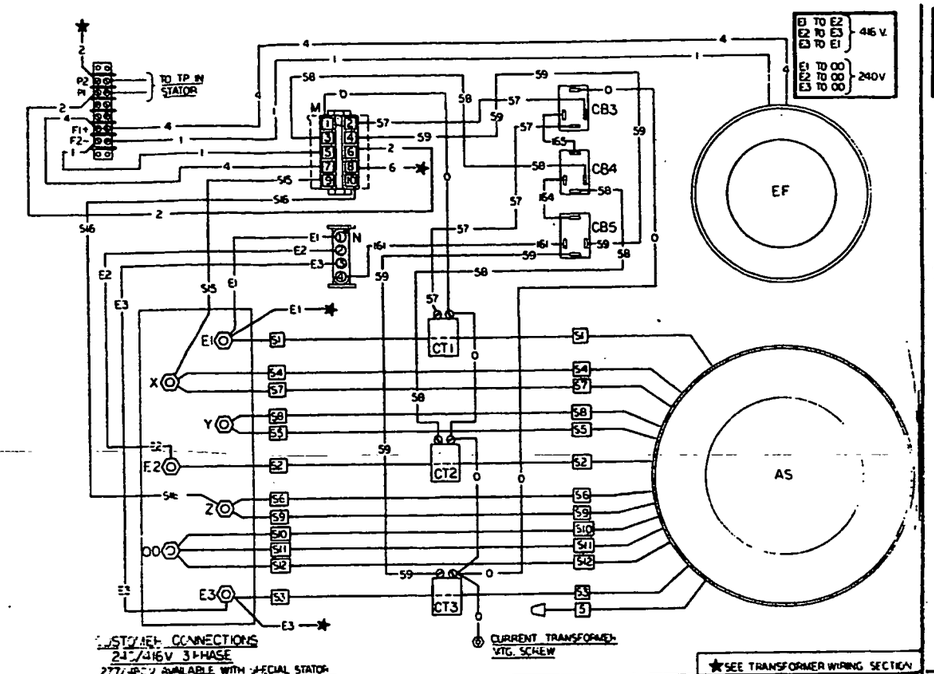
ed 2/20/84 (ECO #B-4767)

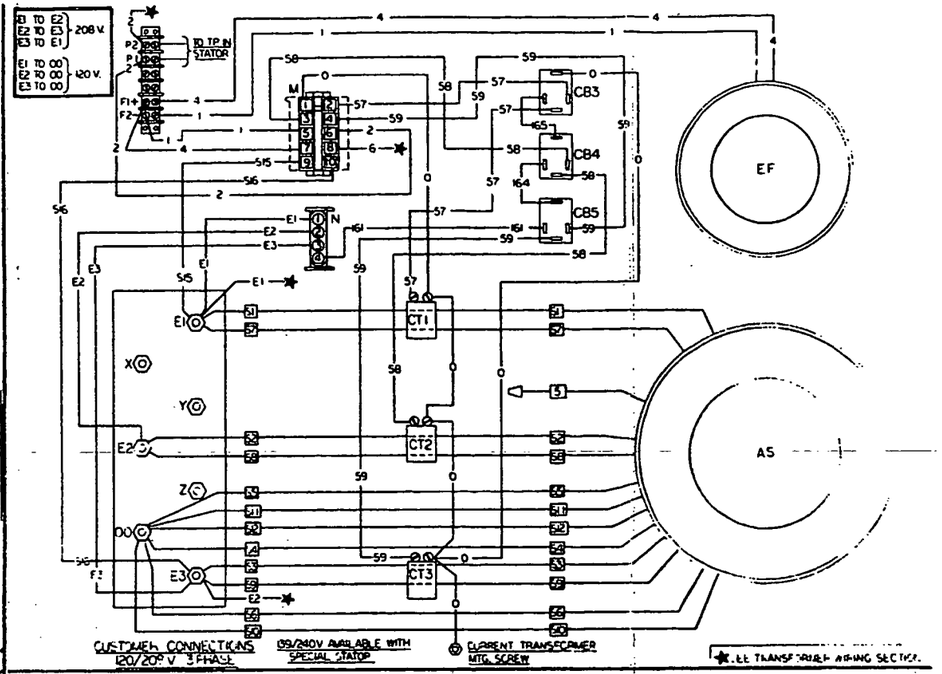
INTERCONNECTION DIAGRAM
REMOTE GENERATOR RUN/LINE AC FAIL PANEL

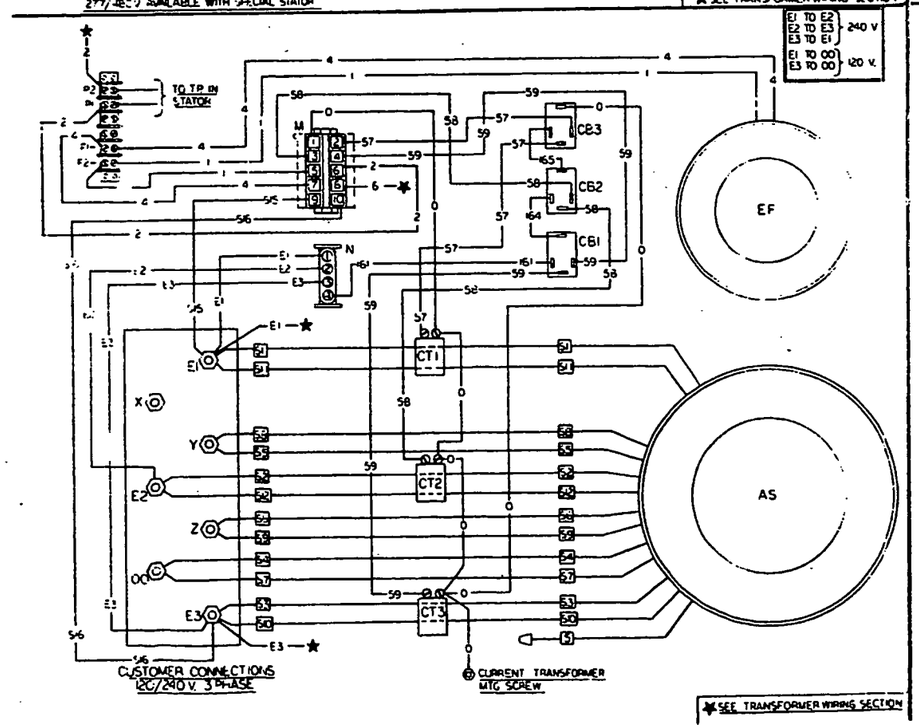
59499

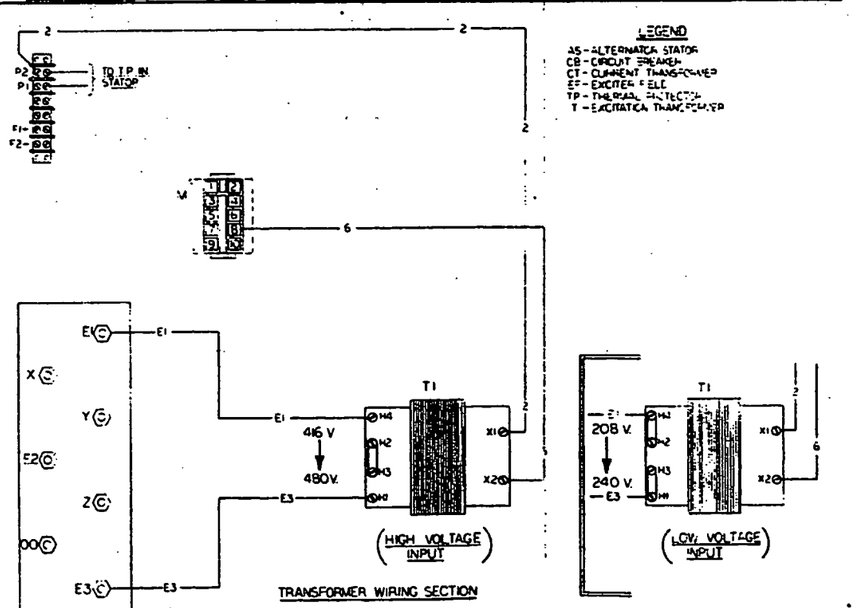


REVISED 4-1-82 ECO.B3858







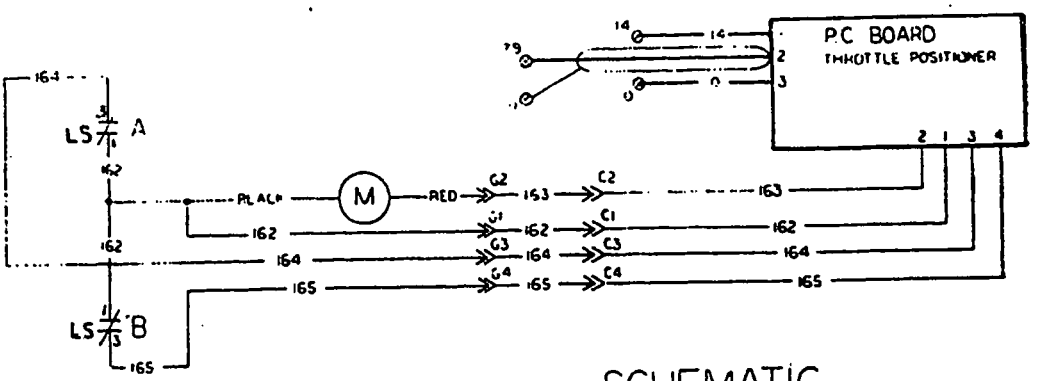


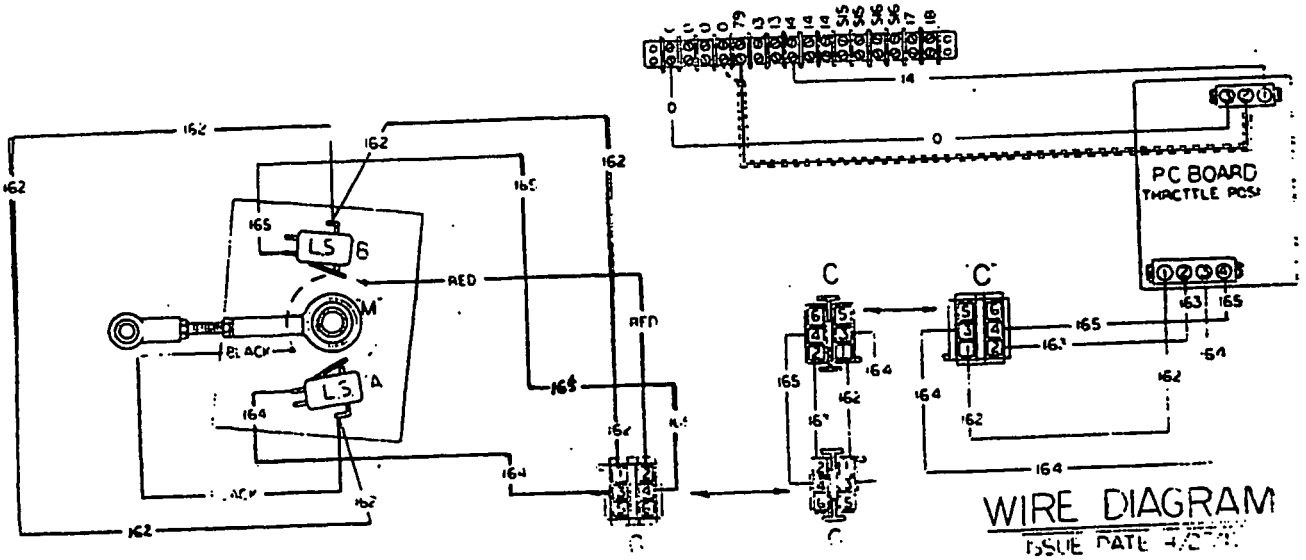
WIRING DIAGRAM

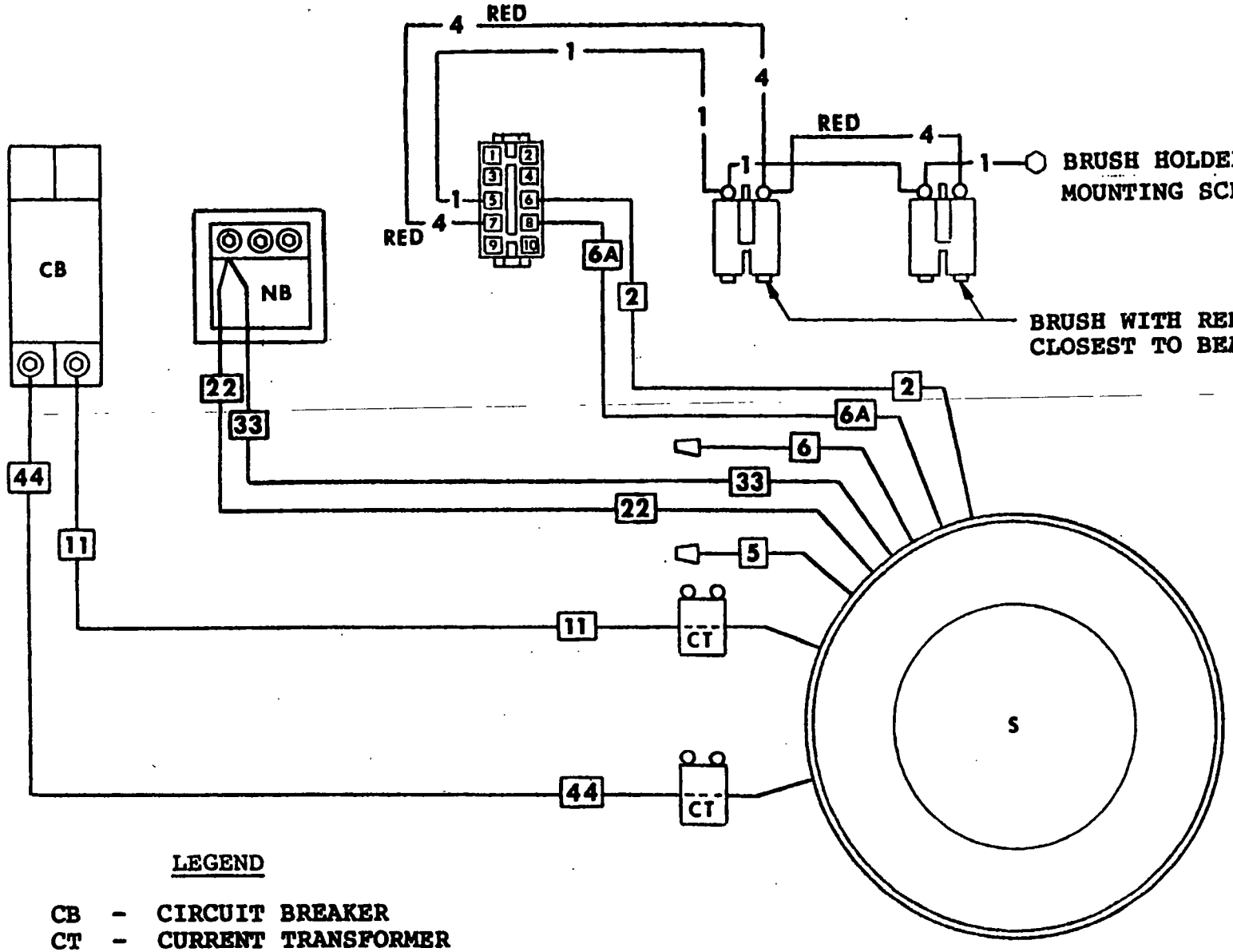
*60370

ISSUE DATE 3/10/92

Electrical Schematic and Wiring Diagram (Drawing No. 60804)



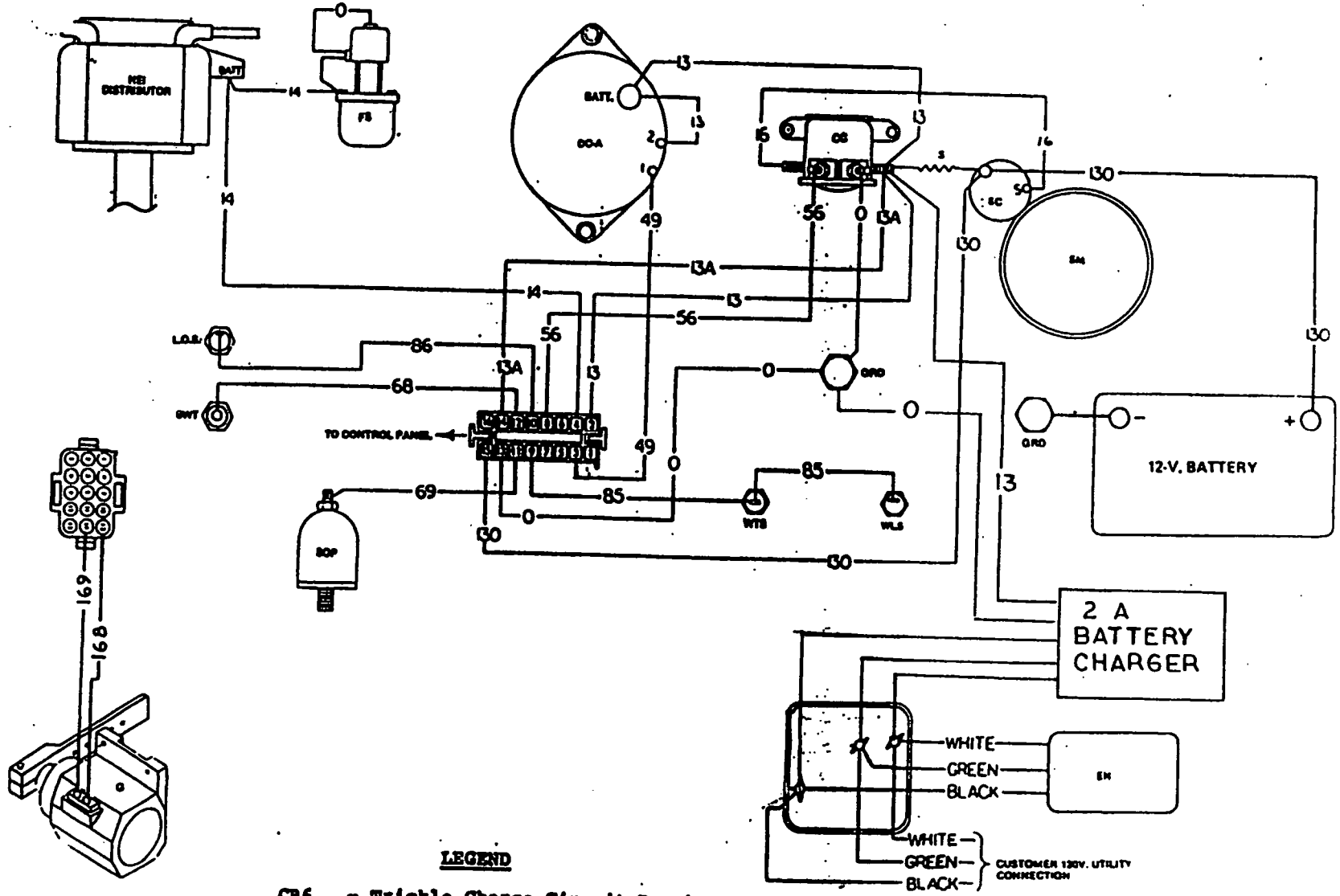




LEGEND

CB - CIRCUIT BREAKER
CT - CURRENT TRANSFORMER
NB - NEUTRAL BLOCK
S - STATOR

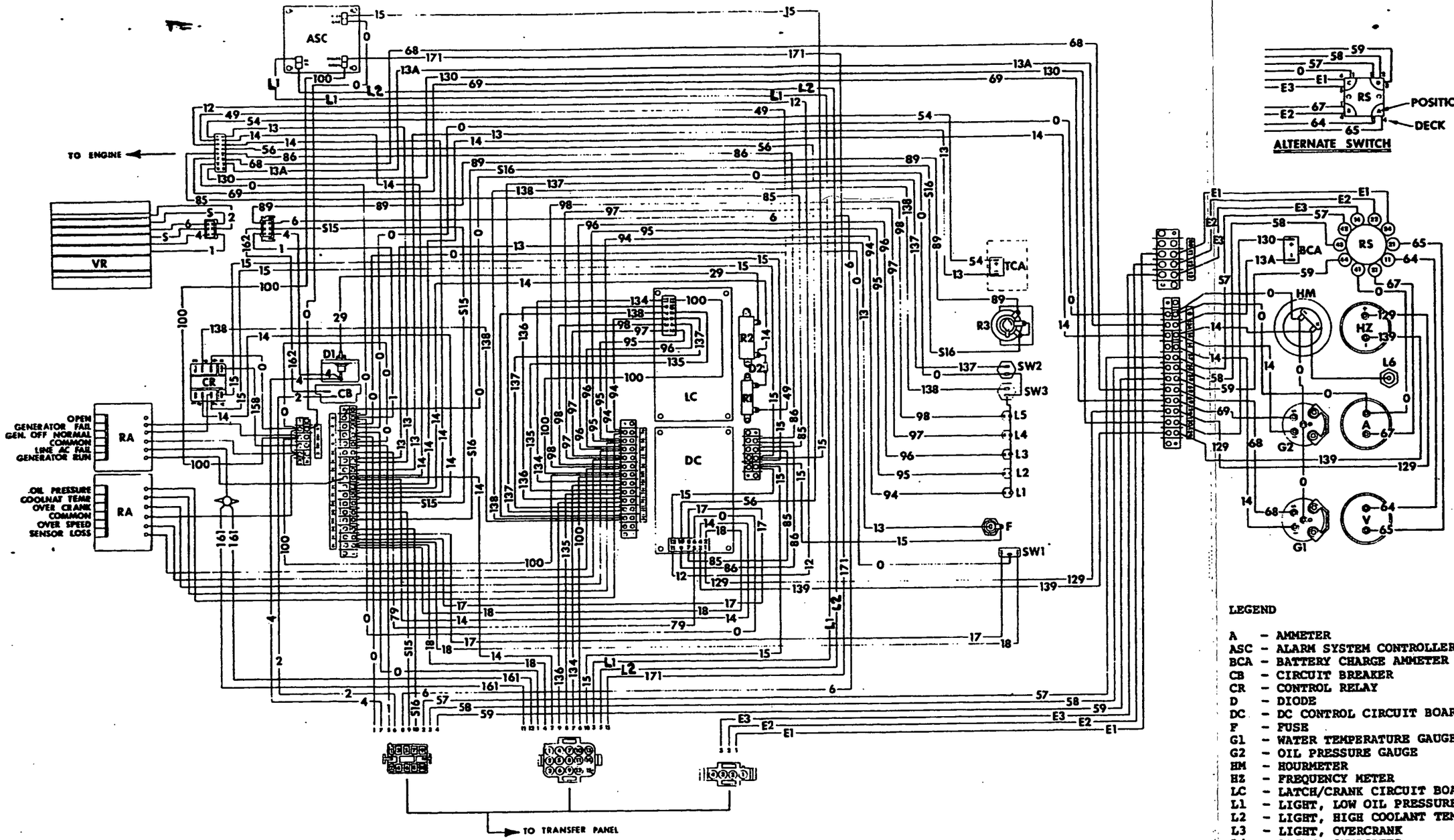
WIRING DIAGRAM
ALTERNATOR CONNECTIONS
Drawing Number 61307



LEGEND

CB6	- Trickle Charge Circuit Breaker
DC-A	- DC Alternator
EH	- Engine Heater
FS	- Fuel Solenoid
GRD	- Ground
HEI	- High Energy Ignition
WLS	- Water Level Sensor
LOS	- Low Oil Pressure Switch
SC	- Starter Contactor
SM	- Starter Motor
SOP	- Sender Oil Pressure
SWT	- Sender Water Temperature
T2	- Trickle Charge Transformer
TC	- Trickle Charge PC Board
WTS	- High Water Temperature Switch
G	- Governor

ENGINE WIRING DIAGRAM
Drawing Number 381
Issued- 11/15/83



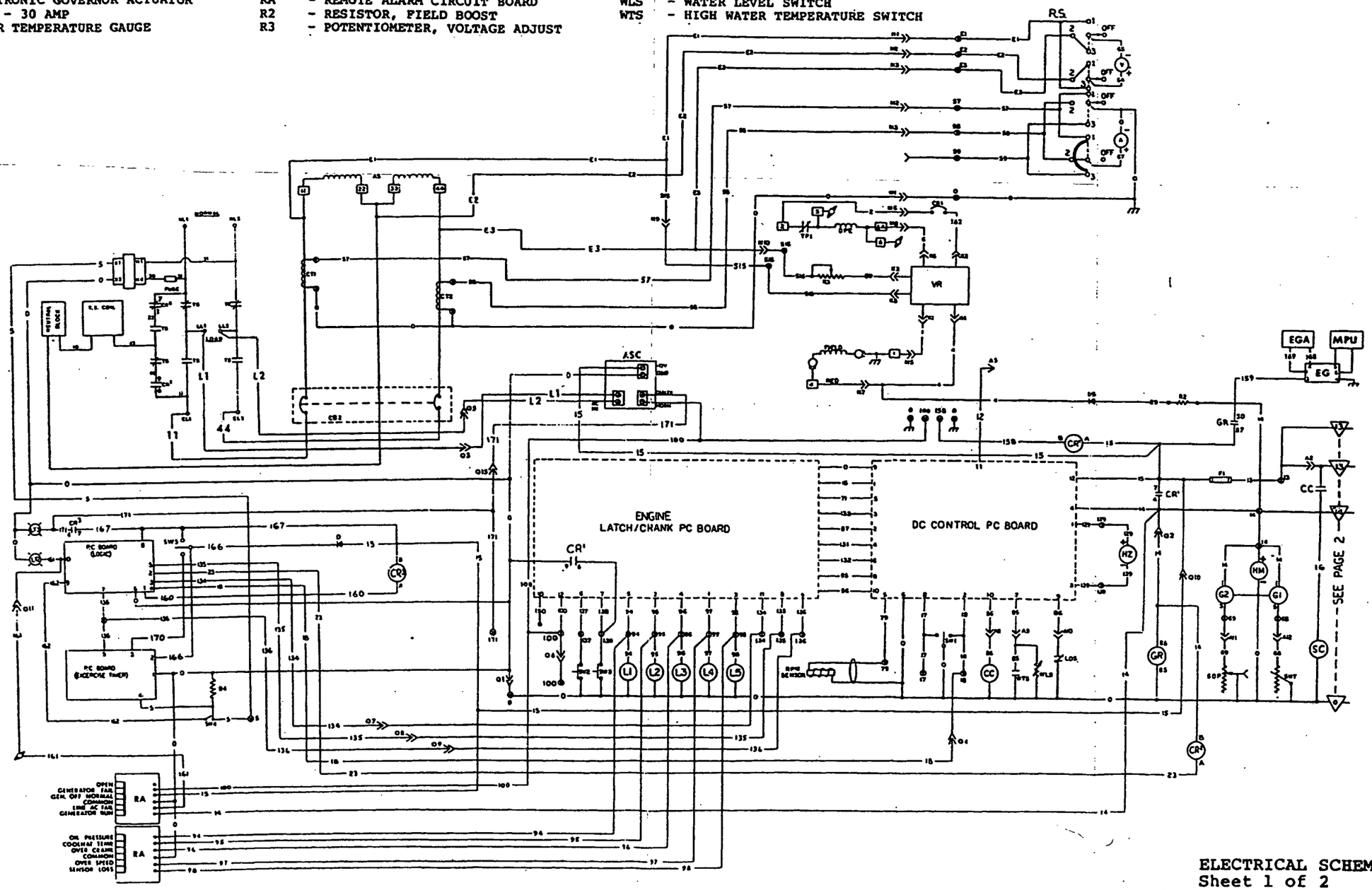
CONTROL PANEL WIRING DIAGRAM
Drawing Number 61384

LEGEND

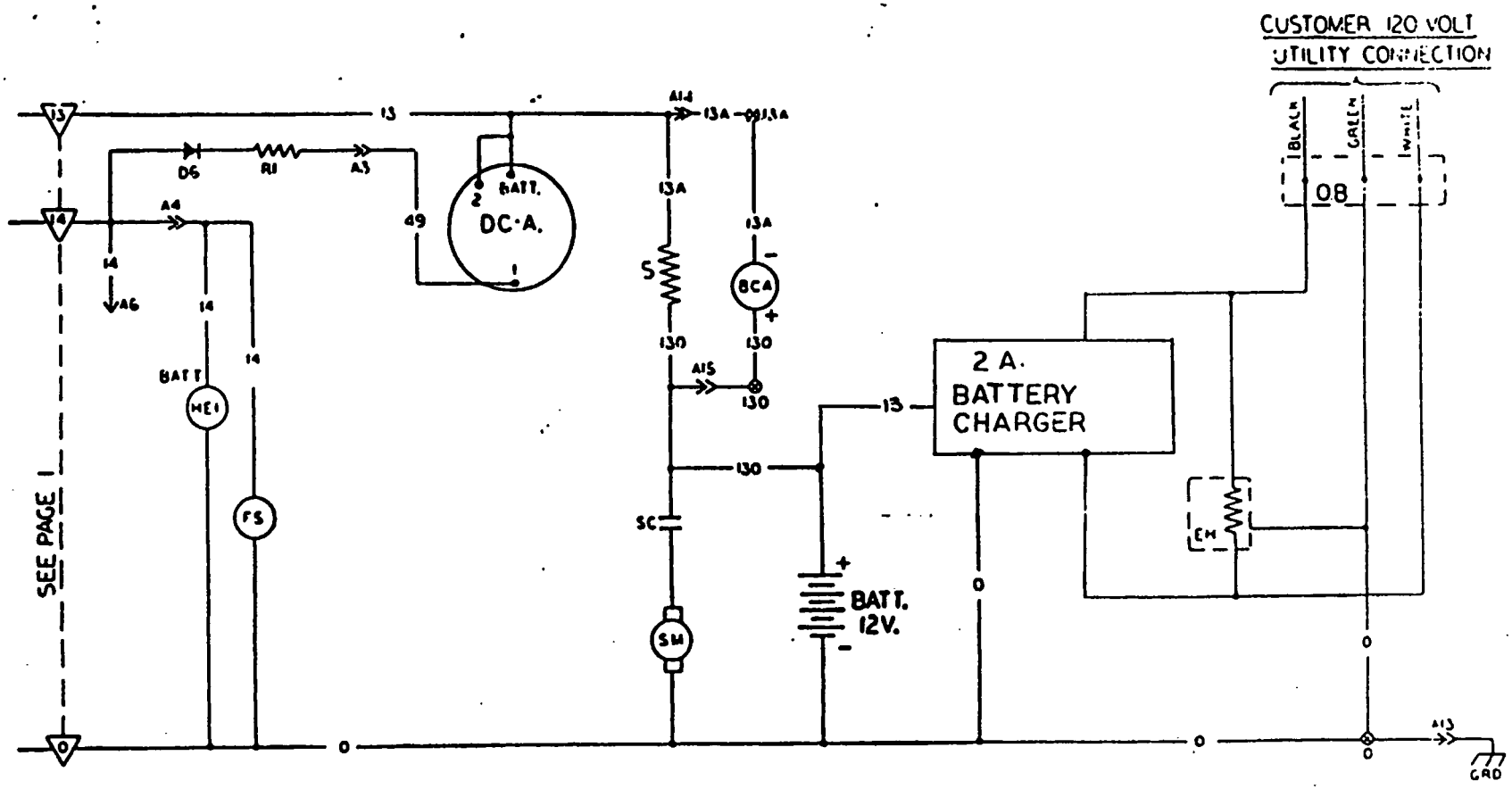
A - AMMETER
ASC - ALARM SYSTEM CONTROLLER
BCA - BATTERY CHARGE AMMETER
CB - CIRCUIT BREAKER
CR - CONTROL RELAY
D - DIODE
DC - DC CONTROL CIRCUIT BOARD
F - FUSE
G1 - WATER TEMPERATURE GAUGE
G2 - OIL PRESSURE GAUGE
HM - HOURMETER
HZ - FREQUENCY METER
LC - LATCH/CRANK CIRCUIT BOARD
L1 - LIGHT, LOW OIL PRESSURE
L2 - LIGHT, HIGH COOLANT TEMPERATURE
L3 - LIGHT, OVERCRANK
L4 - LIGHT, OVERSPEED
L5 - LIGHT, RPM SENSOR LOSS
L6 - LIGHT, PANEL
RA - REMOTE ALARM CIRCUIT BOARD
R1 - RESISTOR - 10 Ohm, 12 Watt
R2 - RESISTOR - 5 Ohm, 20 Watt
R3 - POTENTIOMETER, VOLTAGE ADJUST 10K, 2 Watt
RS - ROTARY SWITCH
SW1 - START/STOP SWITCH
SW2 - TEST SWITCH
SW3 - RESET SWITCH
TCA - TRICKLE CHARGE AMMETER
V - VOLTMETER
VR - VOLTAGE REGULATOR

LEGEND

A	- AMMETER	G2	- OIL PRESSURE GAUGE	R4	- RESISTOR, SENSING
AS	- ALTERNATOR STATOR	GR	- GOVERNOR RELAY	RS	- ROTARY SWITCH
ASC	- ALARM SYSTEM CONTROLLER	HM	- HOUR METER	SC	- STARTER CONTACTOR
CB1	- CIRCUIT BREAKER 8 AMP	HZ	- FREQUENCY METER	SOP	- SENDER, OIL PRESSURE
CB2	- CIRCUIT BREAKER 175 AMP	L1	- LIGHT, LOW OIL PRESSURE	SW1	- SWITCH, START/STOP
CC	- CONTROL CONTACTOR	L2	- LIGHT, HIGH COOLANT TEMPERATURE	SW2	- SWITCH, TEST
CR1	- CONTROL RELAY - SAFETY DISABLE	L3	- LIGHT, OVERCRANK	SW3	- SWITCH, RESET
CR2	- CONTROL RELAY - TRANSFER	L4	- LIGHT, OVERSPEED	SW4	- SWITCH, TEST/NORMAL
CR3	- CONTROL RELAY - ALARM	L5	- LIGHT, RPM SENSOR LOSS	SW5	- SWITCH, AUTO/MANUAL
CT	- CURRENT TRANSFORMER	LOS	- LOW OIL SWITCH	SWT	- SENDER, WATER TEMPERATURE
D	- DIODE	LT2	- LIGHT, LINE FAIL	TP1	- STATOR THERMAL PROTECTOR
DPE	- DISPLACED PHASE EXCITATION	LT3	- LIGHT, SYSTEM FAIL	V	- VOLTMETER
EG	- ELECTRONIC GOVERNOR	MPU	- MAGNETIC PICKUP, GOVERNOR	VR	- VOLTAGE REGULATOR
EGA	- ELECTRONIC GOVERNOR ACTUATOR	RA	- REMOTE ALARM CIRCUIT BOARD	WLS	- WATER LEVEL SWITCH
F1	- FUSE - 30 AMP	R2	- RESISTOR, FIELD BOOST	WTS	- HIGH WATER TEMPERATURE SWITCH
G1	- WATER TEMPERATURE GAUGE	R3	- POTENTIOMETER, VOLTAGE ADJUST		



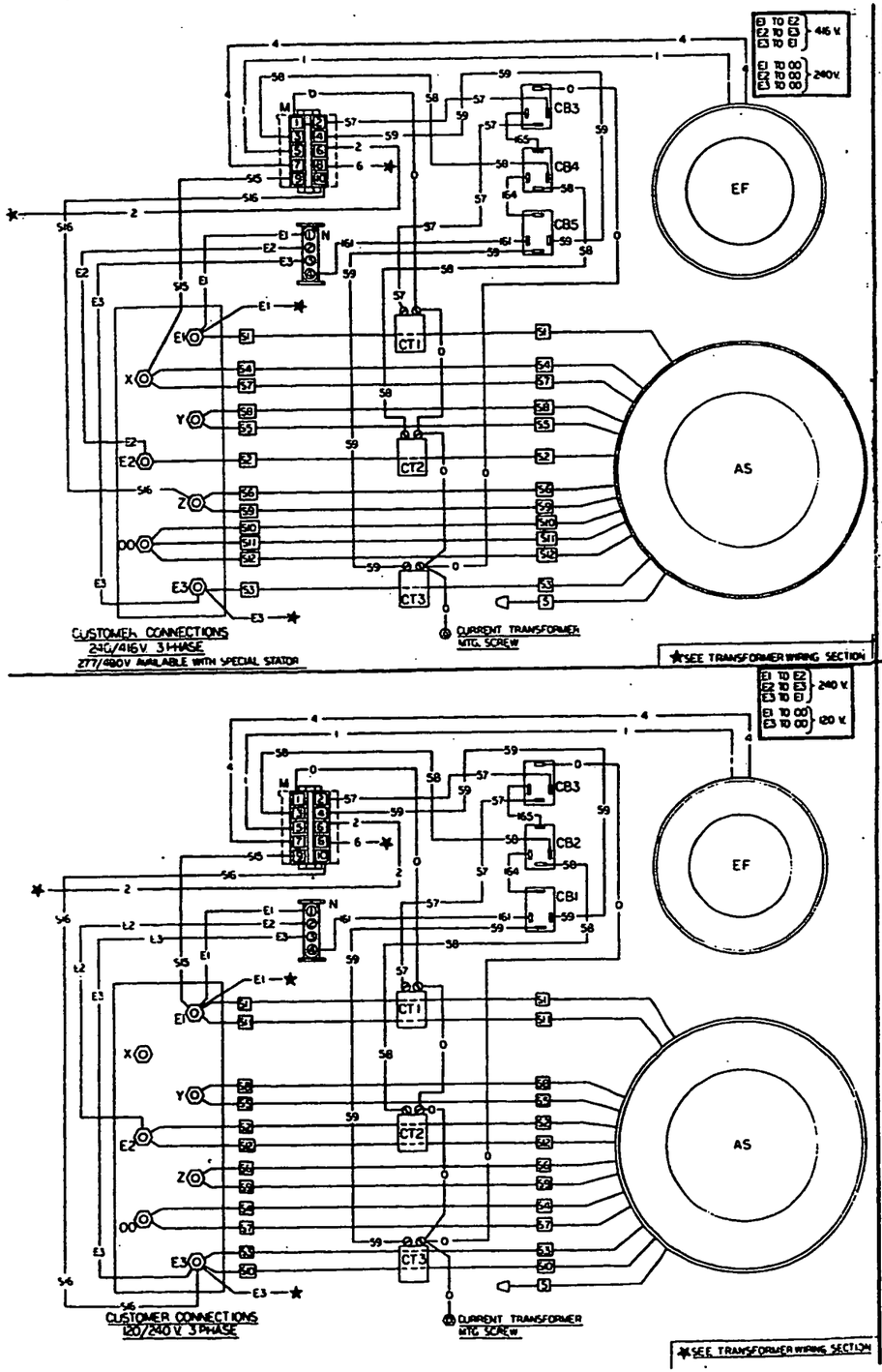
ELECTRICAL SCHEMATIC
Sheet 1 of 2
Drawing Number 61390
Revised - 01/12/83



LEGEND

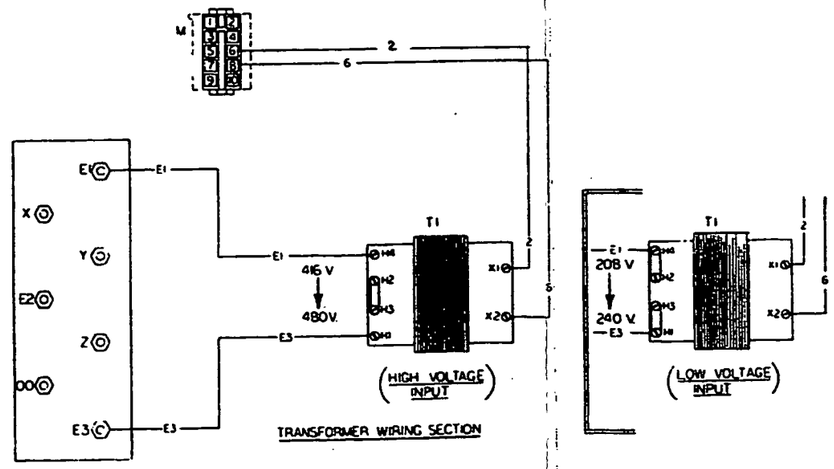
BCA	- BATTERY CHARGE AMMETER
CB6	- TRICKLE CHARGER CIRCUIT BREAKER
D	- DIODE
DC-A	- DC ALTERNATOR
EH	- ENGINE HEATER
FS	- FUEL SOLENOID
GRD	- GROUND
HEI	- HIGH ENERGY IGNITION
OB	- OUTLET BOX
R1	- RESISTOR (10 Ohm, 12 Watt)
S	- SHUNT
SC	- STARTER CONTACTOR
SM	- STARTER MOTOR
TC	- TRICKLE CHARGER CIRCUIT BOARD
TCA	- TRICKLE CHARGE AMMETER
T2	- TRICKLE CHARGER TRANSFORMER

MCI SCHEMATIC
Sheet 2 of 2
Drawing Number 61390



LEGEND

AS - ALTERNATOR STATOR
CB - CIRCUIT BREAKER
CT - CURRENT TRANSFORMER
EF - EXCITER FIELD
TP - THERMAL PROTECTOR
T - EXCITATION TRANSFORMER

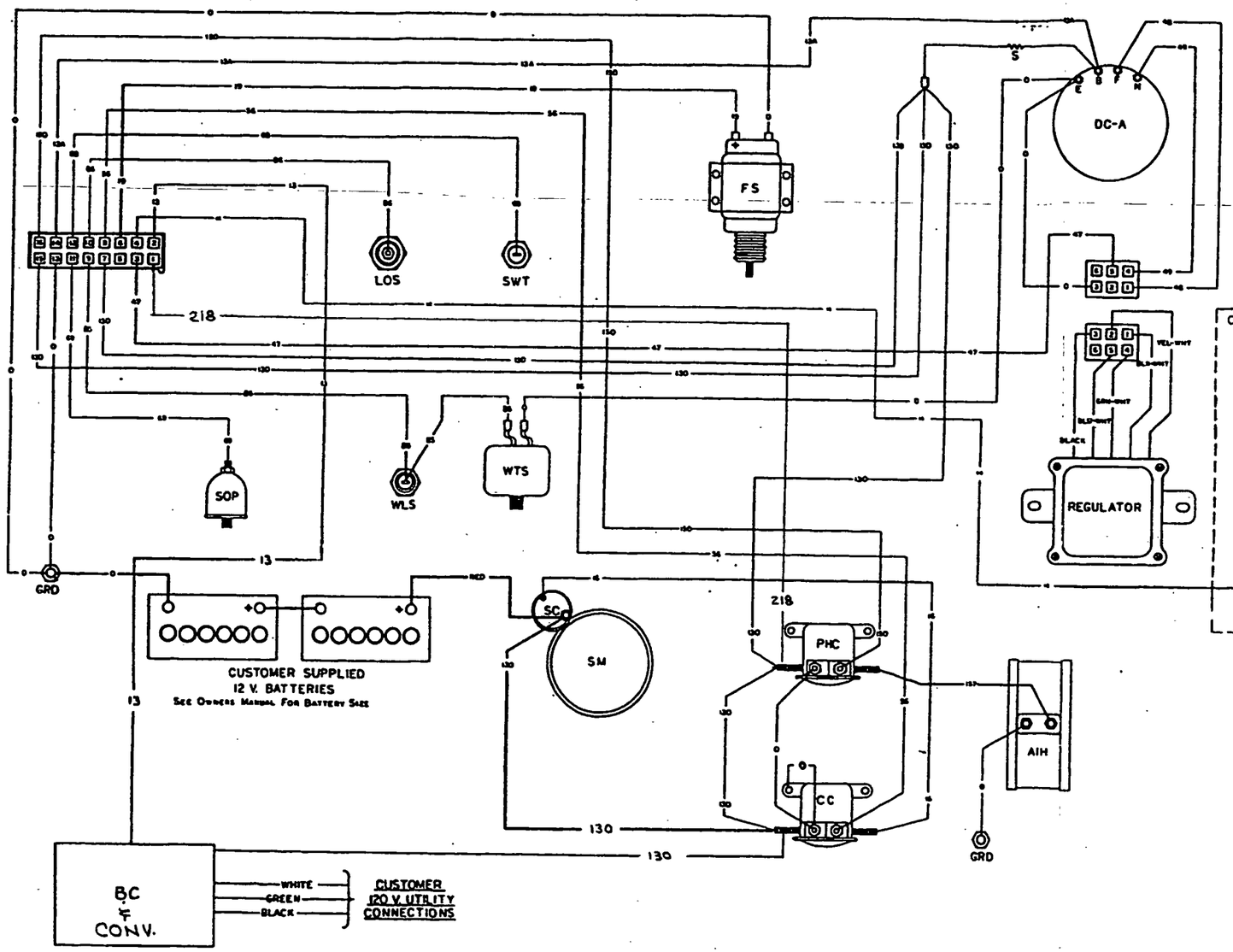


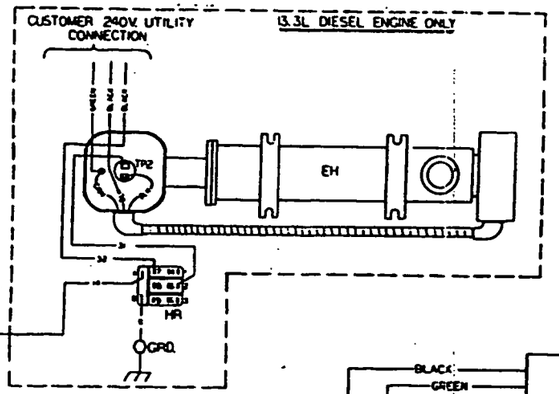
TRANSFORMER WIRING SECTION

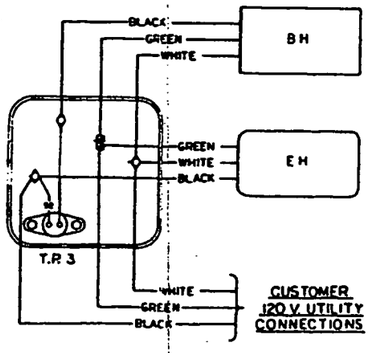
WIRING DIAGRAM

ISSUE DATE

61594



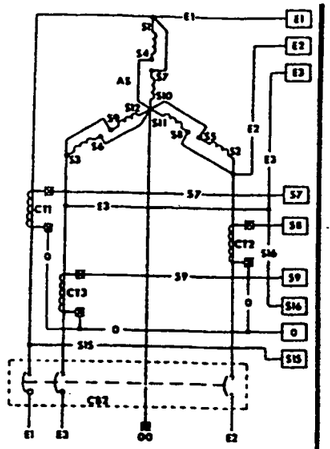


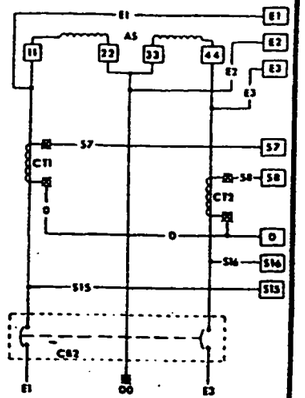


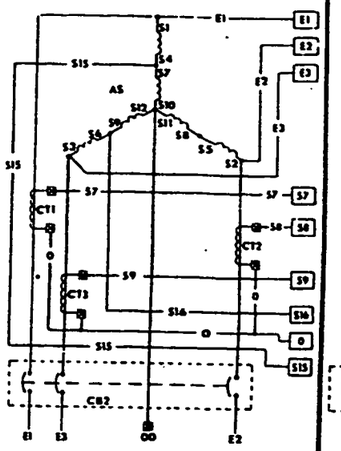
LEGEND

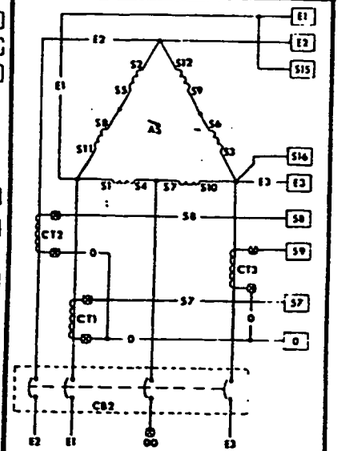
AIH	=	AIR INTAKE HEATER
BC	=	BATTERY CHARGER- 2 AMP
BH	=	BATTERY HEATER
CB	=	CIRCUIT BREAKER
CC	=	CONTROL CONTACTOR
DC-A	=	DC ALTERNATOR
EH	=	ENGINE HEATER
FS	=	FUEL SOLENOID
GRD	=	GROUND
HR	=	ENGINE HEATER RELAY
LOS	=	LOW OIL SWITCH
PHC	=	PRE-HEAT CONTACTOR
S	=	SHUNT
SC	=	STARTER CONTACTOR
SM	=	STARTER MOTOR
SOP	=	SENDER- OIL PRESSURE
SR	=	FUEL SOLENOID RELAY
SWT	=	SENDER- WATER TEMPERATURE
T2	=	TRANSFORMER- TRICKLE CHARGER
TC	=	TRICKLE CHARGER
TP3	=	BATTERY HEATER THERMOSTAT
WLS	=	WATER LEVEL SENSOR
WTS	=	HIGH WATER TEMPERATURE SWITCH
CONV	=	CONVERTER

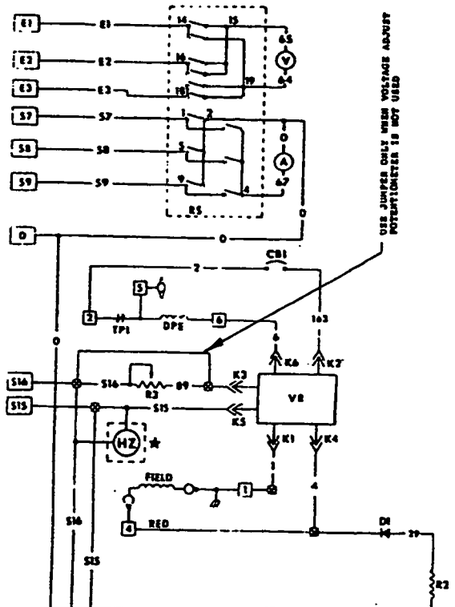
ENGINE WIRING DIAGRAM
Drawing Number 61717
Revised- 04/12/84











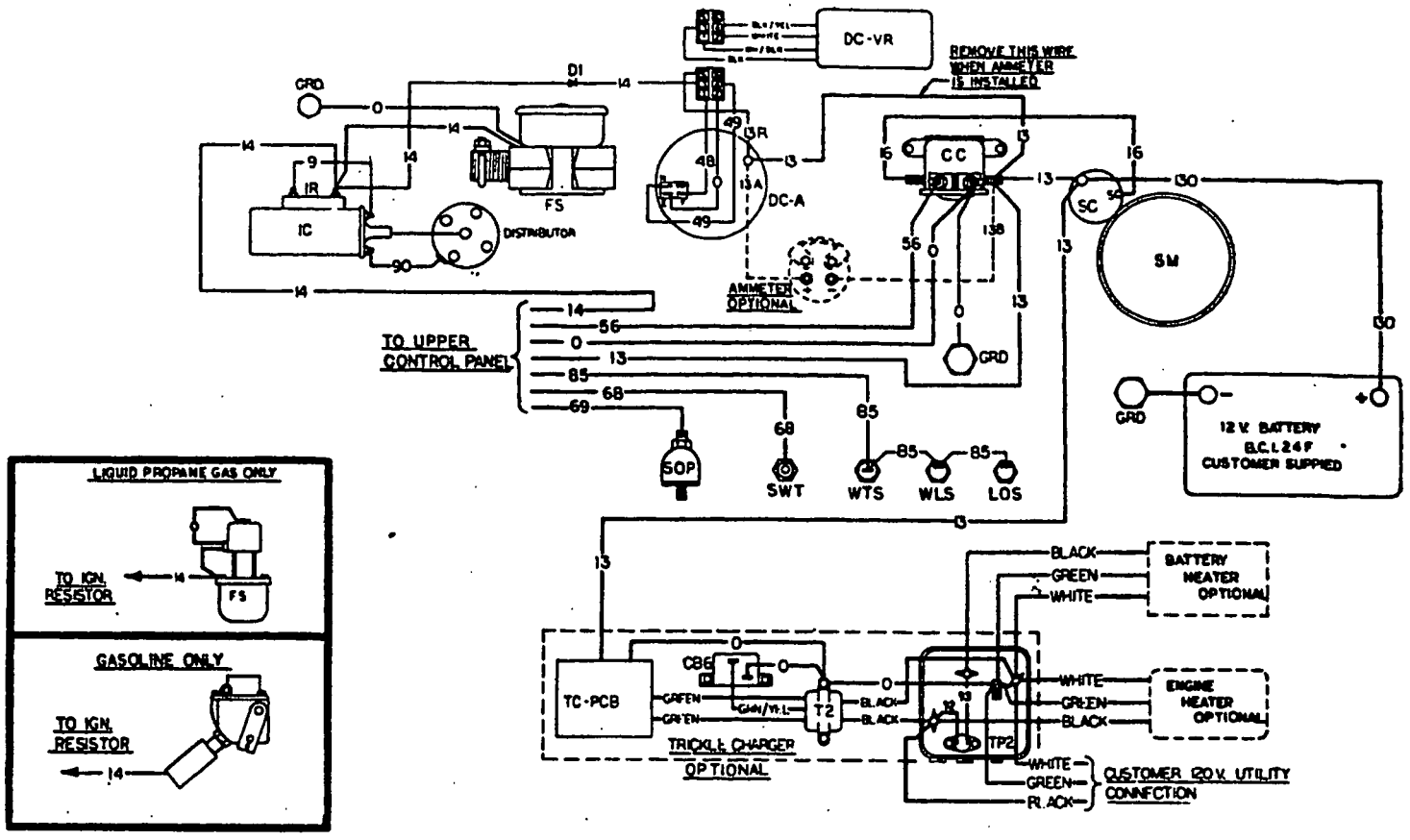
ENGINE MONITOR SYSTEM

- ☐ D = Automatic Start
  1 Light Annuciation
- ☐ H = Same as D
  less AC Meters

LEGEND

A	= AC AMMETER	L1	= LIGHT - SHUTDOWN
AS	= ALTERNATOR STATOR	L2	= LIGHT - PANEL
BC	= BATTERY CHARGER	LOS	= LOW OIL SWITCH
BH	= BATTERY HEATER	OB	= OUTLET BOX
CB1	= CIRCUIT BREAKER - FIELD	PHC	= PRE-HEAT CONTACTOR
CB2	= CIRCUIT BREAKER - MAIN	R2	= RESISTOR - 10 OHM
CC	= CONTROL CONTACTOR	R3	= POTENTIOMETER - 10K-OHM, 2-W, VOLTAGE ADJUST
CT	= CURRENT TRANSFORMER	RS	= ROTARY SWITCH
D	= DIODE	SC	= STARTER CONTACTOR
DC-A	= DC ALTERNATOR	SOP	= SENDER - OIL PRESSURE
AM	= DC AMMETER	SM	= STARTER MOTOR
DC-VR	= DC VOLTAGE REGULATOR	SW1	= SWITCH - START/RUN
DP	= DISTRIBUTOR POINTS	SW2	= SWITCH - AUTO/MANUAL
DPE	= DISPLACED PHASE EXCITATION	SW3	= SWITCH - PRE-HEAT
DS	= ANTI-DIESEL SOLENOID	SWT	= SENDER - WATER TEMPERATURE
EH	= ENGINE HEATER	TC	= TRICKLE CHARGER
F1	= FUSE - 4 AMP	TP1	= STATOR THERMAL PROTECTOR
F2	= FUSE - 10 AMP	TP2	= BATTERY HEATER THERMOSTAT
FS	= FUEL SOLENOID	V	= AC VOLTMETER
G1	= GUAGE - WATER TEMPERATURE	VM	= DC VOLTMETER - 0-18 VOLTS
G2	= GUAGE - OIL PRESSURE	VR	= VOLTAGE REGULATOR
GP	= GLOW PLUG	WLS	= WATER LEVEL SENSOR
GRD	= GROUND	WTS	= HIGH WATER TEMPERATURE SWITCH
HM	= HOUR METER	⊠	= SCREW TERMINAL
HZ	= Hertz Meter - 240-V.	⊸○	= WIRE NUT
IC	= IGNITION COIL	★	= OPTIONAL
IR	= IGNITION RESISTOR	★★	= DIESEL ONLY

ELECTRICAL SCHEMATIC
Drawing Number 61984
Issued - 3/11/83



LEGEND

CB6 = Circuit Breaker
CC = Control Contactor
D1 = Diode
DC-A = DC Alternator
DC-VR = DC Voltage Regulator
FS = Fuel Solenoid
GRD = Ground
IC = Ignition Coil
IR = Ignition Resistor
LOS = Low Oil Switch
SC = Starter Contactor
SM = Starter Motor
SOP = Sender - Oil Pressure
SWT = Sender - Water Temperature
T2 = Transformer - Trickle Charger
TC-PCB = Trickle Charger PC Board
TP2 = Thermostat - Battery Heater
WLS = Water Level Sensor
WTS = High Water Temperature Switch

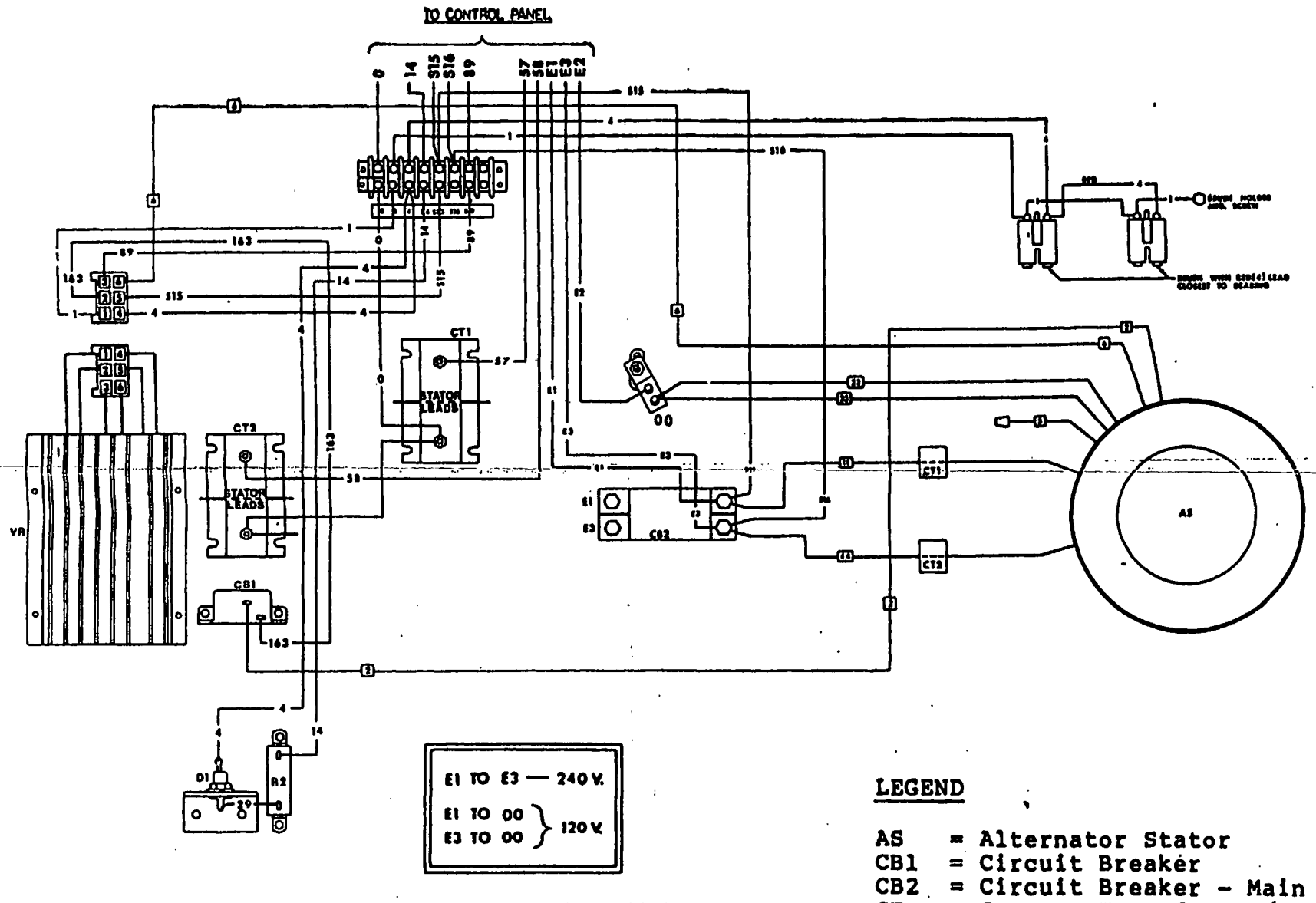
 = Wire Nut

ENGINE MONITOR SYSTEM

☐ D = Automatic Start
1 Light Annuciation

☐ H = Same as D
less AC Meters

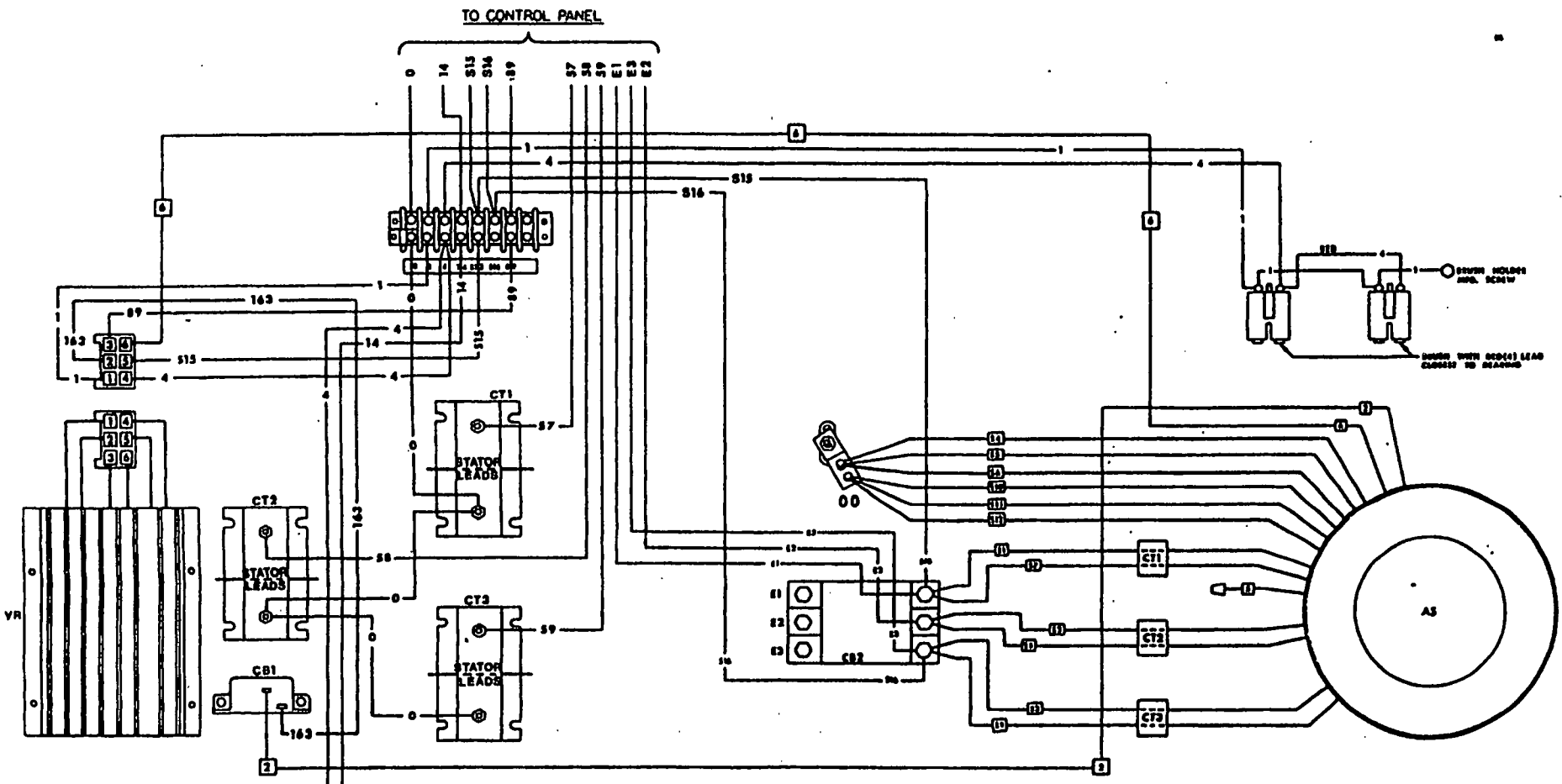
ENGINE WIRING DIAGRAM
Drawing Number 62301
Issued - 3/11/83



CUSTOMER CONNECTION
120/240-V. 1-PHASE

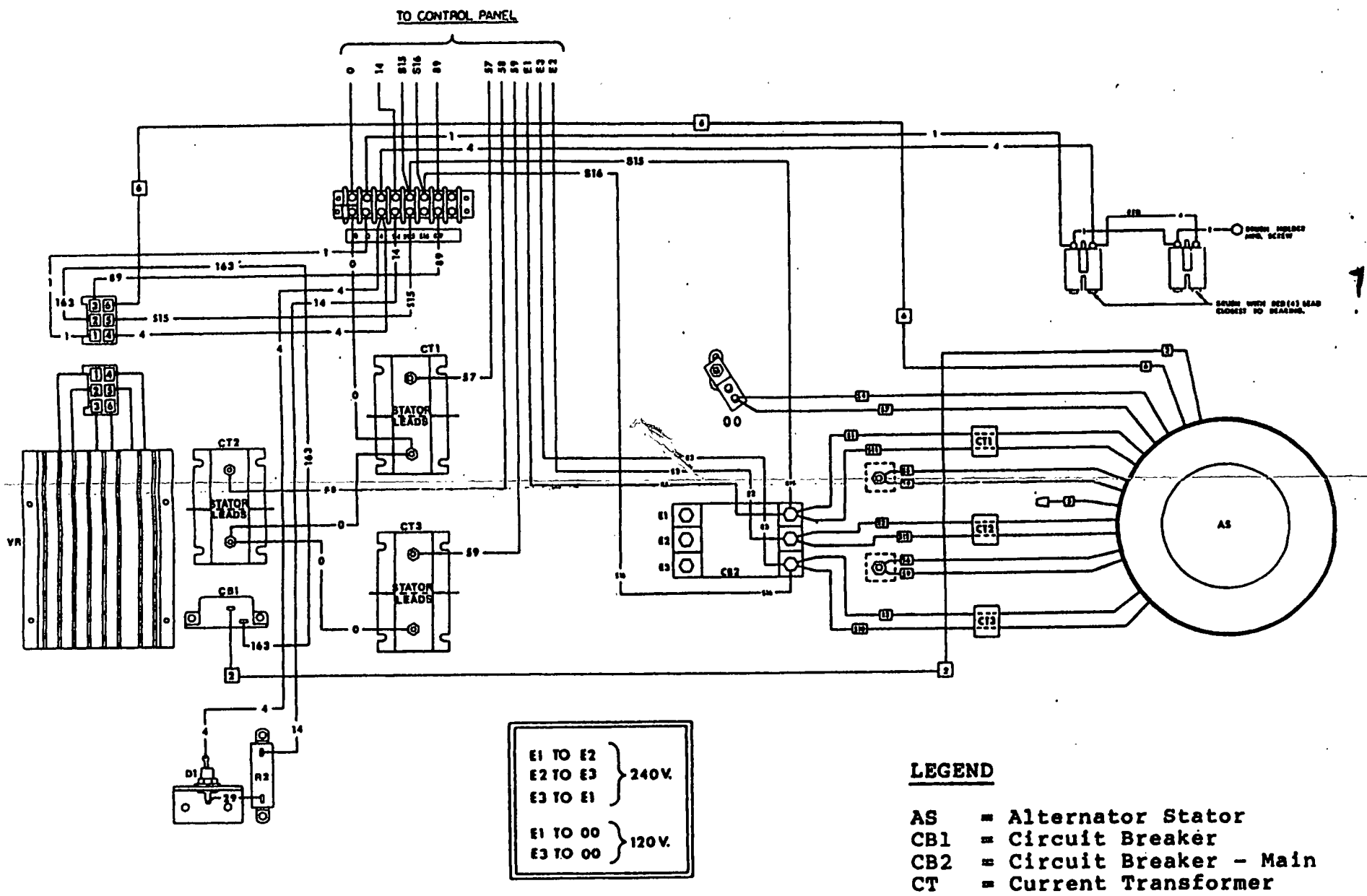
LEGEND

AS = Alternator Stator
CB1 = Circuit Breaker
CB2 = Circuit Breaker - Main
CT = Current Transformer
D1 = Diode
R2 = Resistor
VR = Voltage Regulator



CUSTOMER CONNECTION
120/208-V. 3-PHASE

ALTERNATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 62302
Sheet 1 of 2
Issued - 3/11/83



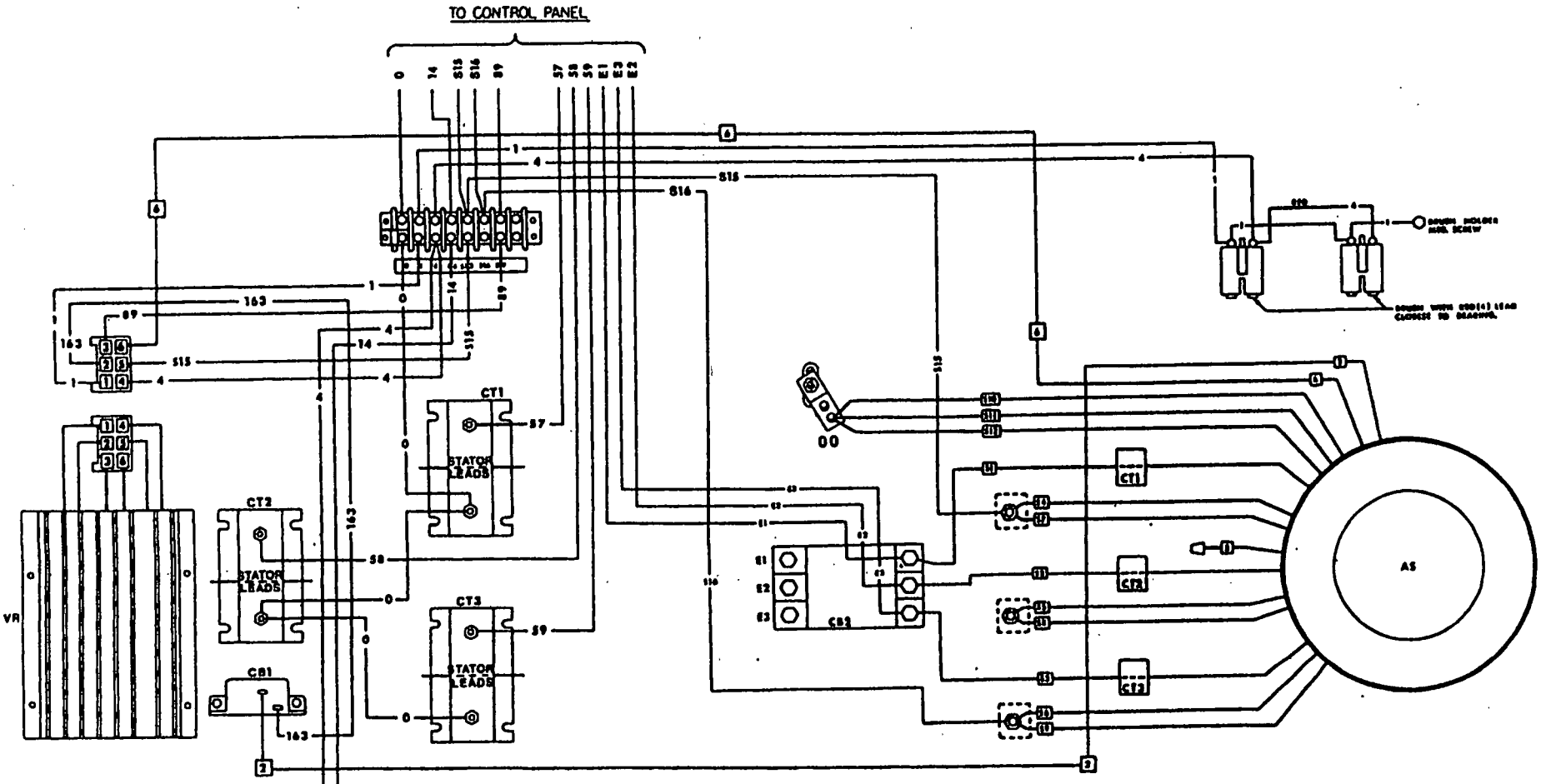
E1 TO E2 E2 TO E3 E3 TO E1	240V.
E1 TO 00 E3 TO 00	120V.

CUSTOMER CONNECTION
120/240-V. 3-PHASE

LEGEND

AS	= Alternator Stator
CB1	= Circuit Breaker
CB2	= Circuit Breaker - Main
CT	= Current Transformer
D1	= Diode
R2	= Resistor
VR	= Voltage Regulator

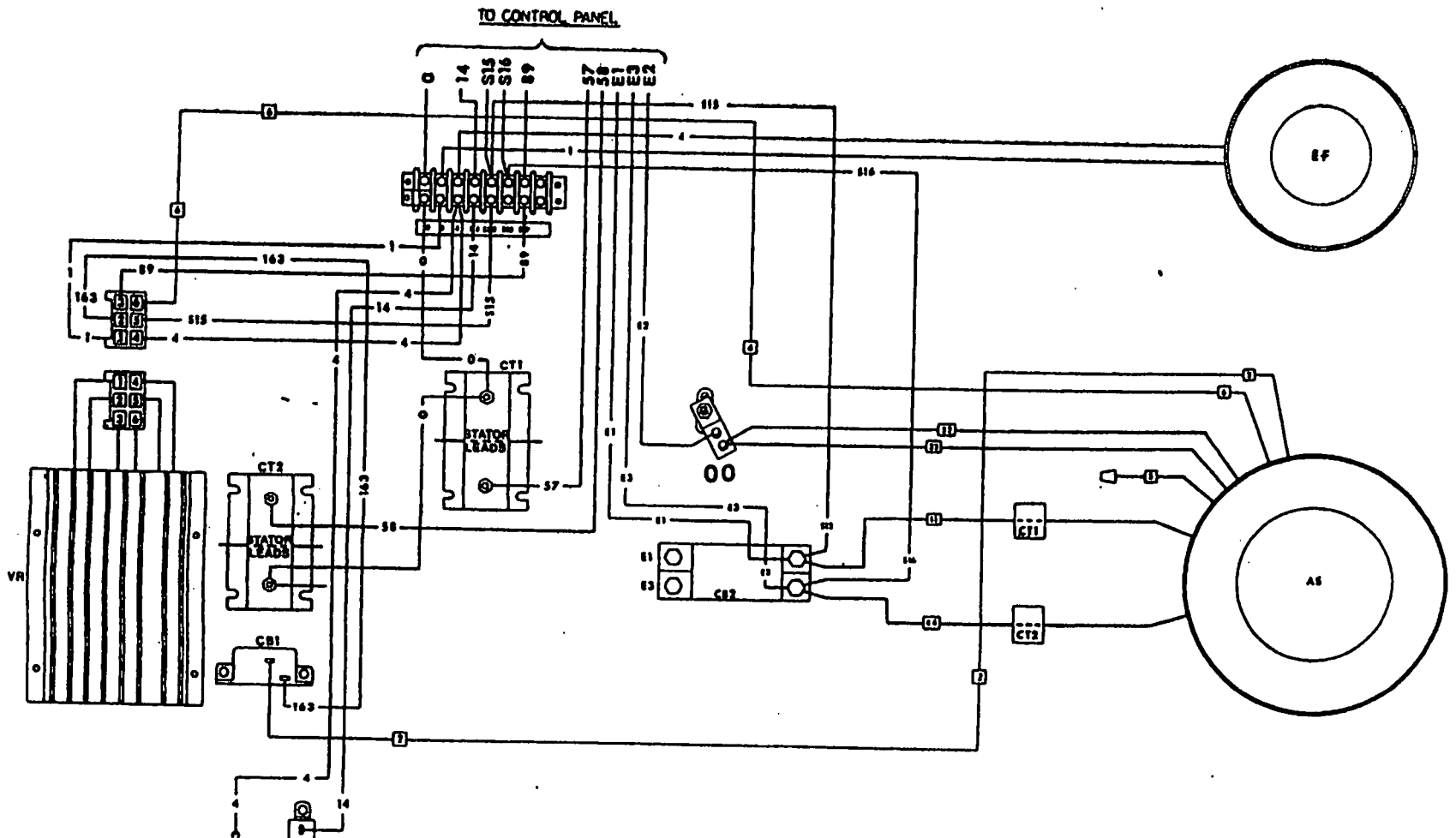
= Bolt, Lock Washer and Nut to be tape insulated



E1 TO E2 E2 TO E3 E3 TO E1	416 V.
E1 TO 00 E2 TO 00 E3 TO 00	240 V.

CUSTOMER CONNECTION
240/416-V. 3-PHASE

ALTERNATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 62302
Sheet 2 of 2
Issued - 3/11/83

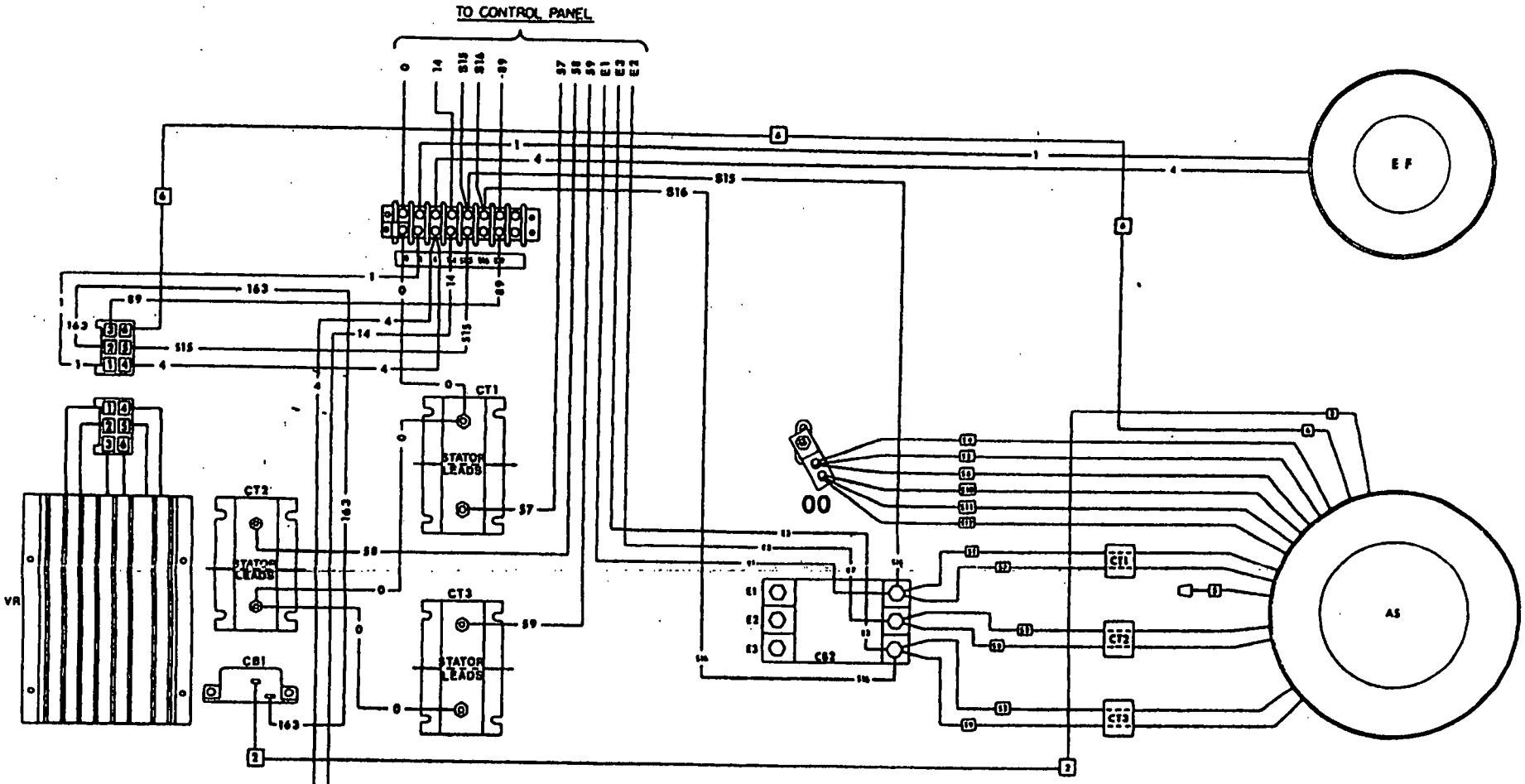


E1 TO E3 — 240 V.
E1 TO 00 } 120 V.
E3 TO 00 }

CUSTOMER CONNECTION
120/240-V. 1-PHASE

LEGEND

AS	=	ALTERNATOR STATOR
CB1	=	CIRCUIT BREAKER
CB2	=	CIRCUIT BREAKER- MAIN
CT	=	CURRENT TRANSFORMER
D1	=	DIODE
EF	=	EXCITER FIELD
R2	=	RESISTOR
VR	=	VOLTAGE REGULATOR



E1 TO E2
E2 TO E3
E3 TO E1
} 208 V.

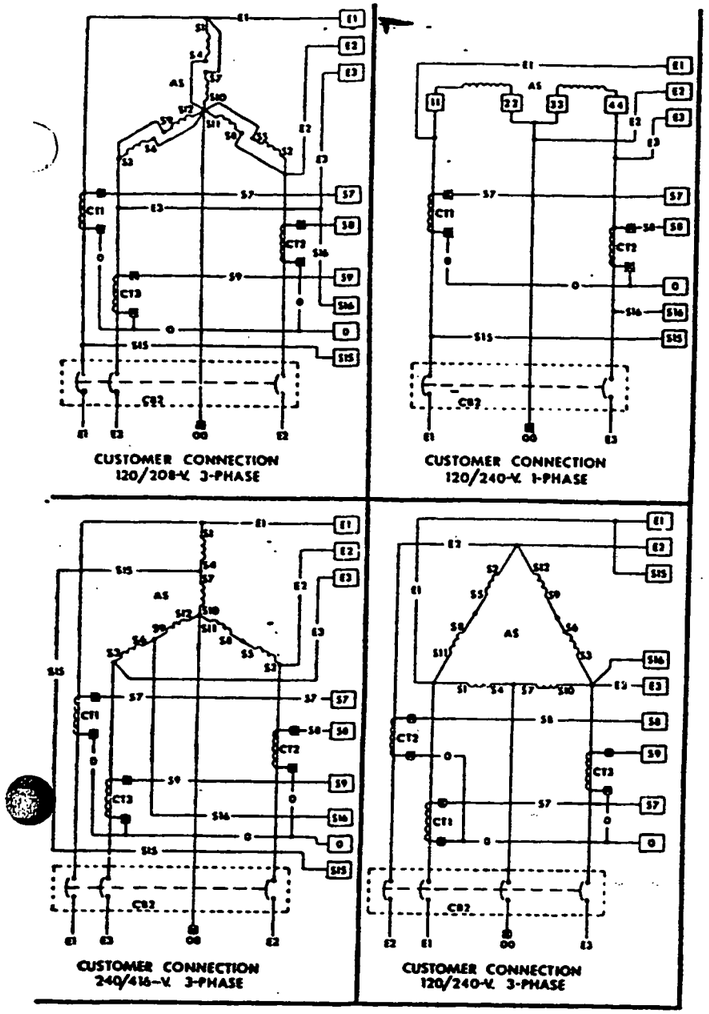
E1 TO 00
E2 TO 00
E3 TO 00
} 120 V.

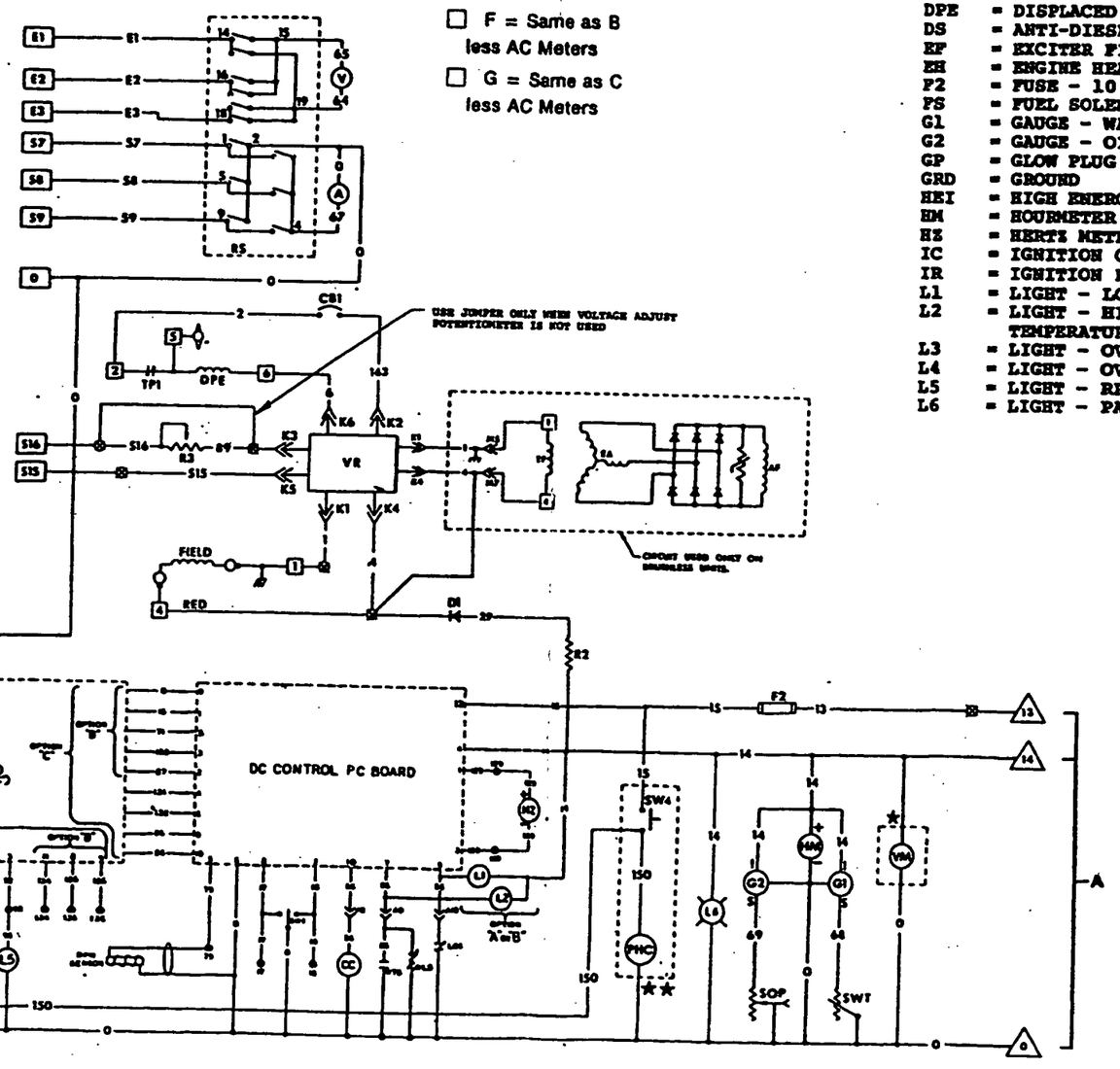
CUSTOMER CONNECTION
120/208-V. 3-PHASE

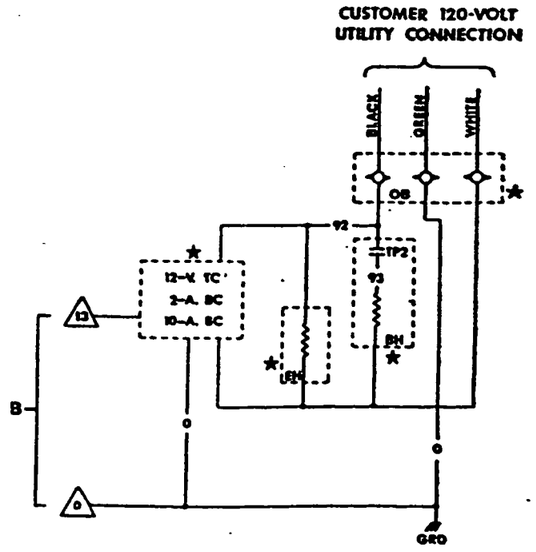
ALTERNATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 62321
Sheet 1 of 2
Issued- 4/5/83

ENGINE MONITOR SYSTEM

- ☐ A = Manual Start
  2 Light Annuciation
- ☐ B = Automatic Start
  2 Light Annuciation
- ☐ C = Automatic Start
  5 Light Annuciation
- ☐ E = Same as A
  less AC Meters
- ☐ F = Same as B
  less AC Meters
- ☐ G = Same as C
  less AC Meters



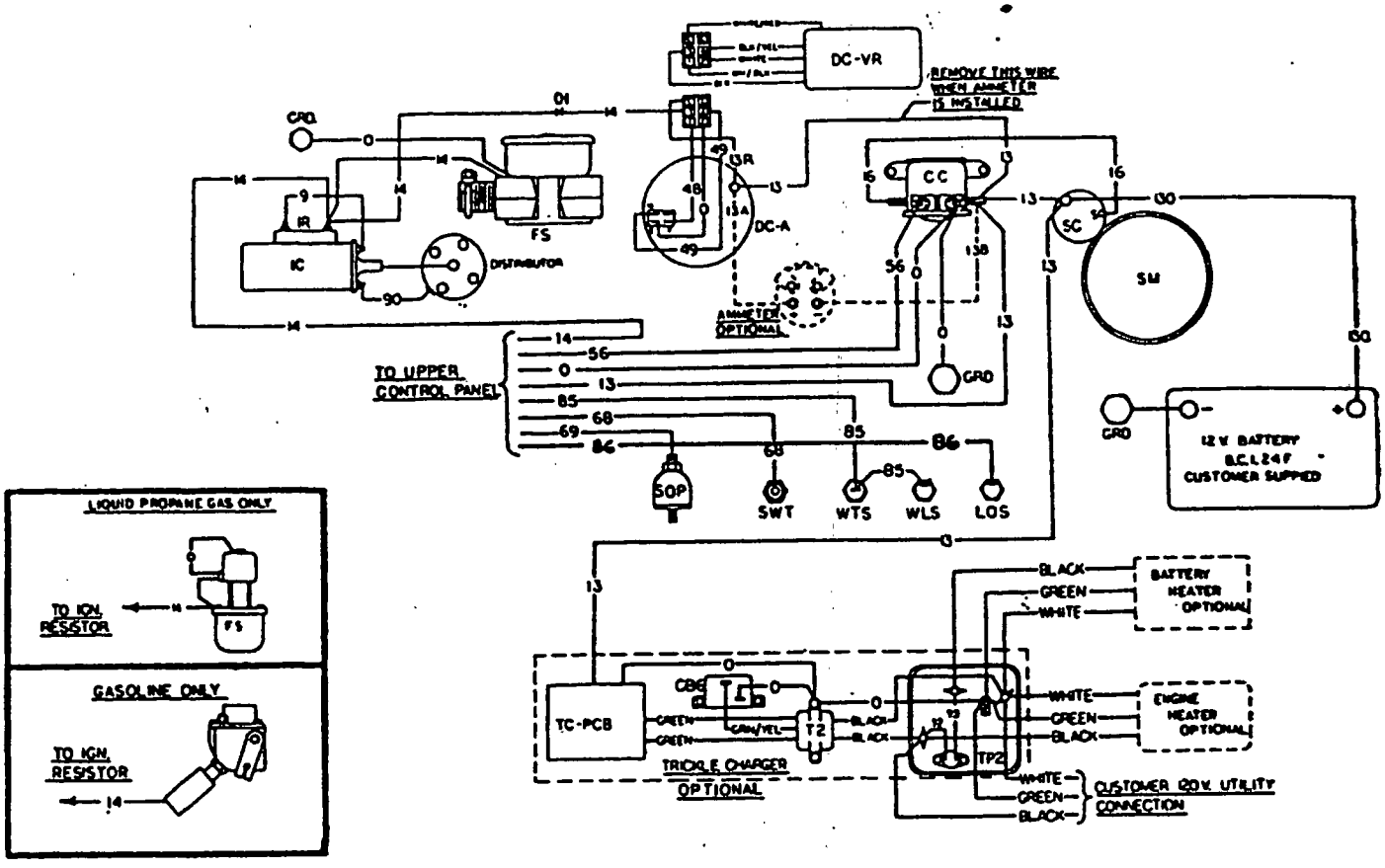




LEGEND

A	= AC AMMETER	LOS	= LOW OIL SWITCH
AF	= ALTERNATOR STATOR	OB	= OUTLET BOX
AS	= ALTERNATOR STATOR	PHC	= PRE-HEAT CONTACTOR
BC	= BATTERY CHARGER	R1	= RESISTOR 10 Ohm, 12 Watt
BH	= BATTERY HEATER	R2	= RESISTOR- FIELD BOOST
CB1	= FIELD CIRCUIT BREAKER	R3	= POTENTIOMETER- VOLTAGE ADJUST- 10K-Ohm, 2-W
CB2	= MAIN CIRCUIT BREAKER	RS	= ROTARY SWITCH
CC	= CONTROL CONTACTOR	SC	= STARTER CONTACTOR
CT	= CURRENT TRANSFORMER	SOP	= SENDER- OIL PRESSURE
D	= DIODE	SM	= STARTER MOTOR
DC-A	= DC ALTERNATOR	SW1	= SWITCH- START/STOP
DC-AM	= DC AMMETER	SW2	= SWITCH- TEST
DC-VR	= DC VOLTAGE REGULATOR	SW3	= SWITCH- RESET
DP	= DISTRIBUTOR POINTS	SW4	= SWITCH- PRE-HEAT
DPE	= DISPLACED PHASE EXCITATION	SWT	= SENDER- WATER TEMPERATURE
DS	= ANTI-DIESELING SOLENOID	TC	= TRICKLE CHARGER
EF	= EXCITER FIELD	TP1	= STATOR THERMAL PROTECTOR
EH	= ENGINE HEATER	TP2	= BATTERY HEATER THERMOSTAT
F2	= FUSE - 10 Ampere	V	= AC VOLTMETER
FS	= FUEL SOLENOID	VM	= DC VOLTMETER- 0-18V.
G1	= GAUGE - WATER TEMPERATURE	VR	= VOLTAGE REGULATOR
G2	= GAUGE - OIL PRESSURE	WLS	= WATER LEVEL SENSOR
GP	= GLOW PLUG	WTS	= SWITCH- HIGH WATER TEMPERATURE
GRD	= GROUND	⊠	= SCREW TERMINAL
HEI	= HIGH ENERGY IGNITION	⬭	= WIRE NUT
HM	= HOURMETER	★	= OPTIONAL
HZ	= HERTZ METER	★★	= DIESEL ONLY
IC	= IGNITION COIL		
IR	= IGNITION RESISTOR		
L1	= LIGHT - LOW OIL PRESSURE		
L2	= LIGHT - HIGH COOLANT TEMPERATURE		
L3	= LIGHT - OVERCRANK		
L4	= LIGHT - OVERSPEED		
L5	= LIGHT - RPM SENSOR LOSS		
L6	= LIGHT - PANEL		

ELECTRICAL SCHEMATIC
Drawing Number 62322
Issued - 4/7/83
Sheet 1 of 3



LEGEND

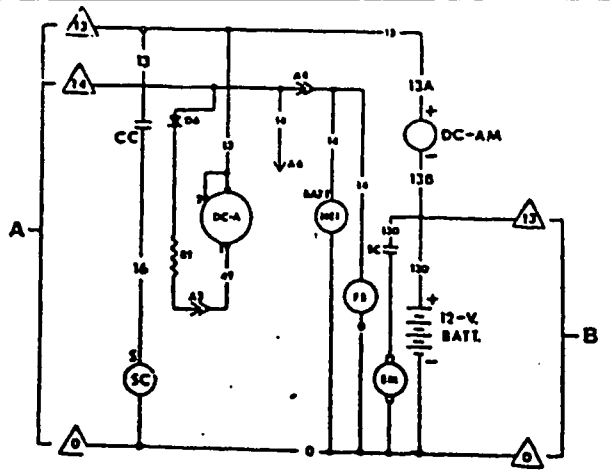
CB6 = Circuit Breaker
CC = Control Contactor
D1 = Diode
DC-A = DC Alternator
DC-VR = DC Voltage Regulator
FS = Fuel Solenoid
GRD = Ground
IC = Ignition Coil
IR = Ignition Resistor
LOS = Low Oil Switch
SC = Starter Contactor
SM = Starter Motor
SOP = Sender - Oil Pressure
SWT = Sender - Water Temperature
T2 = Transformer - Trickle Charger
TC-PCB= Trickle Charger PC Board
TP2 = Thermostat - Battery Heater
WLS = Water Level Sensor
WTS = High Water Temperature Switch

 = Wire Nut

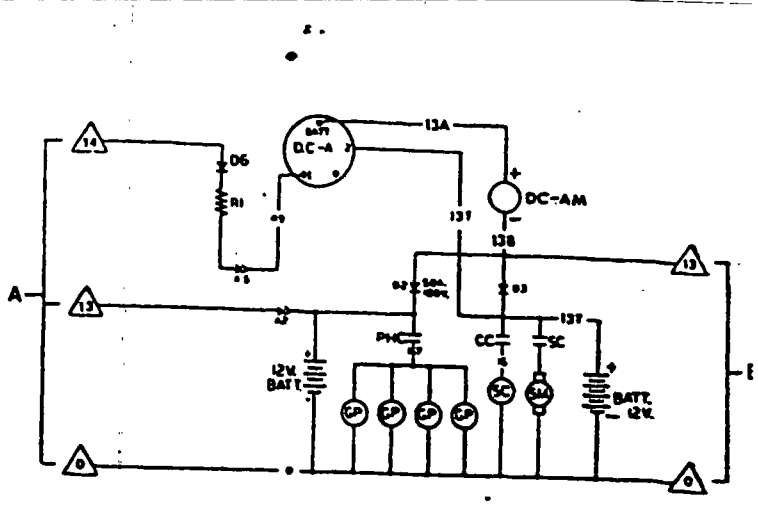
ENGINE MONITOR SYSTEM

- ☐ A = Manual Start
  2 Light Annuciation
- ☐ B = Automatic Start
  2 Light Annuciation
- ☐ C = Automatic Start
  5 Light Annuciation
- ☐ E = Same as A
  less AC Meters
- ☐ F = Same as B
  less AC Meters
- ☐ G = Same as C
  less AC Meters

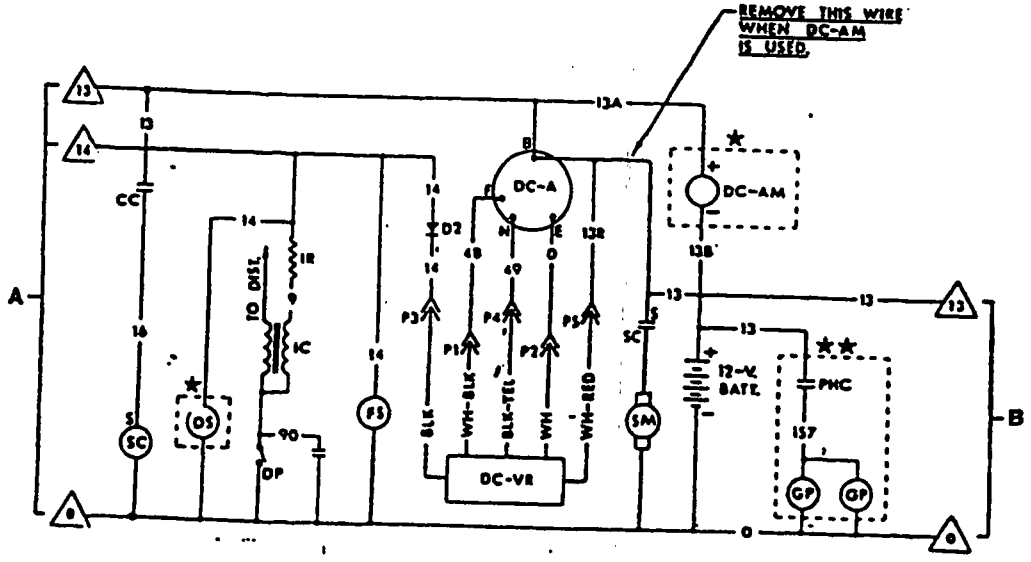
ENGINE WIRING DIAGRAM
Drawing Number 62320
Issued - 3/11/83



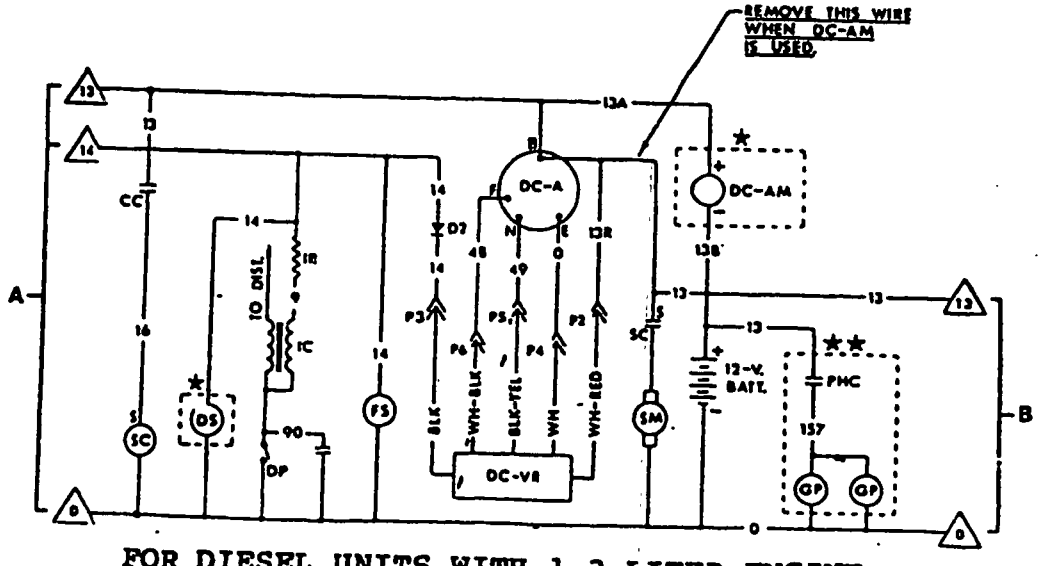
FOR GAS UNITS WITH 2.5, 5.7, 7.4 LITER ENGINES



FOR DIESEL UNITS WITH 3.0 LITER ENGINE

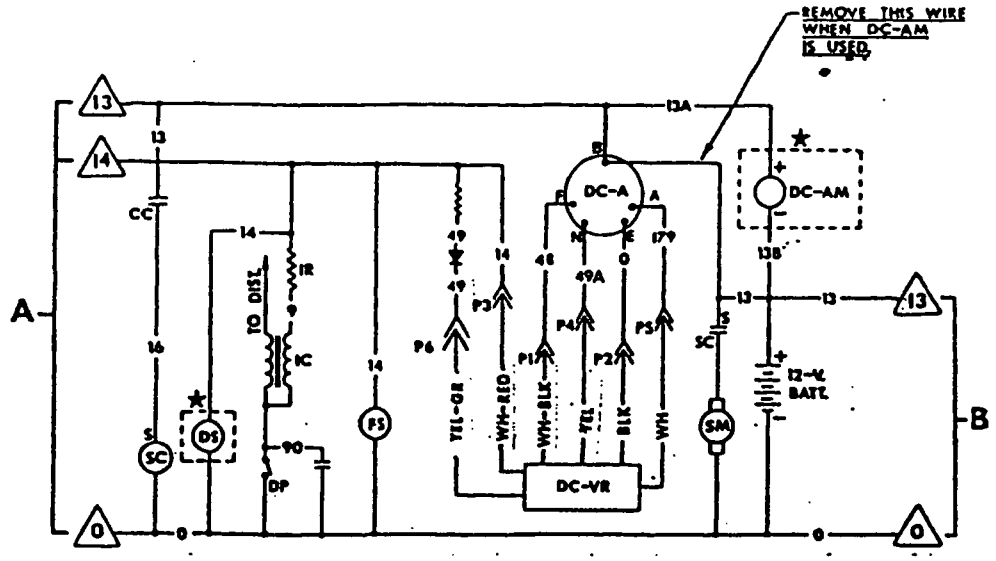


FOR GAS UNITS WITH 1.3 LITER ENGINE

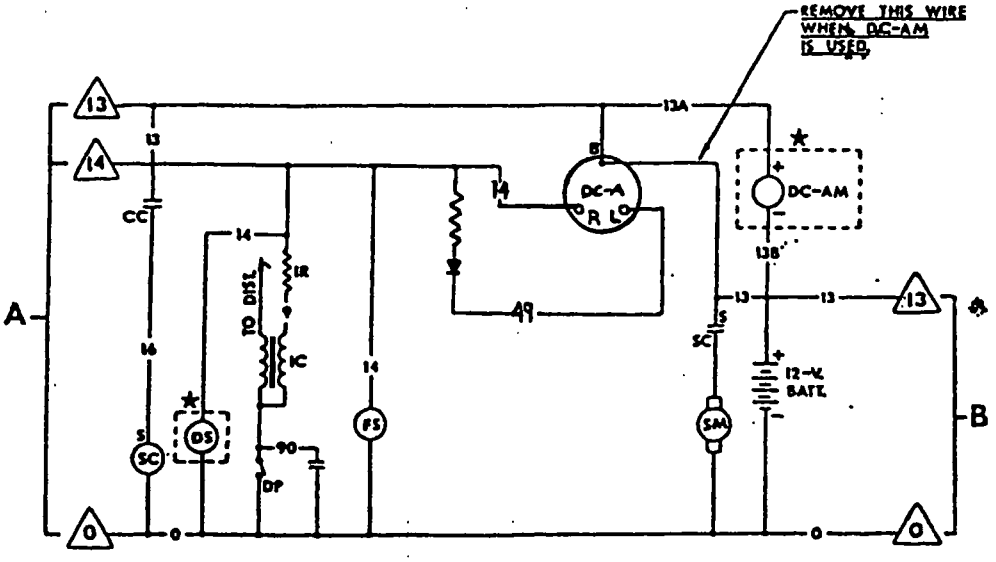


FOR DIESEL UNITS WITH 1.3 LITER ENGINE

ELECTRICAL SCHEMATIC
Drawing Number 62322
Issued - 4/7/83
Sheet 2 of 3

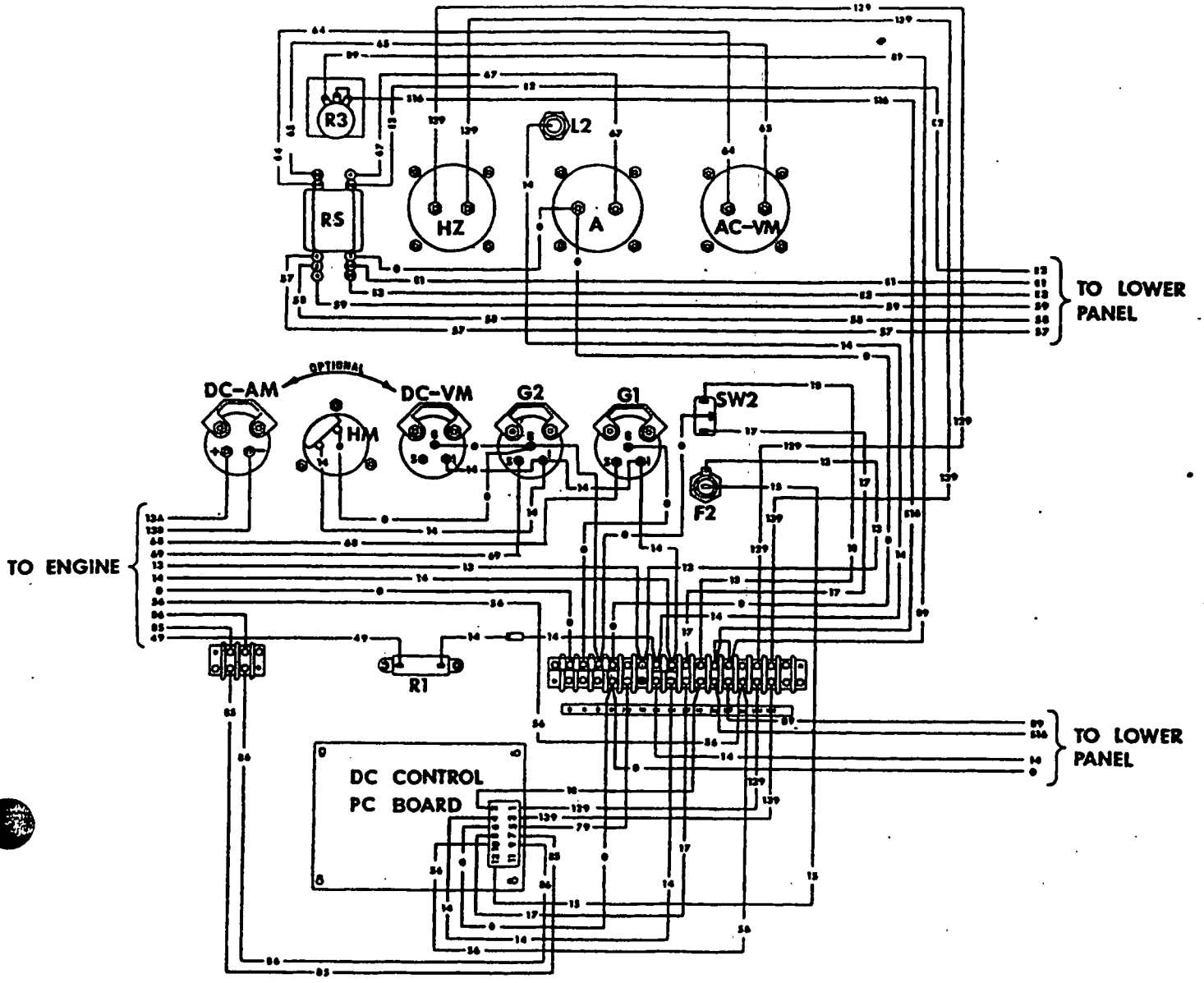


FOR GAS UNITS WITH 2.6 LITER ENGINE/REGULATOR



FOR GAS UNITS WITH 2.6 LITER ENGINE/ELECTRONIC IGNITION

ELECTRICAL SCHEMATIC
Drawing Number 62322
Issued - 4/7/83
Sheet 3 of 3



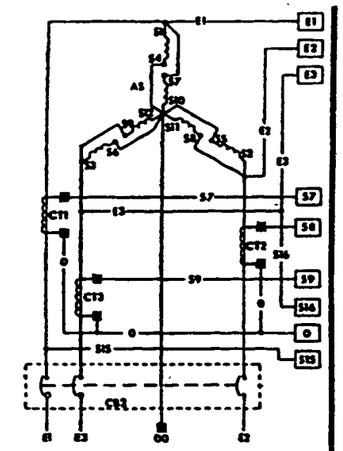
ENGINE MONITOR SYSTEM

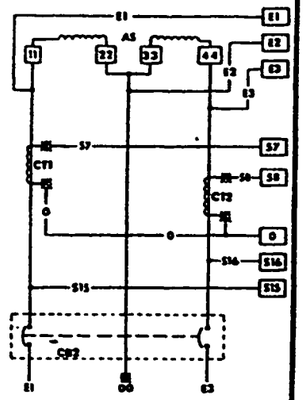
LEGEND

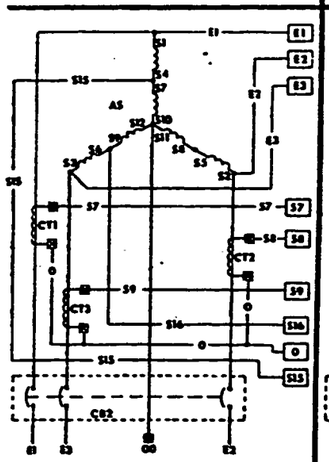
A	=	AC AMMETER
AC-VM	=	AC VOLTMETER
DC-AM	=	DC AMMETER
DC-VM	=	DC VOLTMETER
F2	=	FUSE - 10 Ampere
G1	=	GAUGE - Coolant Temperature
G2	=	GAUGE - Oil Pressure
HM	=	HOURMETER
HZ	=	HERTZ METER - 240 Volts
L2	=	LIGHT - PANEL
R1	=	RESISTOR
R3	=	POTENTIOMETER, Voltage Adjust 10K-Ohm, 2-Watt
RS	=	ROTARY SWITCH
SW2	=	SWITCH, Start/Run

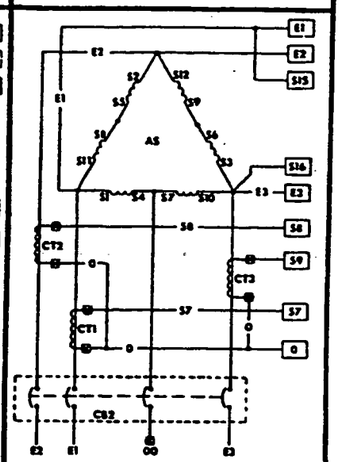
- ☐ A = Manual Start 2 Light Annuciation
- ☐ B = Automatic Start 2 Light Annuciation
- ☐ C = Automatic Start 5 Light Annuciation
- ☐ E = Same as A less AC Meters
- ☐ F = Same as B less AC Meters
- ☐ G = Same as C less AC Meters

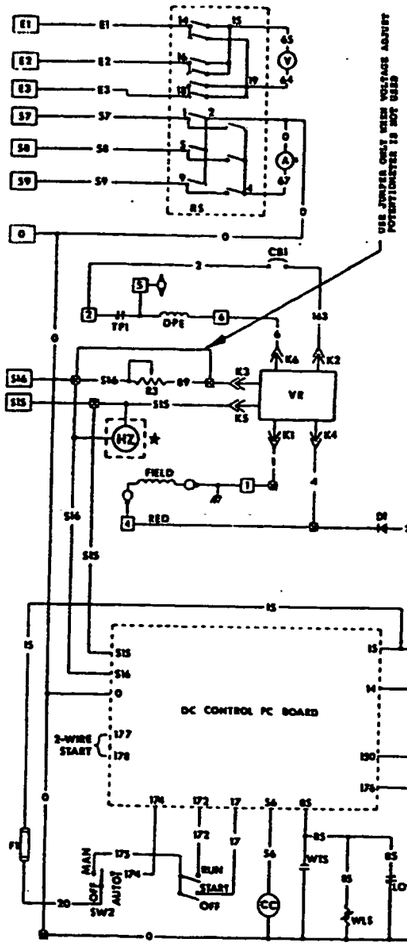
CONTROL PANEL WIRING DIAGRAM
Drawing Number 62323
Revised 11-23-83











LEGEND

A	= AC AMMETER	L1	= LIGHT - SHUTDOWN
AS	= ALTERNATOR STATOR	L2	= LIGHT - PANEL
BC	= BATTERY CHARGER	LOS	= LOW OIL SWITCH
BH	= BATTERY HEATER	OB	= OUTLET BOX
CB1	= CIRCUIT BREAKER - FIELD	PHC	= PRE-HEAT CONTACTOR
CB2	= CIRCUIT BREAKER - MAIN	R2	= RESISTOR - 10 OHM
CC	= CONTROL CONTACTOR	R3	= POTENTIOMETER - 10K-OHM, 2-W, VOLTAGE ADJUST
CT	= CURRENT TRANSFORMER	RS	= ROTARY SWITCH
D	= DIODE	SC	= STARTER CONTACTOR
DC-A	= DC ALTERNATOR	SOP	= SENDER - OIL PRESSURE
AM	= DC AMMETER	SM	= STARTER MOTOR
DC-VR	= DC VOLTAGE REGULATOR	SW1	= SWITCH - START/RUN
DP	= DISTRIBUTOR POINTS	SW2	= SWITCH - AUTO/MANUAL
DPE	= DISPLACED PHASE EXCITATION	SW3	= SWITCH - PRE-HEAT
DS	= ANTI-DIESEL SOLENOID	SWT	= SENDER - WATER TEMPERATURE
EH	= ENGINE HEATER	TC	= TRICKLE CHARGER
F1	= FUSE - 4 AMP	TP1	= STATOR THERMAL PROTECTOR
F2	= FUSE - 10 AMP	TP2	= BATTERY HEATER THERMOSTAT
FS	= FUEL SOLENOID	V	= AC VOLTMETER
G1	= GUAGE - WATER TEMPERATURE	VM	= DC VOLTMETER - 0-18 VOLTS
G2	= GUAGE - OIL PRESSURE	VR	= VOLTAGE REGULATOR
GP	= GLOW PLUG	WLS	= WATER LEVEL SENSOR
GRD	= GROUND	WTS	= HIGH WATER TEMPERATURE SWITCH
HM	= HOUR METER	⊠	= SCREW TERMINAL
HZ	= Hertz Meter - 240-V.	⊙	= WIRE NUT
IC	= IGNITION COIL	★	= OPTIONAL
IR	= IGNITION RESISTOR	★★	= DIESEL ONLY

ENGINE MONITOR SYSTEM

☐ D = Automatic Start
1 Light Annuciation

☐ H = Same as D
less AC Meters

ELECTRICAL SCHEMATIC
Drawing Number 63203
Issued - 9/14/83

A - AMMETER
BCA - BATTERY CHARGE AMMETER
BR - BREAKER RELAY*
CB1 - CIRCUIT BREAKER- FIELD
D - DIODE
F - FUSE
G1 - GAUGE- WATER TEMPERATURE
G2 - GAUGE- OIL PRESSURE
HM - HOURMETER
HZ - FREQUENCY METER
L1 - LIGHT- LOW OIL PRESSURE
L2 - LIGHT- HIGH COOLANT TEMPERATURE
L3 - LIGHT- OVERCRANK
L4 - LIGHT- OVERSPEED
L5 - LIGHT- RPM SENSOR LOSS
L6 - LIGHT- PANEL
R1 - RESISTOR- 10 Ohm, 12 Watt
R2 - RESISTOR- FIELD BOOST (Not used with 13.3 Liter Engine)
R3 - POTENTIOMETER- 10K, 12W (Voltage Adjust)
RS - ROTARY SWITCH
SW1 - SWITCH- START/STOP
SW2 - SWITCH- TEST
SW3 - SWITCH- RESET
SW4 - SWITCH- PRE-HEAT
TB - TERMINAL BLOCK
V - VOLTMETER
VR - VOLTAGE REGULATOR
R1/D6 - Used on 2.2 & 3.0 Liter engines only

* Used on units without Main Circuit Breaker. On units with Main Circuit Breaker, connect Wire 29 to 160, 162 to 163, 13A to 47, cut and insulate Wires 14 and 161.

NOTE:- JUMPER ON R2 USED ON 15 KW, 20 KW ONLY

ALTERNATE

TO CONNECTION BOX

TO ENGINE

OPTION "A"

OPTION "B"

OPTION "C"

ENGINE MONITOR PANEL

LATCH CRANK P.C. BOARD

D.C. CONT BOARD

FUEL SOLENOID CIRCUIT BREAKER 5.4L, 13.3L ENGINES ONLY

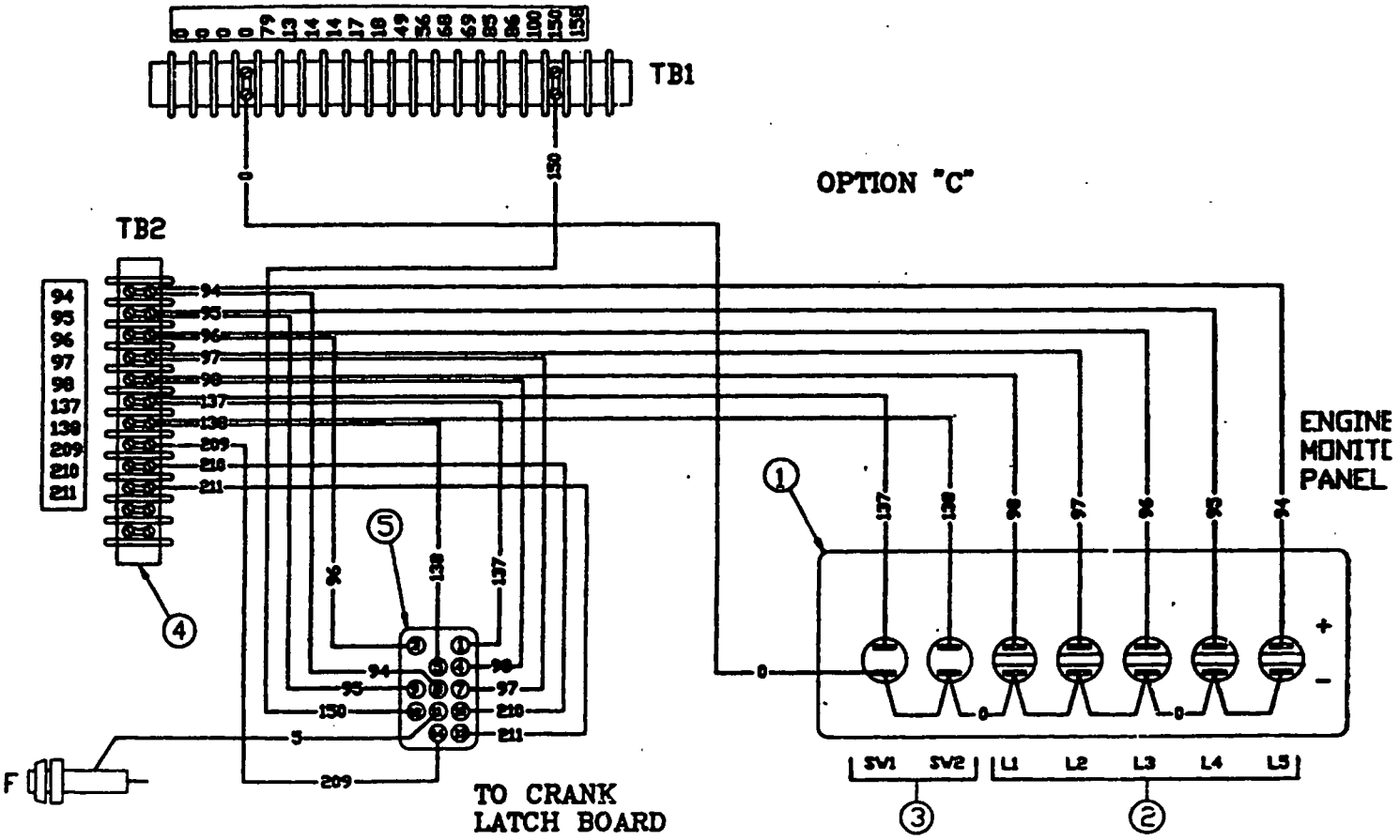
CLEAR PLASTIC INSULATOR

RPM SENSOR

CONTROL PANEL WIRING DIAGRAM- DIESEL
Drawing Number 63438
Revised- November 9, 1983

LEGEND

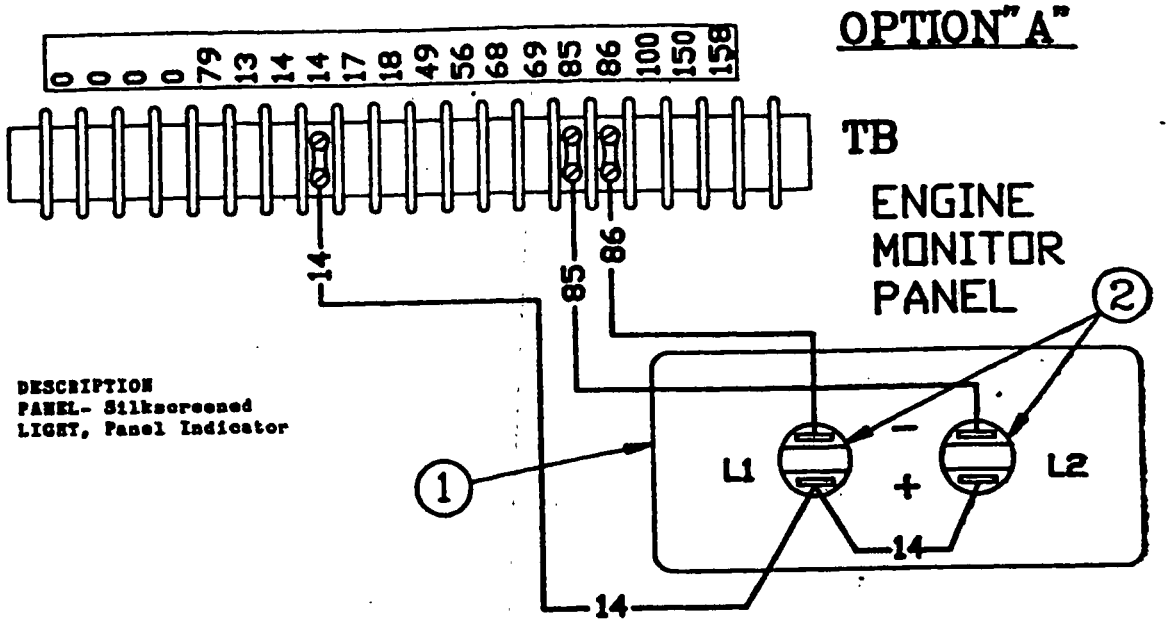
F	=	FUSE
L1	=	LIGHT- RPM SENSOR LOSS
L2	=	LIGHT- OVERSPEED
L3	=	LIGHT- OVERCRANK
L4	=	LIGHT- HIGH COOLANT TEMPERATURE
L5	=	LIGHT- LOW OIL PRESSURE
SW1	=	SWITCH- TEST
SW2	=	SWITCH- RESET
TB	=	TERMINAL BLOCK



ITEM	PART NUMBER	REQ'D	DESCRIPTION
1	64012	1	PANEL- Silkscreened
2	64009	5	LIGHT- Indicator
3	55920	2	SWITCH- Push Button
4	55911	1	BLOCK, Terminal
5	55089	1	PLUG, Connector- 15 pin
6	63694	1	BOARD ASSEMBLY, Printed Circuit (Not Shown)

ENGINE MONITOR ASSEMBLY AND WIRING DIAGRAM- OPTION "C"
Drawing Number 64391
Issued- 05/07/84
File #10-84.4

OPTION "A"

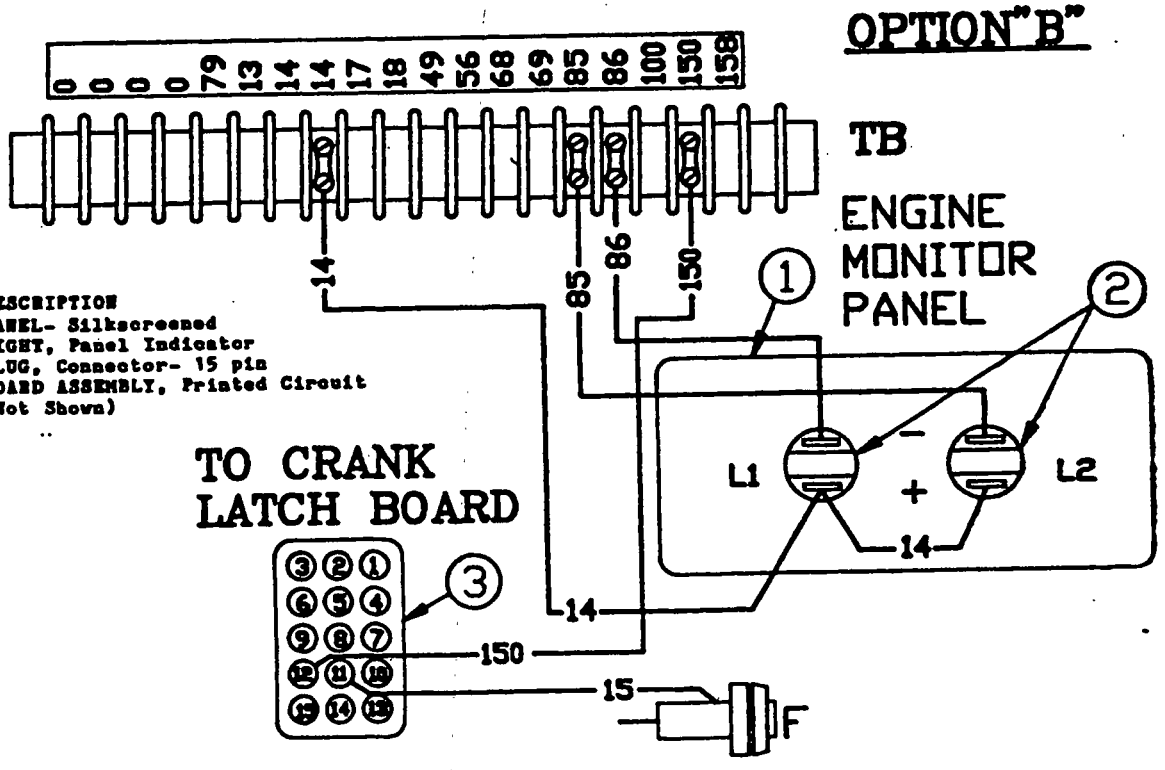


ITEM	PART NUMBER	REQ'D	DESCRIPTION
1	64010	1	PANEL- Silkscreened
2	64009	2	LIGHT, Panel Indicator

LEGEND

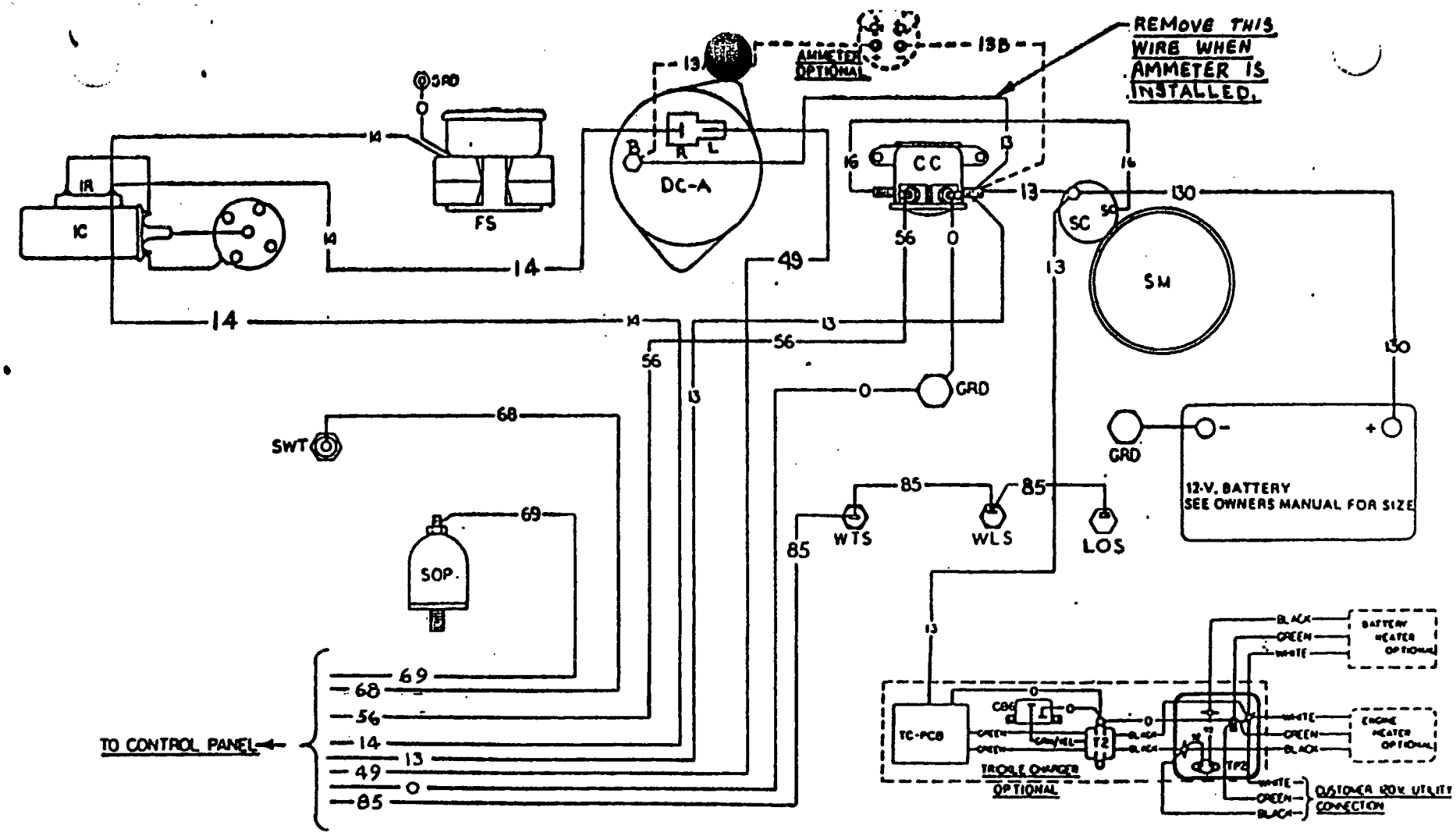
F = FUSE
L1 = LIGHT- HIGH COOLANT TEMPERATURE
L2 = LIGHT- LOW OIL PRESSURE
TB = TERMINAL BLOCK

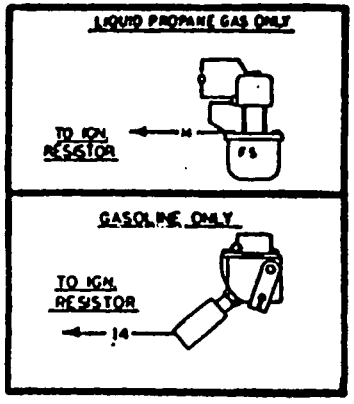
OPTION "B"



ITEM	PART NUMBER	REQ'D	DESCRIPTION
1	64010	1	PANEL- Silkscreened
2	64009	2	LIGHT, Panel Indicator
3	55089	1	PLUG, Connector- 15 pin
4	64484	1	BOARD ASSEMBLY, Printed Circuit (Not Shown)

ENGINE MONITOR ASSEMBLY AND WIRING DIAGRAM
OPTIONS "A" and "B"
Drawing Number 64390
Issued- 05/07/84
File #10-84.4





ENGINE MONITOR SYSTEM

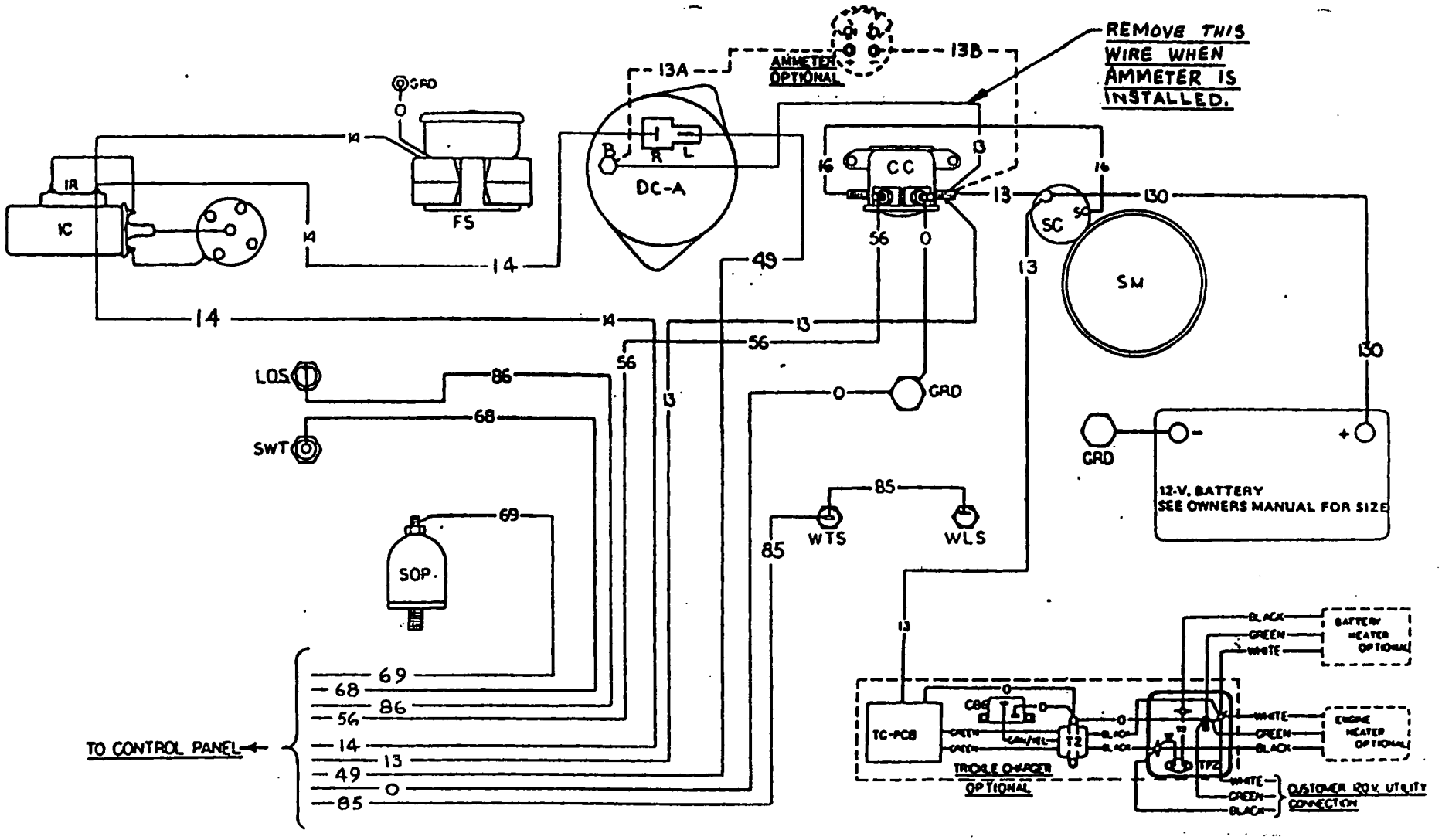
☐ D = Automatic Start
1 Light Annuciation

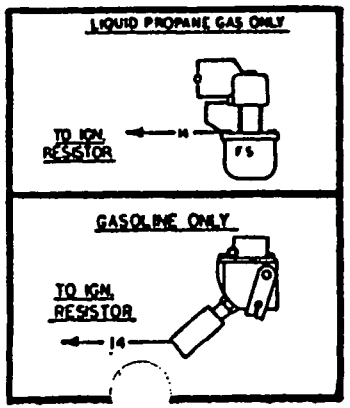
☐ H = Same as D
less AC Meters

LEGEND

CB6	= Circuit Breaker	SOP	= Sender - Oil Pressure
CC	= Control Contactor	SWT	= Sender - Water Temperature
DC-A	= DC Alternator	T2	= Transformer - Trickle Charger
FS	= Fuel Solenoid	TC-PCB	= Trickle Charge PC Board
GRD	= Ground	TP2	= Thermostat - Battery Heater
IC	= Ignition Coil	WLS	= Water Level Sensor
IR	= Ignition Resistor	WTS	= High Water Temperature Switch
LOS	= Low Oil Switch		
SC	= Starter Contactor		= Wire Nut
SM	= Starter Motor		

ENGINE WIRING DIAGRAM
Drawing Number 63486
Issued- 01/16/84





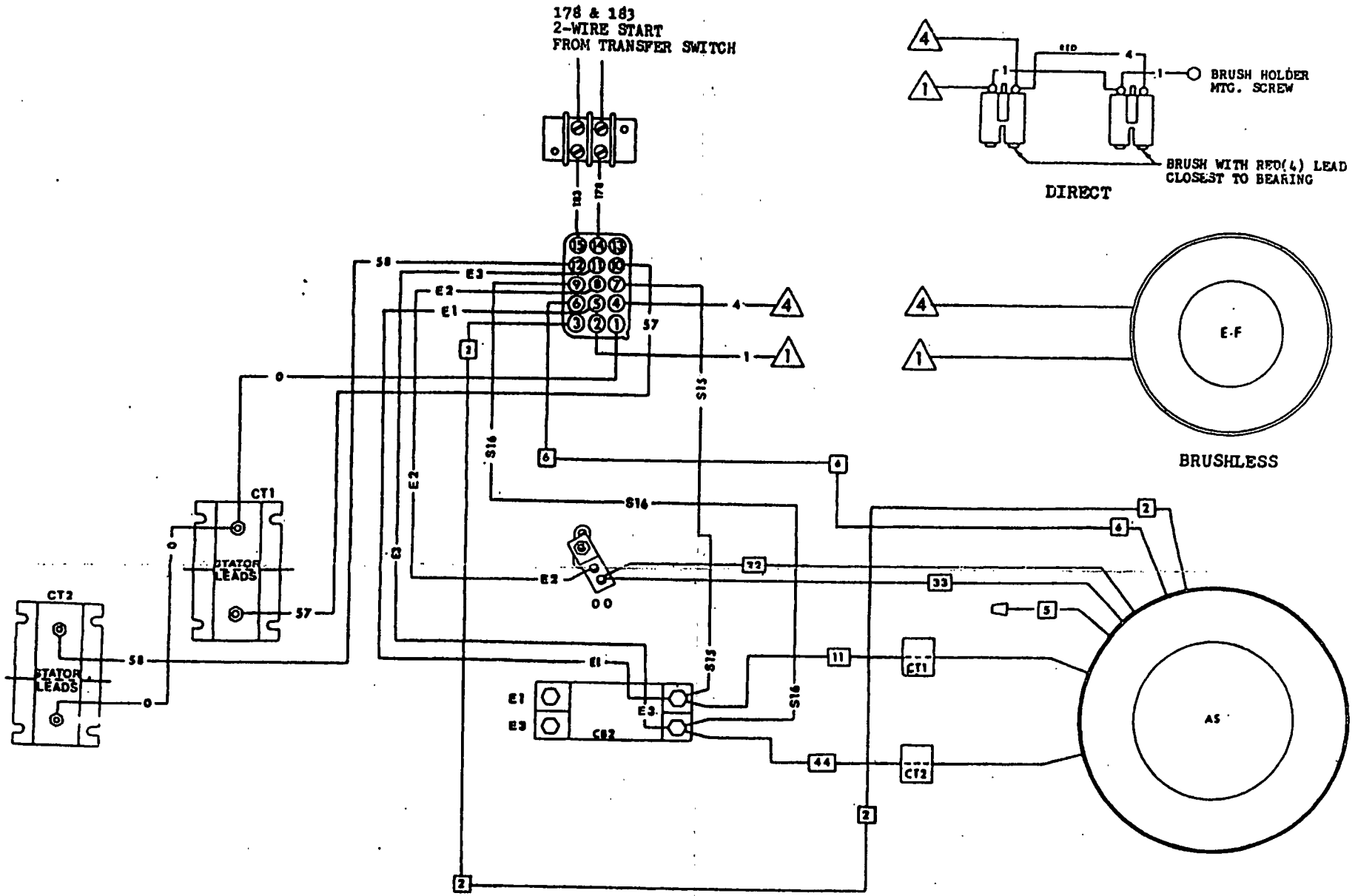
ENGINE MONITOR SYSTEM

- ☐ A = Manual Start
  2 Light Annuciation
- ☐ B = Automatic Start
  2 Light Annuciation
- ☐ C = Automatic Start
  5 Light Annuciation
- ☐ E = Same as A
  less AC Meters
- ☐ F = Same as B
  less AC Meters
- ☐ G = Same as C
  less AC Meters

LEGEND

CB6	= Circuit Breaker	SOP	= Sender - Oil Pressure
CC	= Control Contactor	SWT	= Sender - Water Temperature
DC-A	= DC Alternator	T2	= Transformer - Trickle Charger
FS	= Fuel Solenoid	TC-PCB	= Trickle Charge PC Board
GRD	= Ground	TP2	= Thermostat - Battery Heater
IC	= Ignition Coil	WLS	= Water Level Sensor
IR	= Ignition Resistor	WTS	= High Water Temperature Switch
LOS	= Low Oil Switch		
SC	= Starter Contactor	◁○▷	= Wire Nut
SM	= Starter Motor		

ENGINE WIRING DIAGRAM
Drawing Number 6[illegible]5
Issued- 01/13/84

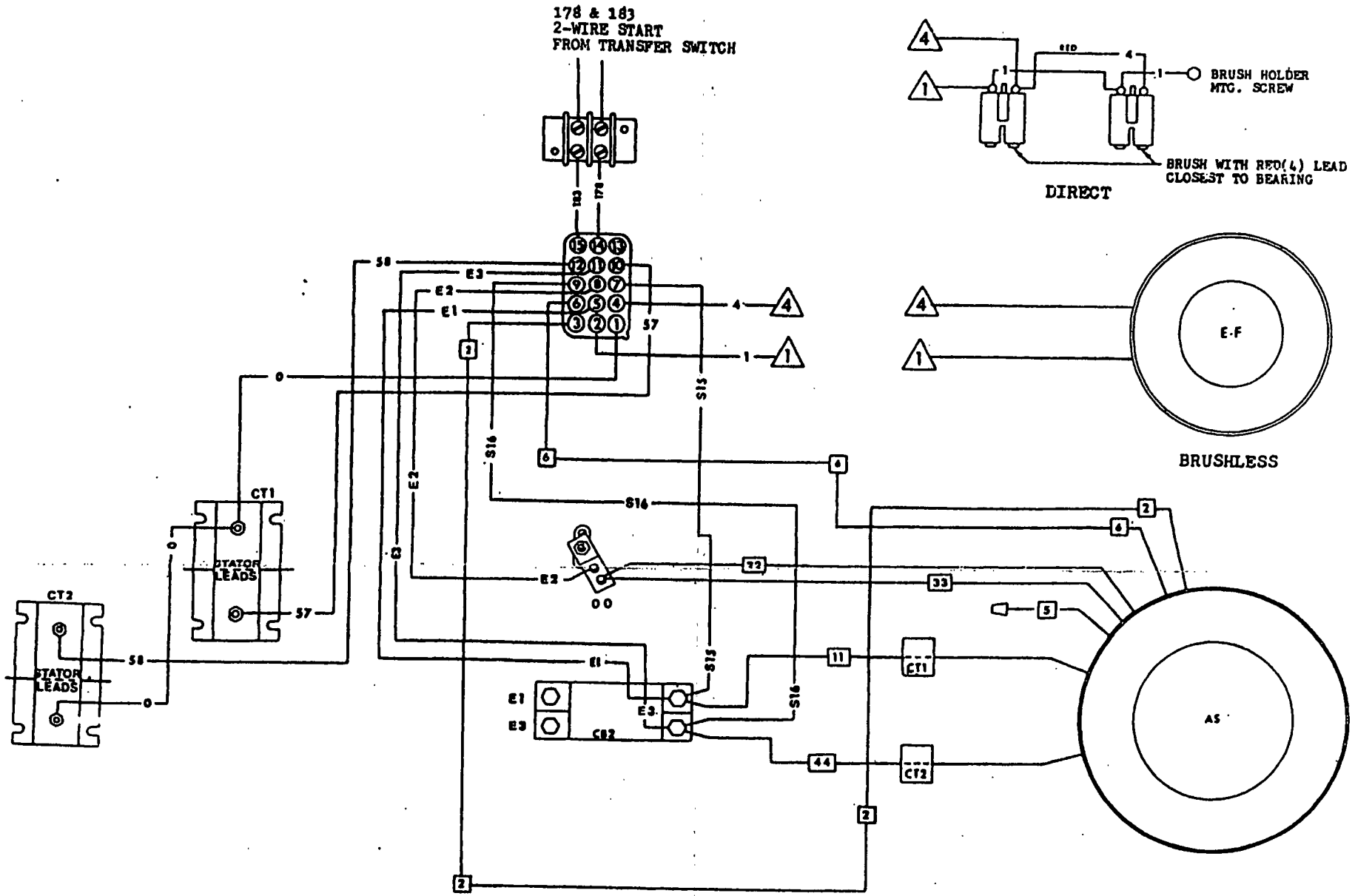


E1 TO E3	240V.
E1 TO 00	120V.
E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V. 1-PHASE

LEGEND

AS = ALTERNATOR STATOR
CB2 = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER
EF = EXCITER FIELD

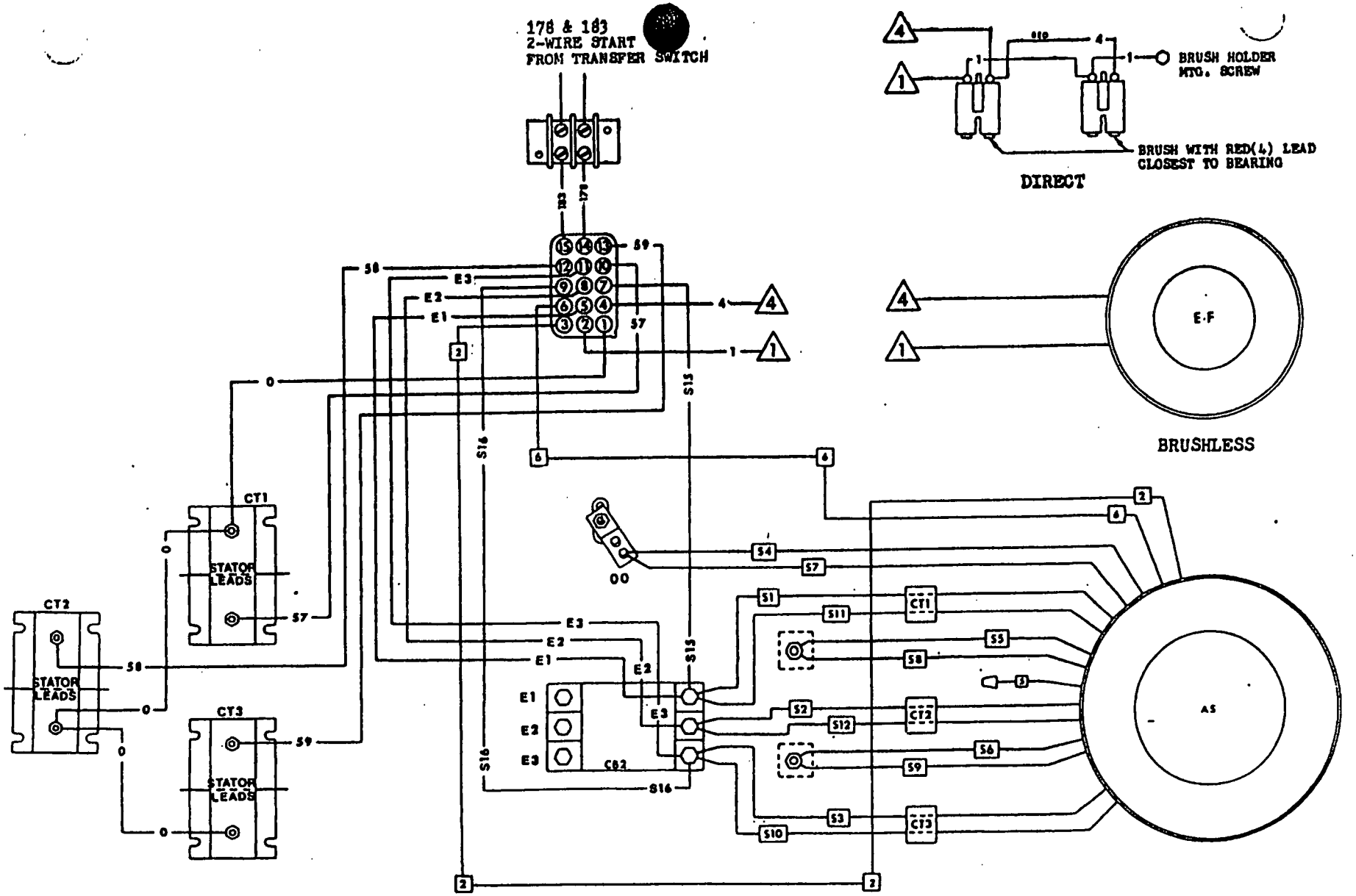


E1 TO E3	240V.
E1 TO 00	120V.
E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V. 1-PHASE

LEGEND

AS = ALTERNATOR STATOR
CB2 = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER
EF = EXCITER FIELD

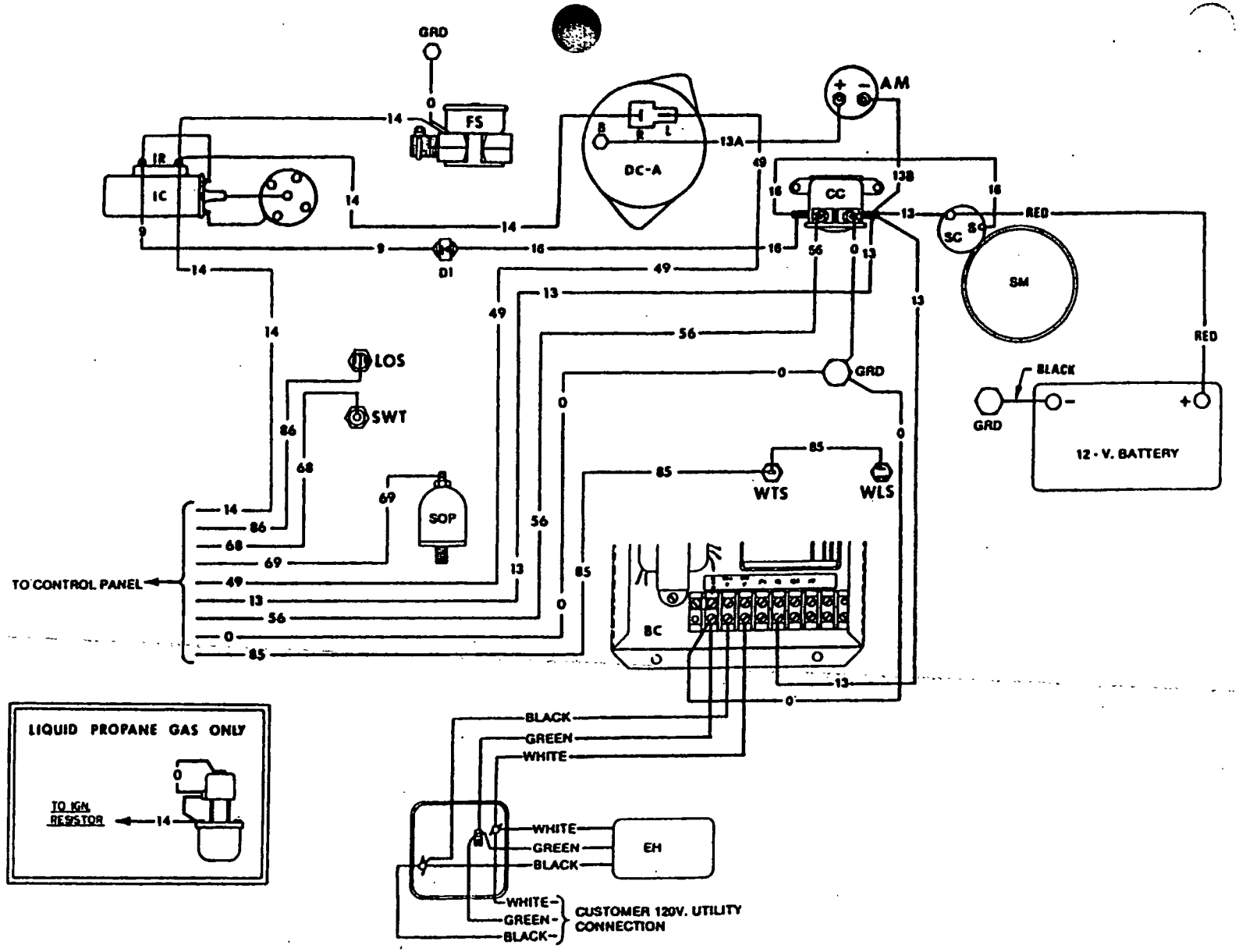


E1 TO E2 E2 TO E3 E3 TO E1	240V.
E1 TO 00 E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V., 3-PHASE

LEGEND

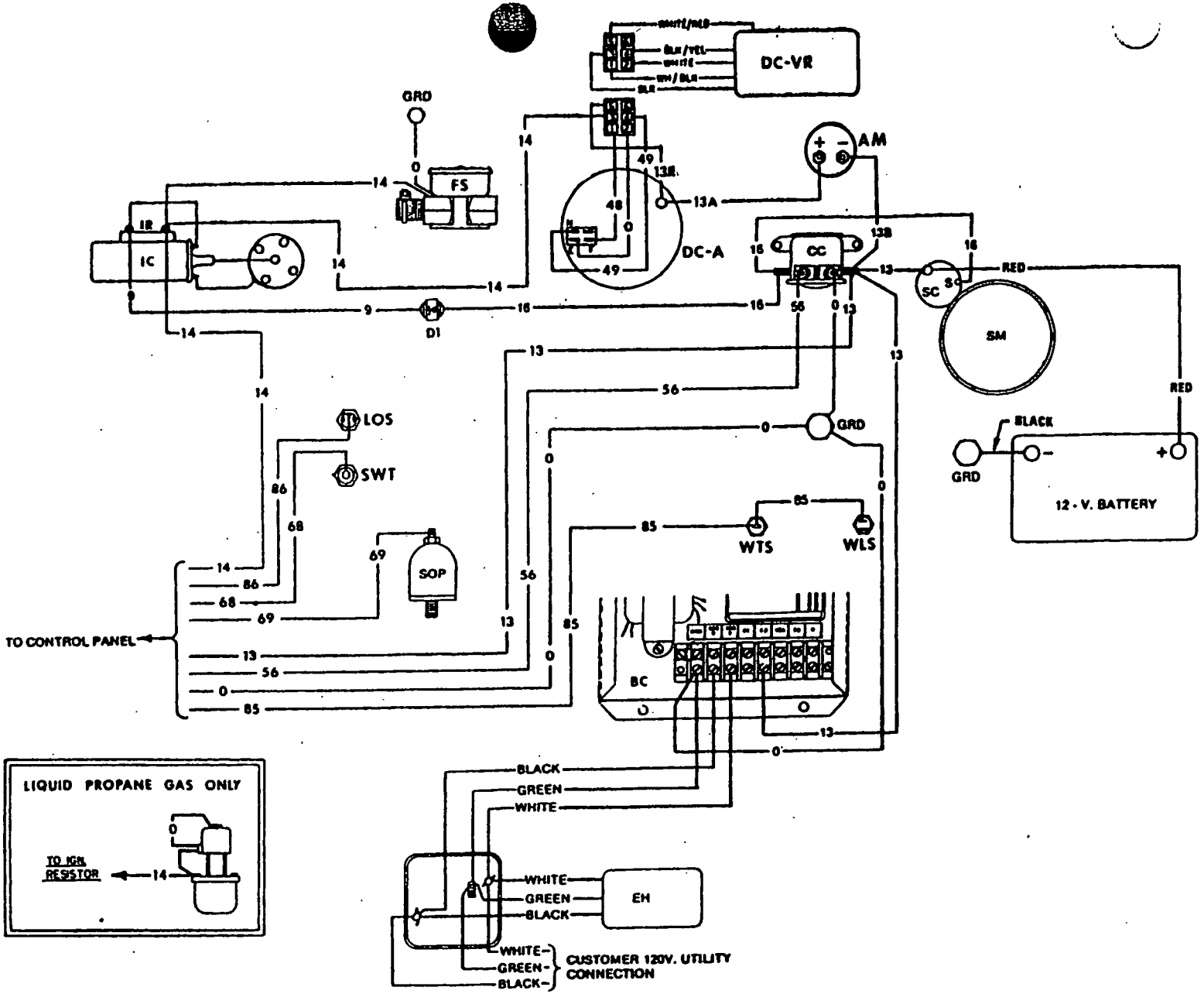
AS = ALTERNATOR STATOR
CB2 = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER
EF = EXCITER FIELD



LEGEND

AM	= DC AMMETER	IR	= IGNITION RESISTOR
BC	= BATTERY CHARGER	LOS	= LOW OIL SWITCH
CC	= CONTROL CONTACTOR	SC	= STARTER CONTACTOR
D	= DIODE	SM	= STARTER MOTOR
DC-A	= DC ALTERNATOR	SOP	= SENDER- OIL PRESSURE
EH	= ENGINE HEATER	SWT	= SENDER- WATER TEMPERATURE
FS	= FUEL SOLENOID	WLS	= WATER LEVEL SENSOR
GRD	= GROUND	WTS	= HIGH WATER TEMPERATURE SWITCH
IC	= IGNITION COIL		

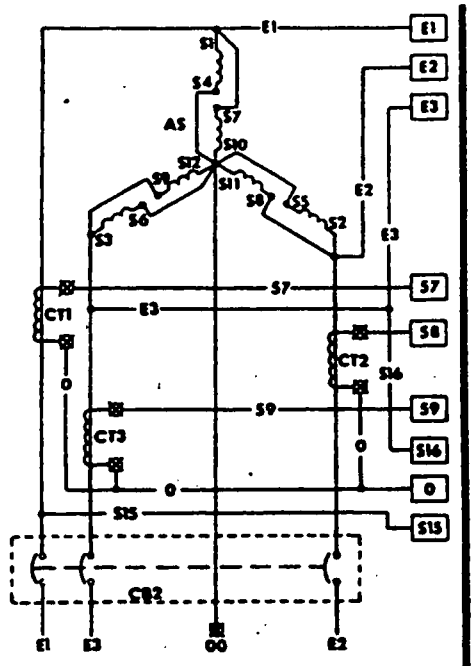
ENGINE WIRING DIAGRAM
Drawing Number 64483
Issued- 05/31/84
File #10-84.5



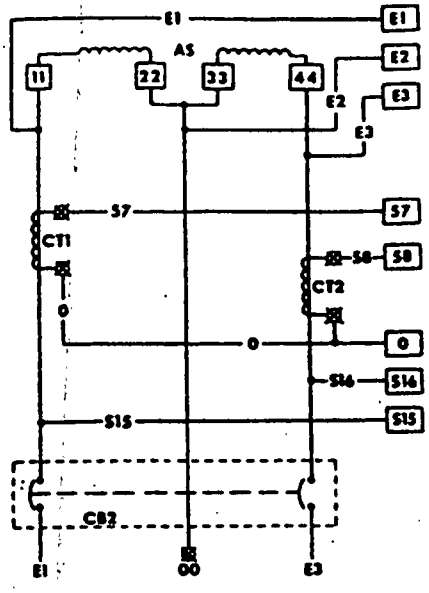
LEGEND

AM	= DC AMMETER	IC	= IGNITION COIL
BC	= BATTERY CHARGER	IR	= IGNITION RESISTOR
CC	= CONTROL CONTACTOR	LOS	= LOW OIL SWITCH
D	= DIODE	SC	= STARTER CONTACTOR
DC-A	= DC ALTERNATOR	SM	= STARTER MOTOR
DC-VR	= DC VOLTAGE REGULATOR	SOP	= SENDER- OIL PRESSURE
EH	= ENGINE HEATER	SWT	= SENDER- WATER TEMPERATURE
FS	= FUEL SOLENOID	WLS	= WATER LEVEL SENSOR

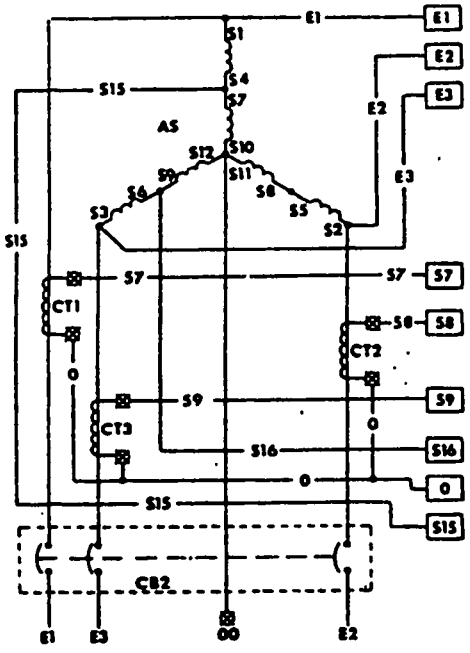
ENGINE WIRING DIAGRAM
Drawing Number 64485
Issued- 05/31/84
File #10-84.5



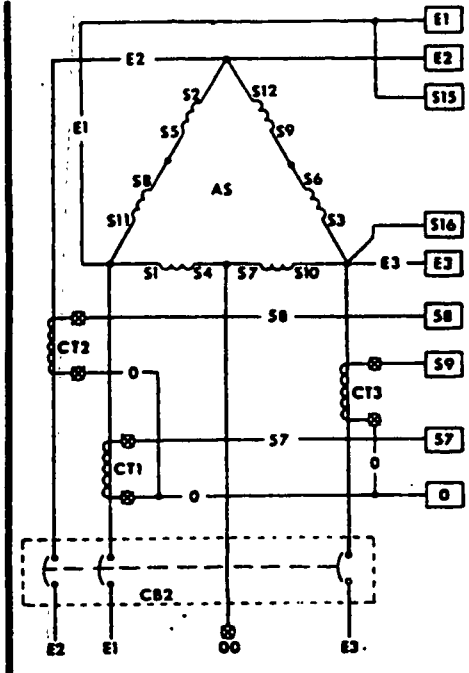
CUSTOMER CONNECTION
120/208-V. 3-PHASE



CUSTOMER CONNECTION
120/240-V. 1-PHASE



CUSTOMER CONNECTION
277/480-V. 3-PHASE

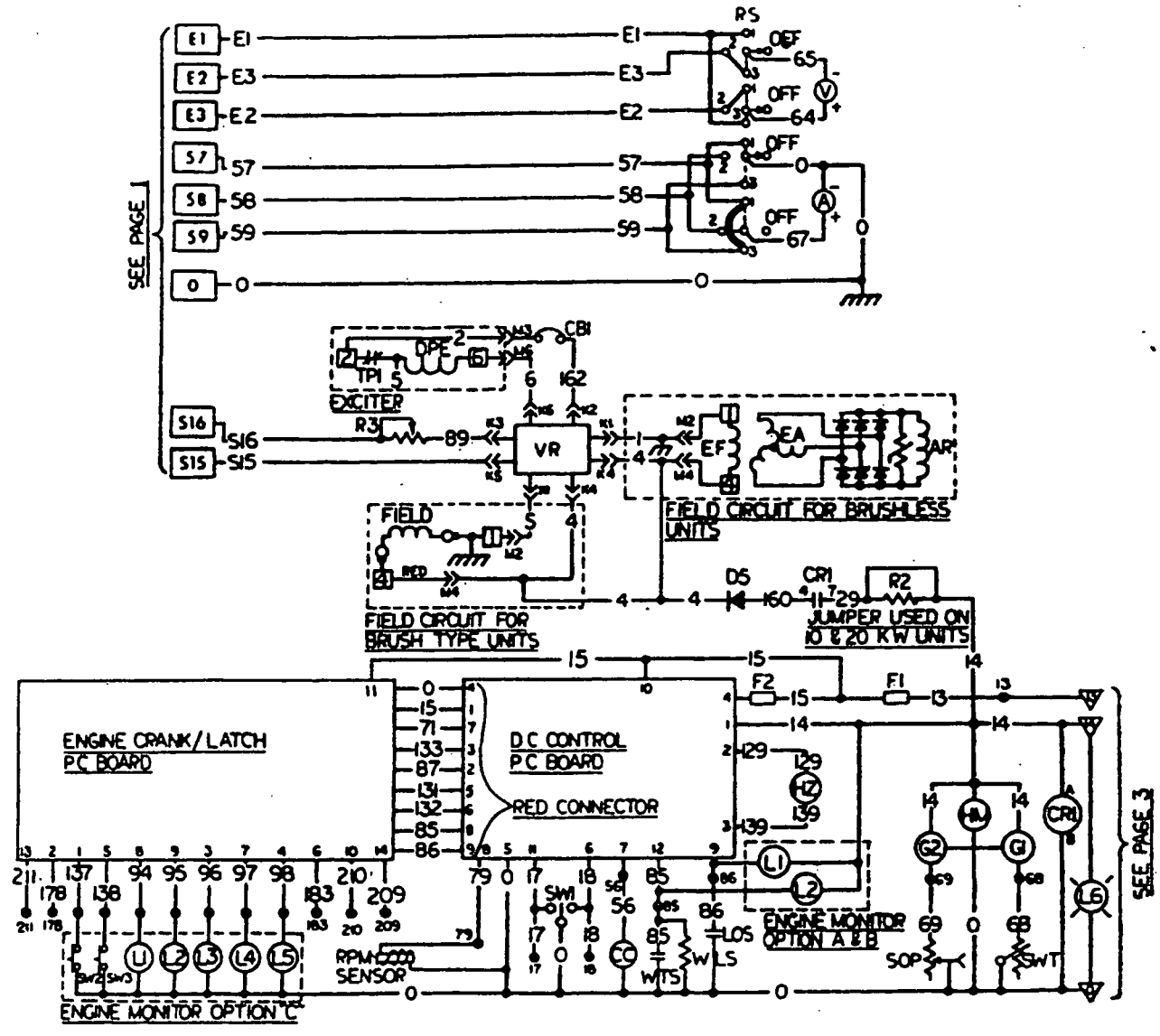


CUSTOMER CONNECTION
120/240-V. 3-PHASE

LEGEND

CB = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER

SCHEMATIC
Drawing Number 64486
Sheet 1 of 3
Issued- 05/31/84
File #10-84.5



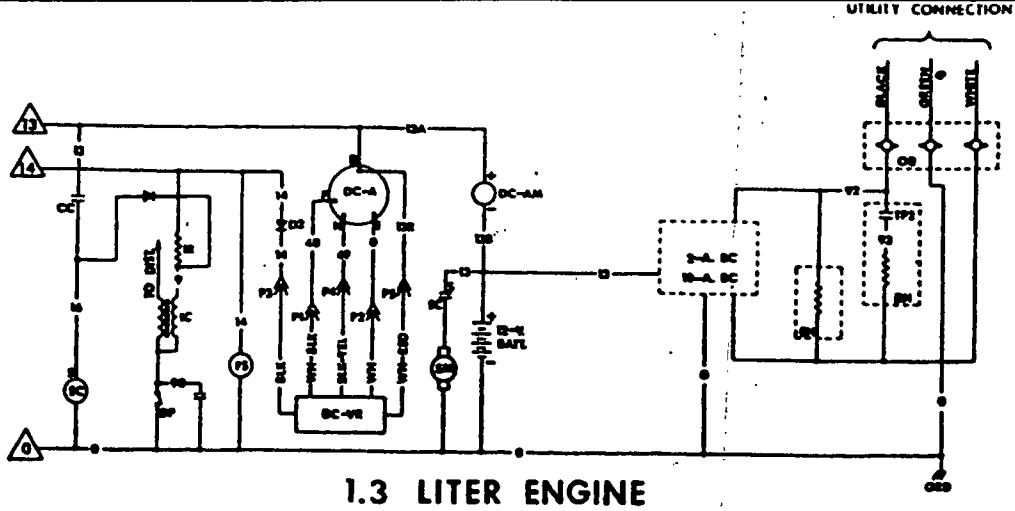
LEGEND

A	= AC AMMETER	LOS	= LOW OIL SWITCH
AR	= ALTERNATOR ROTOR	R2	= RESISTOR- FIELD BOOST
CB1	= FIELD CIRCUIT BREAKER	R3	= POTENTIOMETER- VOLTAGE ADJUST 10 K-Ohms, 2 Watt
CC	= CONTROL CONTACTOR	RS	= ROTARY SWITCH
CR1	= CONTROL RELAY	SOP	= SENDER- OIL PRESSURE
D	= DIODE	SW1	= SWITCH- START/STOP
DPE	= DISPLACED PHASE EXCITATION	SW2	= SWITCH- TEST
EA	= EXCITER ARMATURE	SW3	= SWITCH- RESET
EF	= EXCITER FIELD	SWT	= SENDER- WATER TEMPERATURE
F1	= FUSE - 30 Ampere	V	= AC VOLTMETER
F2	= FUSE - 14 Ampere	VR	= VOLTAGE REGULATOR
G1	= GAUGE- WATER TEMPERATURE	WLS	= WATER LEVEL SENSOR
G2	= GAUGE- OIL PRESSURE	WTS	= SWITCH- HIGH WATER TEMPERATURE
HM	= HOURMETER		
HZ	= FREQUENCY METER	⊠	= SCREW TERMINAL
L1	= LIGHT- LOW OIL PRESSURE	◁▷	= WIRE NUT
L2	= LIGHT- HIGH COOLANT TEMPERATURE		
L3	= LIGHT- OVERCRANK		
L4	= LIGHT- OVERSPEED		
L5	= LIGHT- RPM SENSOR LOSS		
L6	= LIGHT- PANEL		

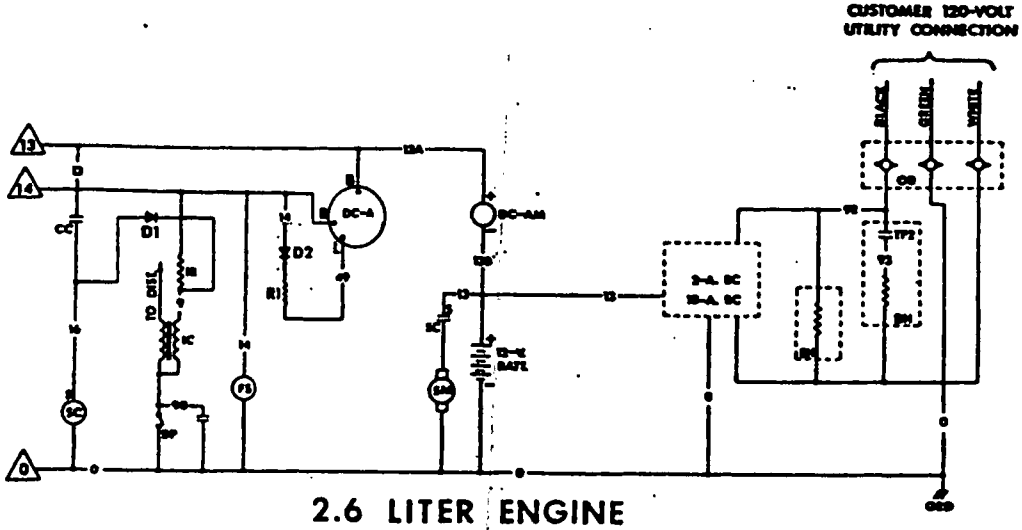
ALARM CONTACT WIRE NUMBERS

209- Normally Closed
210- Common
211- Normally Open

SCHEMATIC
Drawing Number 64486
Sheet 2 of 3
Issued- 05/31/84
File #10-84.5



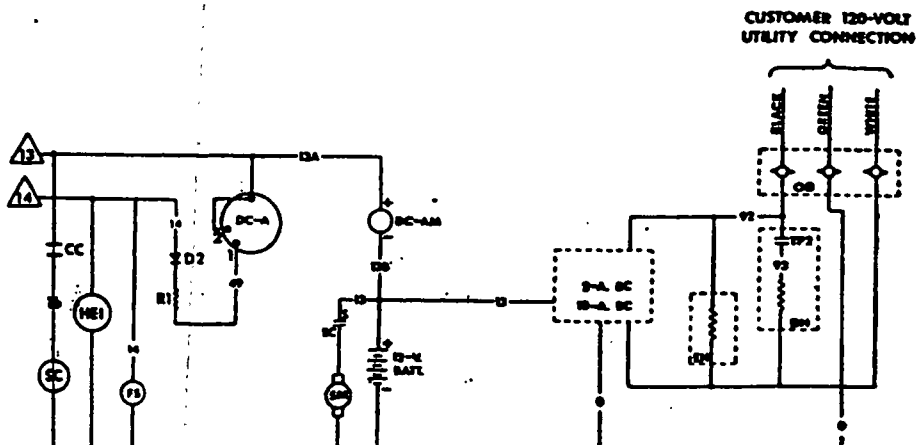
1.3 LITER ENGINE



2.6 LITER ENGINE

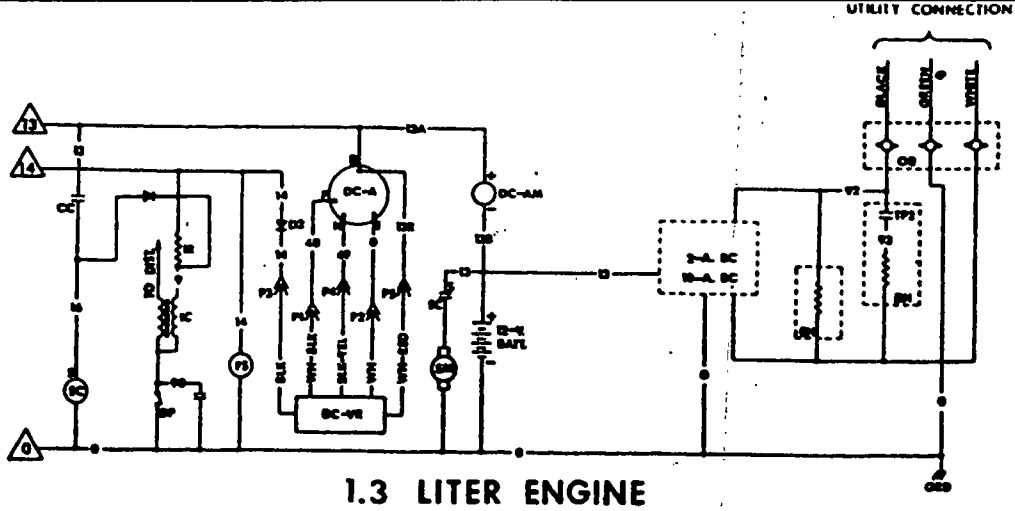
LEGEND

BC	=	BATTERY CHARGER
BH	=	BATTERY HEATER
CC	=	CONTROL CONTACTOR
D	=	DIODE
DC-A	=	DC ALTERNATOR
DC-AM	=	DC AMMETER
DC-VR	=	DC VOLTAGE REGULATOR
DP	=	DISTRIBUTOR POINTS
EH	=	ENGINE HEATER
FS	=	FUEL SOLENOID
GRD	=	GROUND
HEI	=	HIGH ENERGY IGNITION
IC	=	IGNITION COIL
IR	=	IGNITION RESISTOR
OB	=	OUTLET BOX
R1	=	RESISTOR- 10 Ohm, 12 Watt
R2	=	RESISTOR- FIELD BOOST
R3	=	POTENTIOMETER- VOLTAGE ADJUST 10K-OHMS, 2 WATT
SC	=	STARTER CONTACTOR
SM	=	STARTER MOTOR
TP2	=	BATTERY HEATER THERMOSTAT

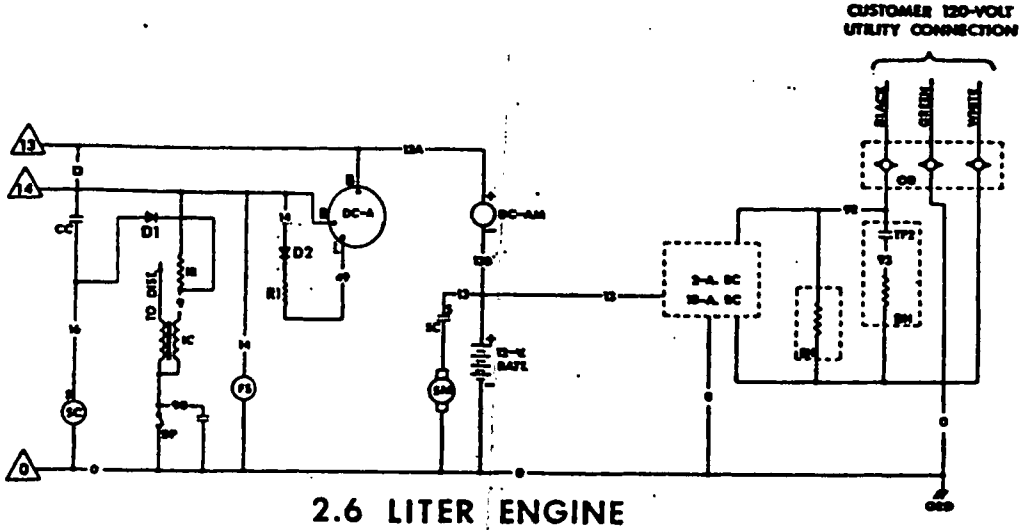


5.7 & 7.4 LITER ENGINE

SCHEMATIC
Drawing Number 64486
Sheet 3 of 3
Issued- 05/31/84
File #10-84.5



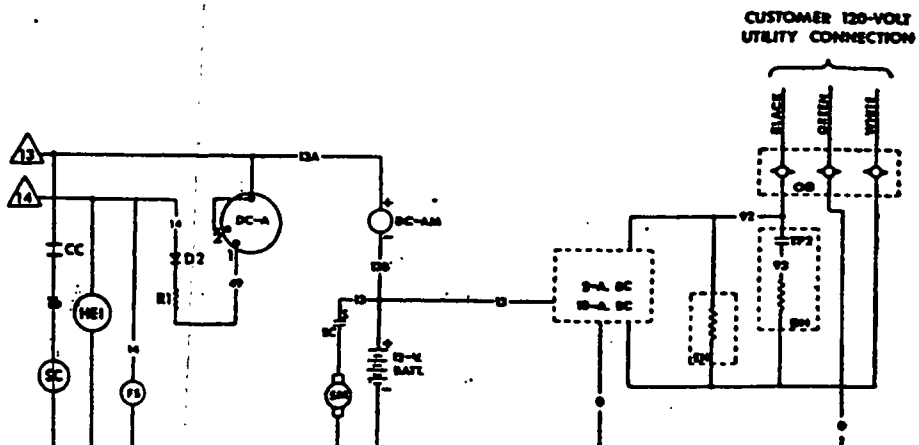
1.3 LITER ENGINE



2.6 LITER ENGINE

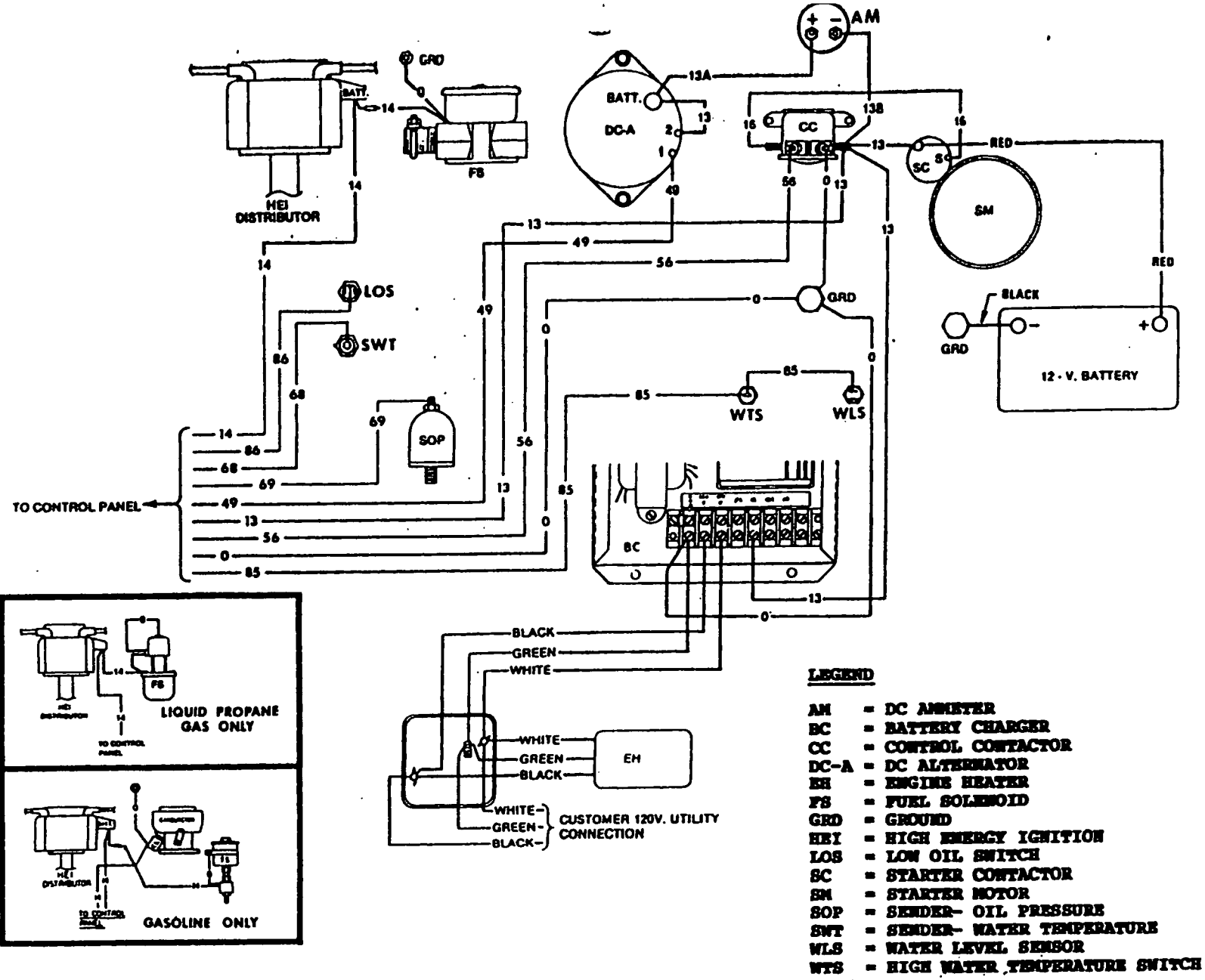
LEGEND

BC	=	BATTERY CHARGER
BH	=	BATTERY HEATER
CC	=	CONTROL CONTACTOR
D	=	DIODE
DC-A	=	DC ALTERNATOR
DC-AM	=	DC AMMETER
DC-VR	=	DC VOLTAGE REGULATOR
DP	=	DISTRIBUTOR POINTS
EH	=	ENGINE HEATER
FS	=	FUEL SOLENOID
GRD	=	GROUND
HEI	=	HIGH ENERGY IGNITION
IC	=	IGNITION COIL
IR	=	IGNITION RESISTOR
OB	=	OUTLET BOX
R1	=	RESISTOR- 10 Ohm, 12 Watt
R2	=	RESISTOR- FIELD BOOST
R3	=	POTENTIOMETER- VOLTAGE ADJUST 10K-OHMS, 2 WATT
SC	=	STARTER CONTACTOR
SM	=	STARTER MOTOR
TP2	=	BATTERY HEATER THERMOSTAT



5.7 & 7.4 LITER ENGINE

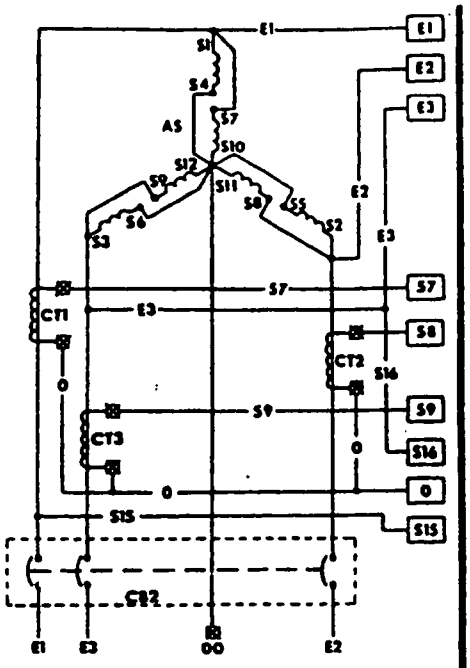
SCHEMATIC
Drawing Number 64486
Sheet 3 of 3
Issued- 05/31/84
File #10-84.5



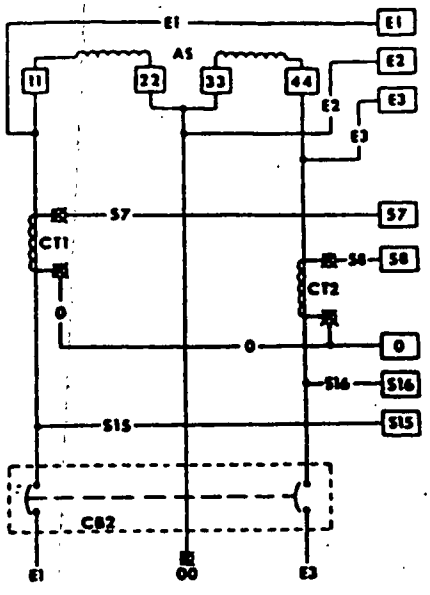
LEGEND

AM	=	DC AMMETER
BC	=	BATTERY CHARGER
CC	=	CONTROL CONTACTOR
DC-A	=	DC ALTERNATOR
EH	=	ENGINE HEATER
FS	=	FUEL SOLENOID
GRD	=	GROUND
HEI	=	HIGH ENERGY IGNITION
LOS	=	LOW OIL SWITCH
SC	=	STARTER CONTACTOR
SM	=	STARTER MOTOR
SOP	=	SENDER- OIL PRESSURE
SWT	=	SENDER- WATER TEMPERATURE
WLS	=	WATER LEVEL SENSOR
WTS	=	HIGH WATER TEMPERATURE SWITCH

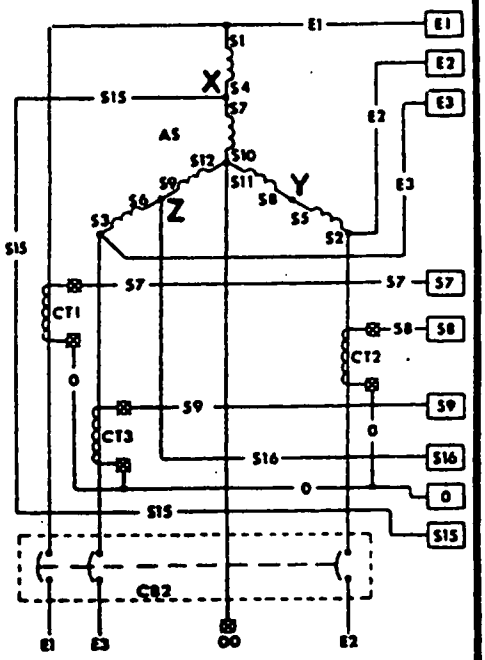
ENGINE WIRING DIAGRAM
Drawing Number 64487
Issued- 06/01/84
File #10-84.5



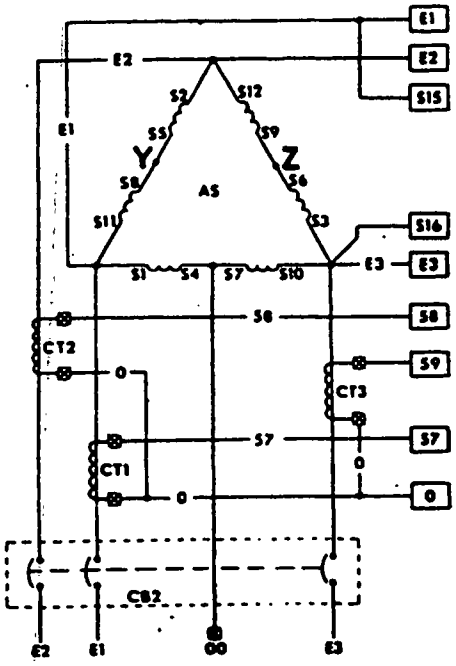
CUSTOMER CONNECTION
120/208-V. 3-PHASE



CUSTOMER CONNECTION
120/240-V. 1-PHASE



CUSTOMER CONNECTION
277/480-V. 3-PHASE

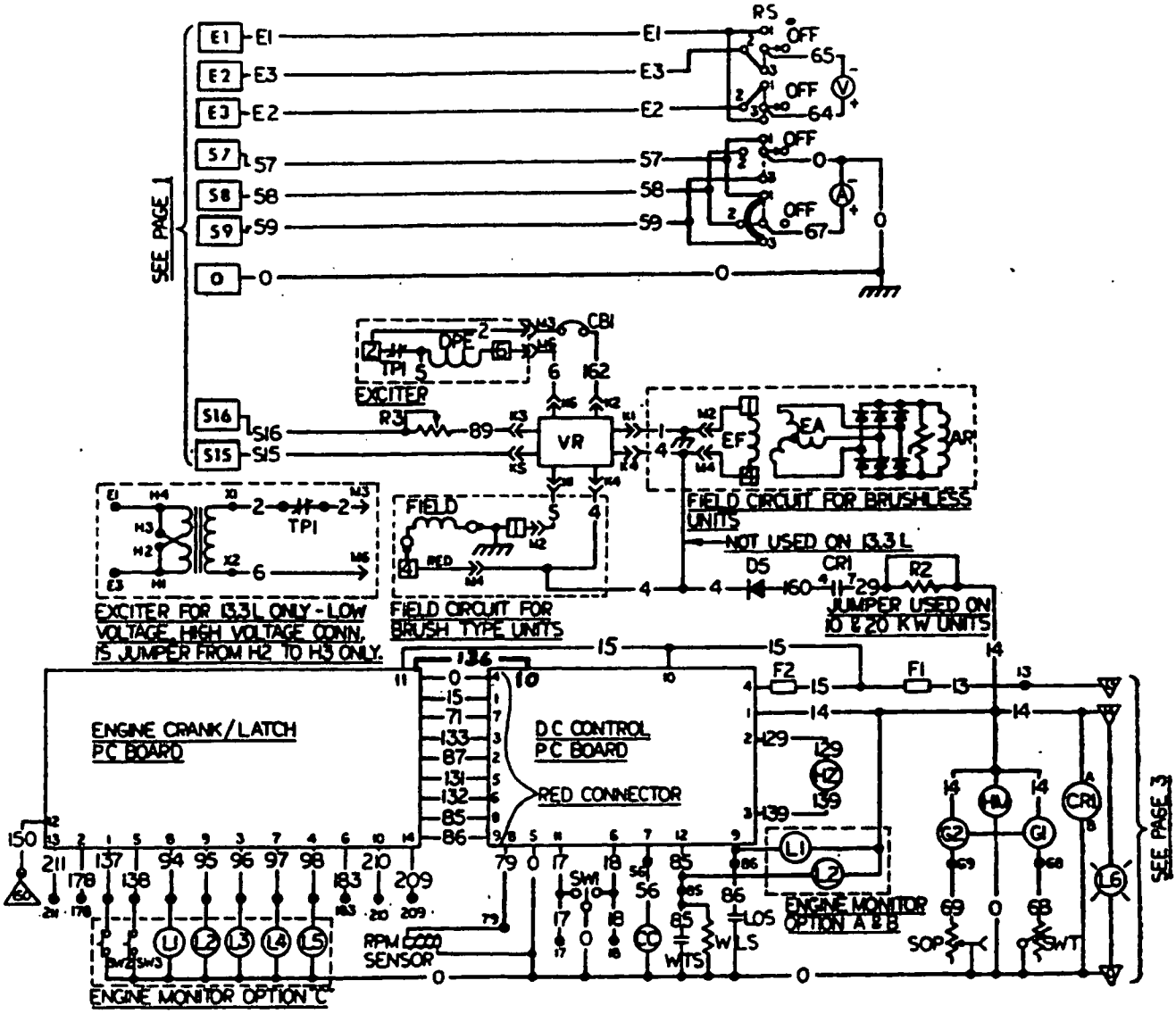


CUSTOMER CONNECTION
120/240-V. 3-PHASE

LEGEND

CB = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER

SCHEMATIC
Drawing Number 64488
Sheet 1 of 4
Issued- 06/04/84
File #10-84.5

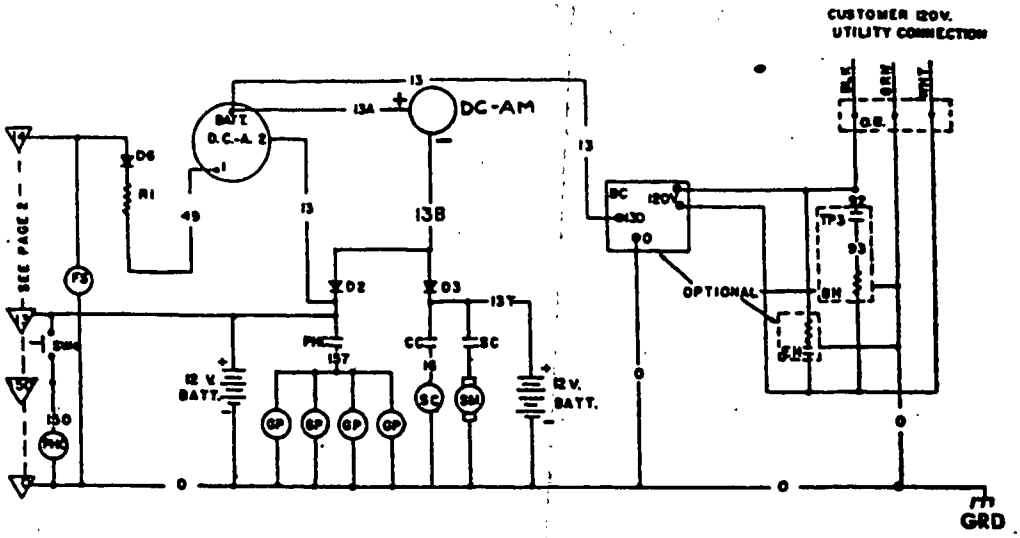


LEGEND

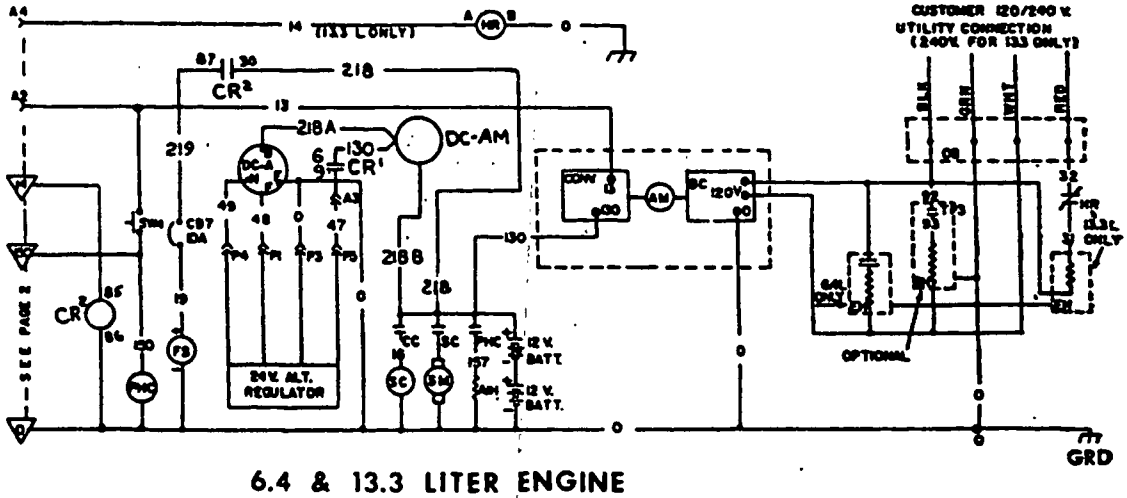
A	= AC AMMETER	LOS	= LOW OIL SWITCH
AR	= ALTERNATOR ROTOR	R2	= RESISTOR- FIELD BOOST
CB1	= FIELD CIRCUIT BREAKER	R3	= POTENTIOMETER- VOLTAGE ADJUST 10 K-Ohms, 2 Watt
CC	= CONTROL CONTACTOR	RS	= ROTARY SWITCH
CR1	= CONTROL RELAY	SOP	= SENDER- OIL PRESSURE
D	= DIODE	SW1	= SWITCH- START/STOP
DPE	= DISPLACED PHASE EXCITATION	SW2	= SWITCH- TEST
EA	= EXCITER ARMATURE	SW3	= SWITCH- RESET
EF	= EXCITER FIELD	SWT	= SENDER- WATER TEMPERATURE
F1	= FUSE - 30 Ampere	TP1	= THERMAL PROTECTOR- STATOR
F2	= FUSE - 14 Ampere	V	= AC VOLTMETER
G1	= GAUGE- WATER TEMPERATURE	VR	= VOLTAGE REGULATOR
G2	= GAUGE- OIL PRESSURE	WLS	= WATER LEVEL SENSOR
HM	= HOURMETER	WTS	= SWITCH- HIGH WATER TEMPERATURE
HZ	= FREQUENCY METER	⊠	= SCREW TERMINAL
L1	= LIGHT- LOW OIL PRESSURE	◁▷	= WIRE NUT
L2	= LIGHT- HIGH COOLANT TEMPERATURE		
L3	= LIGHT- OVERCRANK		
L4	= LIGHT- OVERSPEED		
L5	= LIGHT- RPM SENSOR LOSS		
L6	= LIGHT- PANEL		

ALARM CONTACT WIRE NUMBERS
209- Normally Closed
210- Common
211- Normally Open

SCHEMATIC
Drawing Number 64488
Sheet 2 of 4
Issued- 06/04/84
File #10-84.5



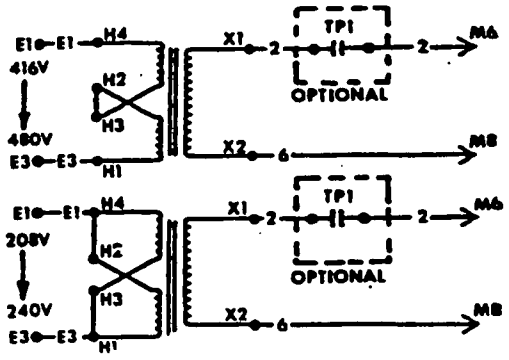
3.0 LITER ENGINE



6.4 & 13.3 LITER ENGINE

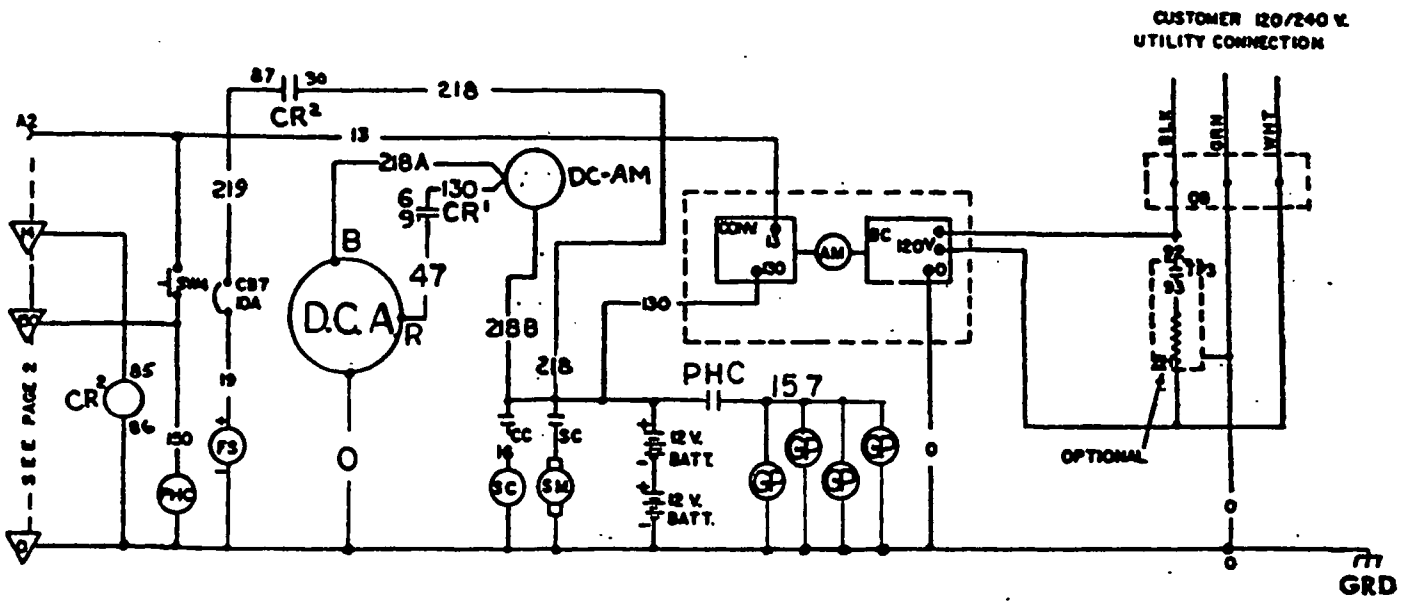
LEGEND

AIH = AIR INTAKE HEATER
AM = AMMETER- BATTERY CHARGER
BC = BATTERY CHARGER
BH = BATTERY HEATER
CB7 = CIRCUIT BREAKER- 24V. SOLENOID
CC = CONTROL CONTACTOR
CONV = 12 V. CONVERTER
CR1 = CONTROL RELAY- FIELD BOOST
CR2 = CONTROL RELAY- 24 V.
D = DIODE
DC-A = DC ALTERNATOR
DC-AM= DC AMMETER
EH = ENGINE HEATER
FS = FUEL SOLENOID
GP = GLOW PLUG
GRD = GROUND
HEI = HIGH ENERGY IGNITION
HR = HEATER RELAY
OB = OUTLET BOX
PHC = PRE-HEAT CONTACTOR
R1 = RESISTOR- 10 Ohm, 12 Watt
SC = STARTER CONTACTOR
SM = STARTER MOTOR
SW4 = SWITCH- PRE-HEAT
TP3 = BATTERY HEATER THERMOSTAT



13 3 LITER ONLY

SCHEMATIC
Drawing Number 64488
Sheet 3 of 4
Issued- 06/04/84
File #10-84.5

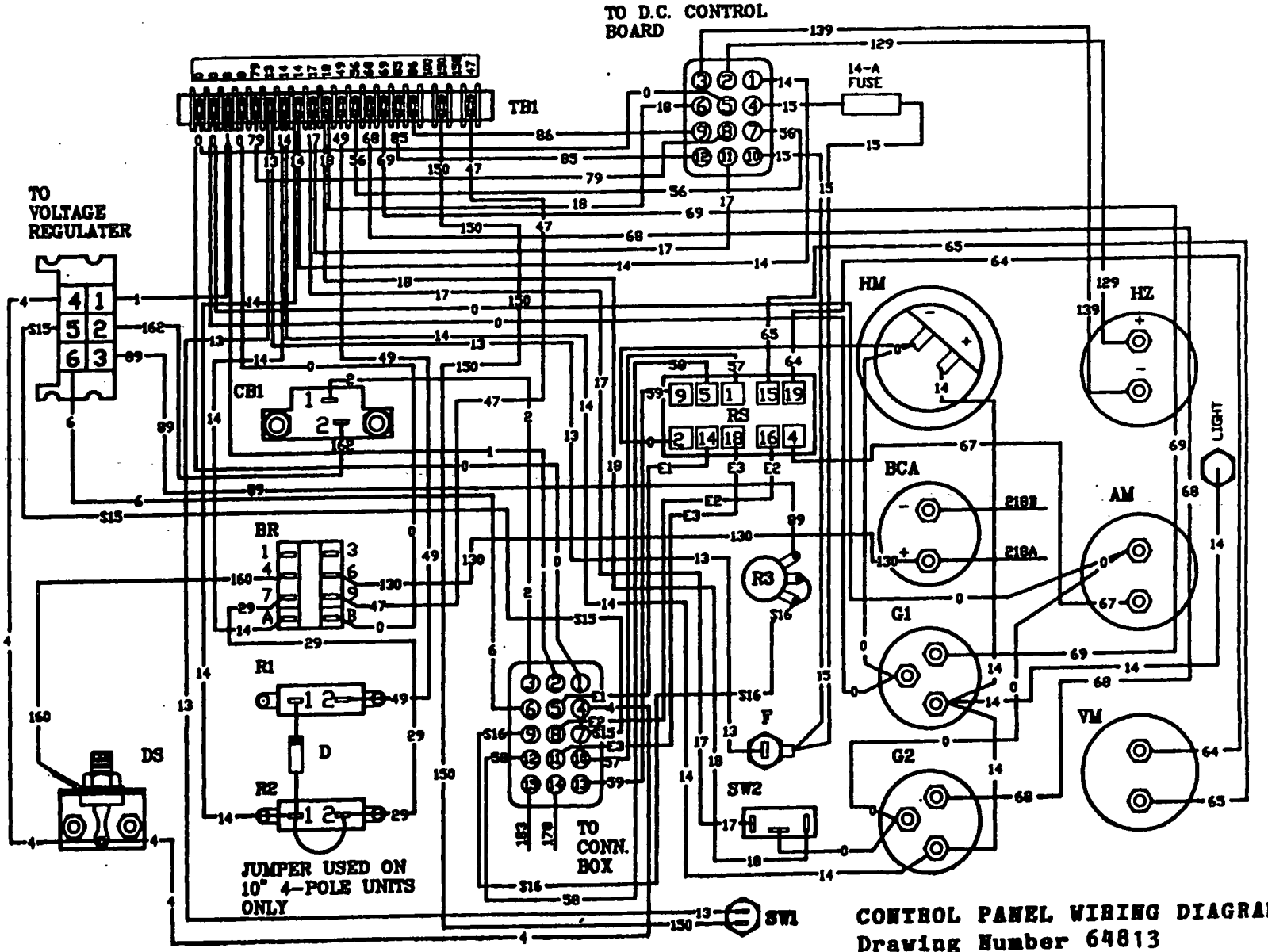


4.0 LITER ENGINE

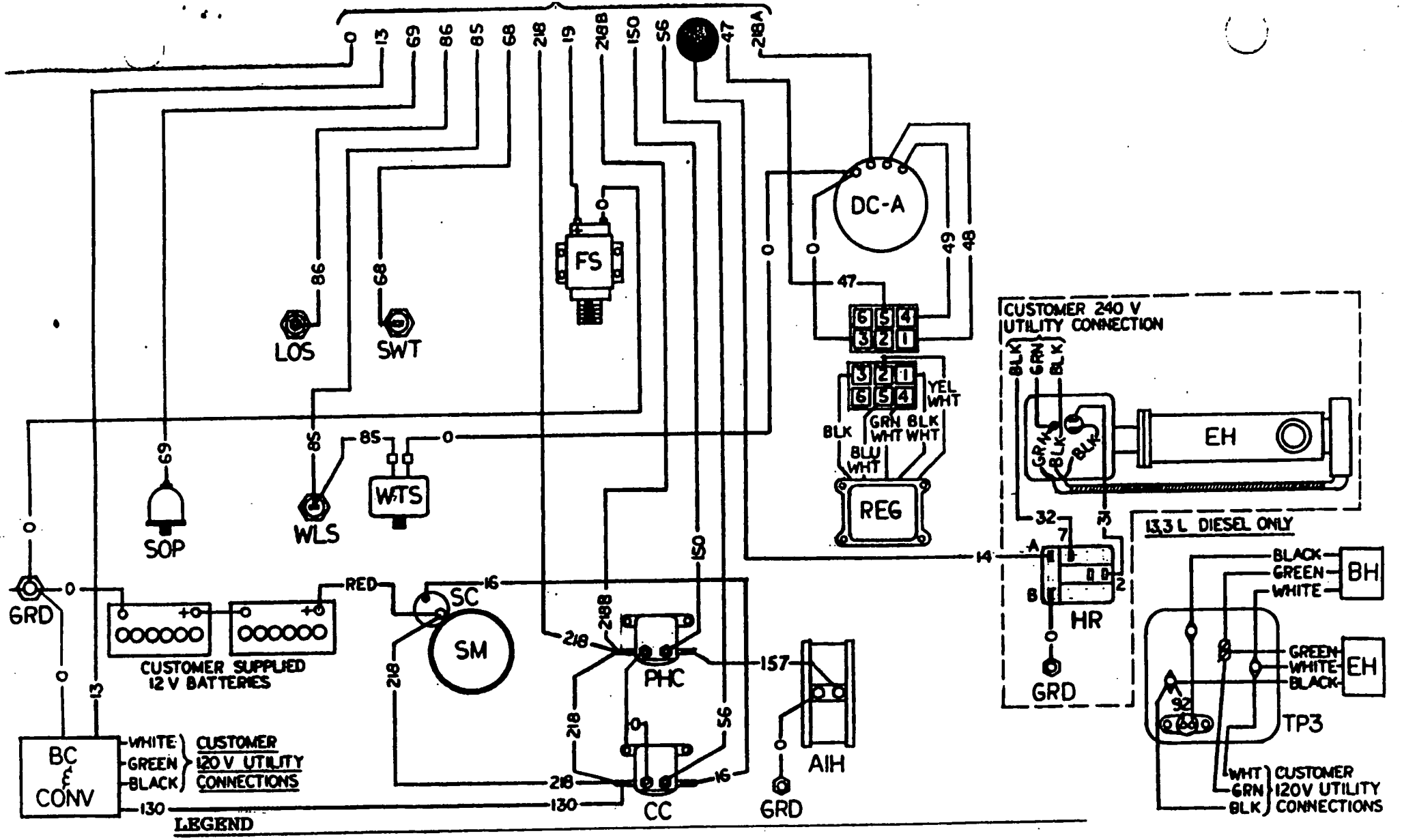
SCHEMATIC
Drawing Number 64488
Sheet 4 of 4
Issued- 06/04/84
File #10-84.5

LEGEND

AM	= AMMETER	G1	= GAUGE- OIL PRESSURE	RS	= ROTARY SWITCH
BCA	= BATTERY CHARGE AMMETER	G2	= GAUGE- WATER TEMPERATURE	SW1	= SWITCH- PREHEAT (Diesel Only)
BR	= BREAKER RELAY	HM	= HOURMETER	SW2	= SWITCH- START/STOP
CB1	= CIRCUIT BREAKER- FIELD	HZ	= FREQUENCY METER	TB1	= TERMINAL BLOCK
D	= DIODE	R1	= RESISTOR- 10 ohm, 12 watt	VM	= VOLTMETER
D5	= DIODE- FIELD BOOST	R2	= RESISTOR- FIELD BOOST		
F	= FUSE	R3	= POTENTIOMETER- VOLTAGE ADJUST 10k, 2 watt		



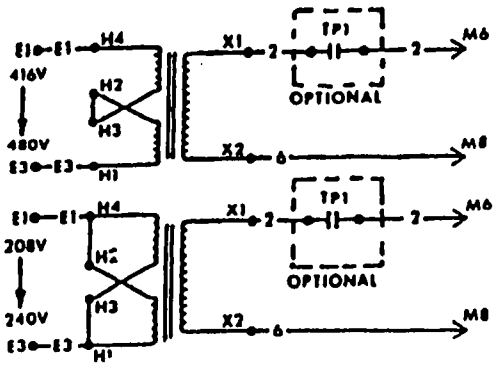
CONTROL PANEL WIRING DIAGRAM- DIESEL
Drawing Number 64813
Issued- 05/29/84
File #10-86.1



LEGEND

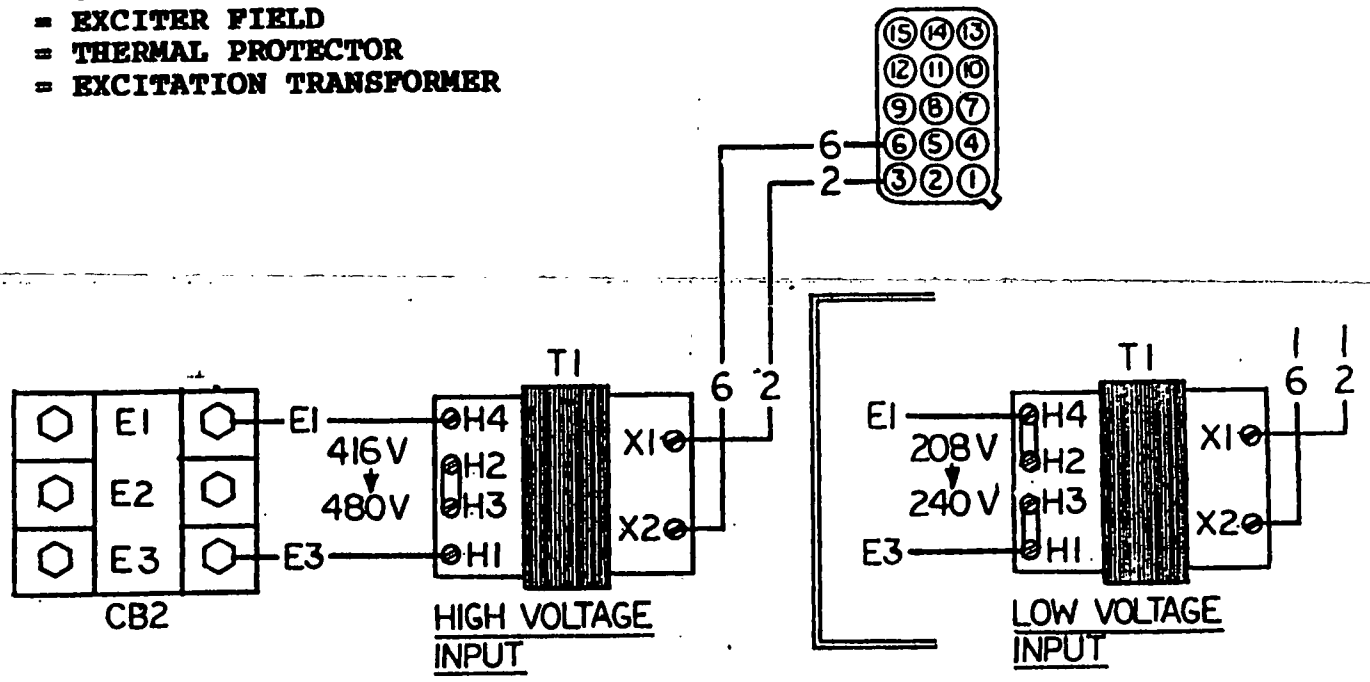
AIH = AIR INTAKE HEATER
BC = BATTERY CHARGER- 2 Ampere
BH = BATTERY HEATER
CC = CONTROL CONTACTOR
CONV = CONVERTER
DC-A = DC ALTERNATOR
EH = ENGINE HEATER
FS = FUEL SOLENOID
GRD = GROUND
HR = ENGINE HEATER RELAY
LOS = LOW OIL SWITCH
PHC = PRE-HEAT CONTACTOR
REG = REGULATOR
SC = STARTER CONTACTOR
SM = STARTER MOTOR
SOP = SENDER- OIL PRESSURE
SWT = SENDER- WATER TEMPERATURE
TP3 = BATTERY HEATER THERMOSTAT
WLS = WATER LEVEL SENSOR
WTS = HIGH WATER TEMPERATURE SWITCH

ENGINE WIRING DIAGRAM
Drawing Number 64812
Issued- 05/29/84
File #10-84.5

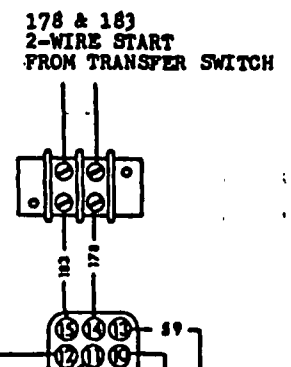


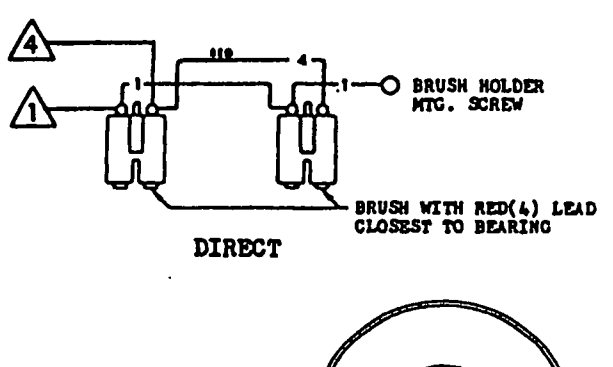
LEGEND

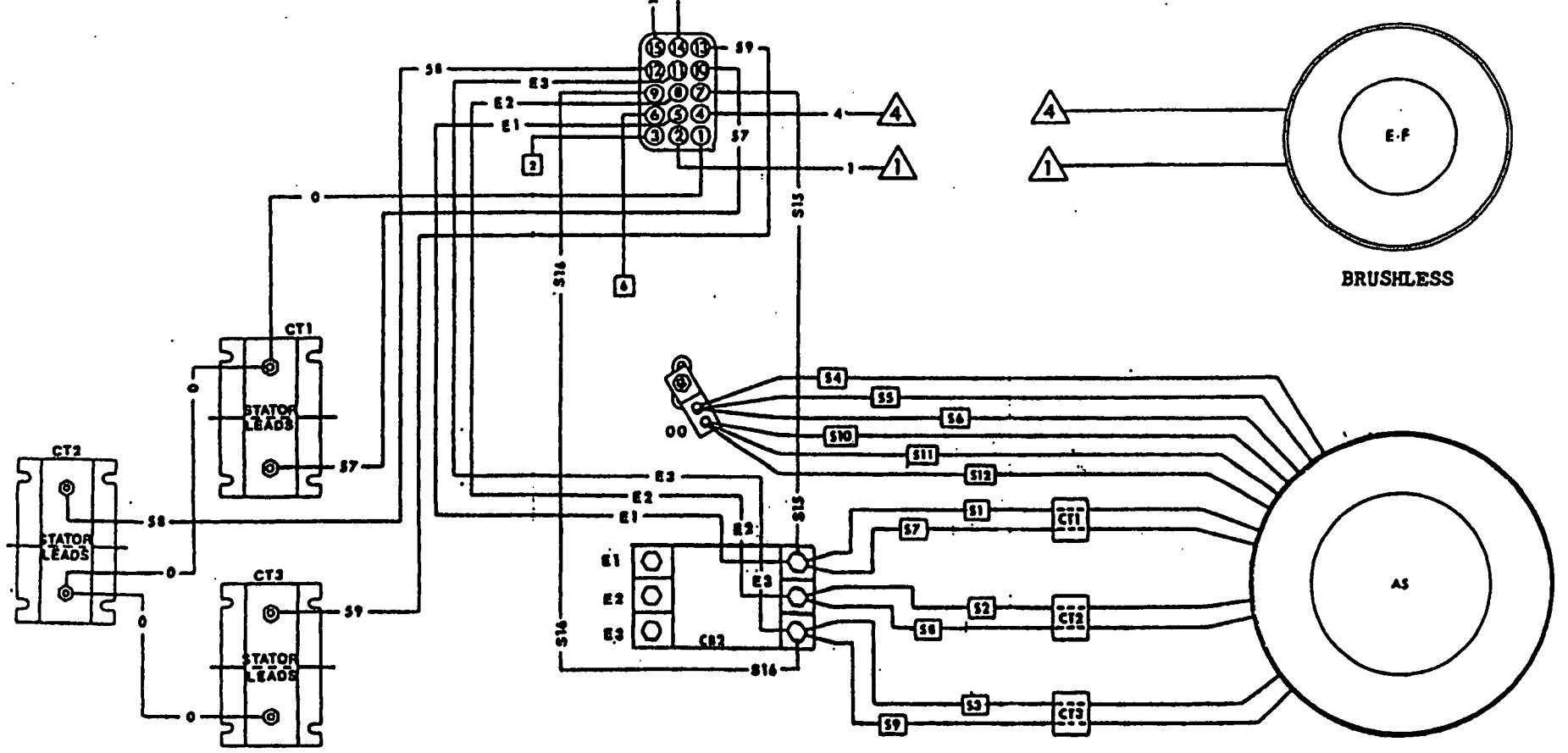
AS	=	ALTERNATOR STATOR
CB2	=	CIRCUIT BREAKER- MAIN
CT	=	CURRENT TRANSFORMER
EF	=	EXCITER FIELD
TP	=	THERMAL PROTECTOR
T1	=	EXCITATION TRANSFORMER



TRANSFORMER WIRING AND SCHEMATIC
In Lower Panel



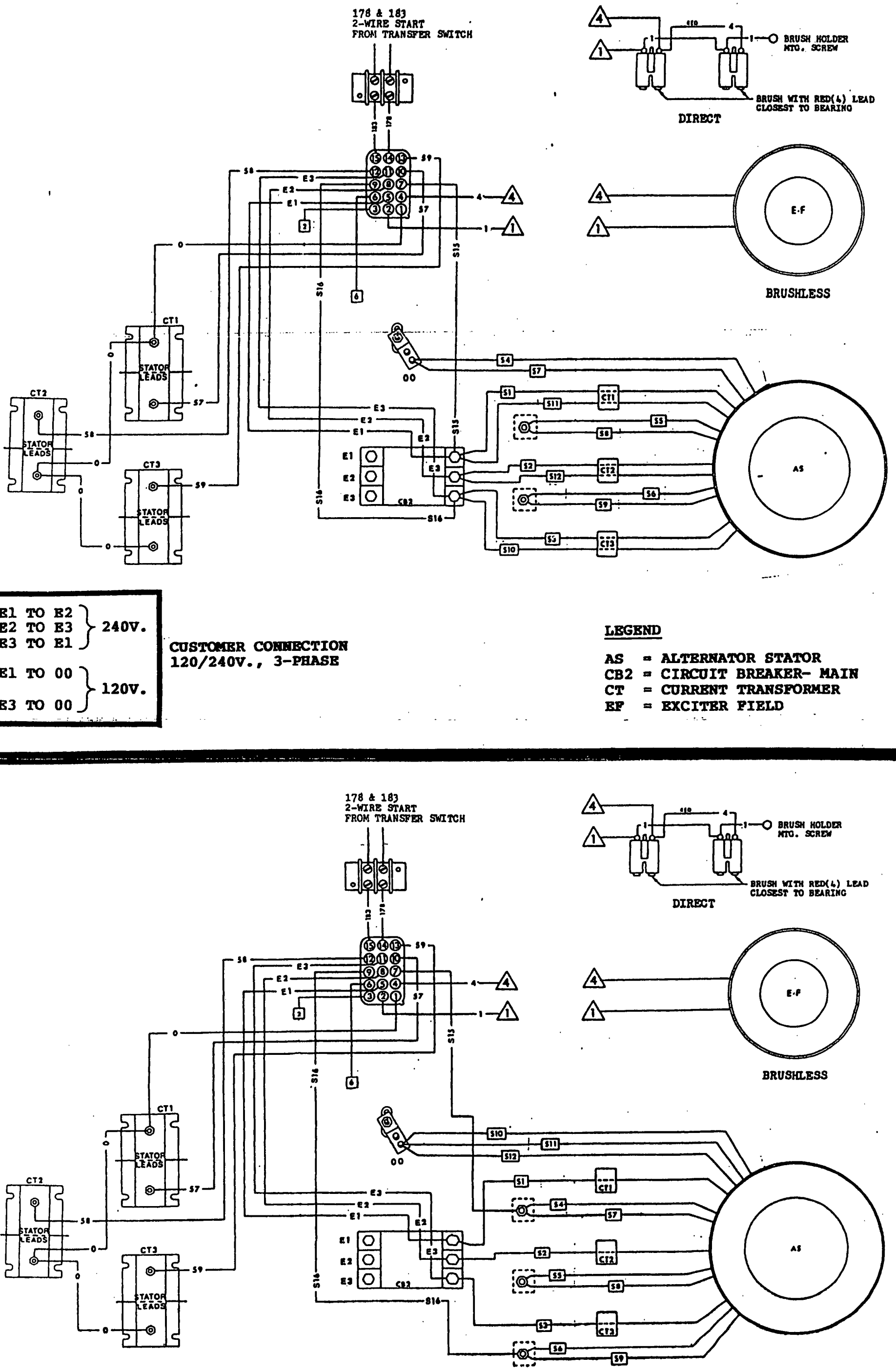




E1 TO E2 E2 TO E3 E3 TO E1	208V.
E1 TO 00 E2 TO 00 E3 TO 00	120V.

CUSTOMER CONNECTION
120/208V., 3-PHASE

GENERATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 64822
Sheet 1 of 3
Issued- 06/11/84
File #10-84.6



E1 TO E2 E2 TO E3 E3 TO E1	240V.
E1 TO 00 E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V., 3-PHASE

LEGEND

AS = ALTERNATOR STATOR
CB2 = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER
EF = EXCITER FIELD

178 & 183
2-WIRE START
FROM TRANSFER SWITCH
DIRECT
BRUSH HOLDER MTG. SCREW
BRUSH WITH RED(4) LEAD CLOSEST TO BEARING
BRUSHLESS
E-F
CT1
CT2
CT3
STATOR LEADS
CB2
AS
00

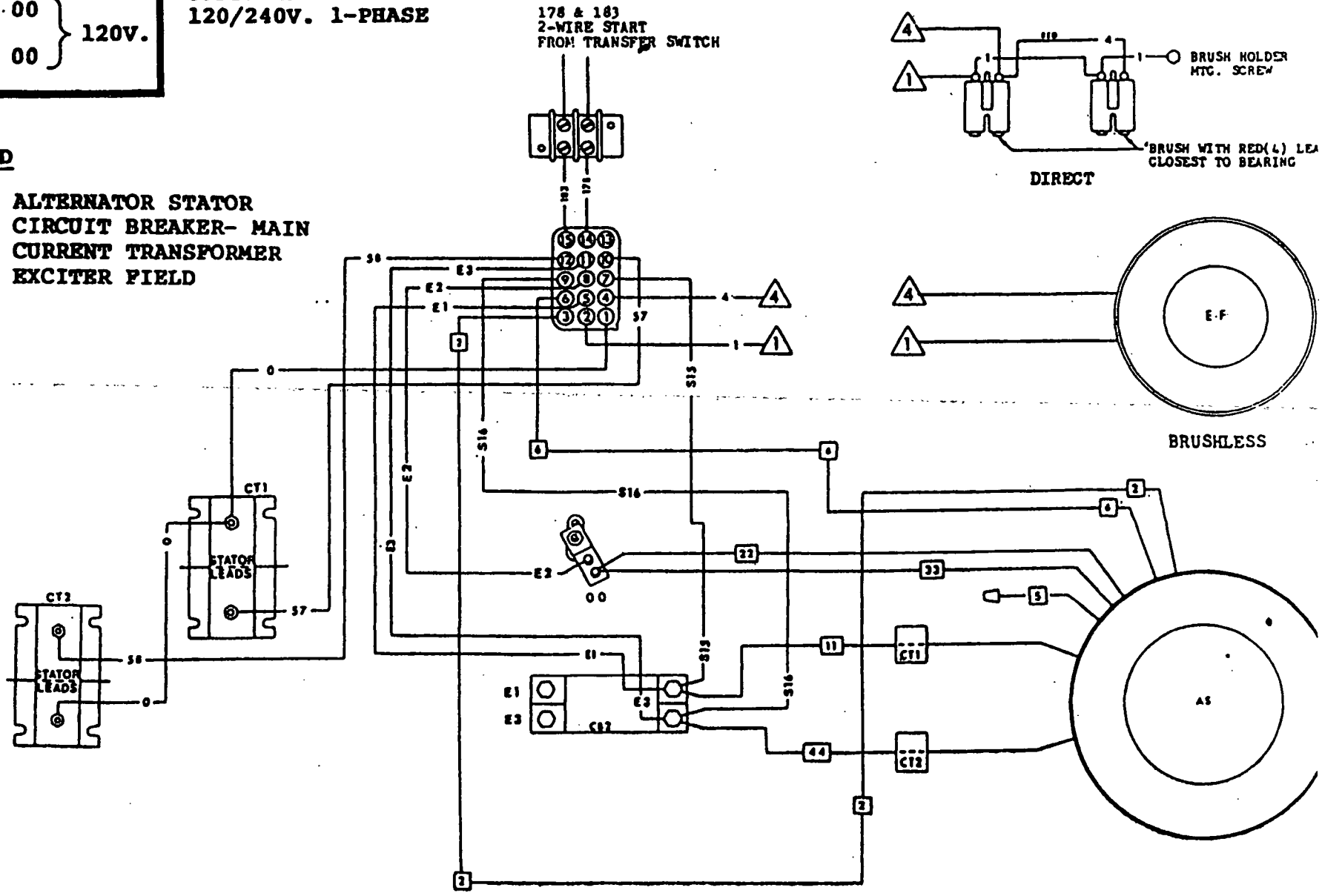
E1 TO E2 E2 TO E3 E3 TO E1	480V.
E1 TO 00 E2 TO 00 E3 TO 00	277V.

CUSTOMER CONNECTION
277/480V., 3-PHASE

GENERATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 64822
Sheet 2 of 3

E1 TO E3		240V.
E1 TO 00	}	120V.
E3 TO 00	}	

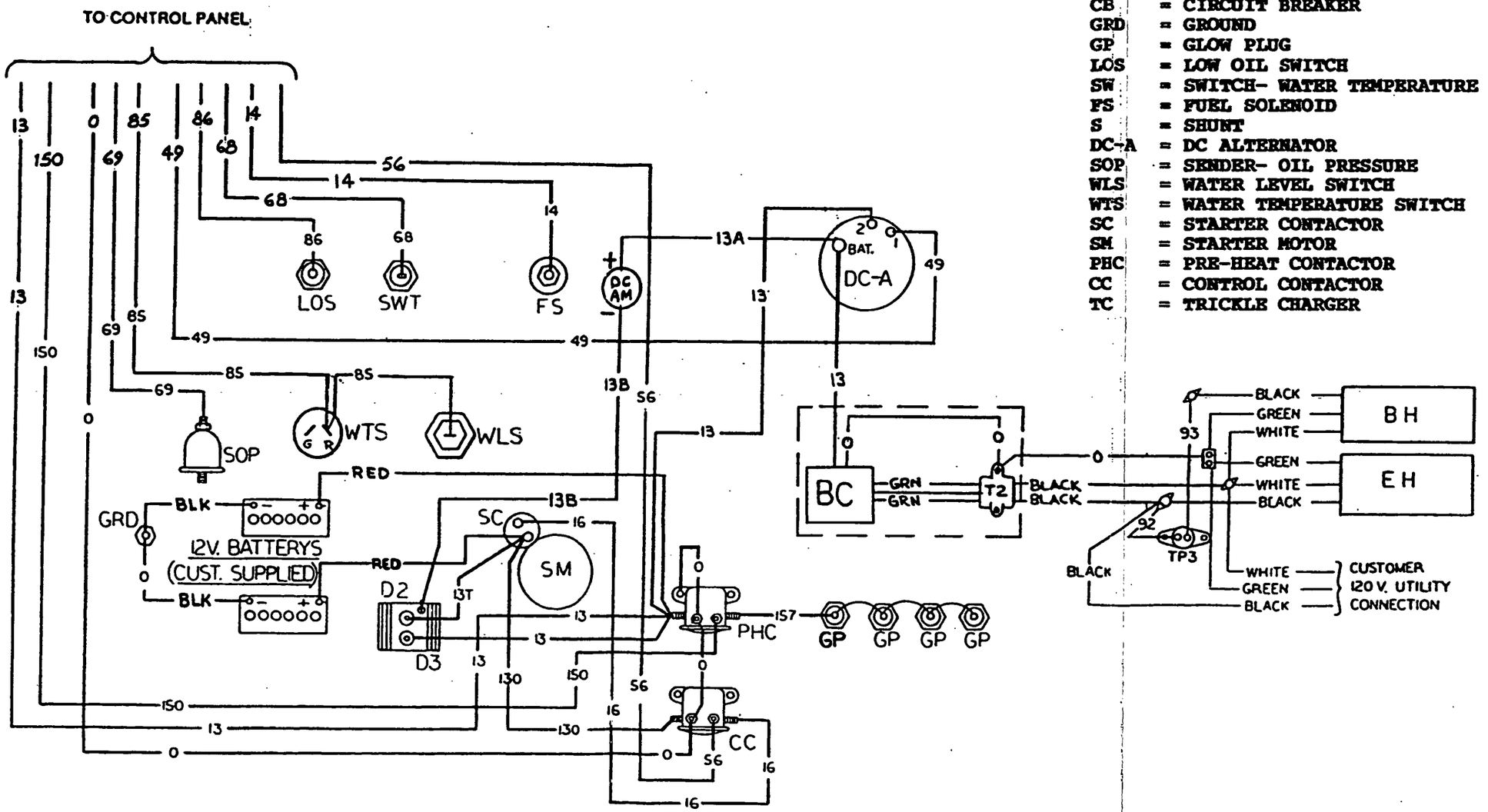
CUSTOMER CONNECTION
120/240V. 1-PHASE



LEGEND

AS = ALTERNATOR STATOR
CB2 = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER
EF = EXCITER FIELD

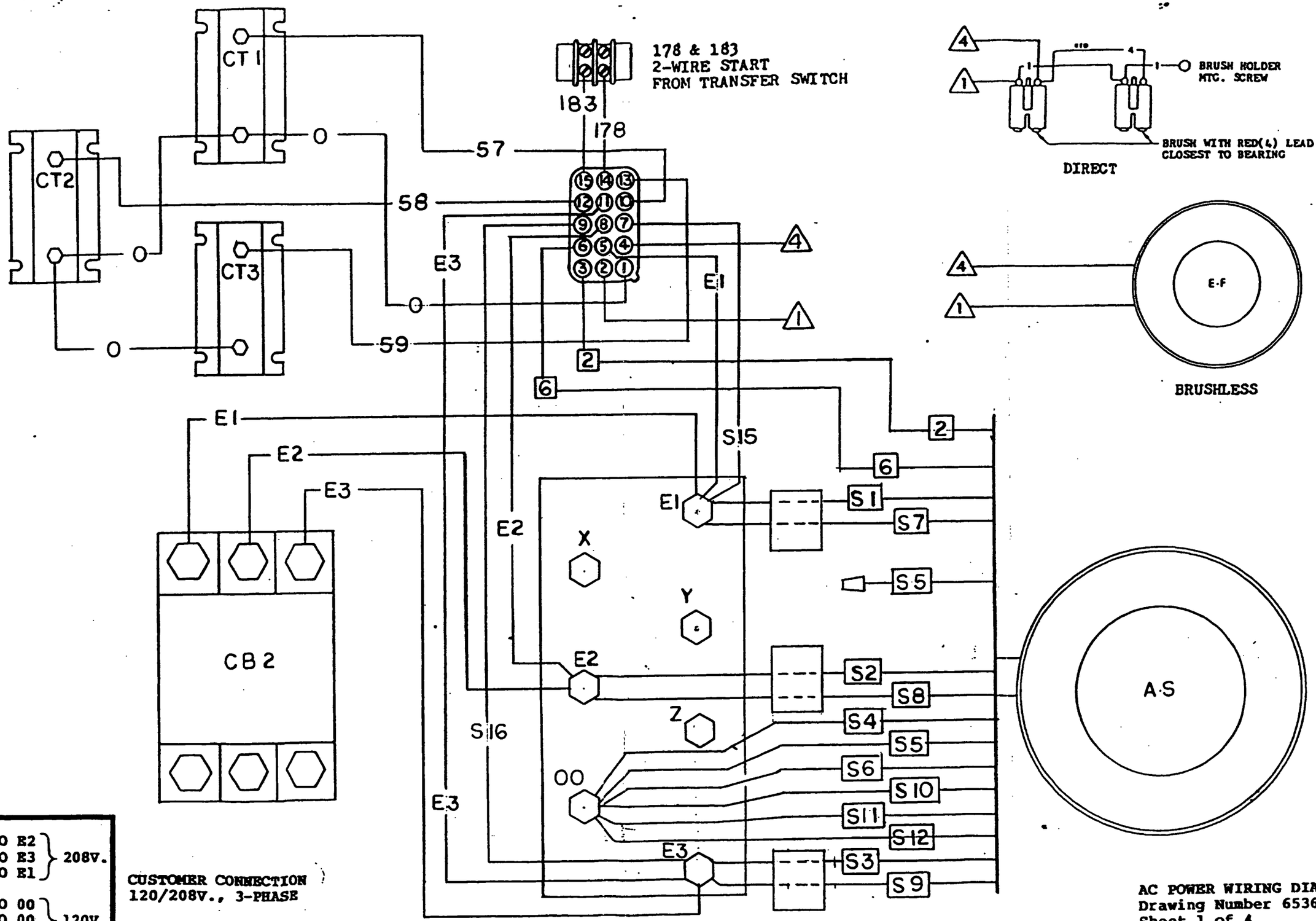
GENERATOR AND LOWER PANEL WIRING DIAGRAM
Drawing Number 64822
Sheet 3 of 3
Issued- 06/11/84
File #10-84.6



LEGEND

D	=	DIODE
DC-AM	=	DC AMMETER
EH	=	ENGINE HEATER
BH	=	BATTERY HEATER
TP3	=	THERMAL PROTECTOR
T2	=	TRANSFORMER
CB	=	CIRCUIT BREAKER
GRD	=	GROUND
GP	=	GLOW PLUG
LOS	=	LOW OIL SWITCH
SW	=	SWITCH- WATER TEMPERATURE
FS	=	FUEL SOLENOID
S	=	SHUNT
DC-A	=	DC ALTERNATOR
SOP	=	SENDER- OIL PRESSURE
WLS	=	WATER LEVEL SWITCH
WTS	=	WATER TEMPERATURE SWITCH
SC	=	STARTER CONTACTOR
SM	=	STARTER MOTOR
PHC	=	PRE-HEAT CONTACTOR
CC	=	CONTROL CONTACTOR
TC	=	TRICKLE CHARGER

ENGINE WIRING DIAGRAM
Drawing Number 65085
Issued- 06/29/84
File #10-84.6



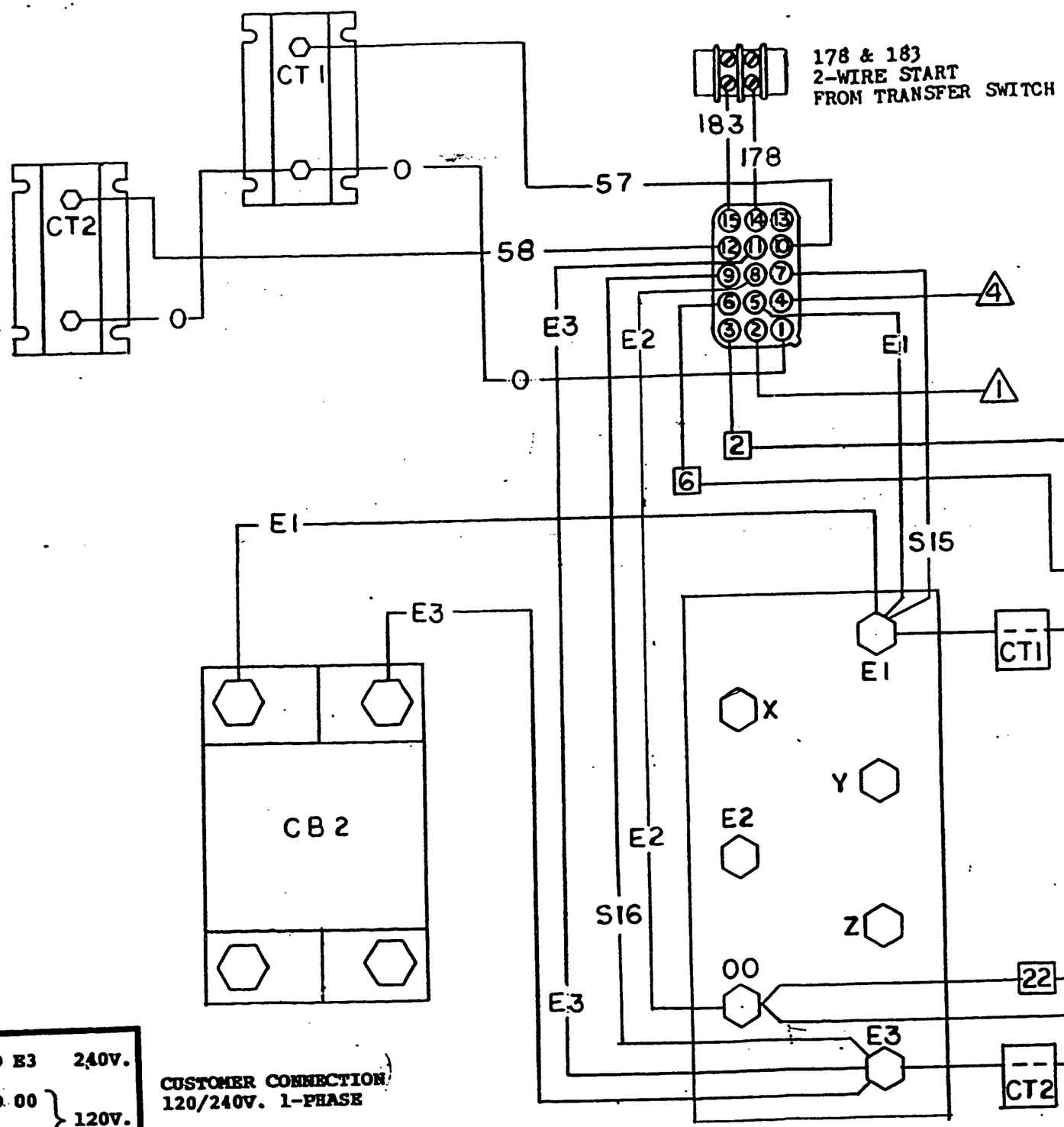
DIRECT

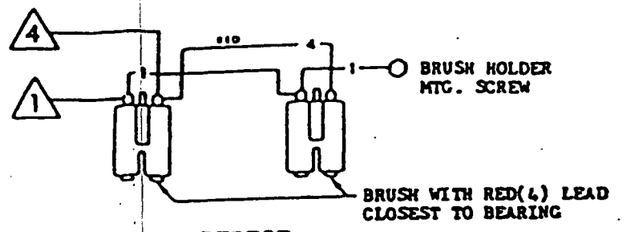
BRUSHLESS

E1 TO E2 E2 TO E3 E3 TO E1	208V.
E1 TO 00 E2 TO 00 E3 TO 00	120V.

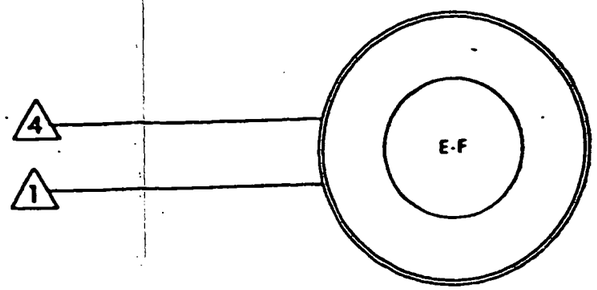
CUSTOMER CONNECTION
120/208V., 3-PHASE

AC POWER WIRING DIAGRAM
Drawing Number 65365
Sheet 1 of 4
Issued- 09/13/84





DIRECT

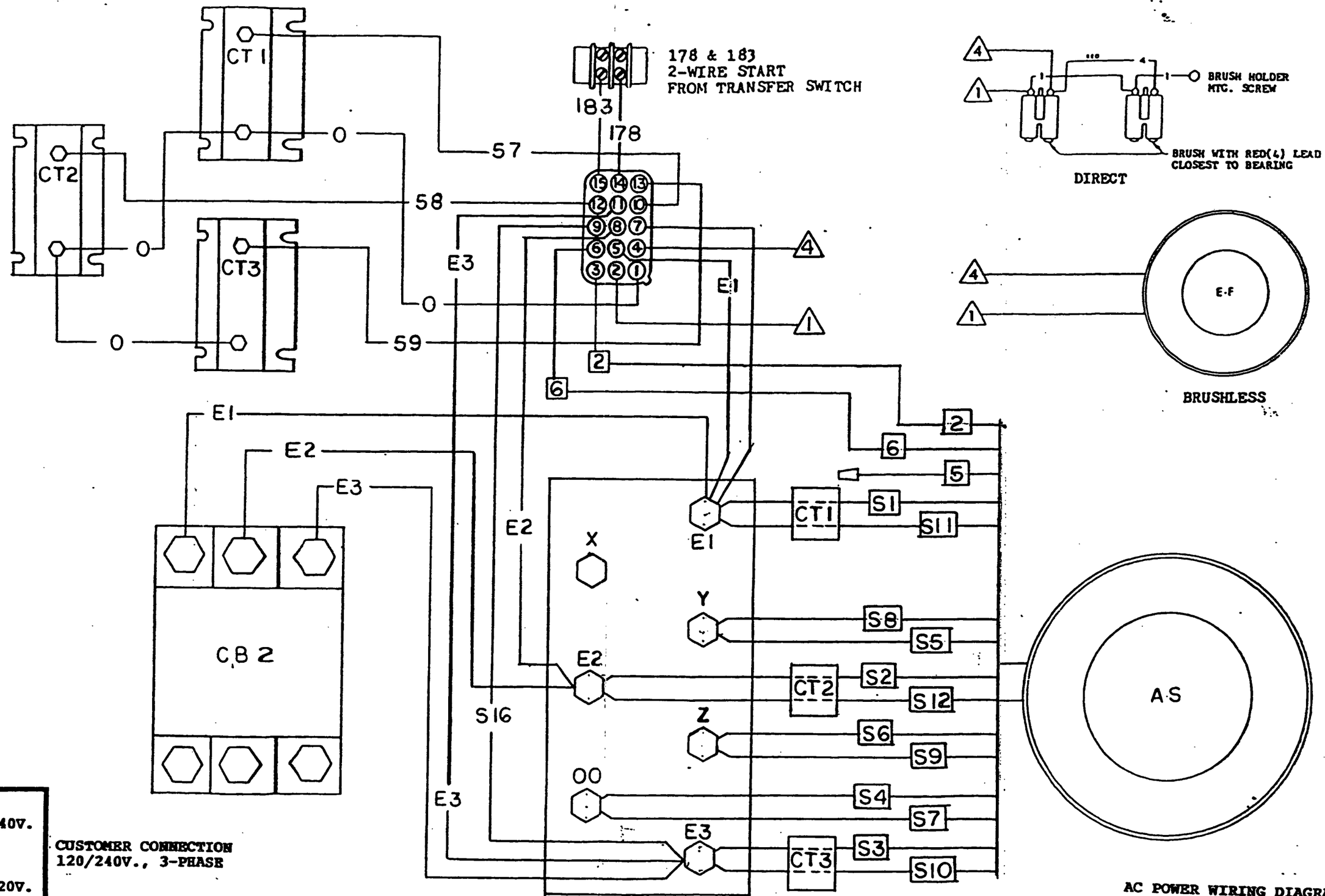


BRUSHLESS

E1 TO E3	240V.
E1 TO 00	120V.
E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V. 1-PHASE

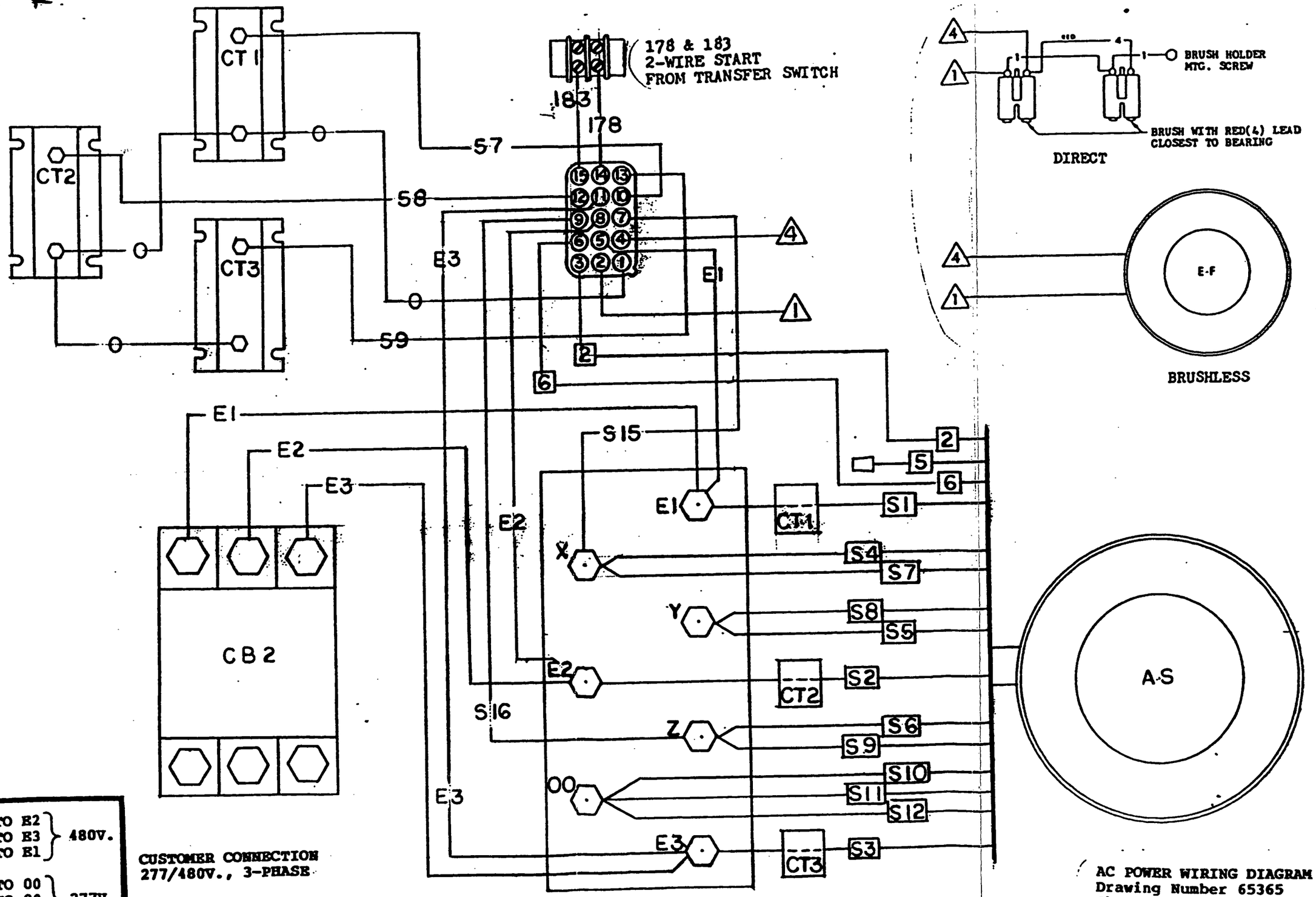
AC POWER WIRING DIAGRAM
Drawing Number 65365
Sheet 2 of 4



E1 TO E2 E2 TO E3 E3 TO E1	240V.
E1 TO 00 E3 TO 00	120V.

CUSTOMER CONNECTION
120/240V., 3-PHASE

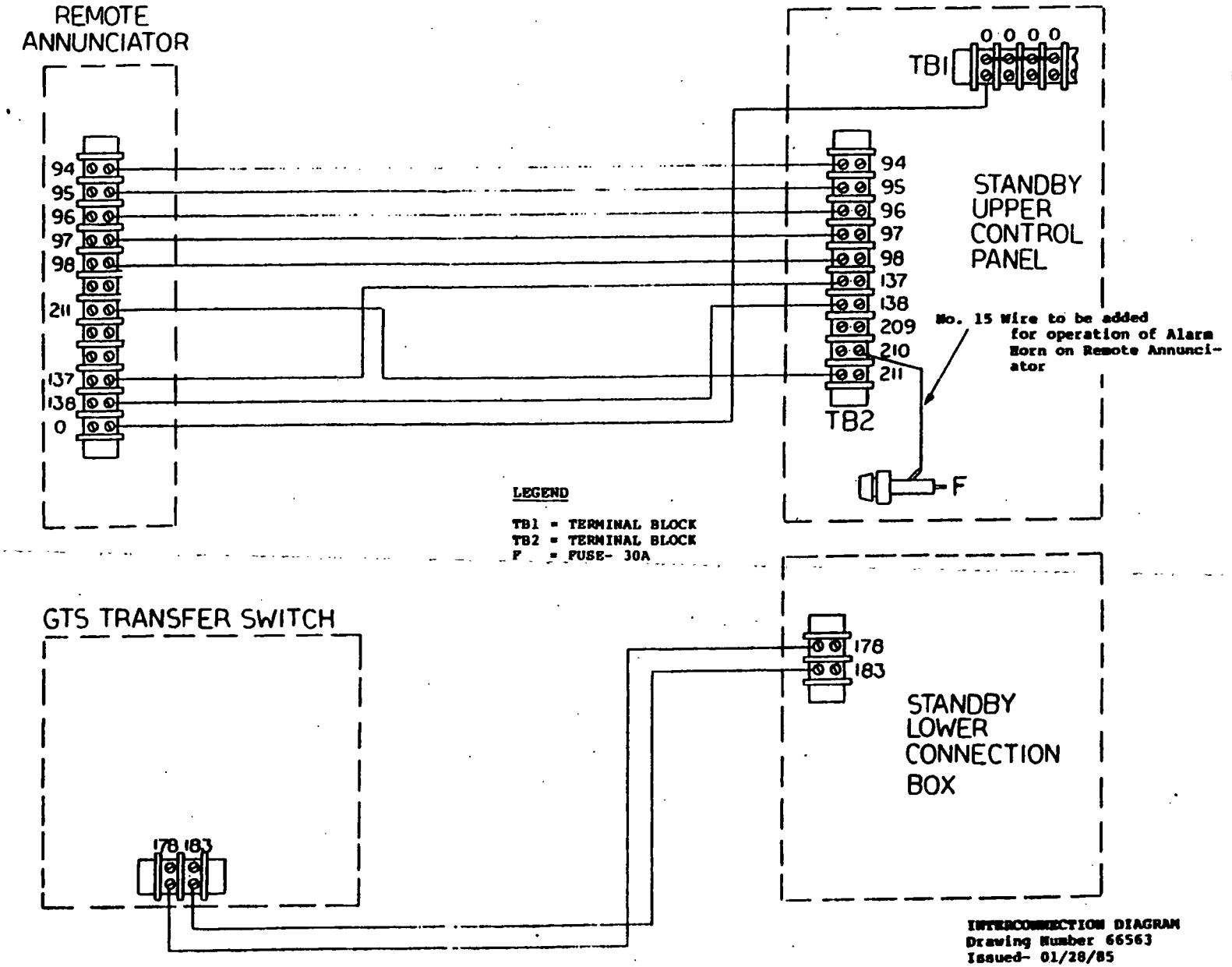
AC POWER WIRING DIAGRAM
Drawing Number 65365
Sheet 3 of 4
Issued- 09/13/84



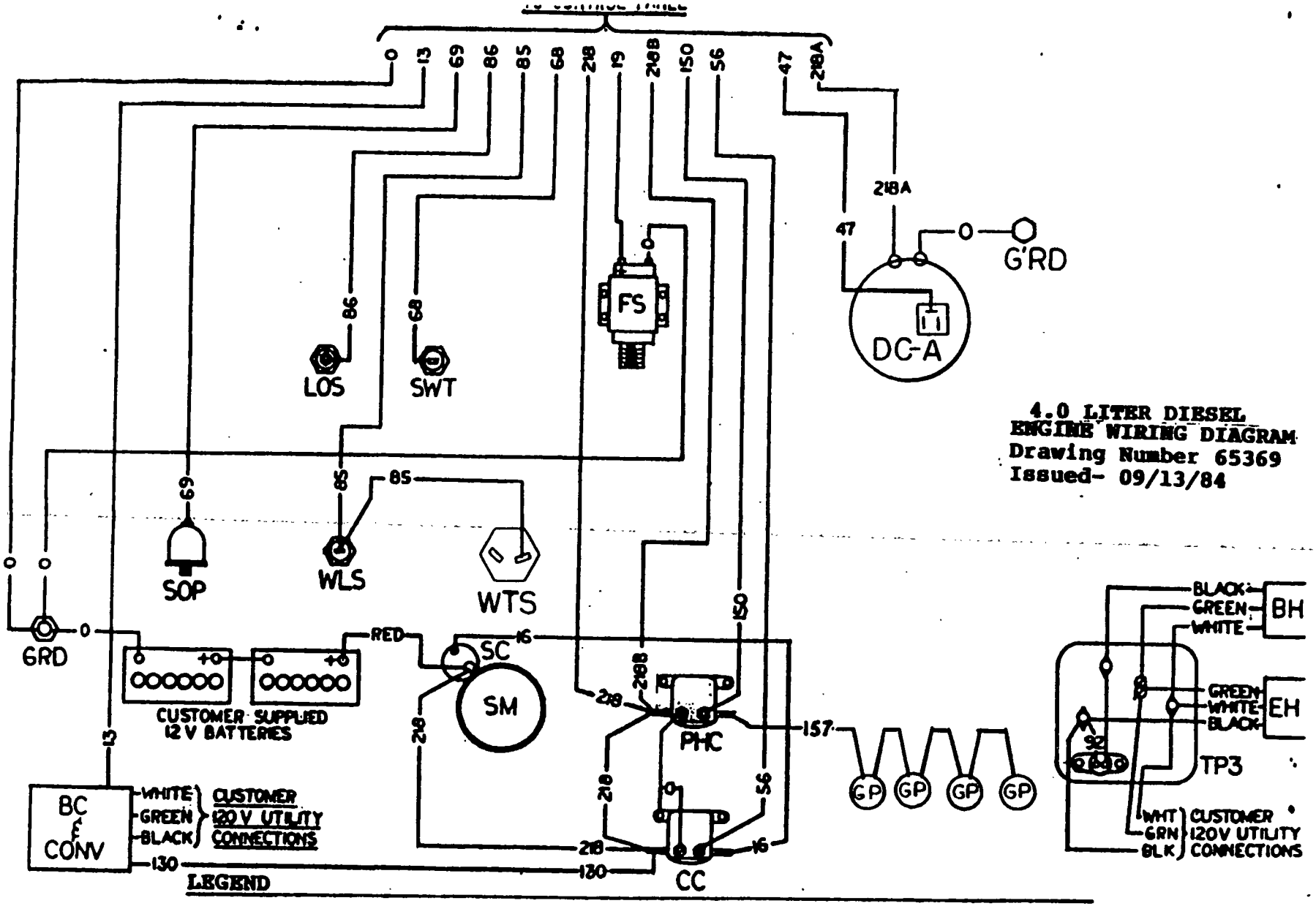
E1 TO E2 E2 TO E3 E3 TO E1	480V.
E1 TO 00 E2 TO 00 E3 TO 00	277V.

CUSTOMER CONNECTION
277/480V., 3-PHASE

AC POWER WIRING DIAGRAM
Drawing Number 65365
Sheet 4 of 4
Issued- 09/13/84



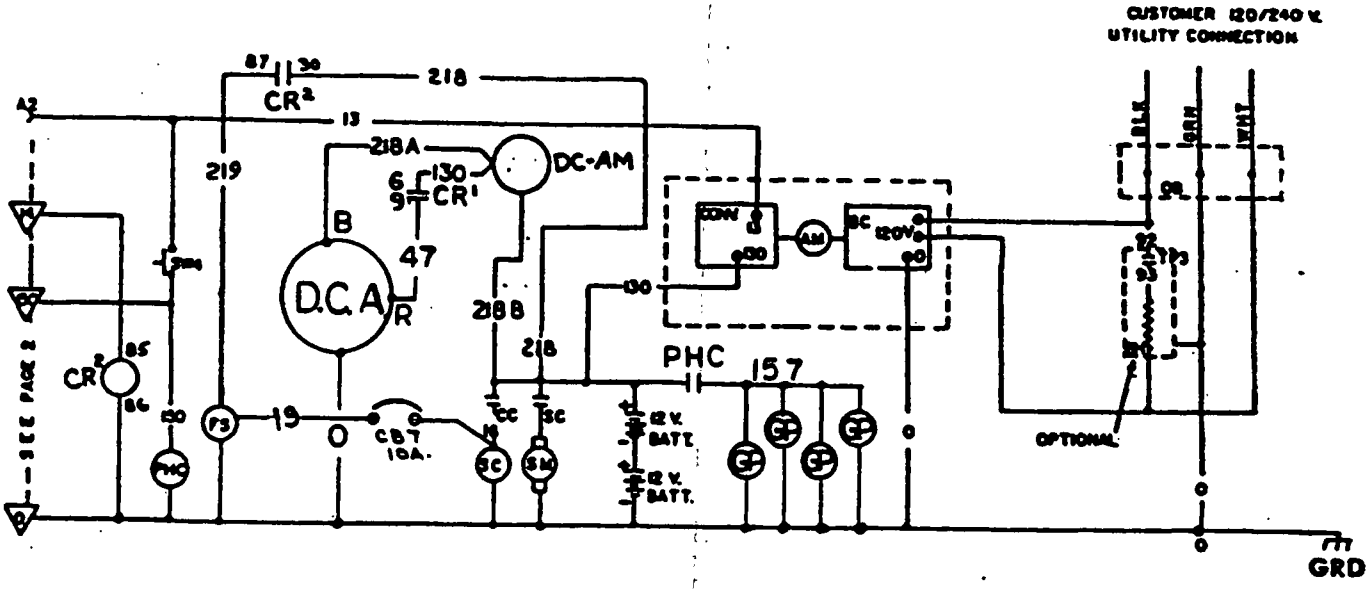
INTERCONNECTION DIAGRAM
Drawing Number 66563
Issued- 01/28/85



4.0 LITER DIESEL ENGINE WIRING DIAGRAM
Drawing Number 65369
Issued- 09/13/84

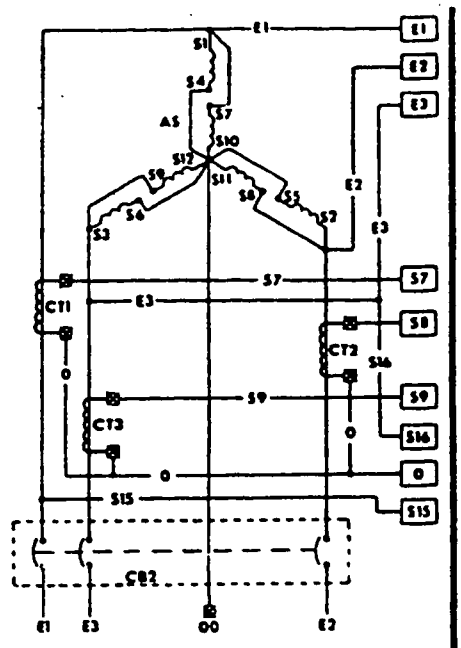
LEGEND

AIH	= AIR INTAKE HEATER	LOS	= LOW OIL SWITCH
BC	= BATTERY CHARGER- 2 Ampere	PHC	= PRE-HEAT CONTACTOR
BH	= BATTERY HEATER	REG	= REGULATOR
CC	= CONTROL CONTACTOR	SC	= STARTER CONTACTOR
CONV	= CONVERTER	SM	= STARTER MOTOR
DC-A	= DC ALTERNATOR	SOP	= SENDER- OIL PRESSURE
EH	= ENGINE HEATER	SWT	= SENDER- WATER TEMPERATURE
FS	= FUEL SOLENOID	TP3	= BATTERY HEATER THERMOSTAT
GRD	= GROUND	WLS	= WATER LEVEL SENSOR
HR	= ENGINE HEATER RELAY	WTS	= HIGH WATER TEMPERATURE SWITCH

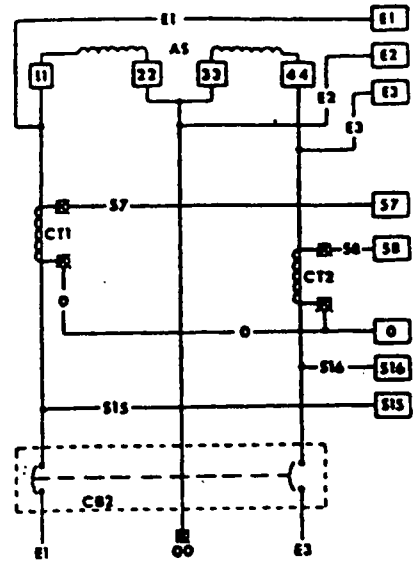


4.0 LITER ENGINE

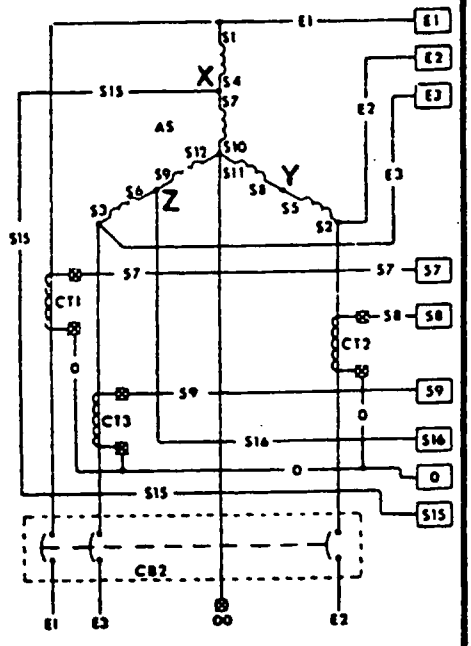
SCHEMATIC
Drawing Number 66144
Sheet 4 of 4
Issued- 06/04/84
File #10-84.5



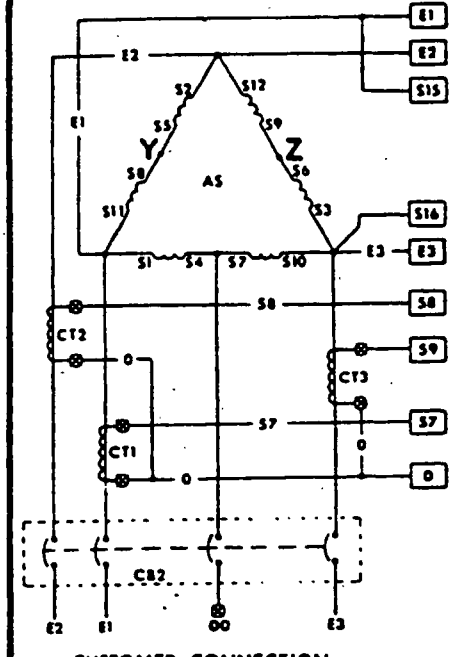
CUSTOMER CONNECTION
120/208-V. 3-PHASE



CUSTOMER CONNECTION
120/240-V. 1-PHASE



CUSTOMER CONNECTION
277/480-V. 3-PHASE

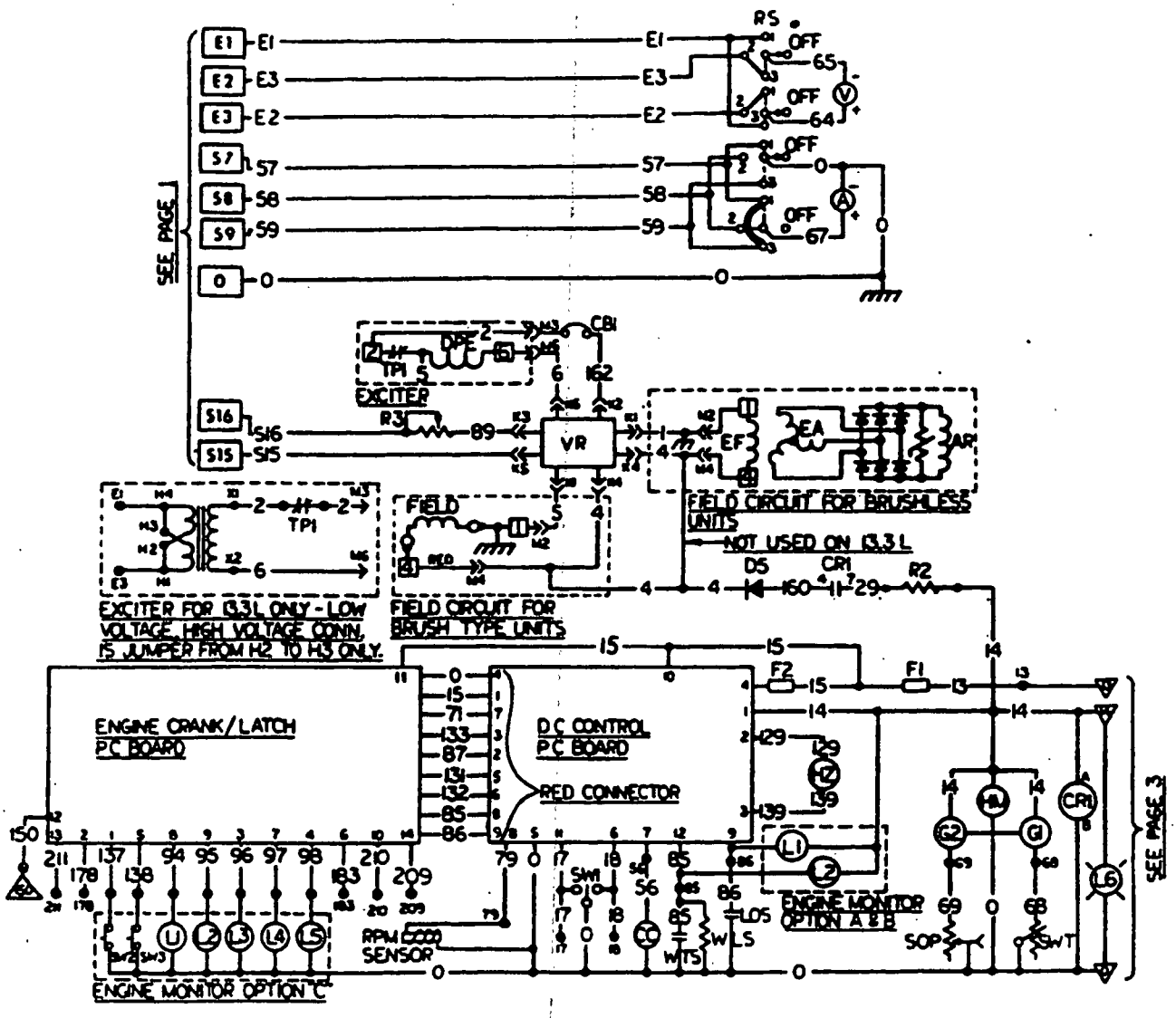


CUSTOMER CONNECTION
120/240-V. 3-PHASE

LEGEND

CB = CIRCUIT BREAKER- MAIN
CT = CURRENT TRANSFORMER

SCHEMATIC
Drawing Number 62144
Sheet 1 of 4
Issued- 06/04/84
File #10-84.5

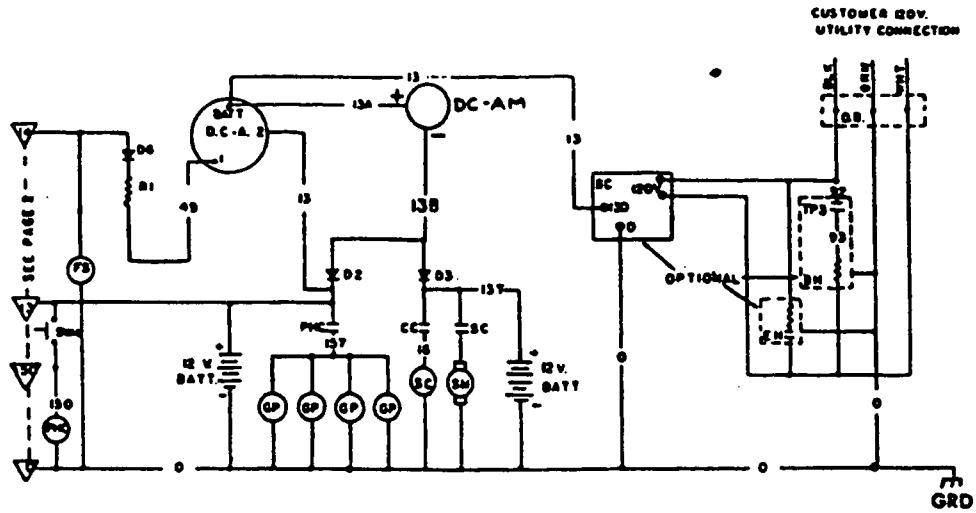


LEGEND

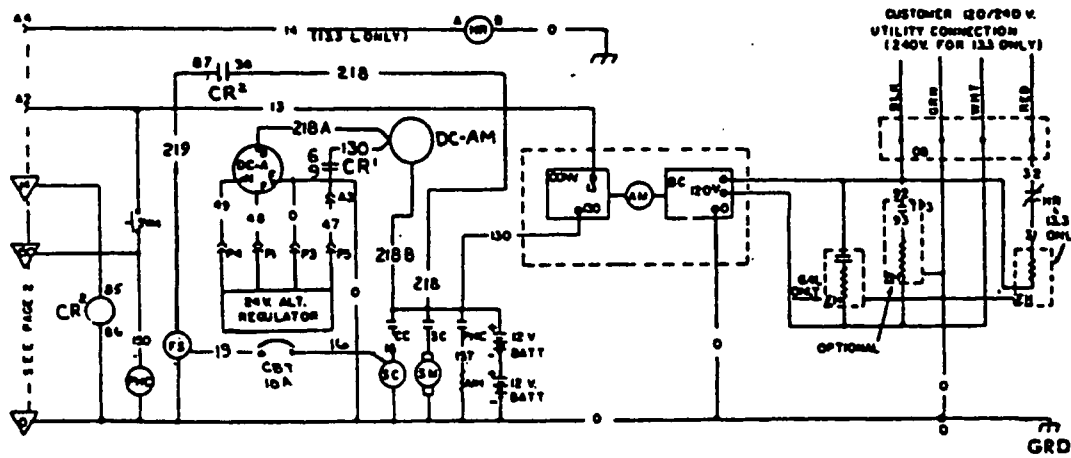
A	= AC AMMETER	LOS	= LOW OIL SWITCH
AR	= ALTERNATOR ROTOR	R2	= RESISTOR- FIELD BOOST
CB1	= FIELD CIRCUIT BREAKER	R3	= POTENTIOMETER- VOLTAGE ADJUST 10 K-Ohms, 2 Watt
CC	= CONTROL CONTACTOR	RS	= ROTARY SWITCH
CR1	= CONTROL RELAY	SOP	= SENDER- OIL PRESSURE
D	= DIODE	SW1	= SWITCH- START/STOP
DPE	= DISPLACED PHASE EXCITATION	SW2	= SWITCH- TEST
EA	= EXCITER ARMATURE	SW3	= SWITCH- RESET
EF	= EXCITER FIELD	SWT	= SENDER- WATER TEMPERATURE
F1	= FUSE - 30 Ampere	TP1	= THERMAL PROTECTOR- STATOR
F2	= FUSE - 14 Ampere	V	= AC VOLTMETER
G1	= GAUGE- WATER TEMPERATURE	VR	= VOLTAGE REGULATOR
G2	= GAUGE- OIL PRESSURE	WLS	= WATER LEVEL SENSOR
HM	= HOURMETER	WTS	= SWITCH- HIGH WATER TEMPERATURE
HZ	= FREQUENCY METER		= SCREW TERMINAL
L1	= LIGHT- LOW OIL PRESSURE		= WIRE NUT
L2	= LIGHT- HIGH COOLANT TEMPERATURE		
L3	= LIGHT- OVERCRANK		
L4	= LIGHT- OVERSPEED		
L5	= LIGHT- RPM SENSOR LOSS		
L6	= LIGHT- PANEL		

ALARM CONTACT WIRE NUMBERS
209- Normally Closed
210- Common
211- Normally Open

SCHEMATIC
Drawing Number 66144
Sheet 2 of 4
Issued- 06/04/84
File #10-84.5



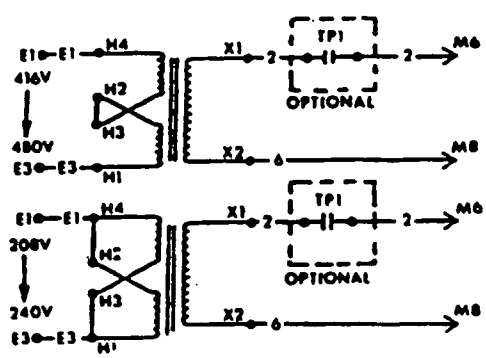
3.0 LITER ENGINE



6.4 & 13.3 LITER ENGINE

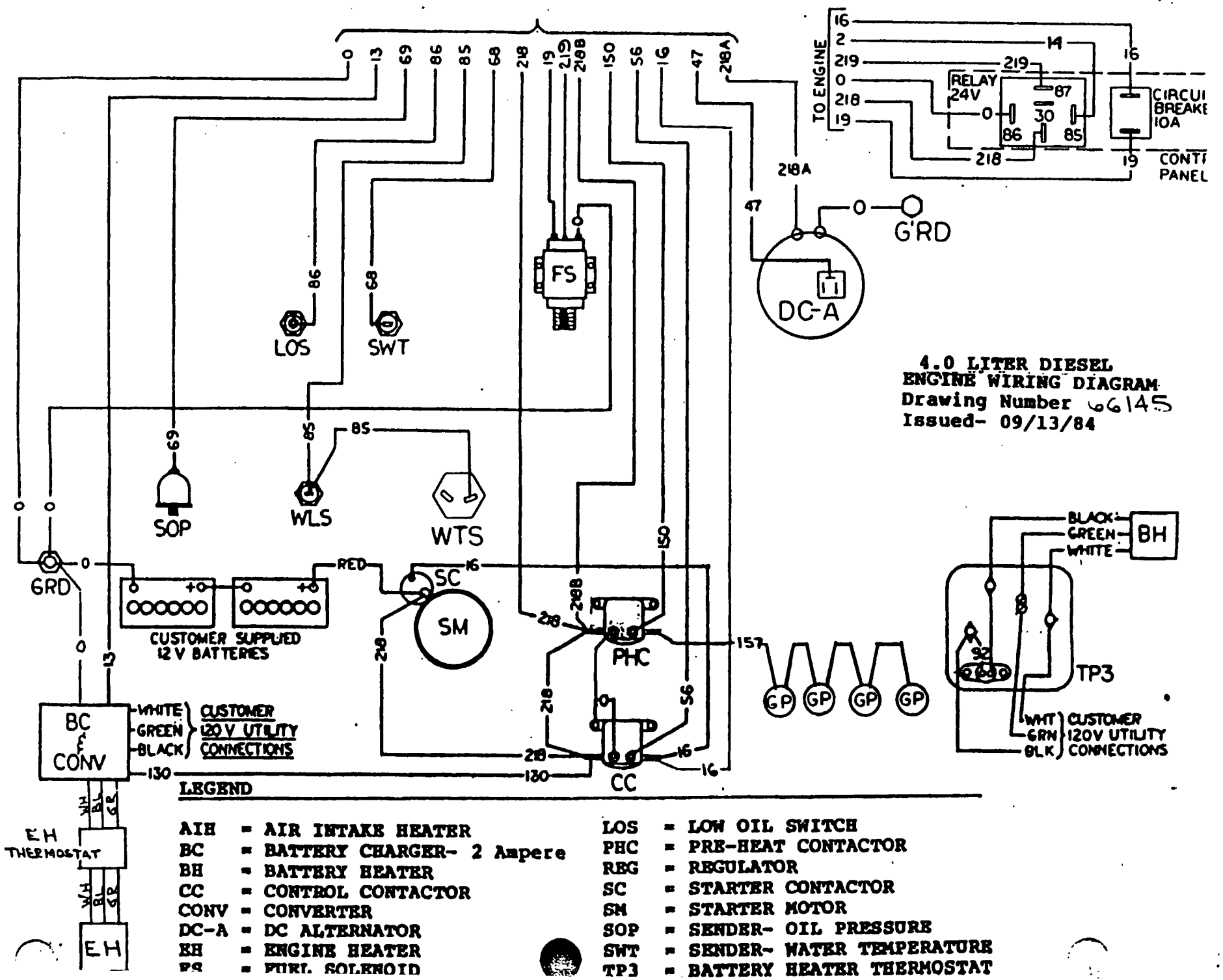
LEGEND

AIH = AIR INTAKE HEATER
AM = AMMETER- BATTERY CHARGER
BC = BATTERY CHARGER
BH = BATTERY HEATER
CB7 = CIRCUIT BREAKER- 24V. SOLENOID
CC = CONTROL CONTACTOR
CONV = 12 V. CONVERTER
CR1 = CONTROL RELAY- FIELD BOOST
CR2 = CONTROL RELAY- 24 V.
D = DIODE
DC-A = DC ALTERNATOR
DC-AM= DC AMMETER
EH = ENGINE HEATER
FS = FUEL SOLENOID
GP = GLOW PLUG
GRD = GROUND
HEI = HIGH ENERGY IGNITION
HR = HEATER RELAY
OB = OUTLET BOX
PHC = PRE-HEAT CONTACTOR
R1 = RESISTOR- 10 Ohm, 12 Watt
SC = STARTER CONTACTOR
SM = STARTER MOTOR
SW4 = SWITCH- PRE-HEAT
TP3 = BATTERY HEATER THERMOSTAT



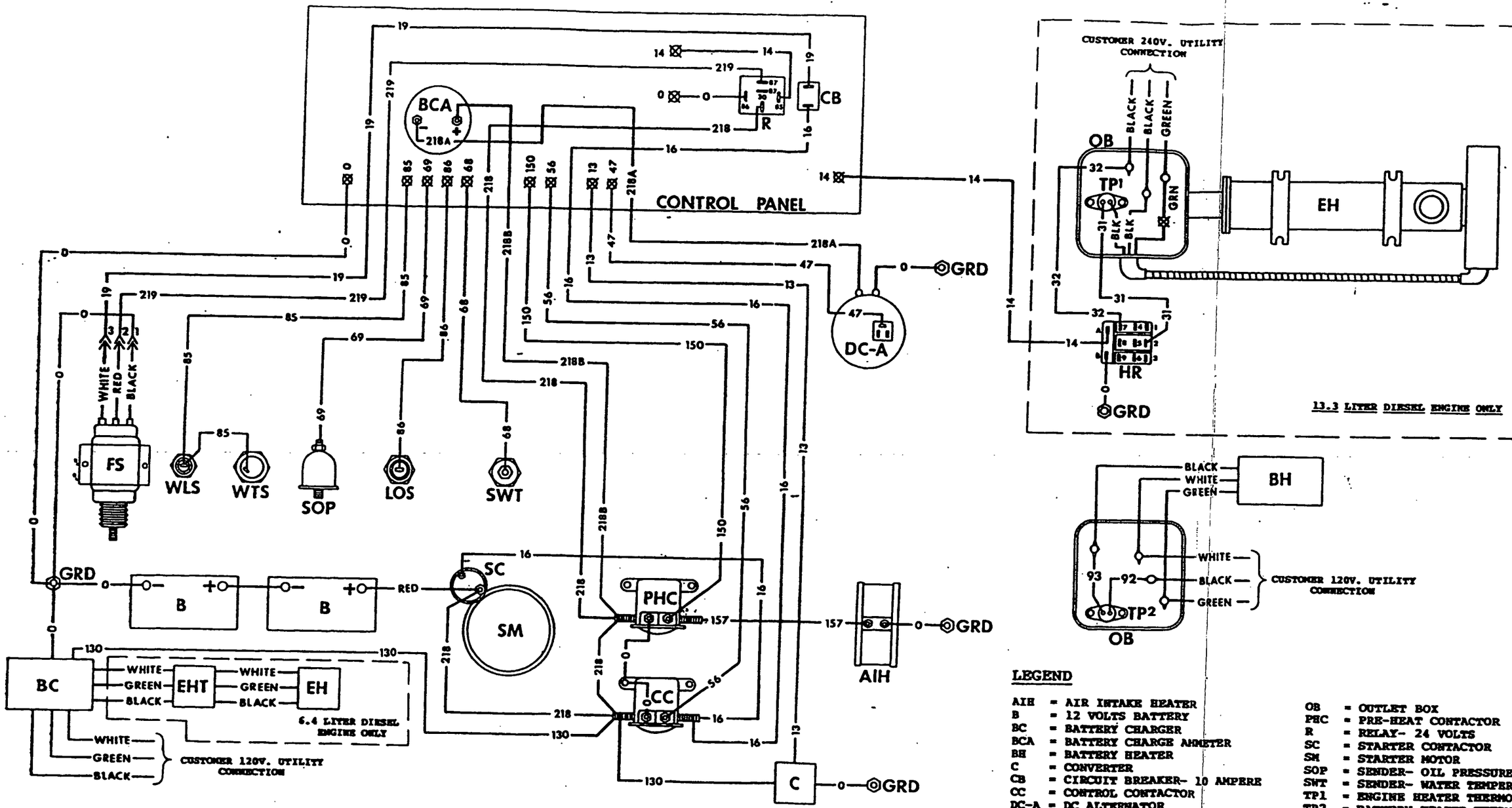
13 3 LITER ONLY

SCHEMATIC
Drawing Number
Sheet 3 of 4
Issued- 06/04/84
File #10-84.5



LEGEND

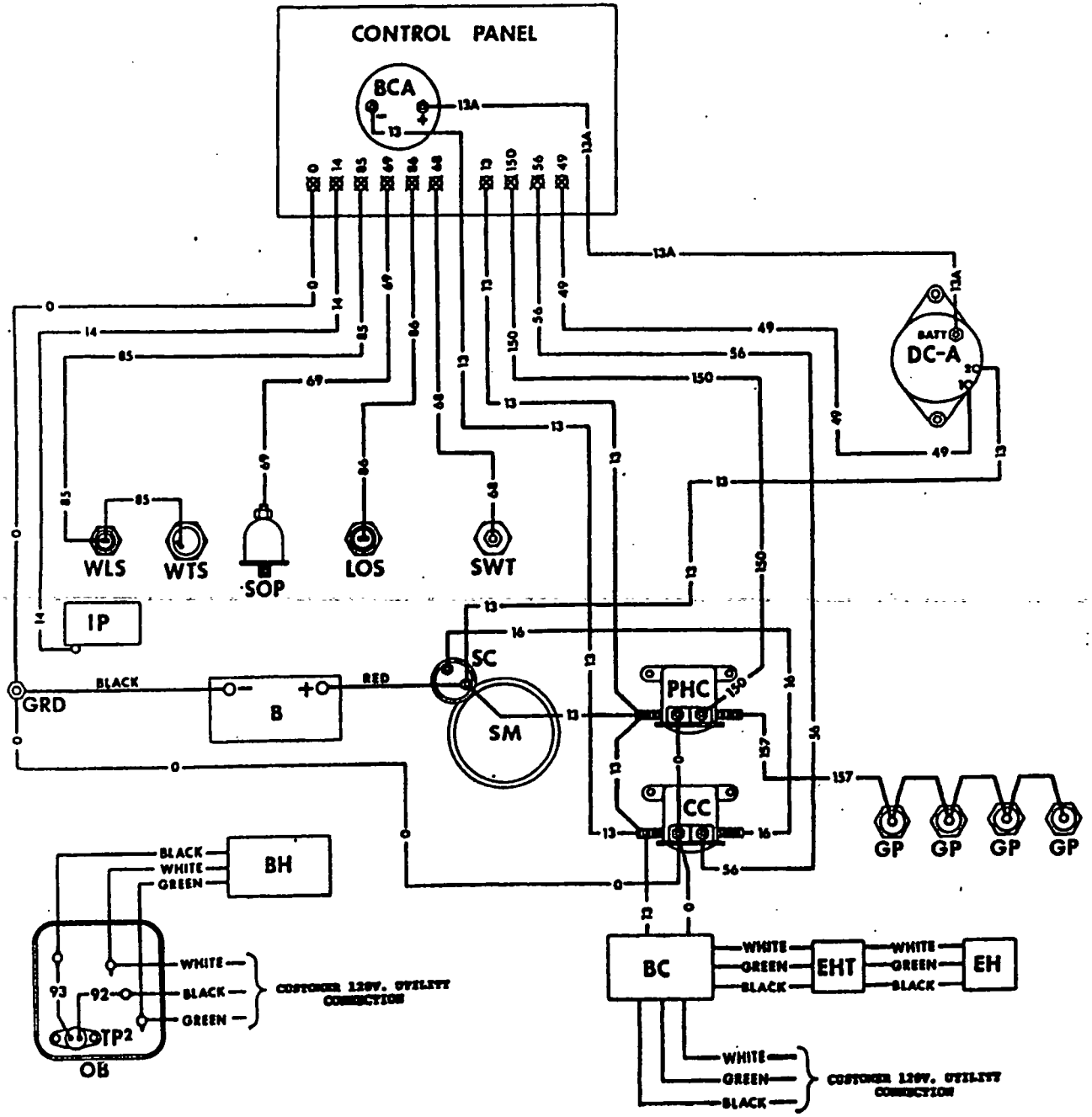
AIH	= AIR INTAKE HEATER	LOS	= LOW OIL SWITCH
BC	= BATTERY CHARGER- 2 Ampere	PHC	= PRE-HEAT CONTACTOR
BH	= BATTERY HEATER	REG	= REGULATOR
CC	= CONTROL CONTACTOR	SC	= STARTER CONTACTOR
CONV	= CONVERTER	SM	= STARTER MOTOR
DC-A	= DC ALTERNATOR	SOP	= SENDER- OIL PRESSURE
EH	= ENGINE HEATER	SWT	= SENDER- WATER TEMPERATURE
FS	= FUEL SOLENOID	TP3	= BATTERY HEATER THERMOSTAT



LEGEND

AIH	= AIR INTAKE HEATER	OB	= OUTLET BOX
B	= 12 VOLTS BATTERY	PHC	= PRE-HEAT CONTACTOR
BC	= BATTERY CHARGER	R	= RELAY- 24 VOLTS
BCA	= BATTERY CHARGE AMMETER	SC	= STARTER CONTACTOR
BH	= BATTERY HEATER	SM	= STARTER MOTOR
C	= CONVERTER	SOP	= SENDER- OIL PRESSURE
CB	= CIRCUIT BREAKER- 10 AMPERE	SWT	= SENDER- WATER TEMPERATURE
CC	= CONTROL CONTACTOR	TP1	= ENGINE HEATER THERMOSTAT
DC-A	= DC ALTERNATOR	TP2	= BATTERY HEATER THERMOSTAT
EH	= ENGINE HEATER	WLS	= WATER LEVEL SENSOR
EHT	= ENGINE HEATER THERMOSTAT	WTS	= WATER TEMPERATURE SWITCH
FS	= FUEL SHUTOFF SOLENOID		= WIRE NUT
GRD	= GROUND		= SCREW TERMINAL
HR	= HEATER RELAY- ENGINE		
LOS	= LOW OIL SWITCH		

ENGINE WIRING DIAGRAM
6.4 & 13.3 Liter Diesel Engine
Drawing Number 67021



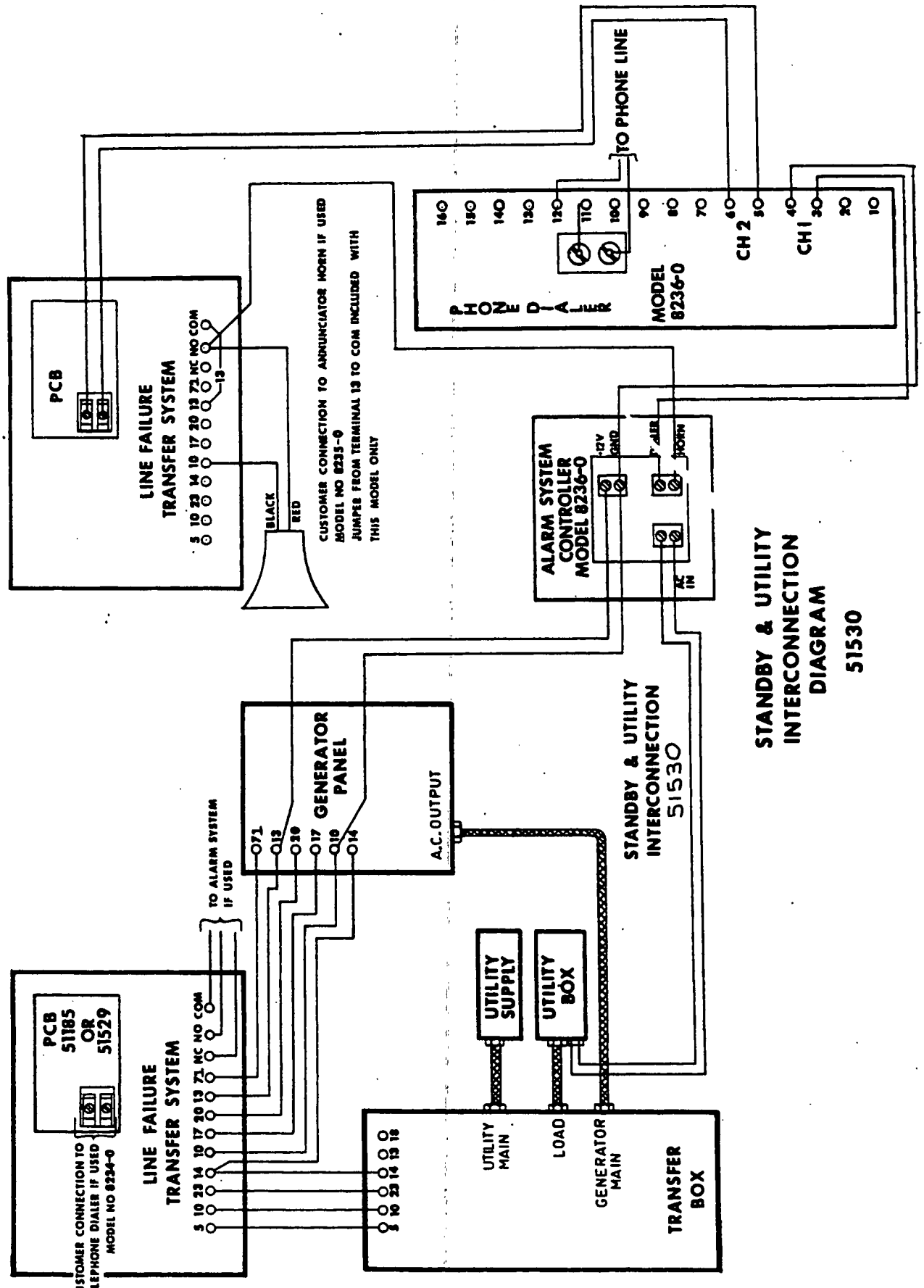
LEGEND

B = 12 VOLTS BATTERY
BC = BATTERY CHARGER
BCA = BATTERY CHARGE AMMETER
BH = BATTERY HEATER
CC = CONTROL RELAY
DC-A = DC ALTERNATOR
EH = ENGINE HEATER
EHT = ENGINE HEATER THERMOSTAT
GRD = GROUND
IP = INJECTION PUMP
LOS = LOW OIL SWITCH
OB = OUTLET BOX
PHC = PRE-HEAT CONTACTOR
SC = STARTER CONTACTOR
SM = STARTER MOTOR
SOP = SENDER- OIL PRESSURE
SWT = SENDER- WATER TEMPERATURE
TP2 = BATTERY HEATER THERMOSTAT
WLS = WATER LEVEL SENSOR
WTS = WATER TEMPERATURE SWITCH

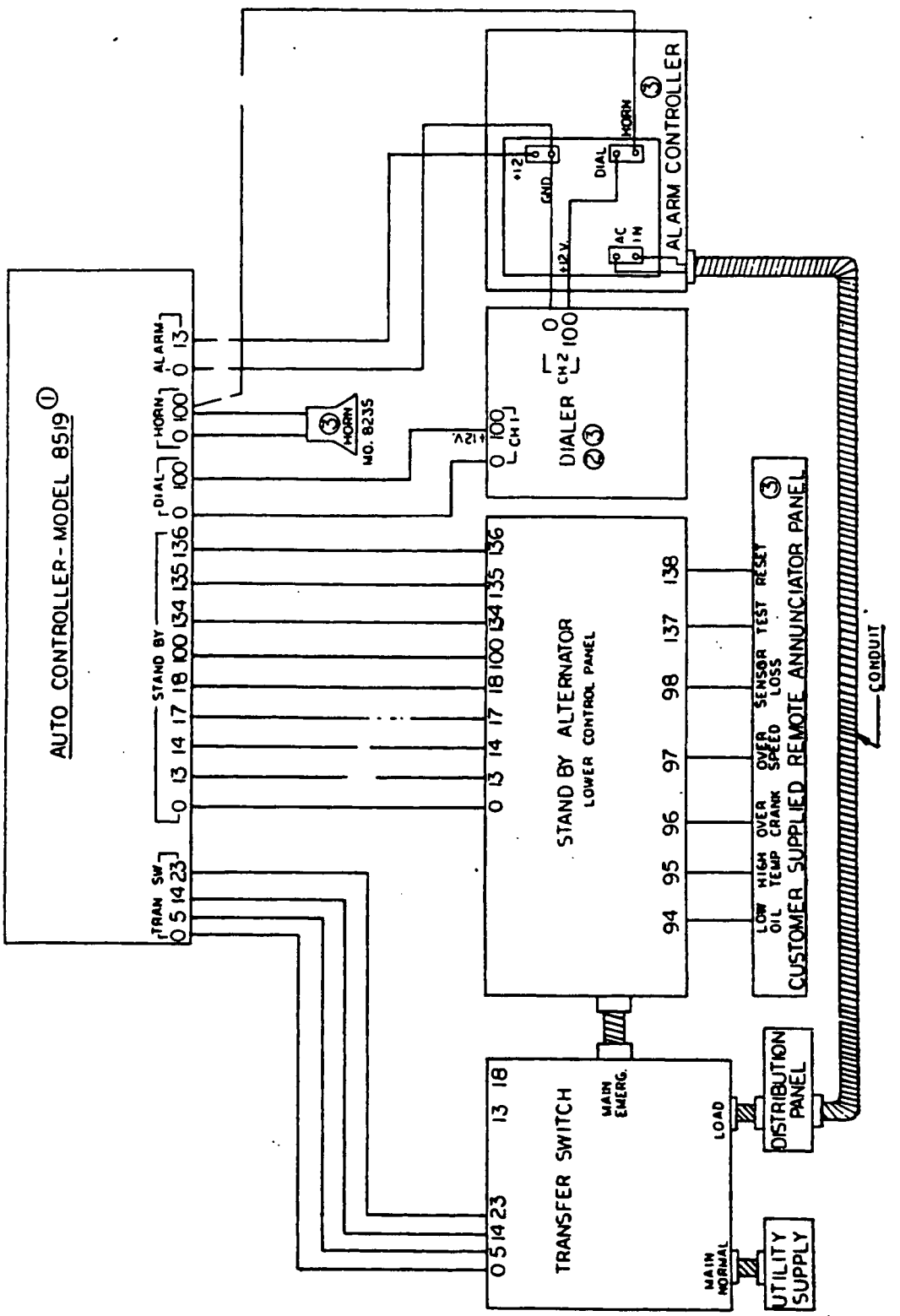
⊠ = SCREW TERMINAL

ENGINE WIRING DIAGRAM
Drawing Number 68440
Issued- 01/20/8
File #10-86.1

SECTION 1.9 - INTERCONNECTION DIAGRAM- EARLY MODELS 6301/6919 CONTROLLER



SECTION 1.10- INTERCONNECTION DIAGRAM- THE MODEL 8519 AUTOMATIC CONTROLLER



NOTES

1. Controller may be integral part of transfer switch in which case transfer switch connections to controller are factory made.
2. See particular model purchased.
3. Options - Not required for minimum system configuration.

PART 2

STANDBY GENERATOR FAMILIARIZATION

Section 2.1 - **GENERAL INFORMATION**
- 2.1.1 - Introduction
- 2.1.2 - Safety
- 2.1.3 - Typical Manually Operated Standby Electric Power System
- 2.1.4 - Typical Automatically Controlled Standby Power System

Section 2.2 - **AC GENERATOR OPERATIONAL ANALYSIS**
- 2.2.1 - General
- 2.2.2 - Electromagnetic Induction
- 2.2.3 - Operational Analysis- Direct Excited Units
- 2.2.4 - Operational Analysis- Brushless Generator Units
- 2.2.5 - Generator Operating Speeds
- 2.2.6 - Thyristor or SCR Controlled Rectifier Loading
- 2.2.7 - Paralleling Basics

Section 2.3 - **AC CONNECTION SYSTEMS**
- 2.3.1 - General
- 2.3.2 - Single Phase, 3-Wire AC Connection System
- 2.3.3 - 3-Phase Connection Systems
- 2.3.4 - 3-Phase, 12 Lead, High Wye System
- 2.3.5 - 3-Phase, 12 Lead, Low Wye System
- 2.3.6 - 3-Phase, 12-Lead, High Delta System
- 2.3.7 - 3-Phase, 12-Lead, Low Delta System
- 2.3.8 - 3-Phase, 12-Lead, Zig Zag System

Section 2.4 - **OPERATIONAL ANALYSIS- DC CONTROL SYSTEM** (Units Manufactured Prior to August 1984)
- 2.4.1 - Introduction
- 2.4.2 - Circuit Condition- Engine Not Running
- 2.4.3 - Pre-Heat Condition- Diesel Engine Units Only
- 2.4.4 - Circuit Condition- Manual Cranking Operation
- 2.4.5 - Circuit Condition- Automatic Cranking Operation
- 2.4.6 - Circuit Condition- Startup and Running
- 2.4.7 - Circuit Condition- Normal Manual Shutdown
- 2.4.8 - Circuit Condition- Normal Automatic Shutdown
- 2.4.9 - Circuit Condition- Annunciated Fault Shutdown (Options "A" and "B" Units)
- 2.4.10- Circuit Condition- Annunciated Fault Shutdown (Option "C" Units)

Section 2.5 - **OPERATIONAL ANALYSIS- DC CONTROL SYSTEMS** (Units Manufactured After August 1984)
- 2.5.1 - Introduction
- 2.5.2 - Circuit Condition- Engine Not Running
- 2.5.3 - Circuit Condition- Pre-Heat (Diesel Units Only)
- 2.5.4 - Circuit Condition- Manual Cranking
- 2.5.5 - Circuit Condition- Automatic Cranking
- 2.5.6 - Circuit Condition- Startup and Running
- 2.5.7 - Circuit Condition- Normal Manual Shutdown
- 2.5.8 - Circuit Condition- Normal Automatic Shutdown
- 2.5.9 - Circuit Condition- Annunciated Fault Shutdown (Option "A" and "B" Units)
- 2.5.10- Circuit Condition- Annunciated Fault Shutdown (Option "C" Units)

SECTION 2.1 - GENERAL INFORMATION

2.1.1- INTRODUCTION

This DIAGNOSTIC REPAIR MANUAL has been prepared especially for the purpose of familiarizing service and repair personnel with Generac standby generator set operating fundamentals, basic electrical circuitry, troubleshooting, testing and adjustments. Keep the Manual in a safe place and refer to it as often as necessary.

Standby generator sets manufactured prior to August 1984, and equipped with solid state circuitry permitting automatic engine startup and stopping (when properly interconnected with an automatic CONTROLLER or a Transfer Switch with integral automatic Controller) required a "9-Wire" interconnection system between the generator set and the controller or automatic transfer switch. Standby generator sets manufactured after August 1984 having automatic start/stop capability (when properly interconnected with a "GTS" style automatic Transfer Switch) require only TWO interconnecting wires between the Generator and Transfer Switch. See Sections 1.9 through 1.13 in this Manual.

Every effort has been expended to ensure that the information contained herein is both accurate and current. However, Generac Corporation reserves the right to change, alter, or otherwise improve its products at any time without advance notice.

2.1.2- SAFETY

Before working on or around any standby generator set (or related equipment), be sure to study the SAFETY RULES at the front of this Manual carefully. All SAFETY RULES must be fully complied with, to help avoid personal injury or damage to equipment and/or property. The standby generator set (as well as some related installed equipment) is a source of dangerously high voltages which requires the use of extreme caution when working on around equipment.

The following definitions apply to DANGER, CAUTION and NOTE blocks found throughout this Manual:-

DANGER!
Under this heading will be found servicing, testing, operating, repair and adjustment procedures that, if not fully complied with, may result in personal injury or death.

CAUTION!
Under this heading will be found servicing, testing, operating, repair and adjustment procedures that, if not fully complied with, may result in damage to equipment.

NOTE
Under this heading will be found explanatory statements that require special emphasis.

2.1.3- TYPICAL MANUALLY OPERATED STANDBY ELECTRIC POWER SYSTEM (Figure 2.1-A)

The standby generator set, along with its related equipment, may be installed outdoors, outdoors on the roof of a structure, inside the room of a structure, or inside a detached structure. Figure 2.1-A illustrates a TYPICAL outdoor installation of an Option "A" generator set. In the event of a failure of the NORMAL (Utility) electric power source, Option "A" units must be cranked and started manually (electrically) and loads must be transferred to the EMERGENCY (Generator) power source manually. When the NORMAL power is restored above an acceptable level, the Transfer Switch must again be actuated manually and the generator must be shut down manually.

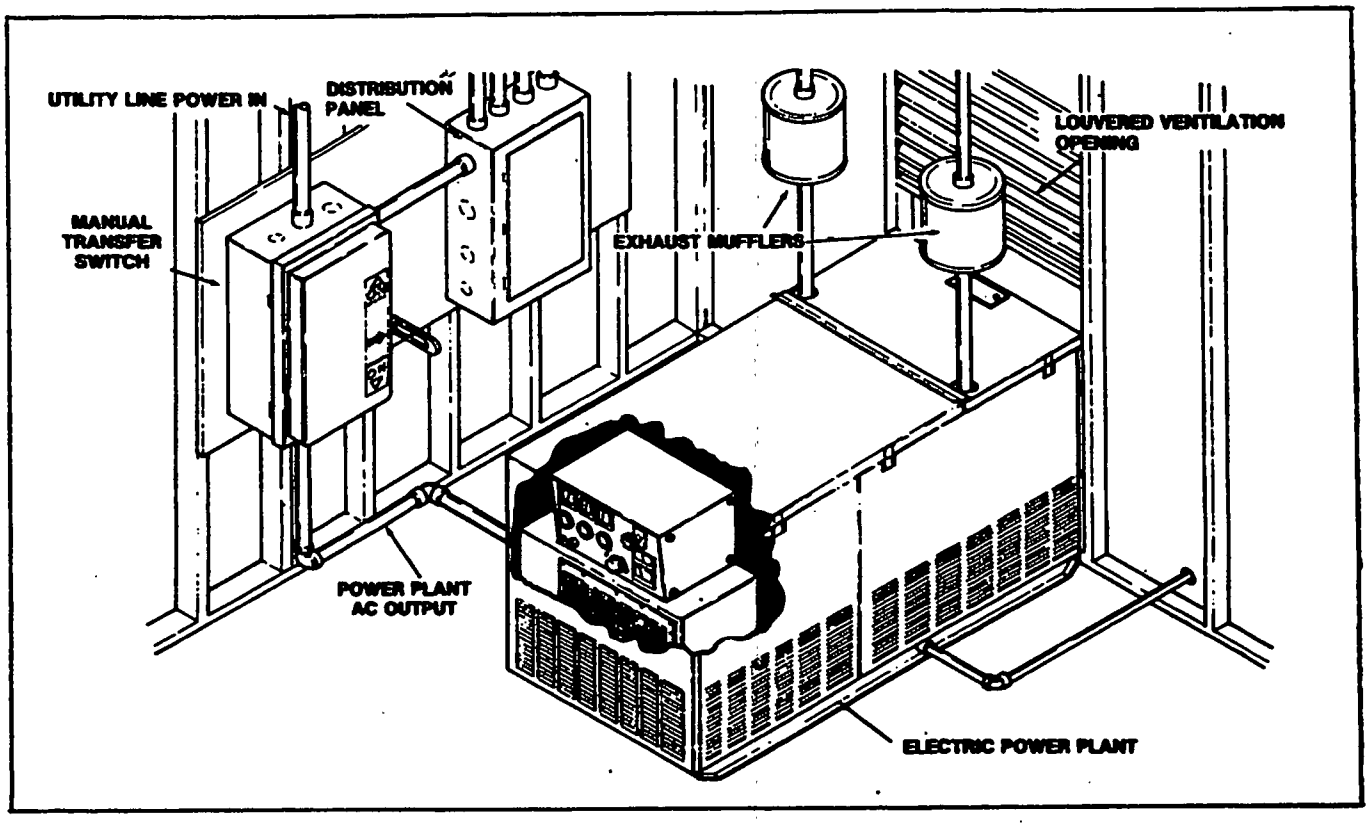


Figure 2.1-A. A TYPICAL Manually Operated Standby Power System

2.1.4- TYPICAL AUTOMATICALLY CONTROLLED STANDBY POWER SYSTEM (Figure 2.1-B)

Option "B" and "C" generator sets, when installed in conjunction with an automatic controller or a transfer switch with integral controller, will crank and start automatically, as well as shut down automatically. Figure 2.1-B shows a TYPICAL installation in conjunction with a "GTS" style automatic transfer switch.

Solid state circuits in the "GTS" transfer switch constantly monitor the NORMAL (Utility) power source voltage. Should that source voltage drop below an acceptable level and remain at such an unacceptable level for a pre-set tgime period, the transfer switch will signal thje generator engine to crank and start. Then, after a pre-set generator

warmup, the transfer switch will automatically transfer connected electrical loads to the EMERGENCY (generator) power source. The transfer switch continues to monitor NORMAL power source voltage and, when that voltage is restored above an acceptable level, will transfer loads back to that source. After a pre-set engine "cool-down" period, the transfer switch will signal the generator to shut down.

NOTE
An INSTALLATION MANUAL FOR STANDBY ELECTRIC POWER SYSTEMS is available from Generac Corporation. To order, specify Manual Part Number 46622.

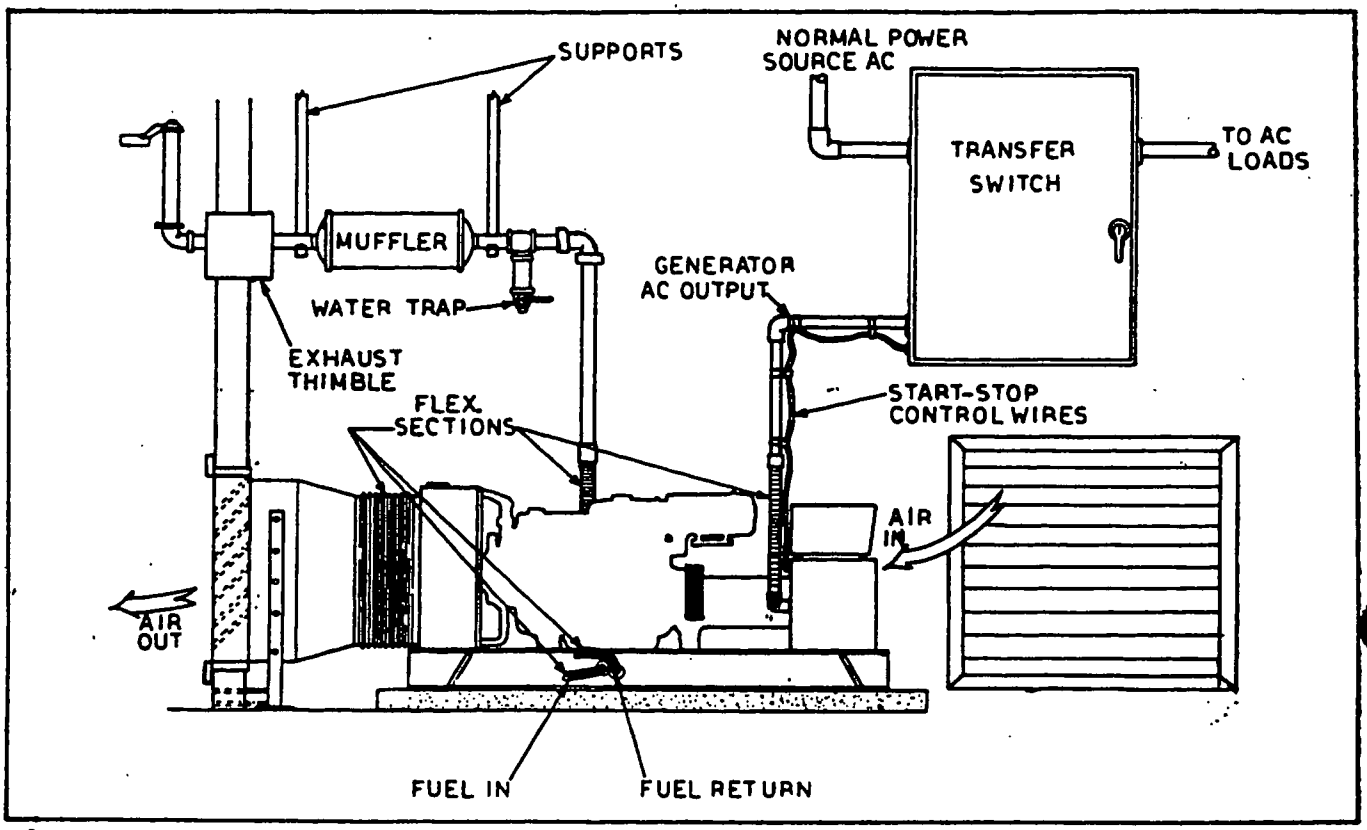


Figure 2.1-B. TYPICAL Installation of an Automatic Standby Electric System Inside a Detached Structure

SECTION 2.2 - AC GENERATOR OPERATIONAL ANALYSIS

2.2.1- GENERAL

This section provides a discussion of the basic operating fundamentals for Generac revolving field AC generators. An operational analysis for both direct excited brush type and brushless AC generators is included.

For additional information pertaining to basic electrical theory, the following booklets are avilable from Generac Corporation:-

1. Manual Part Number 46941, BASIC ELECTRICITY
2. Manual Part Number 46961, CONTROLLING ELECTRICITY

2.2.2- ELECTROMAGNETIC INDUCTION (Figure 2.2-A)

Movement of a magnetic field so that its lines of magnetic flux cut through a series of stationary windings causes a VOLTAGE or ELECTRO-MOTIVE FORCE (EMF) to be induced into the stationary windings. The rotating magnetic field is called a ROTOR, while the stationary wire windings are called the STATOR. The amount of voltage induced into the stationary STATOR windings is directly proportional to (a) the number of turns of wire in the Stator, and (b) the intensity (strength) of the rotating magnetic field. When an electrical load is connected across the stationary Stator windings so as to complete the circuit, current will flow through the circuit.

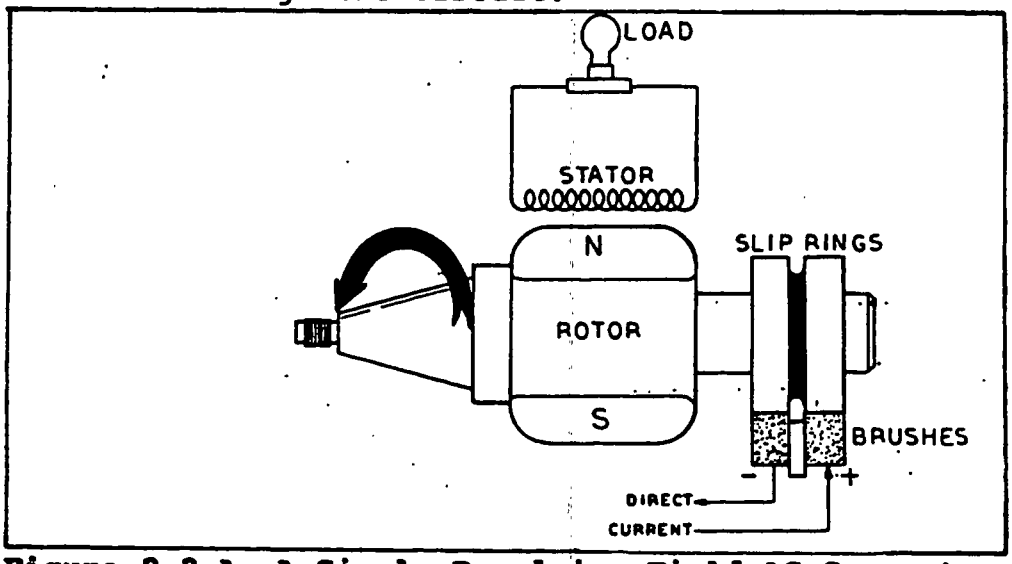


Figure 2.2-A. A Simple Revolving Field AC Generator

See Figure 2.2-A. As the ROTOR rotates, its lines of magnetic flux cut through the stationary STATOR windings, to induce a voltage into those windings that is proportional to the strength of the magnetic field. Conversely, current flow through a wire or coil of wires will create a magnetic field around that wire or coil. The strength or concentration of the created magnetic field is proportional to the amount of current flowing through the wire or coil. The following statement may then be made:-

1. By regulating current flow through the ROTOR windings, the strength or concentration of its magnetic field can be regulated, and
2. By regulating the strength or concentration of the Rotor's magnetic field, the voltage induced into the STATOR windings can be regulated.

2.2.3- OPERATIONAL ANALYSIS- DIRECT EXCITED UNITS (Figure 2.2-B)

During engine startup, as soon as the generator engine starts, a +DC voltage is delivered to the ROTOR via a FIELD BOOST Circuit (Wire #14, a Field Boost DIODE, and a Field Boost RESISTOR). Current flows across the positive (+) BRUSH and SLIP RING, through the ROTOR windings, and to ground through the negative (-) BRUSH and SLIP RING. The "field boost" current flow through the Rotor windings creates a magnetic field around the Rotor that is added to the normal RESIDUAL Rotor magnetism. This helps to ensure instant "pickup" of Stator AC power output even before the Rotor has come up to speed and (in effect) "flashes the field" on every start.

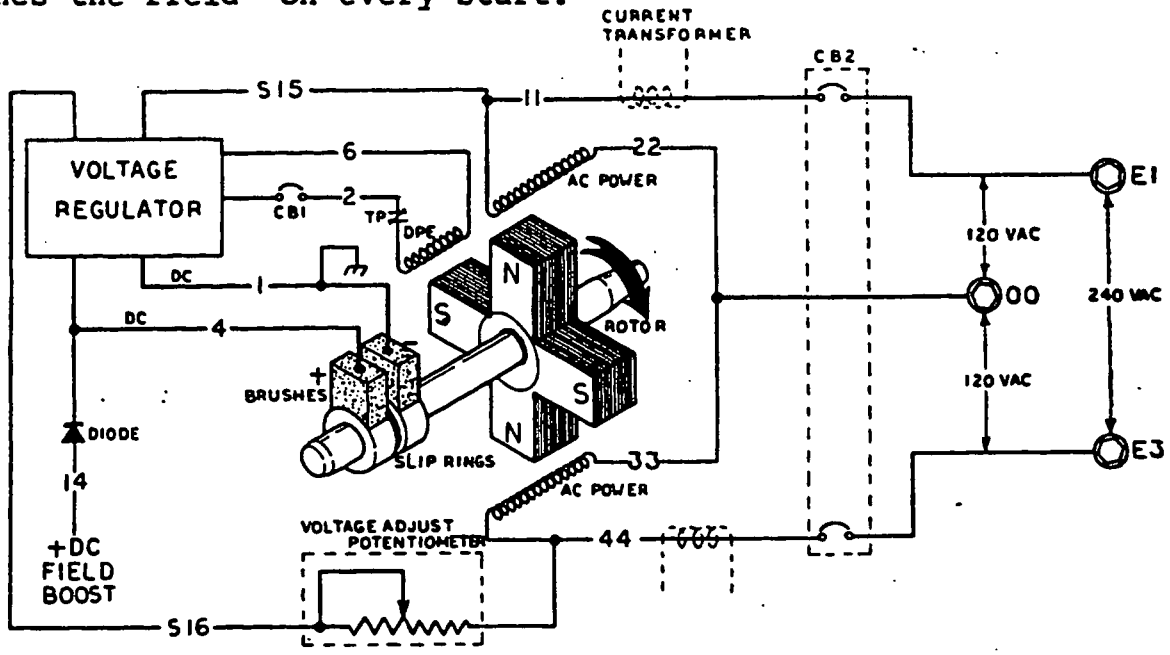


Figure 2.2-B. Operating Diagram- Direct Excited Brush Type AC Generators

The ROTOR is essentially an ELECTROMAGNET. Its revolving lines of magnetic flux cut through the stationary STATOR windings, to induce a voltage into those windings that is proportional to the strength of the revolving magnetic field. The voltage induced into the Stator AC POWER Windings is available at customer connection terminals E1, E3 and 00 and to any loads connected to those terminals.

Induced voltage from the Stator EXCITATION (DPE) windings is delivered to the VOLTAGE REGULATOR, via a THERMAL PROTECTOR (TP) and a FIELD CIRCUIT BREAKER (CB1). The Regulator converts the alternating current output of the DPE Windings to a direct current (DC) and, based on sensing signals from Wires S15 and S16, regulates the DPE Winding output to the Rotor. Thus, the VOLTAGE REGULATOR regul.tes or controls the Rotor's magnetic field strength and (in turn) the voltage induced into the Stator Windings.

A VOLTAGE ADJUST POTENTIOMETER, on the Meter and Control Panel, permits the operator to "fine adjust" the regulated Stator AC output voltage by biasing the sensing signal to the Regulator.

The Stator AC POWER OUTPUT leads pass through CURRENT TRANSFORMERS. Current flow through those leads induces a voltage and current flow into the Transformers, for operation of a panel-mounted AC AMMETER. Two Current Transformers are required for single phase systems, three for 3-phase systems.

2.2.4- OPERATIONAL ANALYSIS- BRUSHLESS GENERATOR UNITS (Figure 2.2-C, 2.2-D)

As a general rule, brushless generator units incorporate a Stator Excitation (DPE) winding. Some units, however, that are powered by the 13.3 liter diesel engine do NOT have an Excitation (DPE) winding.

A. **Brushless Generators with Stator DPE Winding** (Figure 2.2-C):- Rotor rotation induces a voltage into the STATOR AC POWER and DPE windings. Stator AC Power winding output is delivered to customer load connection terminals E1, E2 and 00. The AC output from the DPE winding is delivered to the VOLTAGE REGULATOR, via a THERMAL PROTECTOR (TP) and a FIELD CIRCUIT BREAKER. The Voltage Regulator rectifies the DPE Winding AC output and, based on sensing signals from leads S15 and S16, regulates the DPE output current to a stationary EXCITER FIELD. Regulated and rectified DPE winding current flow through the Exciter Field creates a magnetic field that is proportional to the regulated current flow. Rotation of an EXCITER ARMATURE through that magnetic field causes a voltage to be induced into the Exciter Armature that is proportional to the strength of the Exciter Field's magnetic lines of flux. From the Armature, current flows through DIODES and then to the Generator ROTOR, to create a magnetic field around the Rotor. Rotor rotation then induces a voltage into the Stator AC POWER and DPE Windings.

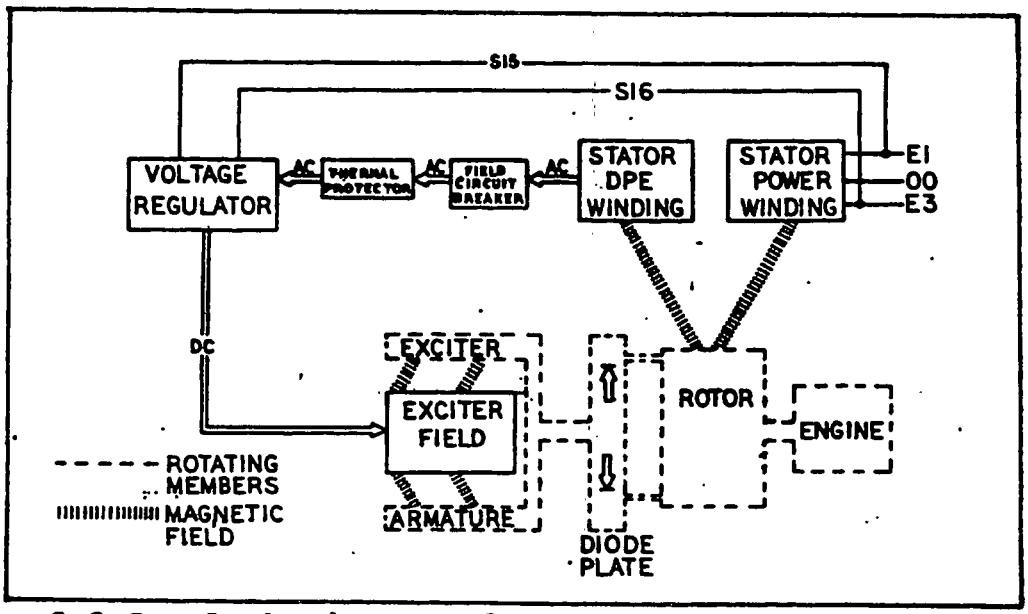


Figure 2.2-C. Block Diagram of Brushless Generator with Stator DPE Winding

B. **Brushless Units without Stator DPE Windings** (Figure 2.2-D):- These units function similarly to units having a DPE winding. However, in this case, the Voltage Regulator rectifies and regulates a portion of the Stator AC POWER winding output for delivery to the EXCITER FIELD. The primary winding of a TRANSFORMER is connected in series with the AC Power winding output to the Regulator. The Transformer's SECONDARY winding output is delivered to the Voltage Regulator. Connection of the Transformer in series or parallel ensures that the correct sensing voltage is delivered to the Regulator.

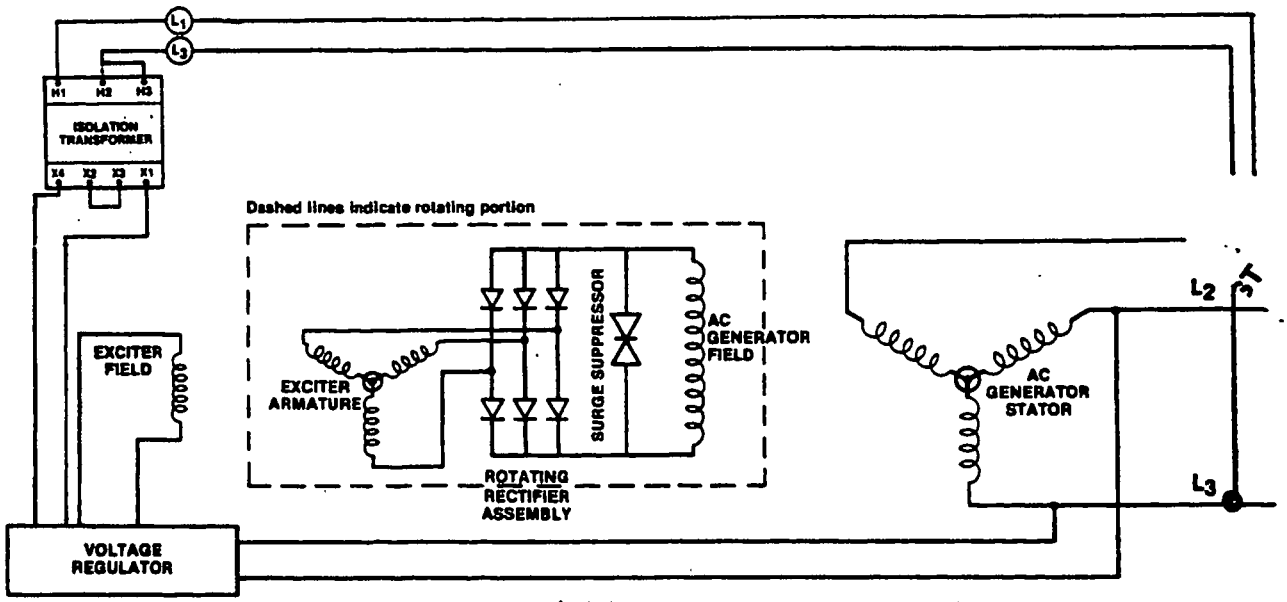


Figure 2.2-D. Block Diagram of Brushless AC Generator without a DPE Winding

2.2.5- GENERATOR OPERATING SPEEDS

The required operating speed of a generator's ROTOR (Revolving Field) is determined by (a) the required AC frequency in HERTZ, and (b) the number of north and south poles in the ROTOR.

A. **Units Having a 2-Pole Rotor**:- Rotors having a single north and a single south pole are called 2-pole Rotors. These units must be driven at 3600 rpm to produce an AC frequency of 60 Hertz, at 3000 rpm to produce a 50 hertz AC frequency.

B. **Units with 4-Pole Rotor**:- Units with a 4-pole rotor (2 NORTH and 2 SOUTH magnetic poles) must be driven at 1800 rpm for a 60 Hertz AC output, at 1500 rpm for a 50 hertz AC output.

C. **Units with Gearbox and Gas Fuel System**:- Some generators are equipped with a GEARBOX. The Gearbox provides increased engine power output by using the higher horsepower available at the higher engine operating speeds. Gearbox units with gaseous fuel systems use a Gearbox having a gear ratio of 1.66 to 1. That is, the engine must operate at 3000 rpm to drive the Rotor at 1800 rpm; at 2490 rpm to drive the Rotor at 1500 rpm.

D. **Units with Diesel Engine and Gearbox**:- Gearboxes used with a diesel engine have a gear ratio of 1.41 to 1. That is, the engine must operate at 2550 rpm to operate the Rotor at 1800 rpm (60 hertz units);

at 2115 rpm to operate the Rotor at 1500 rpm (50 hertz units).

2.2.6- THYRISTOR OR SILICONE CONTROLLED RECTIFIER LOADING

Solid state control devices which utilize THYRISTORS or SILICONE CONTROLLED RECTIFIERS (SCR's) can introduce high frequency harmonics which adversely affect or distort the normal generator waveform. This creates additional heat in the generator Rotor and Stator, and can lead to overheating. Some devives which might use thyristors or SCR's include variable frequency induction motor controls, precision motor speed controls, no-break powered battery chargers, etc.

Control devices with thyristors or SCR's may present problems to standby generators or to any limited power buss system. Such problems are not limited to the generator itself, but may affect solid state control devices, the equipment it controls, other associated loads, monitoring devices, or any number of combinations overt the entire system.

Where THYRISTOR or SCR loads are to be connected, it is important that the control manufacturer, the generator manufacturer, and the systems engineer work together to ensure proper selection of compoinents. It is recommended that Generac be contacted for application assistance when necessary.

2.2.7- PARALLELING BASICS

The following information is only the basic criteria that must be met before two generator units can be paralleled. The information is NOT meant to be specific instructions for paralleling operations.

A. **Voltage Regulators must have paralleling provisions**:- The Voltage Regulator controls generator AC output voltage and the reactive power supplied by the generator. When two or more generators are to be operated in parallel, the regulator must have paralleling provisions (either internally, or external to the Regulator). These paralleling provisions must permit the Regulator to control the reactive or VAR load while operating in parallel. A separate paralleling current transformer is required to sense the reactive current and signal the Voltage Regulator.

B. **The Engine Governor Controls** must have special paralleling and droop provisions to permit parallel operations with other machines.

C. **Switchgear**:- Additional relays and breaker controls are needed, to ensure safe, trouble free parallel operations. Reverse power relays may be used to monitor the direction of power flow, to ensure that the generator is delivering power and not receiving it. These power relays control breakers which act to connect and disconnect the generator from the load. The total system can include over-voltage, over-current, and under frequency protection. Various assorted switchgear, from manual switch gear to micro-processors, may be used. The amount of control gear and the level of sophistication will be determined by the requirements of the particular application.

In addition to the preceding, the following apply to paralleling operations:-

1. Voltage and frequency must be the same for all generators, with voltages in phase.
2. The voltage regulation characteristics of the individual generators should be similar.
3. The generators must have the same phase rotation.
4. The driving engines should have the same speed regulation characteristics- governors must all be adjusted to provide the same speed regulation.
5. Prior to attempting a paralleling operation, each generator should be started, operated and adjusted as individual units.

SECTION 2.3 - AC CONNECTION SYSTEMS

2.3.1- GENERAL (Table 2.3-A)

An AC CONNECTION PANEL is provided on each generator set, for connection of customer load leads. Some connection panels may mount a terminal block for customer wiring connections, others may provide a main circuit breaker for that purpose. Customer connections inside the connection panel should be completed in accordance with the appropriate generator wiring diagram. Use the portion of the wiring diagram that applies to the specific generator voltage range and the number of leads required. Generally, the final voltage setting is established by adjusting the Voltage Regulator.

Generators are available in a wide variety of AC connection systems and rated voltages. Specific connection systems and voltages are specified at the time of purchase of the generator, by specifying a voltage CODE as listed in Table 2.3-A.

VOLTAGE CODE	RATED VOLTAGE	PHASE	FREQUENCY (HERTZ)	TYPE OF CONNECTION SYSTEM
A	120/240	1	60	3-Wire
B	120/208	3	60	Wye-Connected
C	240/416	3	60	Wye-Connected
D	120/240	3	60	Center Tapped Delta
F	139/240	3	60	Wye-Connected
G	120/208	3	60	12-Lead, Reconnectable, Broad Range
H	240/416	3	60	12-Lead, Reconnectable, Broad Range
J	120/240	3	60	12-Lead, Reconnectable, Broad Range
K	277/480	3	60	12-Lead, Reconnectable, Broad Range
L	139/240	3	60	12-Lead, reconnectable, Broad Range
N	220	1	50	3-Wire
O	220/380	3	50	Wye-Connected
P	120/240	3	50	Center Tapped Delta

Table 2.3-A. Types of AC Connection Systems

2.3.2- SINGLE PHASE, 3-WIRE AC CONNECTION SYSTEM (Figure 2.3-A)

Generac single phase generators employ a "3-Wire" AC connection system, consisting of two "hot" leads and a "neutral" lead. Two sets of stator windings are provided in these single phase units. Each stator winding provides a 120 VAC (60 Hertz units) or a 110 VAC (50 Hertz) output. When connected in series, the two stator windings supply a 240 VAC (60 Hertz) or 220 VAC (50 hertz) output. Wires #11 and #44 are the two hot leads, while the junction of Wires #22 and #33 form the neutral lead. Customer load leads are connected inside the AC connection panel at terminals E1 (hot), E3 (hot) and 00 (neutral). Connect 120 VAC (60 Hertz) or 110 VAC (50 Hertz) load leads across terminals E1 and neutral or E3 and neutral. Connect 240 VAC (60 Hertz) or 220 VAC (50 Hertz) load leads across terminals E1 and E3.

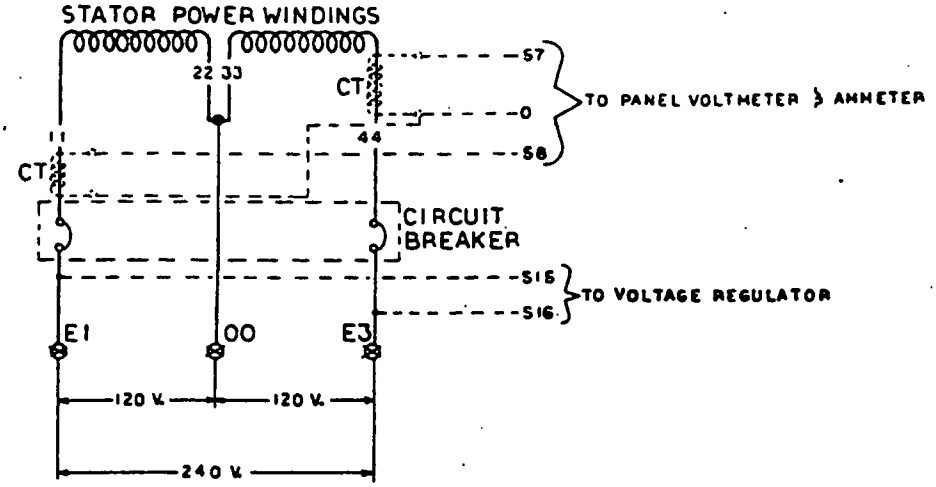


Figure 2.3-A. A Single Phase AC Connection System

2.3.3- 3-PHASE CONNECTION SYSTEMS

There are several advantages to a 3-phase system. Just a few of these advantages are listed below.

1. When the load is balanced in all 3 legs of a 3-phase circuit, instantaneous power is constant. This feature provides improved motor starting and running capabilities.
2. Current flow generated by a 3-phase generator produces a constant flux density, making the 3-phase system best for operating AC motors.
3. When a 3-phase stator is used in a generator, several different voltage values can be obtained from one system by reconnecting the system.

NOTE
Generators may have multiple, identically numbered stator AC output cables for each connection lead or terminal. When making connections to the load, all identically numbered cables must be connected together.

2.3.4- 3-PHASE, 12-LEAD, HIGH WYE SYSTEM (Figure 2.3-B)

These 12-lead, dual voltage units have 6 stator windings which do NOT have the connection of the 3 inner coils. Either 12 or 24 cables will come out of the generator. To obtain specific rated voltages, connect the cables as follows:-

NOTE
The following CHARTS lists wire/terminal numbers as T1, T2, etc. Wire/terminal numbers on the actual generators may hev either a "T" or an "S" prefix. Connections alone may not provide the specific voltage stated- final voltage settings are generally made by adjustment of the Voltage Regulator.

	VOLTAGE		CONNECT	L1	L2	L3	NEUTRAL
	L-L	L-N					
	380	219					
60	416	240	T10, T11, T12				
HZ	440	254					
	460	266	T4, T7				
	480	277		T1	T2	T3	T10,T11,T12
50	380	219	T5,T8				
HZ	400	231	T6,T9				
	416	240					

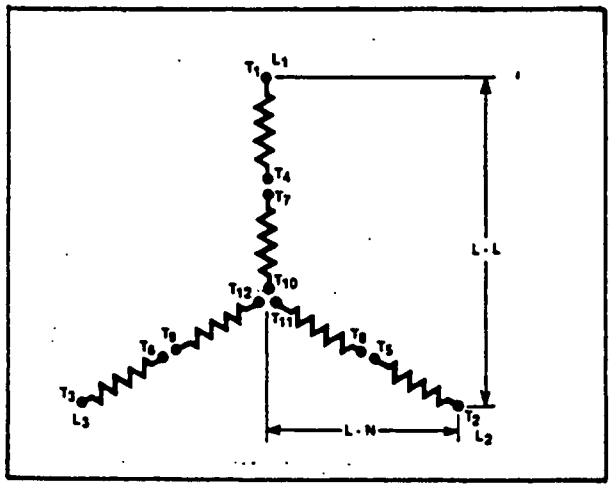


Figure 2.3-B. 3-Phase, 12-Lead, High Wye Connection System

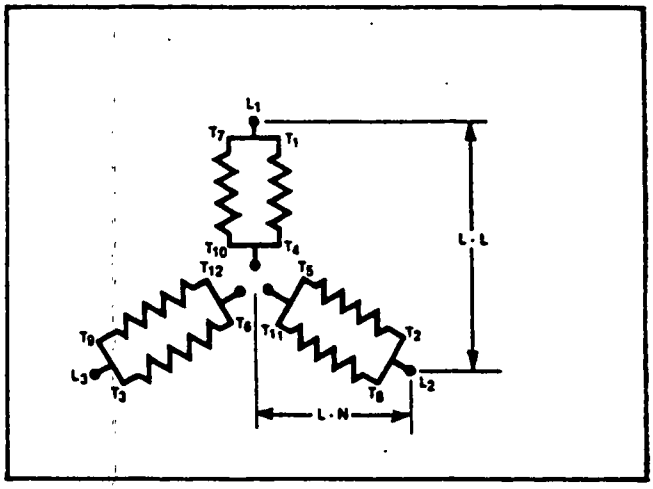


Figure 2.3-C. 3-Phase, 12-Lead, Low Wye Connection System

2.3.5- 3-PHASE, 12-LEAD, LOW WYE CONNECTION SYSTEM (Figure 2.3-C)

This system is similar to the HIGH WYE system, having six windings that do NOT have the connection of the 3 inner windings. Either 12 or 24 cables will come out of the Stator.

	VOLTAGE		CONNECT	L1	L2	L3	NEUTRAL
	L-L	L-N					
	190	110	T10,T11,T12				
60	208	120	T4,T5,T6				T10,T11,T12
HZ	220	127					
	230	133					
	240	139	T1,T7	T1	T2	T3	
50	190	110	T2,T8				T4,T5,T6
HZ	200	115					
	208	120	T3,T9				

2.3.6- 3-PHASE, 12-LEAD, HIGH DELTA SYSTEM (Figure 2.3-D)

	VOLTAGE					
	L-L	L-N	CONNECT	L1	L2	L3
60 HZ	240	120	T4,T7	T1	T2	T3
	277	139	T5,T8			
50 HZ	200	100	T6,T9			
	220	110	T1,T12			
	240	220	T2,T10			
			T3,T11			

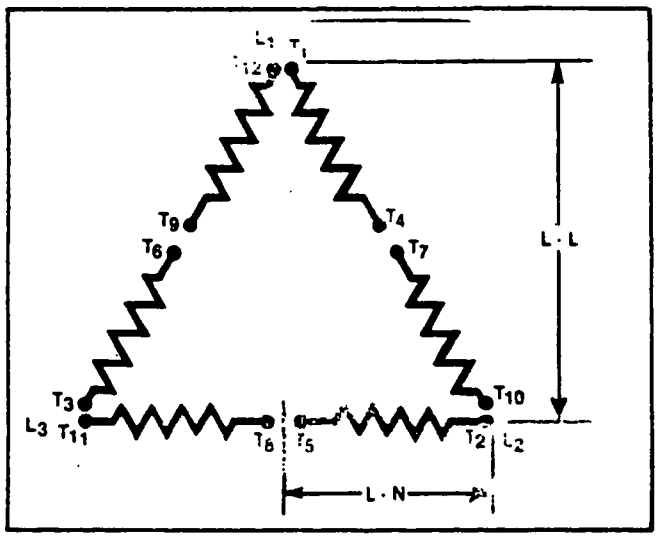


Figure 2.3-D. 3-Phase, 12-Lead, High Delta System

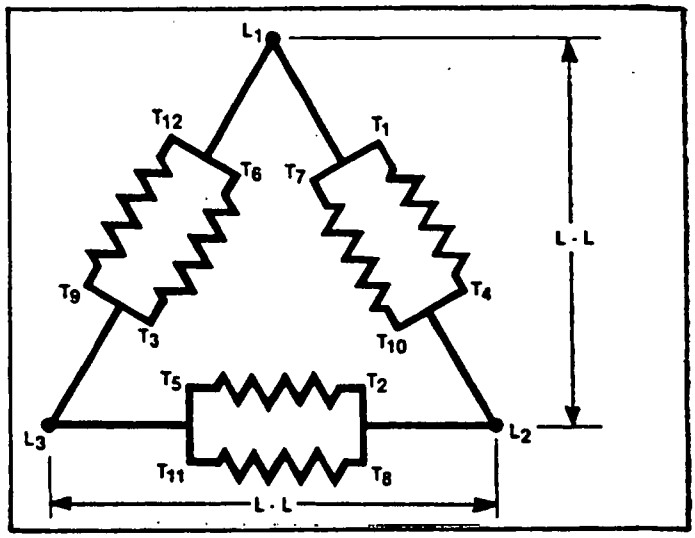


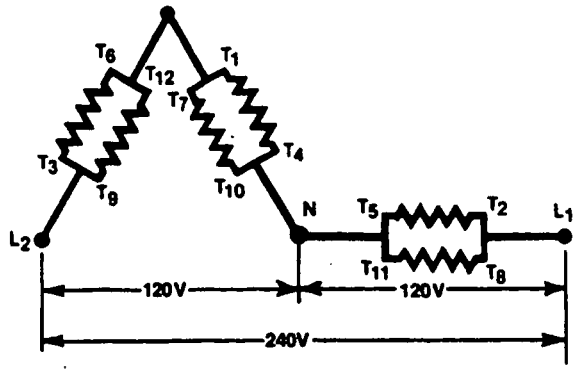
Figure 2.3-E. 3-Phase, 12-Lead, Low Delta System

2.3.7- 3-PHASE, 12-LEAD, LOW DELTA SYSTEM (Figure 2.3-E)

VOLTAGE					
	L-L	CONNECT	L1	L2	L3
60 HZ	120	T1,T7,T6,T12	T1	T2	T3
	139				
50 HZ	100	T2,T8,T4,T10			
	120	T3,T9,T5,T11			

2.3.8- 3-PHASE, 12-LEAD, ZIG ZAG SYSTEM (Figure 2.3-F)

VOLTAGE					
	L-L	CONNECT	L1	L2	NEUTRAL
60 HZ	120/240	T3,T9	T2	T3	T4
		T2,T8			
		T1,T6,T7,T12			
		T4,T10,T5,T11			



ZIG-ZAG connection with 12 lead machine only.

VOLTAGE		CONNECT	L_1	L_2	NEUTRAL
	L-L				
60 HZ	120/240	T_3 T_9	T_2	T_3	T_4
		T_2 T_8			
		T_1 T_6 T_7 T_{12}			
		T_4 T_{10} T_5 T_{11}			

Figure 2.3-F. The 12-Lead Zig Zag System

SECTION 2.4 - OPERATIONAL ANALYSIS- DC CONTROL SYSTEMS

2.4.1- INTRODUCTION

Several different generator meter and control panel options are available, generally classified as Options "A", "B", "C", etc. Part 3 of this Manual (METER AND CONTROL PANEL COMPONENTS) provides a more detailed discussion of panel differences.

This Section provides a general discussion of the various DC Control System operating circuits and how they work. There may be differences between earlier production units and those manufactured after August 1984. These differences are outlined more thoroughly in PART 3. When tracing DC Control system circuits on an actual generator set, refer to the wiring diagram and/or electrical schematic for the specific generator model.

2.4.2- DC POWER SUPPLY CIRCUIT (Figure 2.4-A thru 2.4-D)

A. Option "A" Units with 12 Volts Engine Electrical System (Figure 2.4-A):- The +12 VDC required for Control System operation is delivered from the engine battery and through a 30 ampere FUSE to a DC CONTROL circuit board. The 30 ampere FUSE protects the engine starting circuit against current overload. A second FUSE, rated at 14 DC amperes, is mounted on the DC CONTROL circuit board. The latter protects the "engine running" circuits against overload. That is, a failed 30 ampere FUSE will result in a "no-crank" condition; a failed 14 ampere FUSE will result in a "no-run" condition.

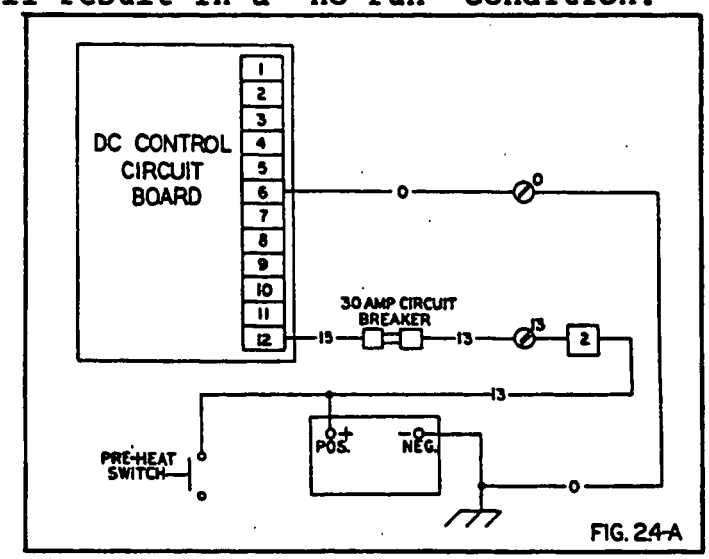


Figure 2.4-A. Typical DC Power Supply Circuit (Option "A" Units)

B. Option "B" and "C" Units with 12 Volts Engine Electrical System (Figure 2.4-B):- Battery Voltage is delivered through a 30 ampere FUSE to a DC CONTROL circuit board, and from that circuit board to a CRANK (Option "B") or a LATCH/CRANK (Option "C") circuit board. The DC CONTROL circuit board mounts a 14 ampere FUSE, for "run circuit" protection.

NOTE

Option "A" units can be started and stopped manually (electrically) only and are NOT equipped with a CRANK or a LATCH/CRANK circuit board.The CRANK circuit board used on Option "B" units is NOT interchangeable with the LATCH/CRANK circuit board used on Option "C" units.

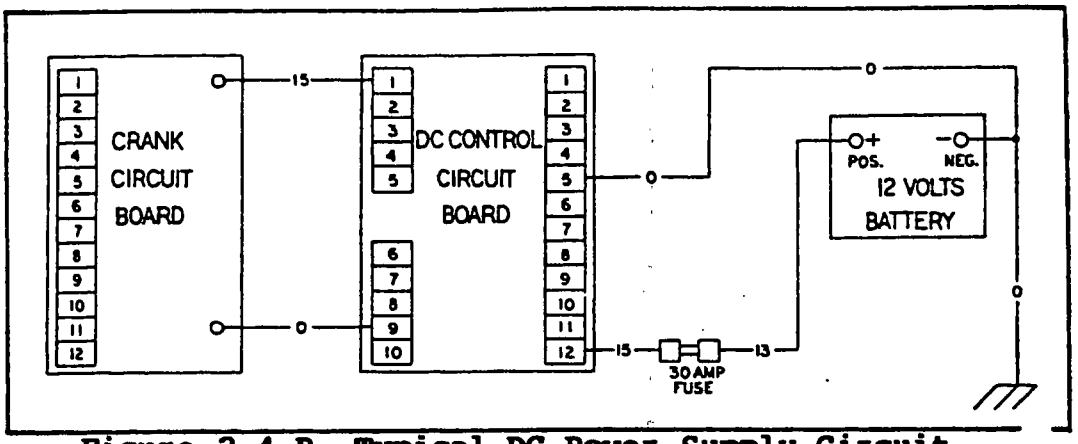


Figure 2.4-B. Typical DC Power Supply Circuit (Option "B" and "C" Units)

C. Units Manufactured After August 1984 (Figure 2.4-C):- These units feature improved circuit boards. The 14 ampere FUSE is not mounted on the DC CONTROL board, but is mounted in-line as is the 30 ampere FUSE. The 30 ampere FUSE protects the engine cranking circuit, while the 14 ampere Fuse protects the "running" circuit.

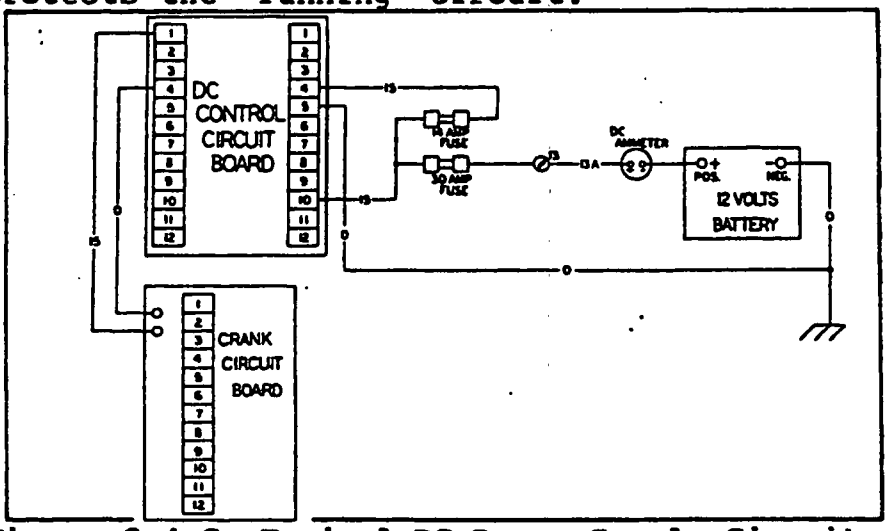


Figure 2.4-C. Typical DC Power Supply Circuit (Units Manufactured After August 1984 with 12 Volts Engine Electrical System)

D. Units Manufactured After August 1984 with 24 Volts Engine Electrical System (Figure 2.4-D):- A 10 ampere Battery Charger is standard on units having a 24 volts engine electrical system. A DC CONVERTER in the Battery Charger changes the 24 volts battery output to 12 volts. The CONVERTER 12 volts output is delivered to the DC CONTROL circuit board for operation of the DC Control System.

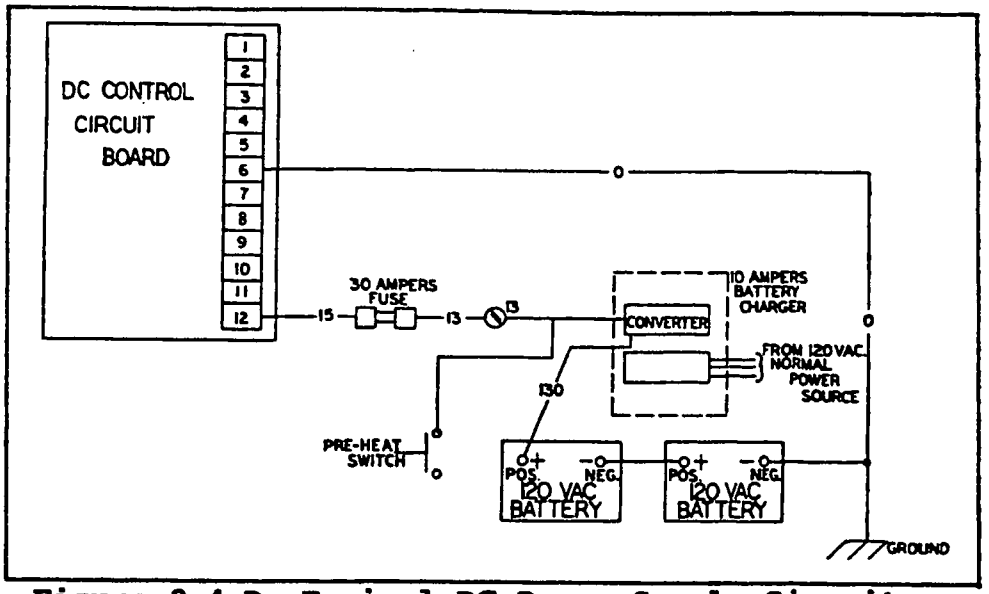


Figure 2.4-D. Typical DC Power Supply Circuit (Later Production Units with 24 VDC Engine Electrical System)

2.4.3- ENGINE CRANKING CIRCUITS (Figure 2.4-E, 2.4-F)

A. Typical Option "A" Units (Figure 2.4-E):- Setting the panel Start/Stop Switch to START position completes the Wire #17 circuit (from the DC Control circuit board) to ground. Circuit board action then causes a CRANK RELAY (on the circuit board) to energize. On CRANK RELAY contact closure, a +DC voltage is delivered through Wire #56 and through a CONTROL CONTACTOR coil, to energize the CONTACTOR. On CONTROL CONTACTOR contact closure, +DC voltage is delivered to a STARTER CONTACTOR coil. On STARTER CONTACTOR contact closure, +DC voltage is delivered to the engine STARTER MOTOR- the engine cranks.

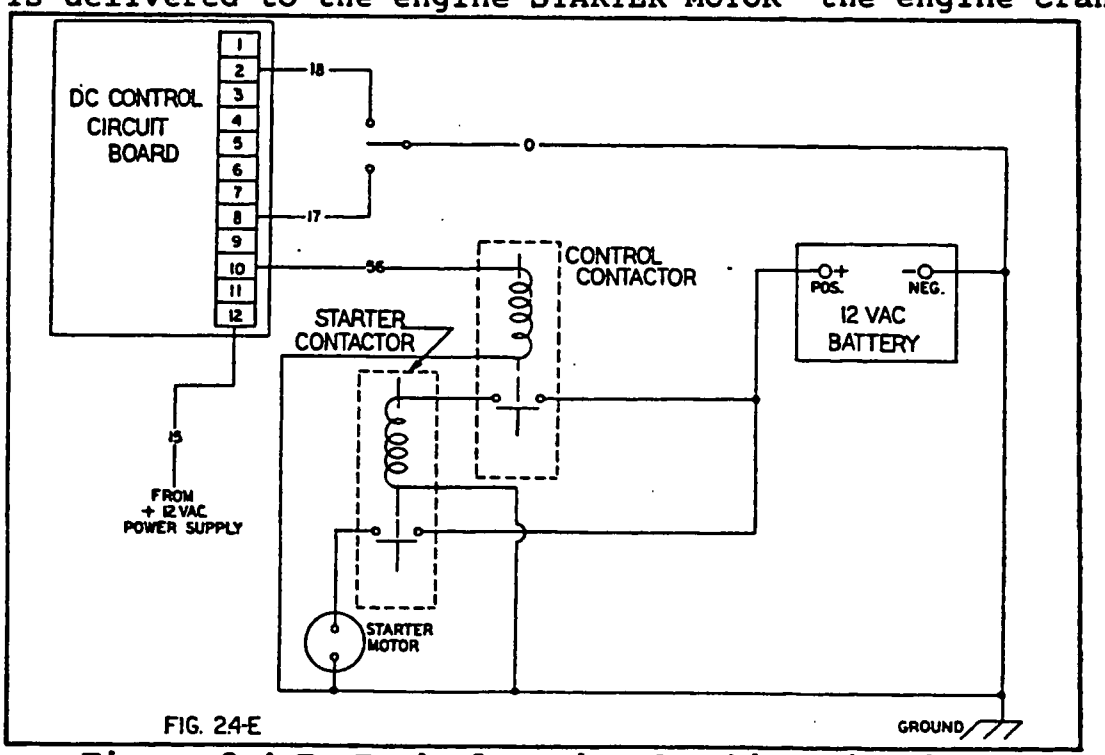


Figure 2.4-E. Typical Engine Cranking Circuit (Option "A" Units)

B. Option "B" and "C" Units (Figure 2.4-F):- Manual startup is accomplished in identical fashion to Option "A" units. In addition, these units can be cranked and started automatically when used in conjunction with an automatic controller or transfer switch with integral controller. The automatic controller monitors the NORMAL (UTILITY) supply source voltage and, on dropout of that voltage below an acceptable level, will signal the CRANK (Option "B") or LATCH/CRANK (Option "C") circuit board to initiate the same sequence of events as during a manual startup.

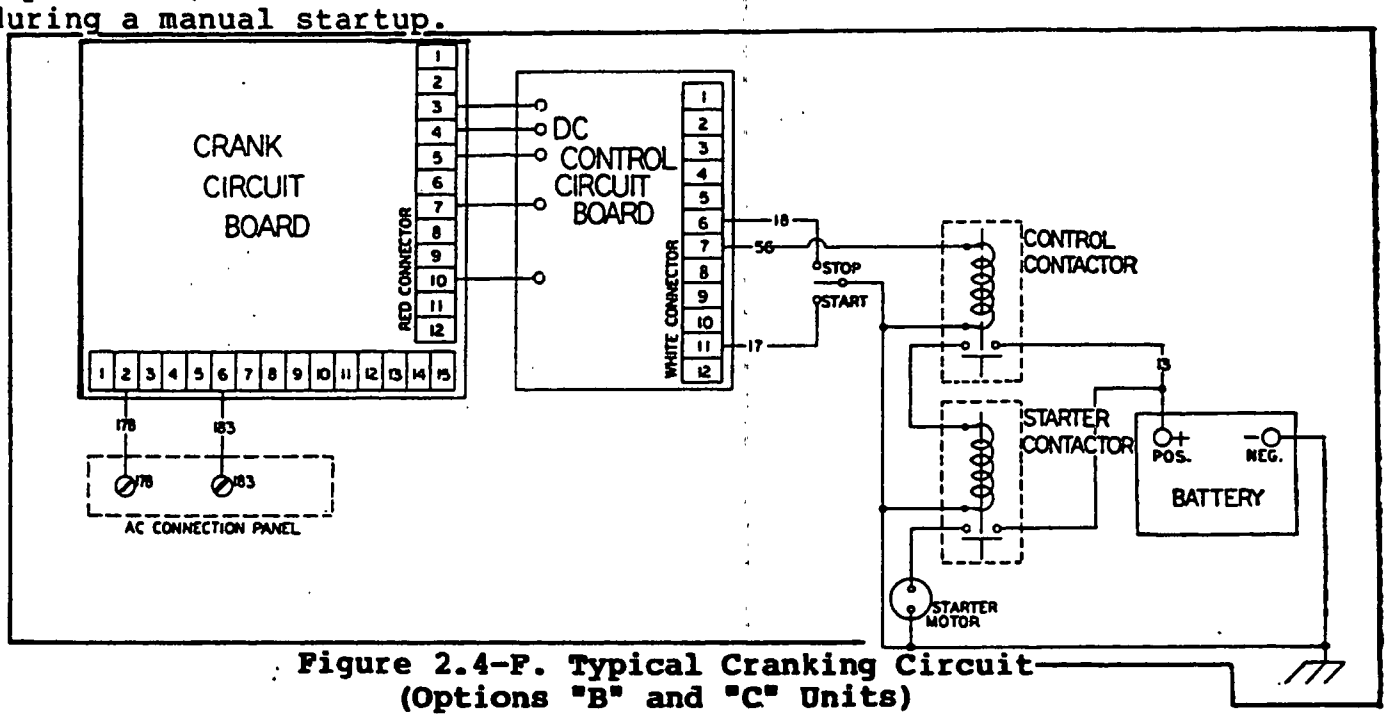


Figure 2.4-F. Typical Cranking Circuit (Options "B" and "C" Units)

2.4.4- ENGINE PRE-HEAT (DIESEL ENGINE UNITS ONLY) (Figure 2.4-G, 2.4-H)

A. Units with 12 VDC Engine Electrical System (Figure 2.4-G):- When panel-mounted PRE-HEAT SWITCH is manually depressed, +12 VDC is delivered across the coils of a PRE-HEAT CONTACTOR. On CONTACTOR contact closure, +12 VDC is delivered to a set of GLOW PLUGS which heat the engine combustion chambers for a faster, easier startup. During an automatically controlled engine start, the PRE-HEAT function is controlled by the CRANK (Option "B") or the LATCH/CRANK (Option "C") circuit board, via Wire #150.

NOTE

Early production units featured a PRE-HEAT cycle during automatic startup that was part of the normal crank-no crank cycle. On units manufactured after August 1984, PRE-HEAT on automatic startup is continuous as long as the engine is cranking.

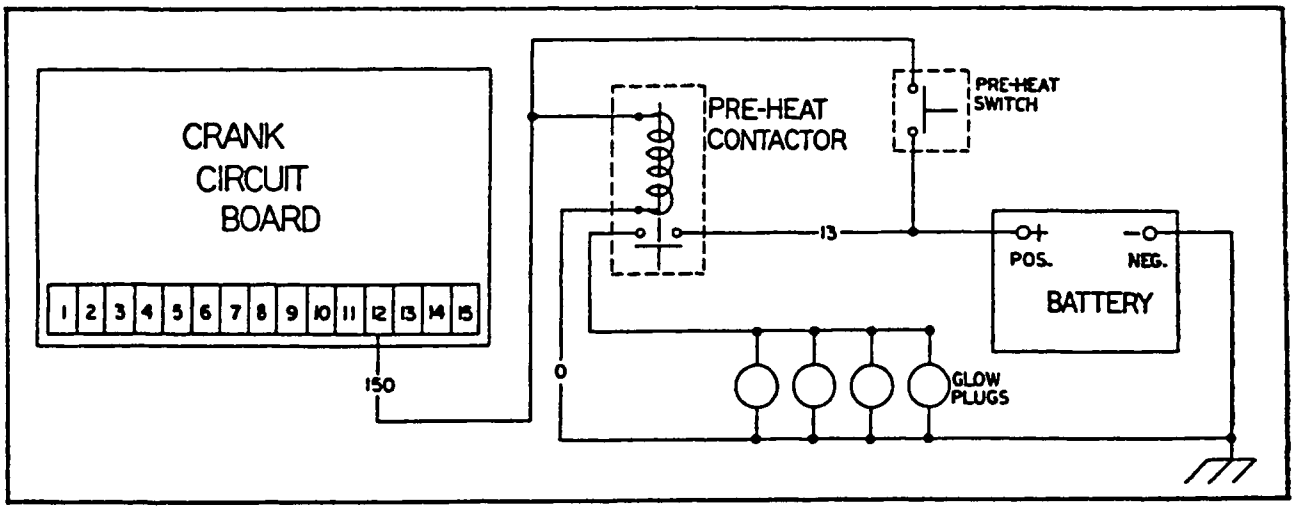


Figure 2.4-G. Typical Engine Pre-Heat Circuit (Units with 12 Volts DC Engine Electrical System)

B. **Units with 24 Volts DC Engine Electrical System** (Figure 2.4-H):- These units may be equipped with either an AIR INTAKE HEATER or a set of GLOW PLUGS. Operation is similar to that of units with a 12 volts DC engine electrical system. However, the PRE-HEAT CONTACTOR is energized by +12 Volts DC from a DC CONVERTER in the unit Battery Charger and the AIR INTAKE HEATER (or GLOW PLUGS) are turned on by +24 Volts DC from the unit's series-connected batteries, on CONTACTOR contact closure.

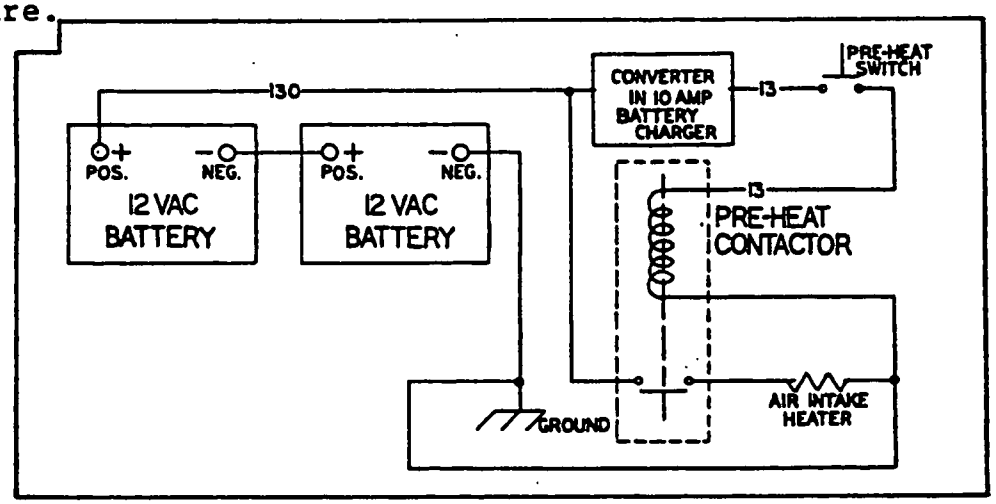


Figure 2.4-H. Typical Pre-Heat Circuit (Units with 24 Volts Engine Electrical System)

2.4.5- ENGINE RUN CIRCUIT (Figure 2.4-I, 2.4-J)

During engine cranking, a RUN RELAY on the DC CONTROL circuit board is energized at the same time as the CRANK RELAY. On RUN RELAY contact closure, a + 12 Volts DC is applied to Wire #14 to energize a SOLENOID RELAY. On SOLENOID RELAY contact closure, a +DC voltage is applied to a FUEL SOLENOID. On opening of the energized FUEL SOLENOID, fuel is supplied to the engine.

NOTE

On gasoline and gaseous fuel engines, Wire #14 supplies a +DC voltage to the engine ignition circuit. With both fuel and ignition available, a startup occurs. On diesel engines, actuating of the fuel solenoid is all that is required for an engine start.

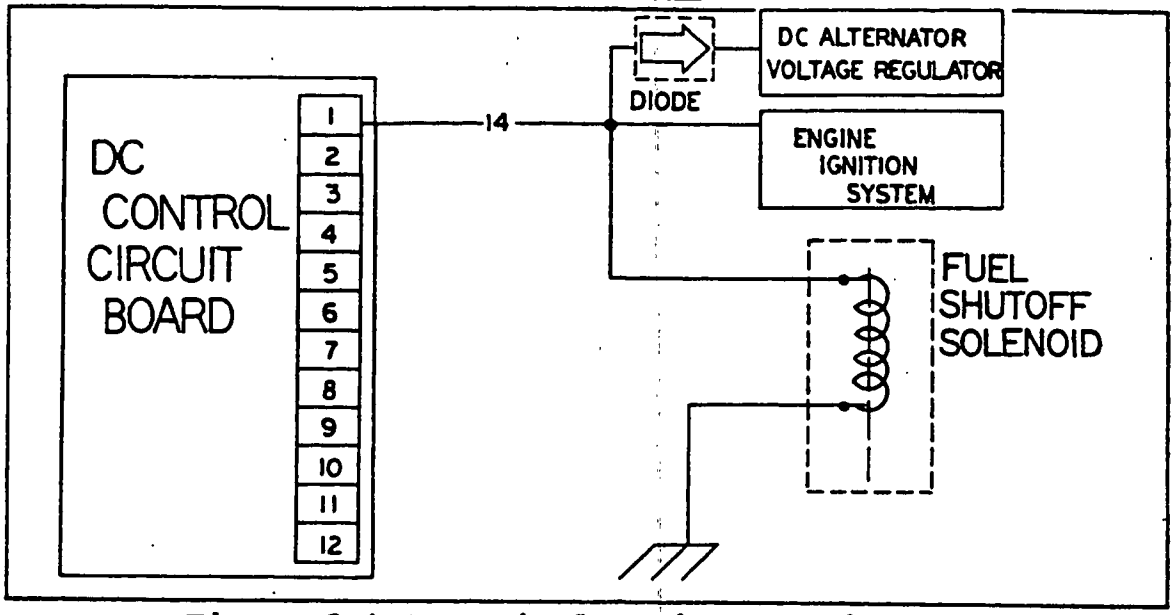


Figure 2.4-I. Typical Engine Run Circuit
(Units with 12 Volts DC Engine Electrical System)

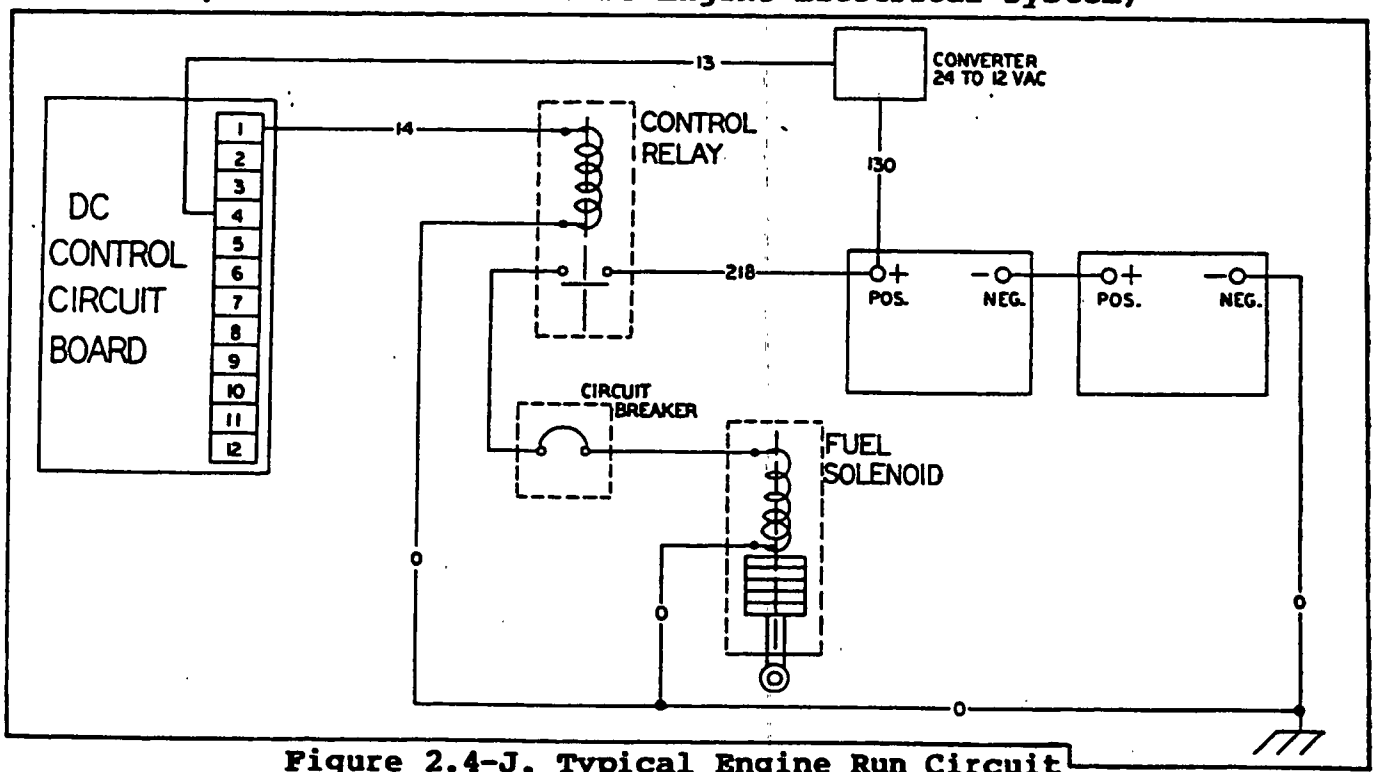


Figure 2.4-J. Typical Engine Run Circuit
(Units with 24 Volts DC Engine Electrical System)

PART 3

METER AND CONTROL PANEL COMPONENTS

Section 3.1 - **METER AND CONTROL PANEL OPTIONS**
- 3.1.1 - Introduction
- 3.1.2 - Option "A" Units
- 3.1.3 - Option "B" Units
- 3.1.4 - Option "C" Units

Section 3.2 - **METER AND CONTROL PANEL EXTERNAL COMPONENTS (Units Manufactured Prior to August 1984)**
- 3.2.1 - General
- 3.2.2 - AC Voltmeter, AC Ammeter and Phase Selector Switch
- 3.2.3 - AC Frequency Meter
- 3.2.4 - Engine Instruments
- 3.2.5 - Hourmeter
- 3.2.6 - Engine-Start/Stop Switch
- 3.2.7 - 30 Ampere Fuse
- 3.2.8 - Voltage Adjust Potentiometer
- 3.2.9 - Trickle Charge DC Ammeter
- 3.2.10- Engine Monitor Panel

Section 3.3 - **METER AND CONTROL PANEL INTERNAL COMPONENTS (Units Manufactured Prior to August 1984)**
- 3.3.1 - Voltage Regulator
- 3.3.2 - Fuel Solenoid Circuit Breaker
- 3.3.3 - 16 Pin receptacle
- 3.3.4 - Field Boost Diode
- 3.3.5 - Terminal Strip TB4
- 3.3.6 - Terminal Strip TB5
- 3.3.7 - Breaker Relay
- 3.3.8 - Field Circuit Breaker
- 3.3.9 - DC Control Circuit Breaker
- 3.3.10- Latch/Crank Circuit Board
- 3.3.11- Crank Circuit Board (Option "B" Units)

Section 3.4 - **METER AND NTROL PANEL EXTERNAL COMPONENTS (Units Manufactured After August 1984)**
- 3.4.1 - General
- 3.4.2 - AC Voltmeter, AC Ammeter and Phase Selector Switch
- 3.4.3 - AC Frequency Meter
- 3.4.4 - Engine Instruments
- 3.4.5 - Preheat Switch
- 3.4.6 - Engine-Start/Stop Switch
- 3.4.7 - 30 Ampere Fuse
- 3.4.8 - Voltage Adjust Potentiometer
- 3.4.9 - Optional Manual/Off/Auto Switch

Section 3.5 - **METER AND CONTROL PANEL INTERNAL COMPONENTS (Units Manufactured After August 1984)**
- 3.5.1 - Voltage Regulator
- 3.5.2 - Control Relay CR2 and Circuit Breaker CB7
- 3.5.3 - Terminal Block TB1
- 3.5.4 - Field Circuit Breaker
- 3.5.5 - Breaker Relay
- 3.5.6 - Engine DC Alternator Field Resistor
- 3.5.7 - Field Boost Resistor
- 3.5.8 - Field Boost Diode

3.5.9 - Terminal Board TB2 (Option "C" Units Only)
3.5.10- DC Control Circuit Board
3.5.11- Latch/Crank Circuit Board
Section 3.6 - **OPTION "A" AND "B" ENGINE MONITOR PANELS**
3.6.1 - General
3.6.2 - Low Oil Pressure Advisory Light
3.6.3 - High Coolant Temperature Advisory Light
Section 3.7 - **OPTION "C" ENGINE MONITOR PANEL**
3.7.1 - General
3.7.2 - Low Oil Pressure Advisory Light
3.7.3 - High Coolant Temperature Advisory Light
3.7.4 - Overcrank Advisory Light
3.7.5 - Overspeed Advisory Light
3.7.6 - RPM Sensor Loss Advisory Light
Section 3.8 - **THE OPTIONAL ANNUNCIATOR PANEL (Units Manufactured After August 1984 Only)**
3.8.1 - General
3.8.2 - Prealarm Low Oil Pressure
3.8.3 - Prealarm High Coolant Temperature
3.8.4 - Low Coolant Temperature Advisory Light
3.8.5 - Low Fuel Advisory Light
3.8.6 - Switch Off Advisory Light
3.8.7 - High Battery Voltage Advisory Light
3.8.8 - Low Battery Voltage Advisory Light

SECTION 3.1 - METER AND CONTROL PANEL OPTIONS

3.1.1- INTRODUCTION

Several different Meter and Control Panel options are available. This Manual will discuss Options "A", "B" and "C". Other options are available, however, those options may be considered as simply a variation of the "A", "B", "C" options.

3.1.2- OPTION "A" UNITS

Units equipped with Option "A" can be started and stopped manually (electrically) only, are intended for use with a manually operated Transfer Switch. These units will shut down automatically in the event of (a) low oil pressure, (b) high coolant temperature, (c) low coolant level, (d) overspeed, and (e) loss of RPM Sensor output. However, the Engine Monitor Panel mounts only two engine fault shutdown advisory lights- a LOW OIL PRESSURE and a HIGH COOLANT TEMPERATURE light. Option "A" units incorporate a DC Control circuit board.

3.1.3- OPTION "B" UNITS

These units may be cranked and started manually (electrically). In addition, when installed in conjunction with an automatic Controller or Transfer Switch with integral Controller, the engine can be started automatically in the event of a NORMAL electrical power source failure. Option "B" units feature the same engine fault shutdown provisions as Option "A" units, as well as the same Engine Monitor Panel advisory lights. A DC Control circuit board and a Crank circuit board are mounted inside the Meter and Control Panel.

3.1.4- OPTION "C" UNITS

Can be started manually or automatically, like the Option "B" units and have the same engine fault shutdown features as those units. However, Option "C" units have a "5-light" Engine Monitor Panel, a DC Control circuit board, and a Latch/Crank circuit board. The latter will hold any engine fault shutdown condition in a "latched" status- that is the applicable shutdown advisory light will remain on after shutdown and further attempts at startup will be inhibited as long as the condition is latched.

SECTION 3.2 - METER AND CONTROL PANEL EXTERNAL COMPONENTS
(Units Manufactured Prior to August 1984)

3.2.1- GENERAL (Figure 3.2-A)

Option "B" and "C" generators manufactured prior to August 1984 were intended for use in conjunction with Generac Models 6301, 6919 and 8519 automatic controllers. See Sections 1.9 and 1.10 in this Manual. A "9-wire" interconnection system was required between the generator set, automatic Controller and Transfer switch.

3.2.2- AC VOLTMETER, AC AMMETER AND PHASE SELECTOR SWITCH (Figure 3.2-A, 3.2-B)

The AC Voltmeter provides an indication of the generator's AC output voltage to connected loads during operation. The AC Ammeter indicates current flow to connected AC loads, in Amperes. These meters will read line-to-line or line-to-neutral voltage and current (single phase units), depending on the position of the Phase Selector Switch. For 3-phase generators, the meters will indicate leg-to-leg volts/amperes as selected with the Phase Selector Switch. The 4-position Phase Selector Switch provides selection of Voltmeter/Ammeter readings as follows:-

SWITCH POSITION	SINGLE PHASE GENERATORS	3-PHASE GENERATORS
1	Line 1 to Neutral	Leg 1 to Leg 2
2	Line 2 to Neutral	Leg 2 to Leg 3
3	Line 1 to Line 2	Leg 3 to Leg 1
OFF	No Reading	No Reading

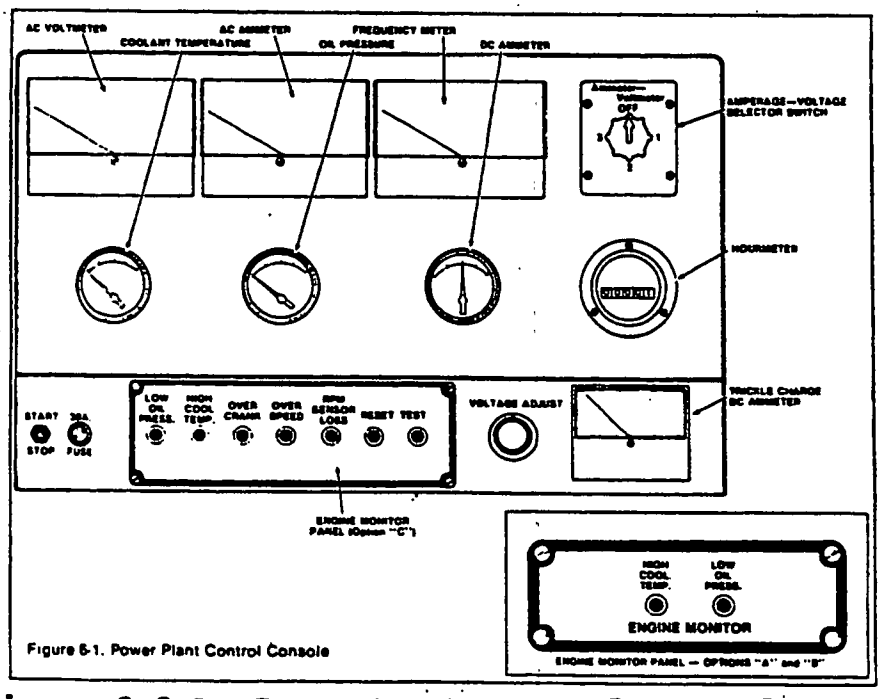


Figure 3.2-A. Generator Meter and Control Panel (Units Manufactured Prior to August 1984)

Figure 3.2-B represents the Voltmeter and Ammeter circuit for a typical single phase generator set. Voltage readings are taken from Stator AC power output leads E1, E2 and E3 and delivered to the Phase Selector Switch terminals. Stator AC power leads 11 and 44 each pass through a CURRENT TRANSFORMER. Current flow through the AC leads creates a magnetic field which induces a resultant current flow into the Transformer windings. The induced current flow is delivered to the Phase Selector Switch via Wires #0, 57 and 58 (single phase units), and then to the AC Ammeter. For 3-phase units, Wires #0, 57, 58 and 59 are used and three Current Transformers are required.

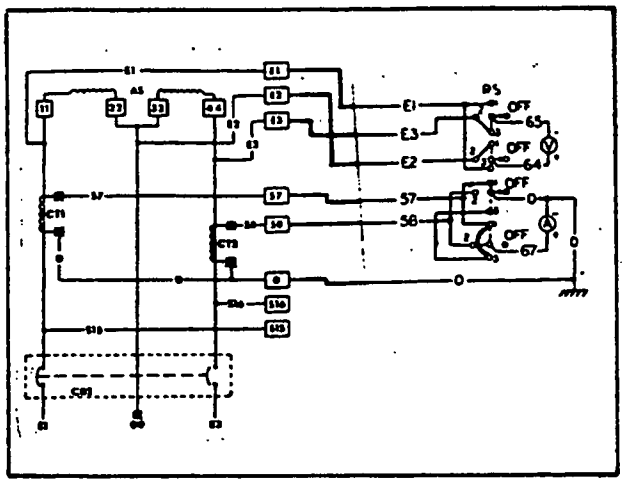


Figure 3.2-B. AC Ammeter and Voltmeter Circuit

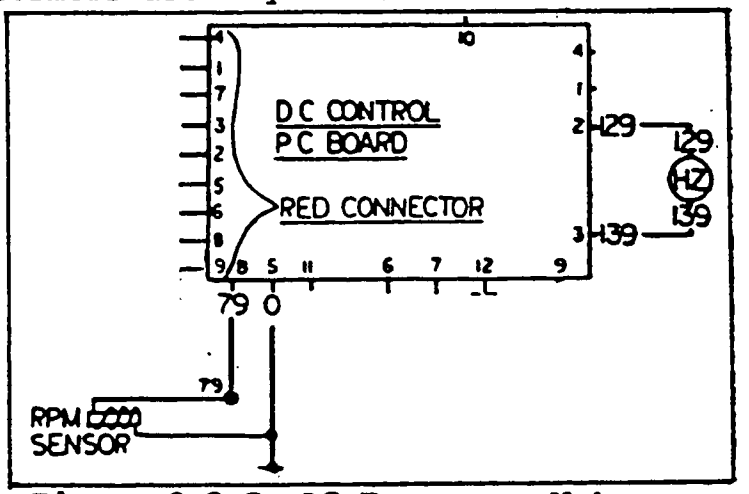


Figure 3.2-C. AC Frequency Meter Circuit

3.2.3- AC FREQUENCY METER (Figure 3.2-A, 3.2-C)

An RPM SENSOR mounts to the generator engine's flywheel housing, directly over the engine flywheel teeth. A magnet is imbedded in the tip of the RPM Sensor so that, during engine operation as each flywheel tooth passes the magnetic pickup, an electrical sine wave is generated. That is, the Sensor measures the operating speed of the engine flywheel. The Sensor frequency signals are delivered to Pin 5 of the DC Control circuit board via Wire #79. The DC Control board is equipped with a special "frequency-to-voltage" conversion circuit, which converts the frequency signals to an equivalent voltage. That equivalent voltage is then delivered to the Panel Frequency Meter via Wires #129 and 139, to operate the Meter. Thus, that Meter is actually not a FREQUENCY Meter at all, but a VOLTMETER that is calibrated in frequency (Hertz).

NOTE

Each time a panel Frequency Meter or DC Control board is replaced, the panel Frequency Meter must be recalibrated. Two adjustable "fine" and "coarse" potentiometers are located on the DC Control board for this purpose. See Part 4, OPERATIONAL TESTS AND ADJUSTMENTS.

NOTE

In addition to operating the Frequency Meter, RPM Sensor output is used to (a) establish an engine crank speed cutout of 1000 rpm, and (b) provide an automatic engine shutdown in the event of overspeed or RPM Sensor loss.

3.2.4- ENGINE INSTRUMENTS (Figure 3.2-A)

The Meter and Control Panel mounts a COOLANT TEMPERATURE gauge, an ENGINE OIL PRESSURE Gauge, and a DC AMMETER. The DC Ammeter indicates the rate of charge to the generator battery during operation, from the engine DC Alternator.

3.2.5- HOURMETER (Figure 3.2-A)

The Hourmeter provides a continuous indication of generator operating time, in hours and tenths. Use the Meter in conjunction with the unit PERIODIC MAINTENANCE SCHEDULE, to perform the required periodic maintenance on the unit. The Hourmeter is powered by generator Wire #14 circuit, which is electrically "hot" only when the unit is running.

3.2.6- ENGINE-START/STOP SWITCH (Figure 3.2-A)

To crank and start the generator engine manually, hold the Switch at START position- release the Switch when the engine starts. To stop the engine, set the Switch to its STOP position.

3.2.7- 30 AMPERE FUSE (Figure 3.2-A)

Also see Section 2.4 in this Manual. This Fuse protects the crank portion of the DC Control circuit against current overload. Should the Fuse element melt open due to an overload, it will be impossible to crank and start the engine either manually or automatically.

3.2.8- VOLTAGE ADJUST POTENTIOMETER (Figure 3.2-A, 3.2-D)

This adjustable potentiometer permits the operator to "fine adjust" generator AC output voltage, within a range of plus or minus 5 percent. The potentiometer is electrically connected in series with one of the Voltage Regulator sensing lines from the stator AC power windings. Potentiometer adjustment biases the sensing signal to the Voltage Regulator, to permit voltage output to be changed.

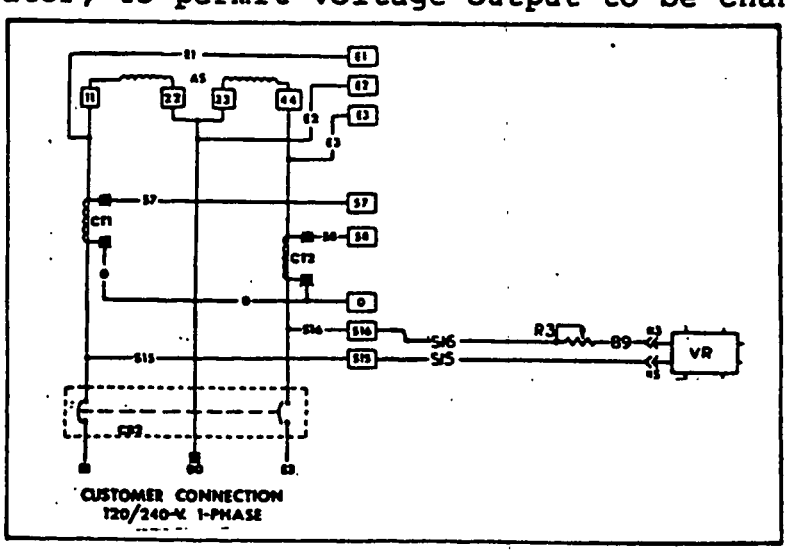


Figure 3.2-D. The Voltage Adjust Potentiometer Circuit

3.2.9- TRICKLE CHARGE DC AMMETER (Figure 3.2-A)

This optional DC Ammeter is generally supplied when the generator unit is equipped with a battery trickle charger. The trickle charger is connected to a 120 VAC NORMAL (Utility) power source line, to maintain the unit battery in a charged state during non-operating periods. The Ammeter indicates the Trickle Charger rate of charge, in DC Amperes.

3.2.10- ENGINE MONITOR PANEL (Figure 3.2-A)

Figure 3.2-A shows the Engine Monitor Panel for Options "A", "B" and "C". Refer to sections 3.6 and 3.7.

SECTION 3.3 - METER AND CONTROL PANEL INTERNAL COMPONENTS
(Units Manufactured Prior to August 1984)

3.3.1- VOLTAGE REGULATOR (Figure 3.3-A, 3.3-B)

The Voltage Regulator is a solid state, "Voltage-over-Frequency" type regulator. That is, it regulates generator AC output voltage in direct proportion to AC frequency, at a 2 to 1 ratio. For example, if a 60 Hertz generator has a rated voltage of 120/240 VAC, the regulator will maintain that rated voltage at an AC frequency of 60 Hertz. Should AC frequency drop to 30 Hertz, the Regulator will maintain approximately 60/120 VAC, and so on. This type of Voltage Regulation system provides greatly improved motor starting characteristics over conventional regulation systems.

The Voltage Regulator is equipped with 3 adjustable potentiometers, for Regulator adjustment (see Part 4, OPERATIONAL TESTS AND ADJUSTMENTS). Section 2.2 (AC GENERATOR OPERATIONAL ANALYSIS) discusses Voltage Regulator circuit operation. A 6-pin connector plug interconnects the Regulator with its related circuits. Connector plug pin numbers, associated wire numbers, and their functions are listed in the following Chart:-

PIN NUMBER	WIRE NUMBER	FUNCTION
1	1	Negative side of DC circuit to Rotor**
2	162	Stator Excitation (DPE) winding unregulated AC input to Voltage Regulator*
3	89	Voltage Adjust Potentiometer to Regulator- from Stator AC Power Sensing lead S16*
4	4	Positive side of DC circuit to Rotor- delivers rectified and regulated Stator Excitation (DPE) winding output to Rotor**
5	S15	From Stator AC Power Sensing lead S15*
6	6	Unregulated Stator Excitation (DPE) winding AC output to Voltage Regulator*

* Generators rated at 130-200 KW and having a 13.3 Liter diesel engine do not have a Stator DPE winding. On these units, Stator AC Power winding output is delivered to the primary winding of a Transformer. Induced current flow from the Transformer secondary winding is then delivered to Pins 2 and 6 as excitation current.

** On BRUSHLESS generators, Pins 1 and 4 and Wires #1 and 4 connect to the Exciter Field

3.3.2- FUEL SOLENOID CIRCUIT BREAKER (Figure 3.3-A)

This circuit breaker is used only on generator units having a diesel engine as the prime mover. Diesel engines use solenoid operated linkage to actuate the Fuel Injection Pump to a "flow" condition during startup and operation. During a shutdown, the solenoid de-energizes to place the Injection Pump into a "no-flow" condition. The circuit breaker protects the Fuel Solenoid circuit against overload. During startup, a SOLENOID RELAY (SR) is energized by the Wire #14 circuit and its contacts close. On contact closure, +DC voltage is delivered to the FUEL SOLENOID and engine fuel flow commences.

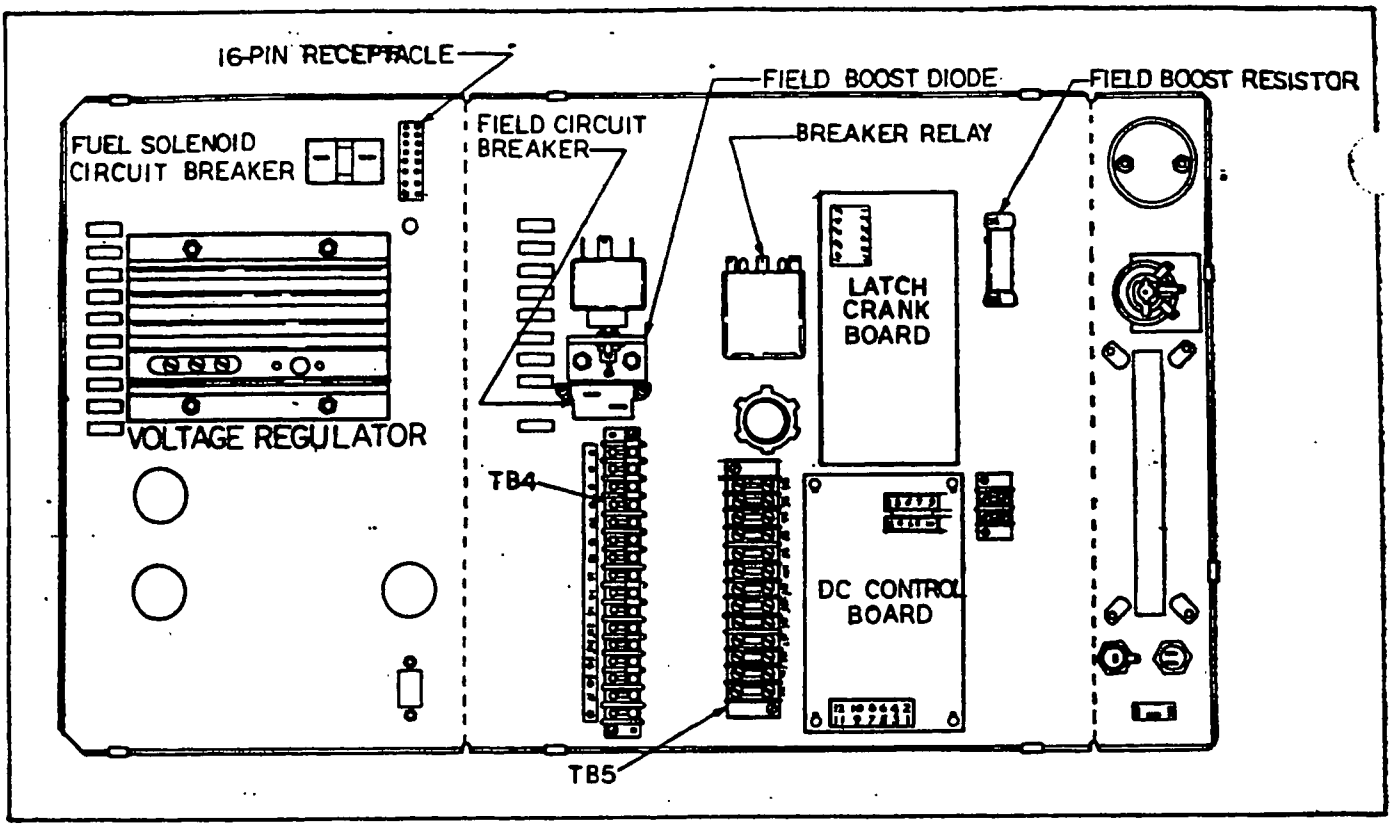


Figure 3.3-A. Meter and Control Panel Internal Components (Units Manufactured Prior to August 1984)

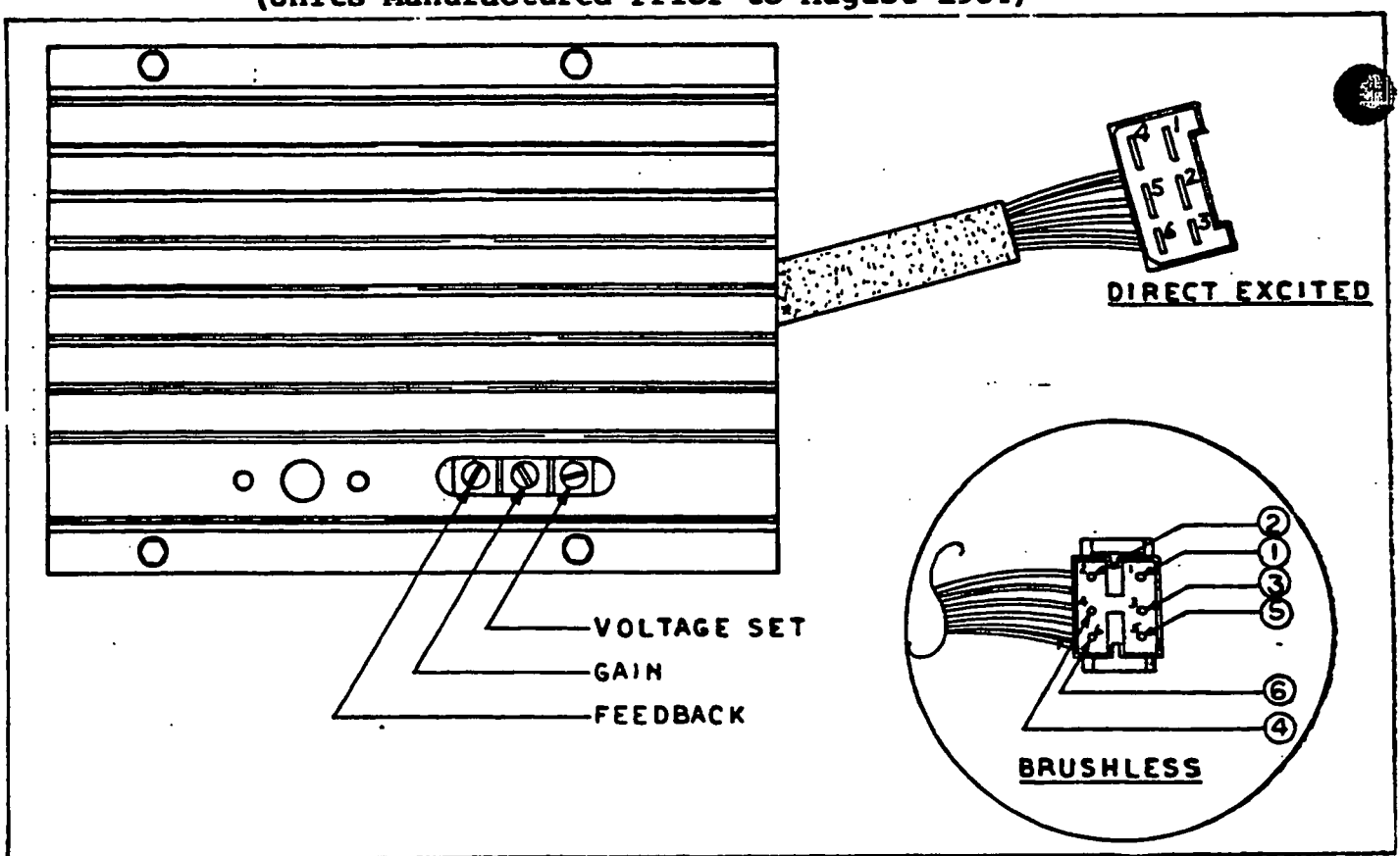


Figure 3.3-B. Voltage Regulator

3.3.3- 16-PIN RECEPTACLE (Figure 3.3-A, 3.3-C)

This receptacle interconnects Meter and Control Panel circuits with the engine circuits. Receptacle pin functions and associated wires are listed in the following chart:-

PIN	WIRE	FUNCTION
1	---	Not Used
2	13	+12 VDC battery voltage to panel circuits
3	47	+DC Voltage to engine DC Alternator field when running
4	14	+DC Voltage with engine running only
5	49	+DC Voltage to engine DC Alternator field when running
6	19	+DC Voltage to diesel engine Fuel Solenoid when running
7	130	To panel Battery Charge Ammeter (-) side
8	56	+DC Voltage to Control Contactor while cranking
9	85	To High Coolant Temperature Switch/Low Coolant Sensor
10	86	To Low Oil Pressure Switch
11	69	To Panel Oil Pressure Gauge from Oil Pressure Sending Unit
12	68	To Panel Coolant Temperature Gauge from engine
13	0	Common Ground
14	13A	+ side of Battery Charge Ammeter
15	130	+DC to DC Alternator Regulator
16	150	Preheat during automatic startup (Diesel engines)

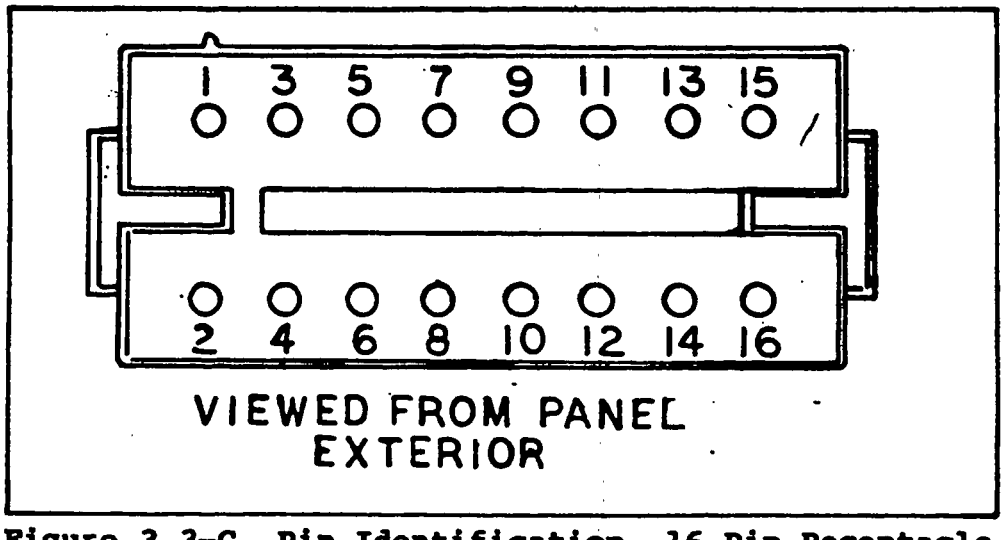


Figure 3.3-C. Pin Identification- 16 Pin Receptacle

3.3.4- FIELD BOOST DIODE (Figure 3.3-A)

Refer to Section 2.2, AC GENERATOR OPERATIONAL ANALYSIS.

3.3.5- TERMINAL STRIP TB4 (Figure 3.3-A, 3.3-D)

Terminals, associated wire numbers and functions are listed in the following Chart:-

TERMINAL	WIRE	FUNCTION
0	0	Common GROUND
79	79	Panel RPM Sensor connection
13	13	+DC Battery Voltage- always hot
14	14	+DC battery voltage when engine is running only
S15	S15	AC Power sensing to Voltage Regulator connector
S16	S16	AC Power sensing to Voltage Regulator connector
17	17	Engine crank lead- if terminal is connected to ground, engine should crank
18	18	Engine stop- if connected to ground, engine should shut down

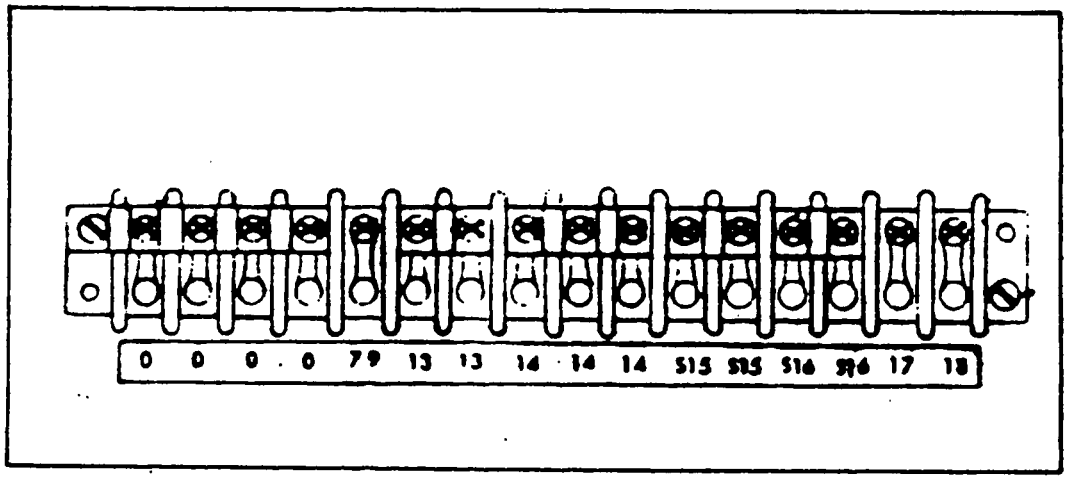


Figure 3.3-D. Terminal Strip TB4

3.3.6- TERMINAL STRIP TB5 (Figure 3.3-A, 3.3-E)

This Terminal Strip is installed only on Option "C" units, which incorporate the Latch/Crank circuit board. Terminals, connecting wires and functions are listed in the following Chart:-

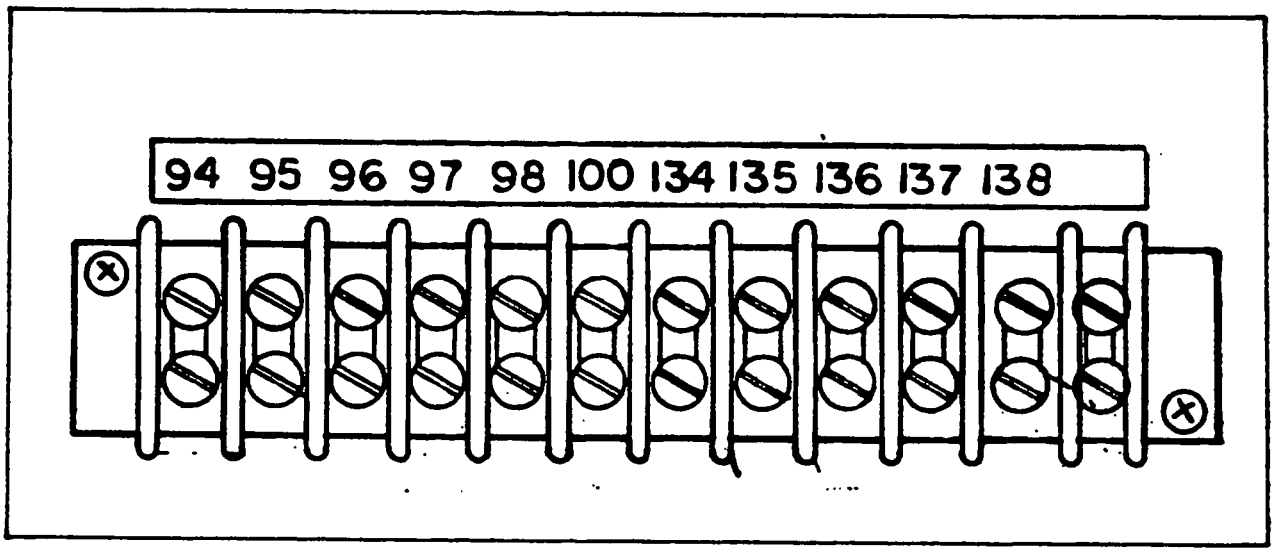


Figure 3.3-E. Terminal Strip TB5

TERMINAL	WIRE	FUNCTION
94	94	+12 VDC is applied here from Latch/Crank board when a low oil pressure shutdown occurs
95	95	High Coolant Temperature- +12 VDC on terminal when a high water temperature/low coolant level shutdown occurs
96	96	Overcrank- +12 VDC on terminal if automatic startup does not start engine in 8 crank cycles (OVERCRANK light comes on)
97	97	Overspeed- +12 VDC on terminal if overspeed shutdown occurs (OVERSPEED light comes on)
98	98	RPM Sensor Loss- +DC on terminal if RPM Sensor output to DC Control board is lost (RPM SENSOR LOSS light on)
100	100	+12 VDC is applied to this terminal whenever any annunciated fault shutdown occurs. Connect a +12 VDC alarm device (such as an annunciator horn, telephone dialer, etc.) to terminal- alarm device will come ON if an annunciated fault shutdown occurs.
134	134	Connect to automatic Controller- delivers crank limit signal to Controller
135	135	Connect to automatic Controller- delivers an "engine not running" signal to Controller
136	136	Engine automatic crank signal from Controller
137	137	To Engine Monitor Panel TEST Switch
138	138	To Engine Monitor Panel RESET Switch

3.3.7- BREAKER RELAY (Figure 3.3-A)

This Relay is energized during startup, when the Wire #14 circuit is energized by DC Control board action. When energized and upon contact closure the Relay provides the following:-

1. Closes the Excitation (DPE) winding circuit to the Voltage Regulator
2. Closes the +DC circuit to the engine DC Alternator field
3. Closes the +DC Field Boost circuit to the Rotor

3.3.8- FIELD CIRCUIT BREAKER (Figure 3.3-A)

This circuit breaker is electrically connected in series with the Stator Excitation (DPE) winding output to the Voltage Regulator. In the event of an overcurrent condition in the DPE circuit, the breaker will open. Stator AC power voltage will then be reduced to that which is induced by the Field Boost circuit.

3.3.9- DC CONTROL CIRCUIT BOARD (Figure 3.3-A, 3.3-F)

The DC Control circuit board acts as a "control center" for engine cranking, startup, running and shutdown operations. The Board also incorporates a "frequency-to-voltage" conversion circuit, which converts RPM Sensor frequency signals to an equivalent voltage for operation of the panel Frequency Meter. Two different DC Control boards were used- one with a CHOKE function (gasoline engines), one without CHOKE function.

The DC Control board mounts a 14 ampere FUSE, which protects the engine run circuit against current overload. An open Fuse element will prevent engine startup. The Fuse comes with a convenient puller, for ease of removal. Two adjustable potentiometers- a COARSE and a FINE RPM ADJUST pot- permit adjustment of the panel Frequency Meter (see Part 4, OPERATIONAL TESTS AND ADJUSTMENTS). An OVERSPEED adjustment potentiometer provides for adjustment of the engine overspeed shutdown setting. The board mounts two CONTROL RELAYS- a CRANK RELAY and an ENGINE RUN RELAY.

Two receptacles are provided on the DC Control board. A 10-pin receptacle provides for interconnection of the DC Control board with the CRANK (Option "B") or the LATCH/CRANK (Option "C") circuit boards. (Option "A" units do not require a Crank circuit board.) A 12-pin receptacle interconnects the DC Control board with other DC Control system components.

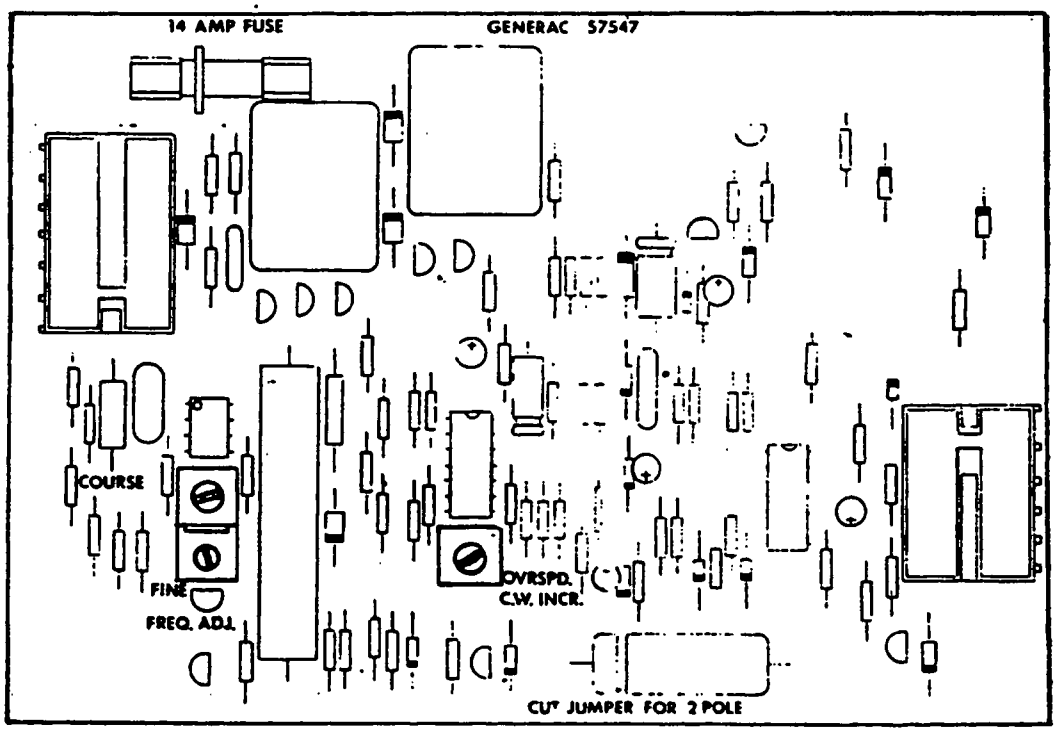


Figure 3.3-F. DC Control Circuit Board

The DC Control board's 12-PIN receptacle pins, associated wiring and pin functions are listed in the following Chart:-

PIN	WIRE	FUNCTION
1	129	(+) voltage signal from frequency-to-voltage converter circuit to panel Frequency Meter
2	18	Engine STOP circuit- engine will shut down if this circuit is grounded
3	139	(-) voltage signal from frequency-to-voltage converter circuit to panel Frequency Meter
4	14	+DC with engine running only- On energizing and contact closure of DC Control board's ENGINE RUN RELAY, +DC is applied to this circuit for running operations
5	79	RPM Sensor frequency signals to DC Control board
6	0	Common GROUND
7	85	High Coolant Temperature shutdown- High coolant temperature switch or low coolant level sensor ground this circuit to effect an automatic engine shutdown
8	17	Engine Manual Crank- Pin 8 and Wire #17 are always hot at 1/2 battery voltage
9	86	Low Oil Pressure Shutdown- Low oil pressure switch will ground this circuit to effect an automatic shutdown
10	56	Engine CRANK circuit- +DC voltage is delivered to this circuit on closure of CRANK RELAY contacts, to energize a CONTROL CONTACTOR and initiate cranking
11	12	Not used with gaseous fuel systems- supplies engine carburetor CHOKE signals on engines with gasoline fuel system
12	15	+DC Battery voltage into DC Control circuit board

Pin numbers, associated wire numbers and functions of the DC Control circuit board's 10-pin receptacle are listed below:-

NOTE

Option "C" units with Latch/Crank board use all receptacle pins as listed. Option "B" units (with Crank board) use only Pins 1, 2, 3, 5 and 9.

PIN	WIRE	FUNCTION
1	15	+12 VDC from DC Control to Crank (Option "B") or Latch/Crank (Option "C") circuit board
2	87	MINIMUM SPEED SIGNAL (Starter Cutout at 1000 rpm)- to the Latch/Crank board to terminate engine cranking and prevent transmission of "Engine Not Running" signal
3	133	Automatic cranking signal from Latch/Crank to DC Control circuit board
4	131	OVERSPEED shutdown signal from DC Control to Latch/Crank circuit board
5	71	"Engine Running" signal- from DC Control to Latch/Crank circuit board
6	132	RPM SENSOR LOSS signal to Latch/Crank circuit board
7	---	Not Used
8	85	HIGH COOLANT TEMP/LOW COOLANT LEVEL signal to Latch/Crank circuit board
9	0	Common GROUND
10	86	LOW OIL PRESSURE shutdown signal to Latch/Crank board

3.3.10- LATCH/CRANK CIRCUIT BOARD (Figure 3.3-G, 3.3-H)

The LATCH/CRANK circuit board is used only with Option "C" generator units. Two different Latch/Crank boards may be encountered- one with PREHEAT (Diesel engines), one without PREHEAT (Gas engines). This circuit board controls automatic startup/stopping, and annunciated engine fault shutdown conditions.

Latch/Crank Board with Preheat:- Mounts two adjustable potentiometers, one for adjustment of PREHEAT time and one for adjustment of engine CRANK TIME. The following facts apply:-

1. PREHEAT- During an automatically controlled engine cranking operation, the Latch/Crank board provides up to 8 equal-duration crank/no-crank cycles (along with a preheat cycle) until the engine starts. For units with diesel engine, the cranking cycles occur as follows:-

CRANK	- 6 to 12 seconds
REST	- 6 to 12 seconds
CRANK	- 6 to 12 seconds
PREHEAT	- 15 to 30 seconds

The PREHEAT time is adjustable to any time length between 15 and 30 seconds. If operating under extremely cold conditions, adjustable time length of PREHEAT can be extended to 15-60 seconds by cutting a PRE-HEAT JUMPER wire.

2. CRANK TIME- May be adjusted to any time length between 6-12 seconds by means of a slotted potentiometer.

Latch/Crank Board without Preheat:- Includes only a CRANK TIME adjustment potentiometer, for adjustment of engine cranking cycle time from 6-12 seconds.

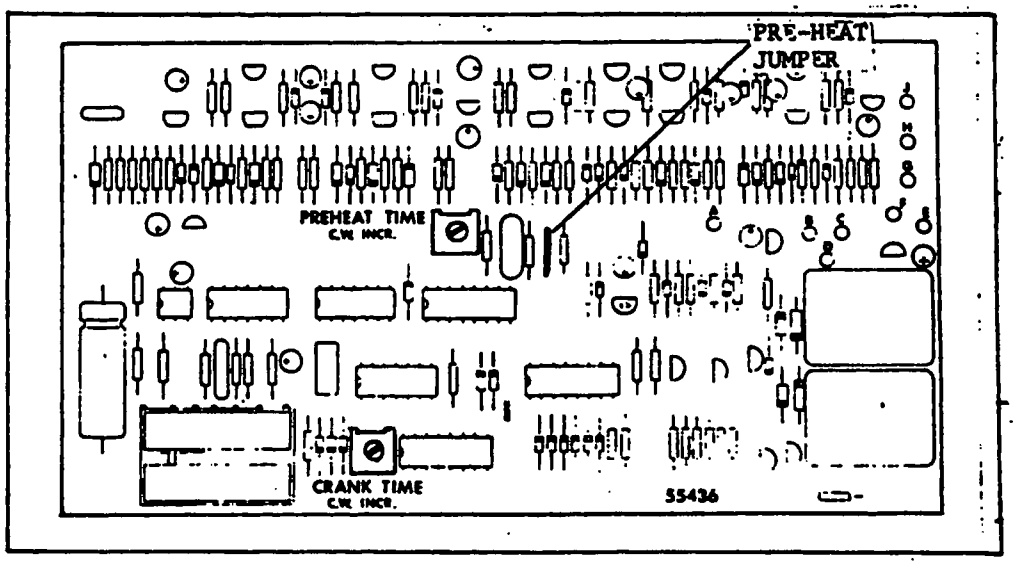


Figure 3.3-G. Latch/Crank Circuit Board with Preheat (Option "C" Units Only)

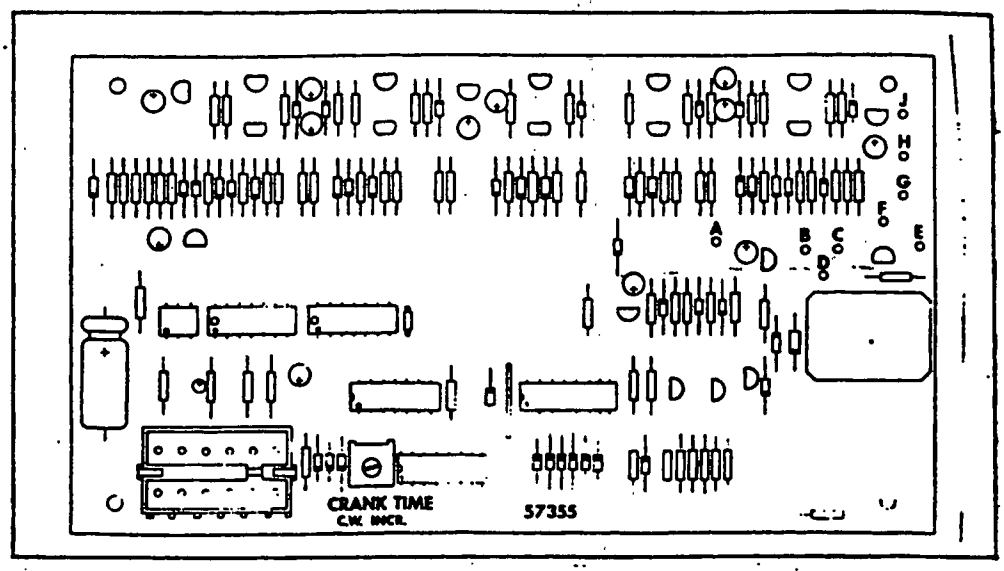


Figure 3.3-H. Latch/Crank Board without Preheat (Option "C" Units Only)

The Latch/Crank circuit board mounts a single 12-pin Receptacle. Receptacle pin numbers, associated wire numbers and functions for Latch/Crank circuit boards are listed in the following chart:-

PIN	WIRE	FUNCTION
1	97	+12 VDC to Engine Monitor Panel OVERSPEED light when an automatic overspeed shutdown occurs
2	95	+12 VDC to Monitor Panel HIGH COOLANT TEMP light when an automatic shutdown due to high temp/low coolant level occur
3	98	+12 VDC to Panel RPM SENSOR LOSS light when shutdown caused by Sensor signal loss occurs
4	96	+12 VDC to Panel OVERCRANK light if engine does not start in 8 crank cycles during an automatic start
5	94	+12 VDC to Panel LOW OIL PRESSURE light if shutdown caused by a low oil pressure condition occurs
6	137	Engine Monitor panel TEST Switch
7	138	Engine Monitor Panel RESET Switch
8	135	ENGINE RUNNING Signal to automatic Controller
9	136	ENGINE CRANK signal to Controller Logic circuit board
10	150	PREHEAT (Diesel engine units only)- +12 VDC applied to this pin/wire during PREHEAT cycle on automatic starts
11	134	CRANK LIMIT signal to Controller Logic circuit board
12	100	ALARM OUTPUT to automatic Controller- a +12VDC will be applied to this terminal and wire whenever an annunciated engine fault shutdown occurs

3.3.11- CRANK CIRCUIT BOARDS (Option "B" Units)- (Figure 3.3-I, 3.3-J)

These circuit boards do not provide the "latch" feature, which is common to the Option "C" LATCH/CRANK circuit boards. Two types of CRANK circuit boards were used- one with PREHEAT (Diesel engine units), one without Preheat (Gas engine units). The CRANK circuit board mounts the same 12-pin receptacle used on Latch/Crank boards. However, receptacle Pins 1 through 7 are NOT used (see CHART in Paragraph 3.3.10).

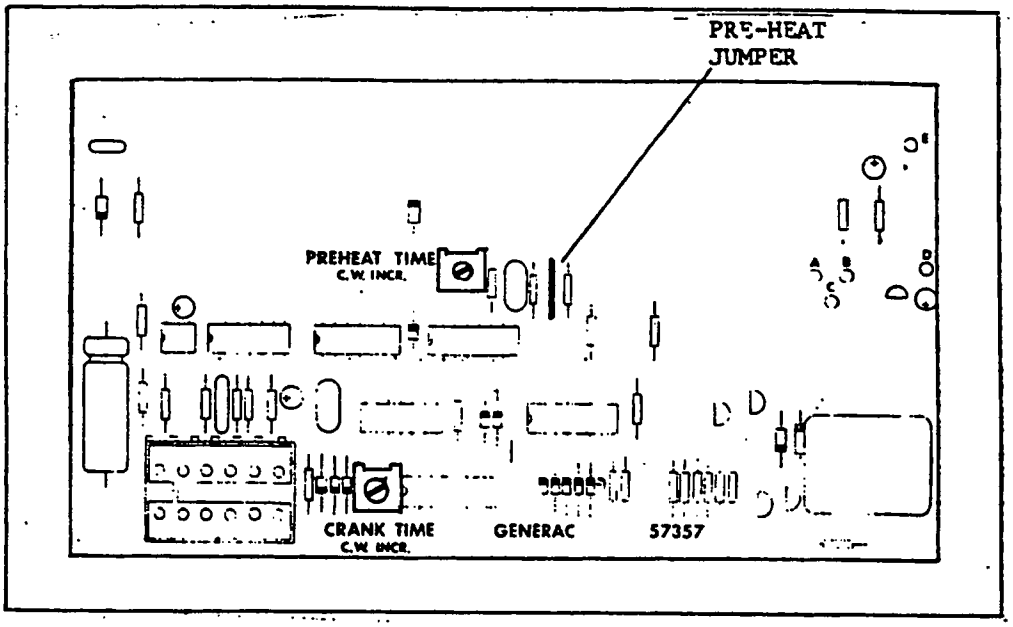


Figure 3.3-I. Crank Circuit Board with Preheat (Option "B" Units)

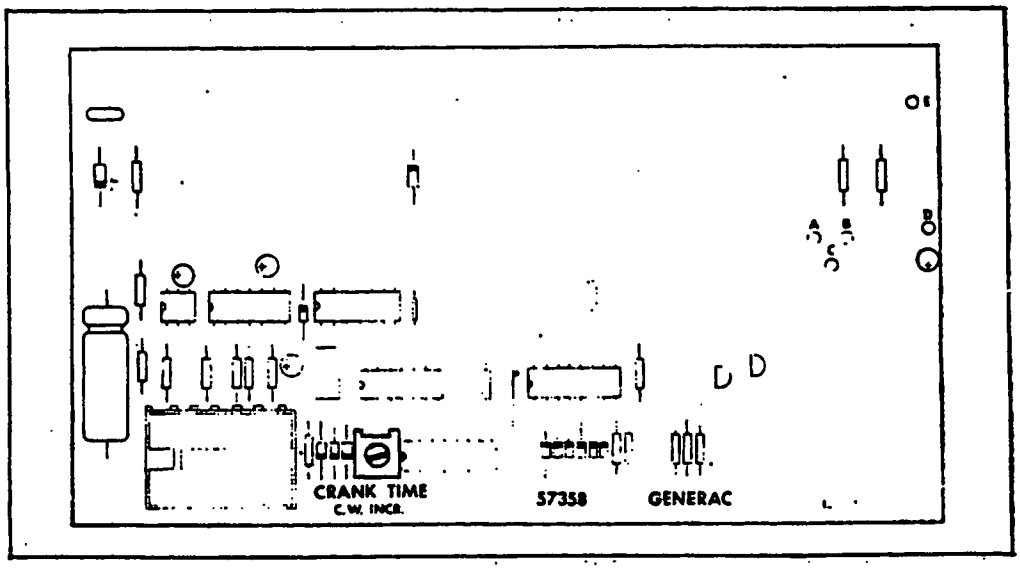


Figure 3.3-J. Crank Circuit Board without Preheat (Option "B" Units)

SECTION 3.4 - METER AND CONTROL PANEL EXTERNAL COMPONENTS
(Units Manufactured After August 1984)

3.4.1- GENERAL (Figure 3.4-A)

Meter and Control Panel options are discussed in Section 3.1 of this Manual. Units manufactured AFTER August 1984 were intended for use in conjunction with the "GTS" style automatic Transfer Switches (see Sections 1.11, 1.12, and 1.13). A "2-Wire" interconnection system is required between the generator set and the Transfer Switch. The newer generators incorporate improved DC Control, Crank and Latch/Crank circuit boards. The later production units also feature a remote alarm connection system which provides a COMMON, NORMALLY-OPEN and NORMALLY-CLOSED connection point for remote mounted generator fault alarm devices. In addition, these later units are equipped with an Engine Monitor Panel with LED's (Light-Emitting-Diodes) rather than the old lamp system. Provisions are made on the newer production Meter and Control Panels for mounting an optional 7-light ANNUNCIATOR PANEL.

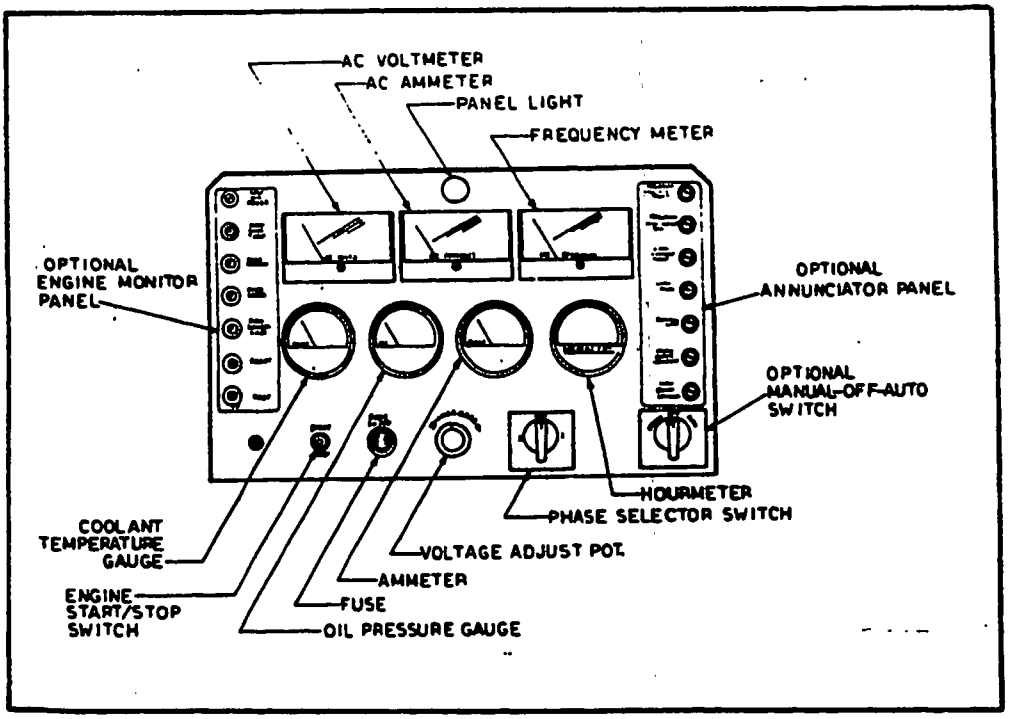


Figure 3.4-A. Meter and Control Panel (Units Manufactured After August 1984)

3.4.2- AC VOLTMETER, AC AMMETER AND PHASE SELECTOR SWITCH (Figure 3.2-A, 3.2-B)

The AC Voltmeter and Ammeter provide an indication of the generator's AC output voltage and current, respectively, to connected loads. The maters will indicate line-to-line or line-to-neutral voltage and current (1-phase units), or leg-to-leg voltage and current (3-phase units), depending on the selected position of a Phase Selector Switch, as follows:-

SWITCH POSITION	SINGLE PHASE GENERATORS	3-PHASE GENERATORS
1	Line 1 to Neutral	Leg 1 to Leg 2
2	Line 2 to neutral	Leg 2 to Leg 3
3	Line 1 to Line 2	Leg 3 to Leg 1

Figure 3.2-B represents the Voltmeter/Ammeter circuit for a typical single phase generator set. Voltage signals are delivered to the Phase Selector Switch from Stator AC Power output leads E1, E2 and E3 (Line 1, neutral and Line 2 respectively). AC power leads E1 and E3 (Wires #11 and #44) each pass through a CURRENT TRANSFORMER, to induce a current flow into the Transformer windings during operation. The induced current from the Transformer is delivered to the Phase Selector Switch via Wires #0, #57 and #58 (1-phase units), and then to the AC Ammeter. (The 3-phase units require 3 current transformers and use Wires #0, #57, #58 and #59.)

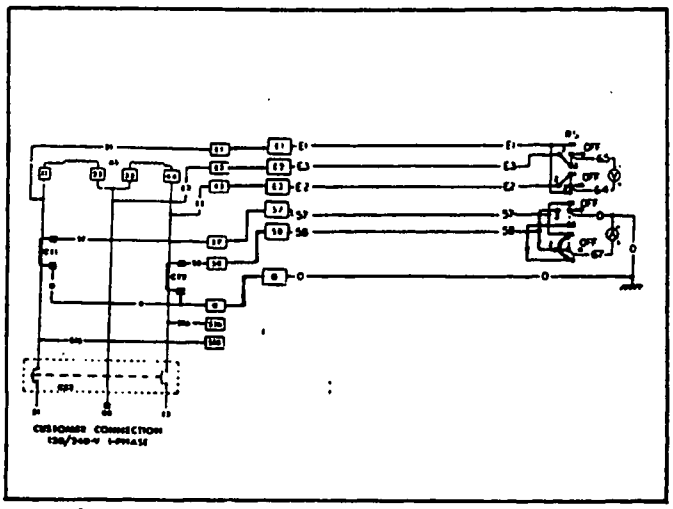


Figure 3.4-B. AC Ammeter and Voltmeter Circuit

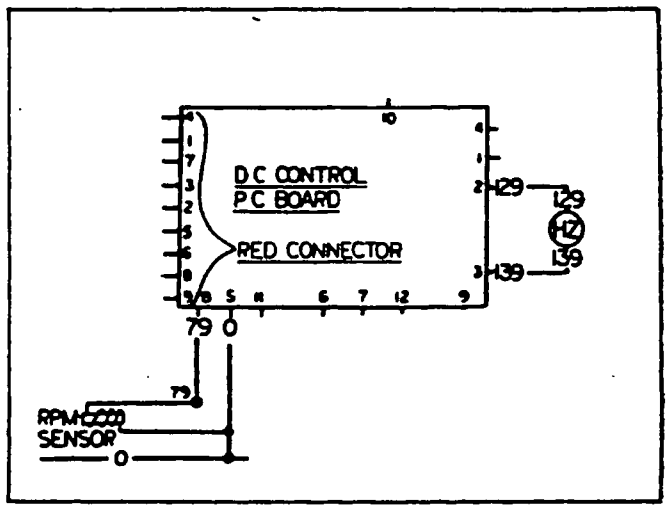


Figure 3.4-C. AC Frequency Meter Circuit

3.4.3- AC FREQUENCY METER (Figure 3.4-A, 3.4-C)

An RPM SENSOR is mounted to the generator engine's flywheel housing, directly over the flywheel teeth. The Sensor is a magnetic "pickup"- each flywheel tooth that passes the Sensor generates a sine wave, thus providing a means of measuring engine flywheel speed. The Sensor's sine wave pulses are delivered to DC Control circuit board Pin 8, via Wire #79. That circuit board incorporates a "Frequency-to-Voltage" conversion circuit, which converts the frequency signals to an equivalent voltage. The equivalent voltage is delivered to the panel Frequency Meter via Wires #129 and #139. The Meter is actually a Voltmeter that is calibrated in FREQUENCY.

NOTE

Each time a panel Frequency Meter or a DC Control circuit board is replaced, the Frequency Meter must be recalibrated. Two adjustable potentiometers are located on the DC Control board for this purpose. See Part 4, OPERATIONAL TESTS AND ADJUSTMENTS.

NOTE

In addition to operating the panel Frequency Meter, RPM Sensor output is used to (a) establish an engine cranking cutout speed of about 1000 rpm, and (b) provide an automatic engine shutdown in the event of OVERSPEED or RPM SENSOR LOSS.

3.4.4- ENGINE INSTRUMENTS (Figure 3.4-A)

The panel mounts a COOLANT TEMPERATURE and an OIL PRESSURE GAUGE. Engines are equipped with electrical "sending" units which operate these gauges. A DC AMMETER indicates the rate of charge (in Amperes) to the generator battery, from the engine driven DC Alternator during operation.

3.4.5- PREHEAT SWITCH (Figure 3.4-A, 3.4-D)

This Switch is provided for diesel engine-driven generator units only. Diesel engines are equipped with either a set of GLOW PLUGS (one for each cylinder) or an AIR INTAKE HEATER. Preheat switch closure delivers +12 VDC to a PREHEAT CONTACTOR PHC coil and to ground. The PHC energizes and its contacts close to deliver +24 VDC to the engine GLOW PLUGS or AIR INTAKE HEATER (if diesel engine has a 24 Volts system).

NOTE

During automatic startup of Option "B" and "C" units, +12 VDC power is delivered to the PREHEAT CONTACTOR PHC from Pin 12 of the Crank (Option "B") or Latch/Crank (Option "C") circuit board, through Wire #150. The PREHEAT function then occurs from start of cranking until the engine starts (Wire #14 circuit energizes).

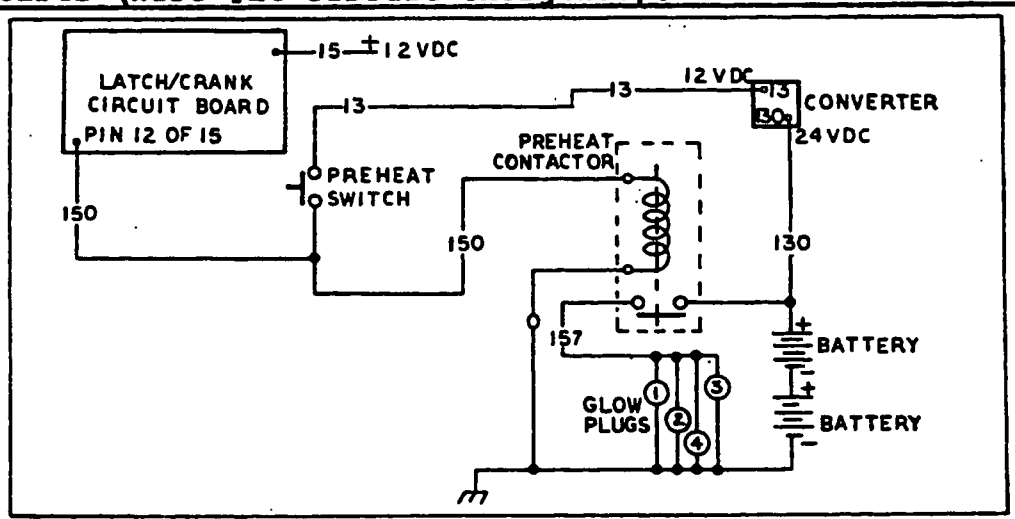


Figure 3.4-D. Preheat Circuit (Diesel Engine Units Only)

3.4.6- ENGINE-START/STOP SWITCH (Figure 3.4-A, 3.4-E)

Hold Switch at START to crank engine manually, release the Switch when the engine starts. To stop the engine, set the switch to its STOP position.

Holding the Switch at START grounds the Wire #17 and Pin 11 circuit from the DC Control board. Circuit board transistor "switching" action then causes the board's CRANK RELAY K2 to energize. On K2 contact closure, +12 VDC is delivered to a CONTROL CONTACTOR CC via DC Control board Pin 7 and Wire #56. On closure of the CC contacts, +12 VDC (units with 12 Volts engine system) or +24 VDC (units with 24 Volts engine system) is delivered to a STARTER CONTACTOR SC. On SC contact closure, +12 VDC (12 volts system) or +24 VDC (24 Volts system) is delivered to the STARTER MOTOR SM. The engine cranks. RUN RELAY K1 (on the DC Control board) energizes simultaneously with CRANK RELAY K2 and, on K1 contact closure, +12 VDC is applied to the Wire #14 circuit from DC Control board Pin 1. Wire #14 supplies the required power to engine fuel system and ignition system (gas engines) components to effect a startup.

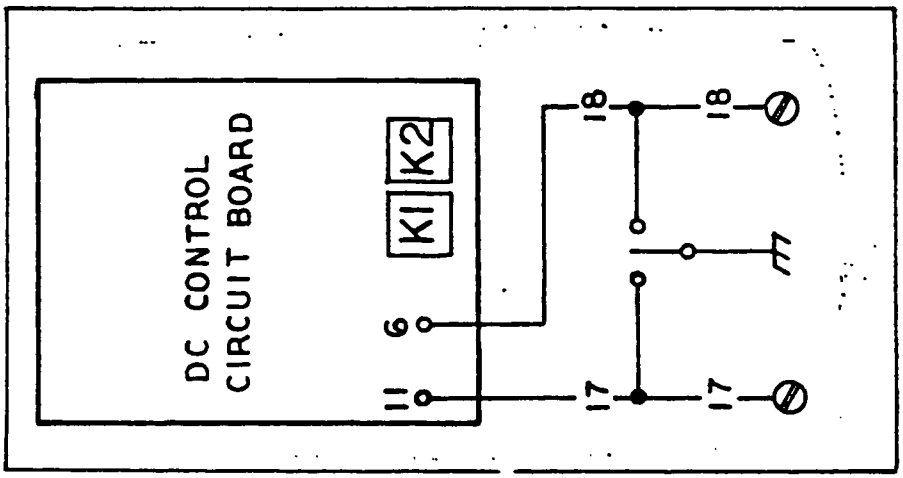


Figure 3.4-E. Engine-Start/Stop Switch Circuit

Setting the Start/Stop Switch to STOP closes the DC Control board Pin 6 and Wire #18 circuit to ground. Solid state "switching" circuits on the DC Control board then de-energize RUN RELAY K1- +DC power is removed from the Wire #14 circuit and engine shutdown occurs.

3.4.7- 30 AMPERE FUSE (Figure 3.4-E, 3.4-F)

This Fuse protects the engine cranking circuit against current overload. The protected circuit consists of Wire #15 to Pin 10 of the DC Control board and to Pin 11 of the Crank (Option "B") or Latch/Crank (Option "C") board. A "blown" Fuse element will make engine cranking impossible, i.e., will prevent DC Control board CRANK RELAY K2 from energizing.

NOTE

A second FUSE, rated at 14 DC Amperes, protects the RUN circuit against overload. This Fuse is electrically connected in series with Wire #15 and Pin 4 of the DC Control board.

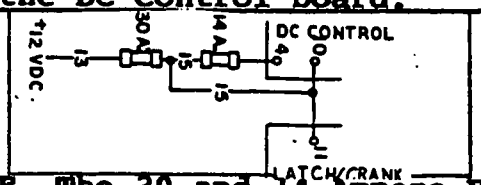


Figure 3.4-F. The 30 and 14 Ampere Fuse Circuits

3.4.8- VOLTAGE ADJUST POTENTIOMETER (Figure 3.4-A, 3.4-G)

This potentiometer permits the operator to "fine adjust" the generator's AC output voltage to connected loads, within a range of plus or minus 5 percent. The Potentiometer is electrically connected in series with one of the Voltage Regulator "sensing" leads from the Stator AC Power windings, to permit bias of the sensing signal to the regulator.

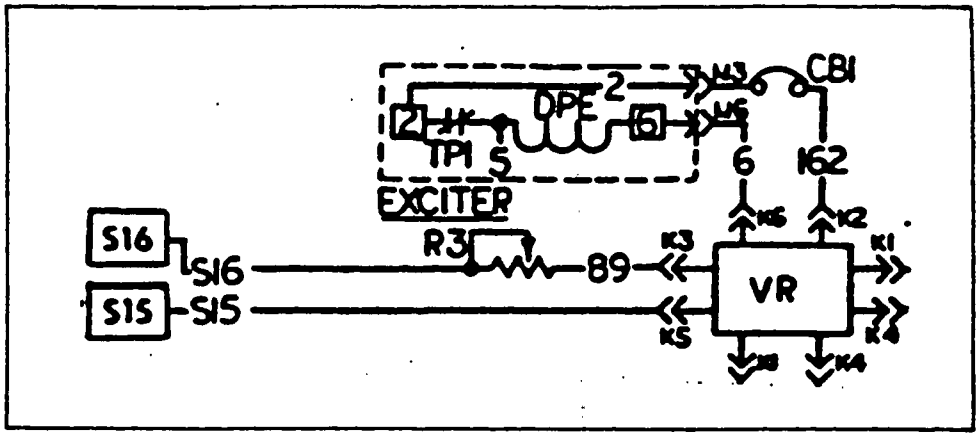


Figure 3.4-G. Voltage Adjust Potentiometer Circuit

3.4.9- OPTIONAL MANUAL/OFF/AUTO SWITCH (Figure 3.4-A, 3.4-H)

DANGER!
Option "B" and "C" generator units, when installed in conjunction with an automatic controller or transfer switch with integral controller, can crank and start suddenly without warning. To prevent possible injury from such sudden startup (a) remove the panel 30 ampere Fuse, OR (b) disconnect the generator battery cables, OR (c) if equipped with a Manual/Off/Auto Switch, set that Switch to OFF BEFORE working on or around the unit.

This optional safety switch may be used as follows:-

1. Set Switch to **MANUAL** position:- Before attempting to crank and start the generator manually. **The unit cannot be cranked and started automatically with MANUAL position selected.**
2. Set Switch to **OFF** position:- Before working on or around the generator **(unit cannot crank either manually or automatically when Switch is set to OFF)**
3. Set Switch to **AUTO**:- For all normal automatically controlled operations- with Switch set to **MANUAL or OFF, loss or dropout of NORMAL (Utility) power source voltage will NOT effect an automatic startup.**

NOTE
The optional 3-position Switch is equipped with a set of normally-open (N.O.) contacts, for use when the optional ANNUNCIATOR PANEL is installed. When properly interconnected with these contacts, the ANNUNCIATOR PANEL's "SWITCH OFF" advisory light will illuminate whenever the Swicth is set to either OFF or MANUAL.

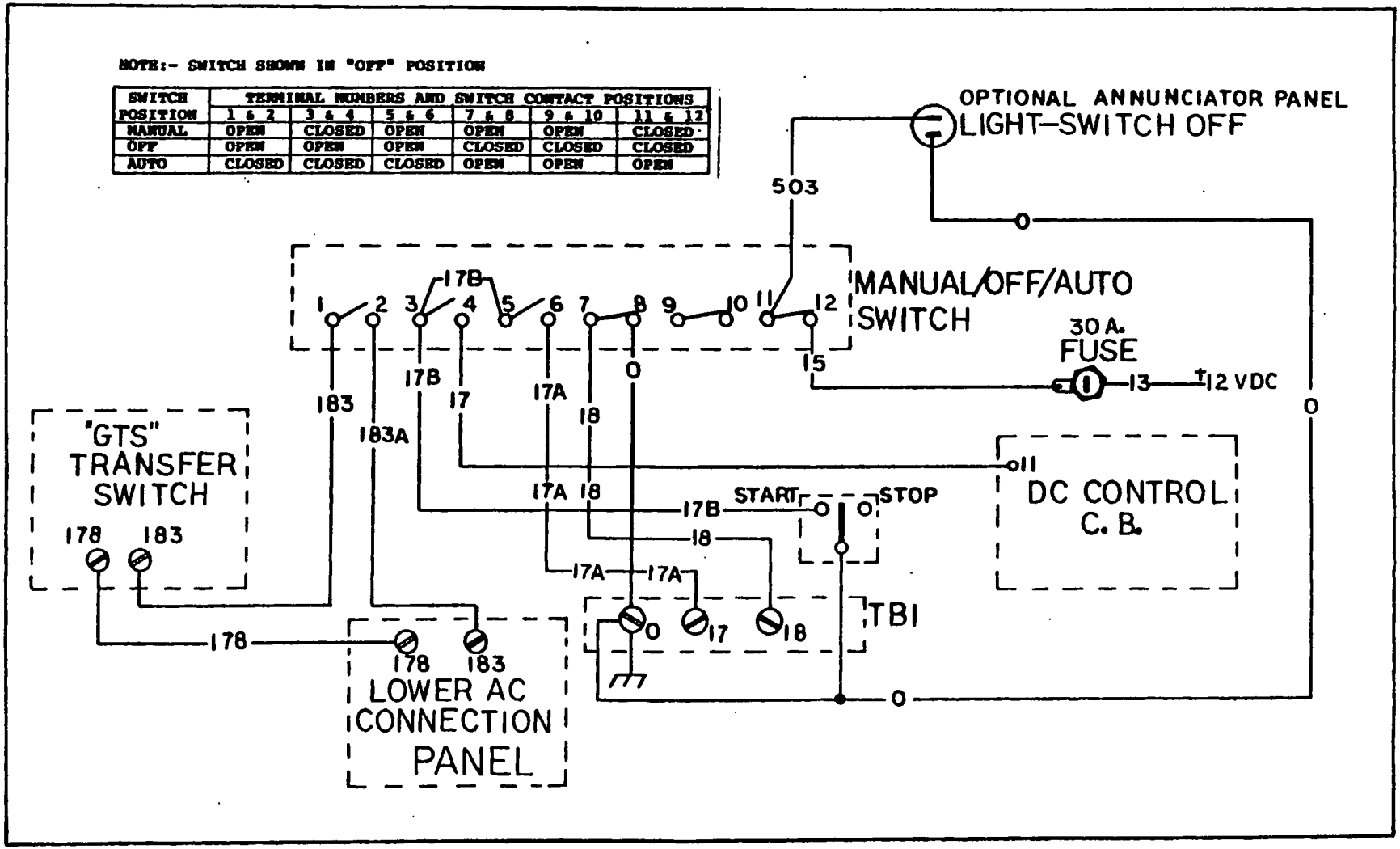


Figure 3.4-H. The Optional 3-Position Switch Circuit

SECTION 3.5 - METER AND CONTROL PANEL INTERNAL COMPONENTS
(Units Manufactured After August 1984)

3.5.1- VOLTAGE REGULATOR (Figure 3.5-A)

Refer to Paragraph 3.3.1 in this Manual.

3.5.2- CONTROL RELAY CR2 AND CIRCUIT BREAKER CB7 (Figure 3.5-A, 3.5-B)

NOTE
The CR2 RELAY is used on DIESEL ENGINE UNITS equipped with a FUEL SOLENOID ONLY. All diesel engines may not require this Relay.

During a start, when DC Control Board RUN RELAY K1 energizes, a +12 VDC is delivered to Wire #14 on K1 contact closure. Control Relay CR2 energizes, its contacts close, and +24 VDC is delivered to the engine Fuel Injection Pump FUEL SOLENOID FS via Wire #218, the closed contacts of CR2, Wire #219, CIRCUIT BREAKER CB7, and Wire #19. FS energizes to place the Injection Pump into a "flow" condition for engine startup.

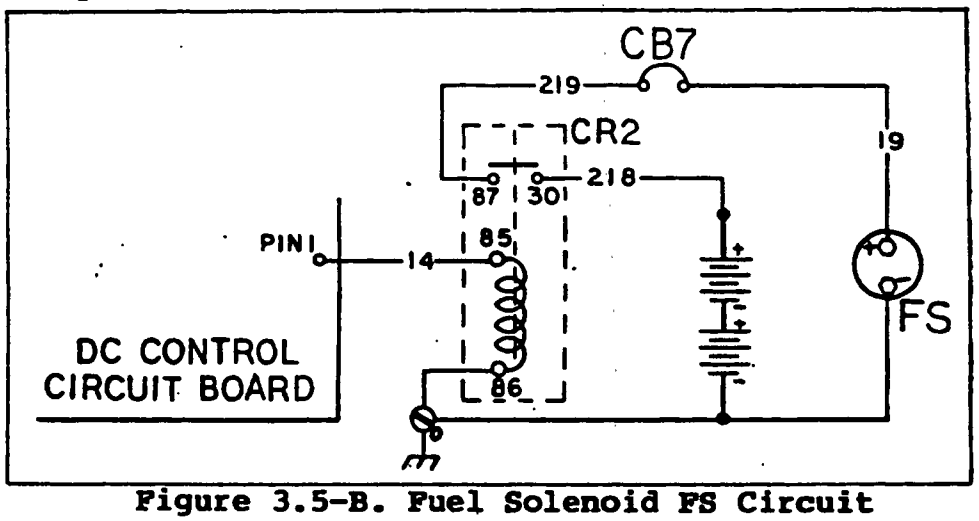


Figure 3.5-B. Fuel Solenoid FS Circuit (Used on some Diesel Engine Units)

3.5.3- TERMINAL BLOCK TB1 (Figure 3.5-A, 3.5-C)

This terminal block provides a convenient means of interconnecting Meter and Control Panel components with engine and other circuits. Terminals, associated wire numbers and circuit functions are listed in the CHART that follows.

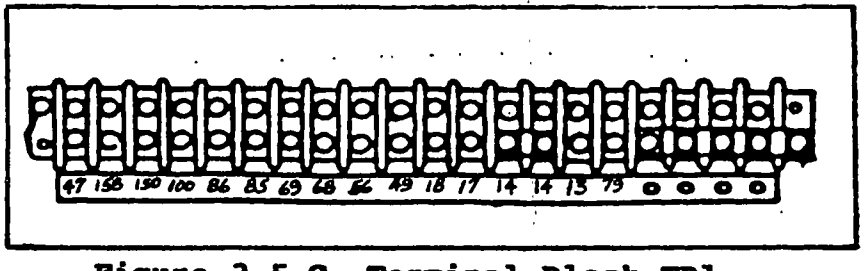


Figure 3.5-C. Terminal Block TB1

TERMINAL	WIRE	FUNCTION
0	0	Common GROUND
79	79	RPM sensor signals to Pin 8 of the DC Control board
13	13	+12 VDC to 30 Ampere Fuse (Always "hot")
14	14	+12 VDC to engine components with engine running only
17	17	Manual start- Grounding this terminal should result in engine cranking
18	18	Manual engine shutdown- When connected to ground, engine should shut down
49	49	+DC to engine DC Alternator field
56	56	+12 VDC to Control Contactor CC during cranking only
68	68	From engine coolant temperature sender to panel Coolant Temperature Gauge
69	69	From engine oil pressure sending unit to panel Coolant Temperature Gauge
85	85	To Pin 12 of DC Control board from HIGH COOLANT TEMPERATURE SWITCH/LOW COOLANT LEVEL SENSOR
86	86	To Pin 9 of DC Control board from LOW OIL PRESSURE SWITCH
100	--	Not Used
150	150	Diesel Engine Units only- From Pin 12 of Crank (Option "B") or Latch/Crank board (Option "C") to PREHEAT CONTACTOR PHC
158	---	Not Used
47	47	To engine DC Alternator field

3.5.4- FIELD CIRCUIT BREAKER (Figure 3.5-A, 3.5-D)

This Circuit Breaker is electrically connected in series with Wires #2 and #162, between the Stator Excitation (DPE) winding and the Voltage Regulator.

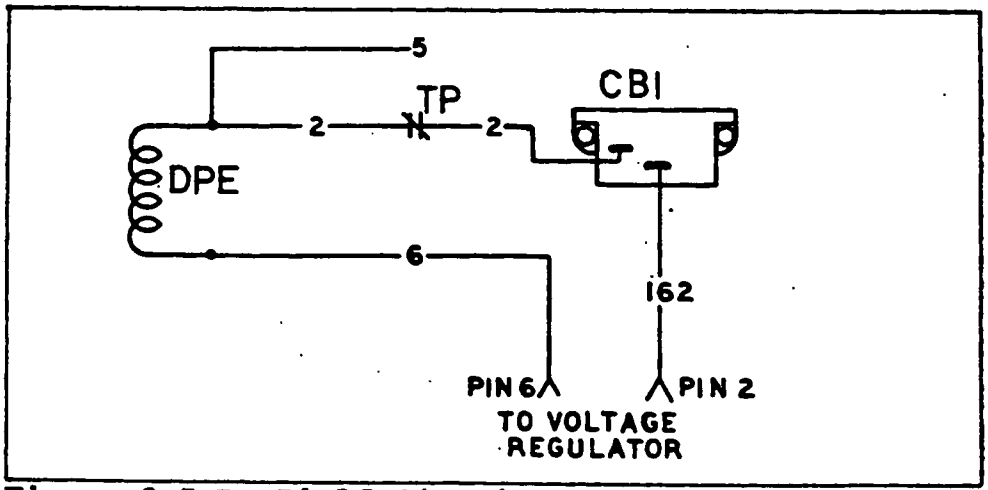


Figure 3.5-D. Field Circuit Breaker in DPE Circuit

3.5.5- BREAKER RELAY (Figure 3.5-A)

NOTE

Some electrical schematics/wiring diagrams may represent the Breaker Relay (BR) as CONTROL RELAY (CR1).

The BREAKER RELAY is energized by Wire #14 circuit +DC voltage. When energized and upon contact closure, (a) +DC is delivered to the FIELD BOOST circuit, and (b) +DC is delivered to the engine DC Alternator field.

3.5.6- ENGINE DC ALTERNATOR FIELD RESISTOR (Figure 3.5-A)

This Resistor, when used, is electrically connected in the +DC circuit to the engine's DC Alternator field.

3.5.7- FIELD BOOST RESISTOR (Figure 3.5-A, 3.5-E)

This voltage limiting resistor is connected in the Rotor FIELD BOOST circuit.

3.5.8- FIELD BOOST DIODE (Figure 3.5-A, 3.5-E)

This DIODE (D5) is connected in series with the +DC FIELD BOOST circuit to the generator Rotor.

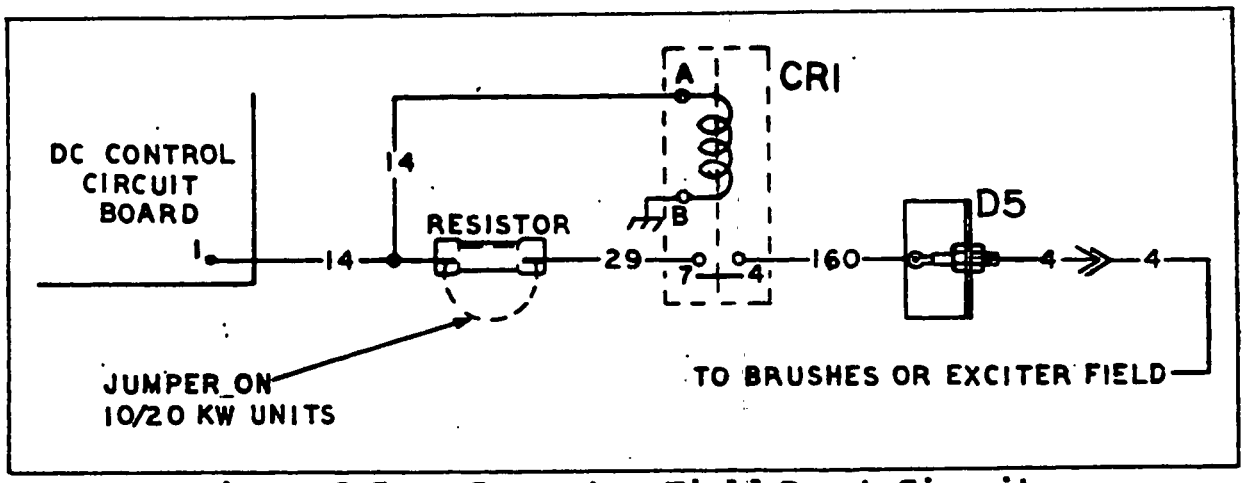


Figure 3.5-E. Generator Field Boost Circuit

3.5.9- TERMINAL BOARD TB2 (Option "C" Units Only)
(Figure 3.5-A, 3.5-F)

This Terminal Board, used only with Option "C" generator units, provides a convenient connection point for customer remote alarm or remote annunciator devices. Terminal numbers, associated wires, and circuit functions are listed in the CHART that follows:-

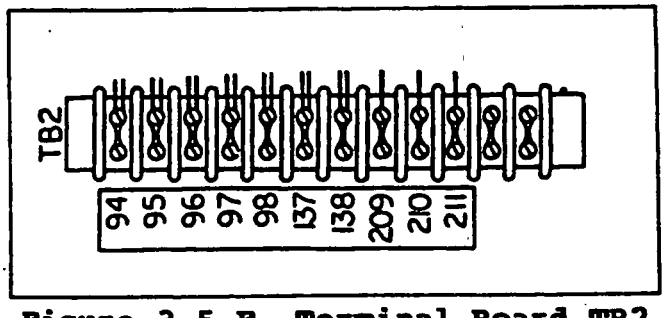


Figure 3.5-F. Terminal Board TB2 (Option "C" Units Only)

TERMINAL	WIRE	CIRCUIT FUNCTION
94	94	+12 VDC is applied to this terminal when a LOW OIL PRESSURE shutdown occurs
95	95	+12 VDC applied to this terminal when HIGH COOLANT TEMPERATURE/LOW COOLANT LEVEL shutdown occurs
96	96	OVERCRANK- +12 VDC is applied to this terminal when engine does not start in its allotted 8 crank/no-crank cycles
97	97	OVERSPEED- +12 VDC is applied to this terminal in the event of an automatic OVERSPEED shutdown (above 68-70 Hertz)
98	98	RPM SENSOR LOSS- +12 VDC is applied to this terminal in the event of a loss of RPM SENSOR output to the DC Control circuit board
137	137	TEST SWITCH connection for Monitor Panel
138	138	RESET SWITCH connection for Monitor Panel
209	209	NORMALLY CLOSED Contacts- For connection of customer remote alarm device(s)
210	210	COMMON Contacts- For connection of customer remote alarm device(s)
211	211	NORMALLY OPEN Contacts- For connection of customer remote alarm device(s)

3.5.10- DC CONTROL CIRCUIT BOARD (Figure 3.5-A, 3.5-G)

The DC Control circuit board acs as the "control center" for engine cranking, startup and running operations. The circuit board also provides an automatic engine shutdown in the event of (a) high coolant temperature, (b) low coolant level, (c) low oil pressure, (d) overspeed, and (e) RPM Sensor Loss. Finally, the board incorporates a "frequency-to-voltage" conversion circuit for operation of the panel frequency meter.

The DC Control board mounts two RELAYS. CRANK RELAY K2 is energized by solid state circuit board "switching" action, to initiate engine cranking operations. RUN RELAY K1, also energized by circuit board "switching" action, controls engine running operations by delivering +12 VDC to the Wire #14 circuit. The Relays are energized simultaneously during an engine start.

A WHITE, 12-Pin CONNECTOR PLUG interconnects the DC Control circuit board with other generator unit components. A RED, 12-Pin CONNECTOR PLUG interconnects the DC Control board with a Latch/Crank board (Option "C" units) or a Crank board (Option "B" units).

NOTE

All generator units include a DC Control circuit board. A Latch/Crank cirucit board is included only with Option "C" units. A Crank circuit board is included with Option "B" units. Option "A" units are NOT equipped with a Crank or a Latch/Crank circuit board.

The WHITE Connector Plug Pins, associated wire numbers and functions of that circuit are listed in thg following CHART:-

PIN	WIRE	FUNCTION
1	14	+12 VDC applied to pin/circuit only with RUN RELAY K1 energized (engine running)
2	129	+DC voltage signal to panel Frequency Meter from DC Control board "frequency-to-voltage" circuit
3	139	-DC voltage signal to panel Frequency Meter from DC Control circuit board "frequency-to-voltage" circuit
4	15	+12 VDC battery power input to DC Control board, fused at 14 DC amperes
5	0	Common GROUND
6	18	Engine Manual STOP circuit- engine will shut down when this circuit is grounded
7	56	+12 VDC is applied to this circuit when DC Control board CRANK RELAY K2 energizes, to initiate engine cranking
8	79	RPM SENSOR frequency input to DC Control board
9	86	LOW OIL PRESSURE SWITCH- engine should shut down when this circuit is grounded
10	15	+12 VDC battery circuit- fused at 30 DC amperes, always hot but current flow only while cranking
11	17	Manual Engine START- when connected to ground, engine should crank
12	85	HIGH COOLANT TEMP/LOW COOLANT LEVEL- when connected to ground, engine should shut down

RED connector plug (DC Control to Latch/Crank or Crank board) pins, associated wire numbers and circuit functions are as follows for Option "C" units:-

PIN	WIRE	FUNCTION
1	15	+12 VDC to Latch/Crank (Option "C") or to Crank (Option "B") circuit board for circuit board operations
2	87	Circuit voltage drops low when an RPM SENSOR LOSS shutdown occurs
3	133	AUTOMATIC SHUTDOWN- Latch/Crank or Crank board grounds this circuit when 2-wire start/stop system calls for shutdown
4	0	Common GROUND
5	131	STARTER CUTOUT/MINIMUM RUN SPEED SIGNAL- circuit voltage goes HIGH (10-12 VDC) when engine speed during startup reaches 1000 rpm
6	132	HIGH COOLANT TEMP/LOW COOLANT LEVEL- line voltage goes high when an automatic high temp/low coolant level shutdown occurs
7	71	ENGINE RUNNING SIGNAL- circuit voltage goes high (10-12 VDC) when engine is running OR when a monitored shutdown occurs, to prevent engine starter engagement
8	85	OVERSPEED shutdown- voltage goes high (10-12 VDC) when engine speed exceeds 68-70 Hertz and automatic shutdown occurs
9	86	LOW OIL PRESSURE- voltage goes high (10-12 VDC) when automatic shutdown caused by low oil pressure condition occurs
10	--	AUTOMATIC START- line will pulse on and off for up to eight equal-duration crank/no-crank cycles of 6-12 seconds each during an automatically controlled startup
11	--	NOT USED
12	--	NOT USED

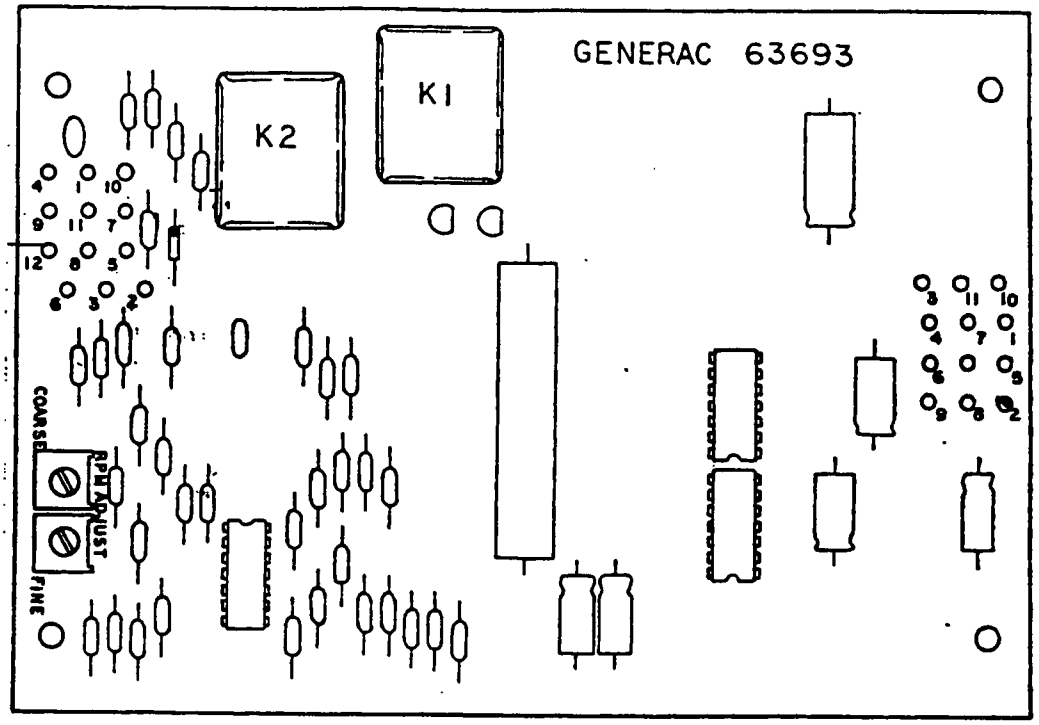


Figure 3.5-G. DC Control Circuit Board (Units Manufactured After August 1984)

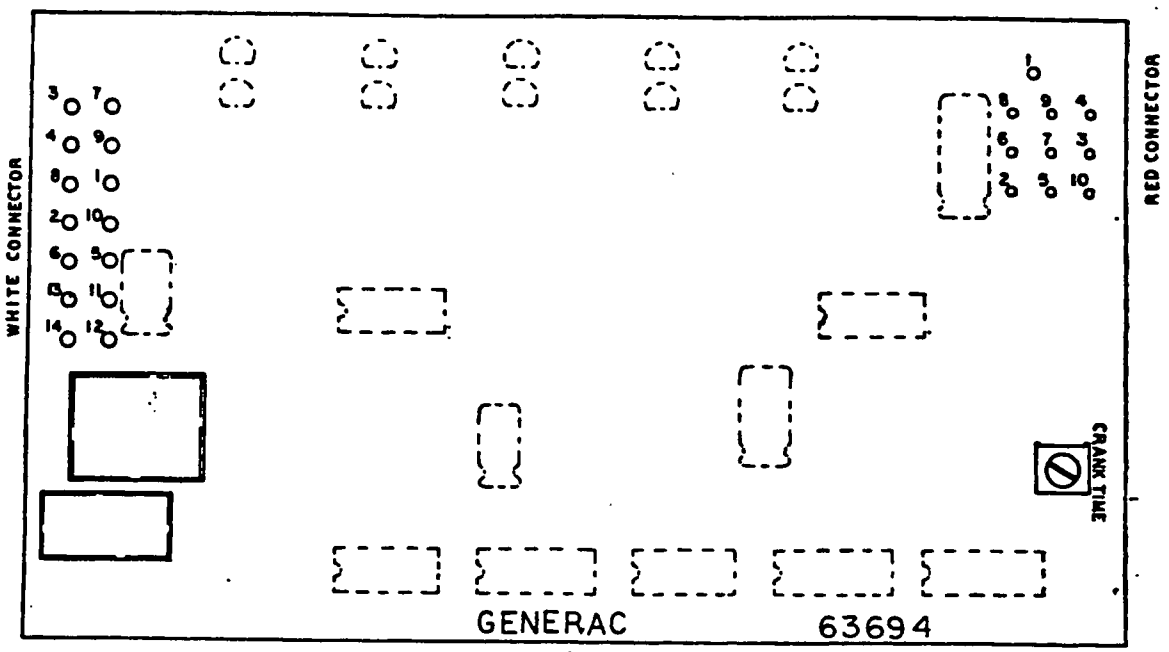


Figure 3.5-H. The Option "C" Latch/Crank Circuit Board (Units Manufactured After August 1984)

3.5.11- LATCH/CRANK CIRCUIT BOARD (Figure 3.5-H)

NOTE

Option "A" (manual start only) generator units are NOT equipped with a Latch/Crank circuit board. Option "B" units are equipped with a CRANK circuit board, which is NOT interchangeable with the LATCH/CRANK board used on Option "C" units. The CRANK circuit board used on Option "B" units does NOT have an ENGINE RUN SIGNAL (see Pin 7, Wire 71 in RED connector plug CHART on Page 11).

The Latch/Crank circuit board is equipped with a RED, 12-pin connector plug which connects to the DC Control board's RED, 12-pin connector. See RED CONNECTOR PLUG CHART, Page 11.

The Latch/Crank board is also equipped with a WHITE, 15-pin CONNECTOR PLUG. That Connector Plug's PIN, ASSOCIATED WIRES and FUNCTIONS are shown in the following CHART:-

PIN	WIRE	FUNCTION
1	137	TEST SWITCH for Option "C" Engine Monitor panel
2	178	GROUNDED side of automatic, 2-wire Start/Stop system- connects to Terminal #178 in AC Connection Panel
3	96	OVERCRANK- +12 VDC is applied to line if engine does not start in 8 crank/no-crank cycles during automatic startup
4	98	RPM SENSOR LOSS- +12 VDC applied to line if RPM SENSOR frequency signals to DC Control board are lost
5	138	RESET SWITCH for Option "C" Engine Monitor Panel
6	183	+DC side of 2-wire automatic Start/Stop system connects to Terminal #183 in AC Connection Panel
7	97	OVERSPEED- +12 VDC applied to line if automatic shutdown due to overspeed above 68-70 hertz occurs
8	94	LOW OIL PRESSURE- +12 VDC applied if engine shuts down due to low oil pressure condition
9	95	HIGH COOLANT TEMP/LOW COOLANT LEVEL- +12 VDC is applied if a high coolant temp or low coolant level shutdown occurs
10	210	COMMON side of customer alarm installation- to energize a remote alarm (horn, telephone dialer, etc.), connect a +DC power source (Terminal #15) at Terminal Strip (see Paragraph 3.5.9, TERMINAL BOARD TB2)
11	15	+12 VDC battery power for cranking- fused at 30 amperes
12	150	PREHEAT (Diesel engine units only)- +12 VDC applied from start of cranking to end of cranking during automatic starts
13	211	NORMALLY OPEN side of customer alarm installation (see Pin 10 and 14)- (Also see Paragraph 3.5.9)
14	209	NORMALLY CLOSED side of customer alarm installation (see 10 and 13)- (Also see Paragraph 3.5.9)
15	---	NOT USED

SECTION 3.6 - OPTION "A" AND "B" ENGINE MONITOR PANELS

3.6.1- GENERAL (Figure 3.6-A)

The Engine Monitor Panel on generators produced after August 1984 is mounted vertically on the Meter and Control Panel. Earlier units featured a horizontally located Monitor Panel. The Option "A" and "B" unit Engine Monitor Panels have only two advisory lights- LOW OIL PRESSURE and HIGH COOLANT TEMPERATURE- which do NOT have the "latch" feature of Option "C" units. Also see Paragraph 2.5.9 in this Manual.

The Option "A" and "B" Monitor Panel advisory lights are powered by +12 VDC from the Wire #14 circuit, which is electrically hot only while the engine is running (DC board RUN RELAY K1 is energized). Thus, on any annunciated engine shutdown, the applicable advisory light will remain ON until the DC Control board's RUN RELAY K1 de-energizes and then will go out.

3.6.2- LOW OIL PRESSURE ADVISORY LIGHT (Figure 3.6.2)

The engine mounts a low oil pressure switch. The switch is normally closed, is held open by engine oil pressure during cranking and operation. Should oil pressure drop below approximately 15 psi during operation, the switch will close to connect Wire #86 and DC Control board Pin 9 to ground- an automatic engine shutdown will then occur. Pressure switch closure will also connect the Wire #14 circuit through the advisory light to ground- the light will then come ON. As soon as the Wire #14 circuit goes dead (RUN RELAY K2 on the DC Control board de-energizes), the light will go OUT. To determine the cause of the automatic shutdown, crank the engine manually- the applicable advisory light will illuminate during cranking.

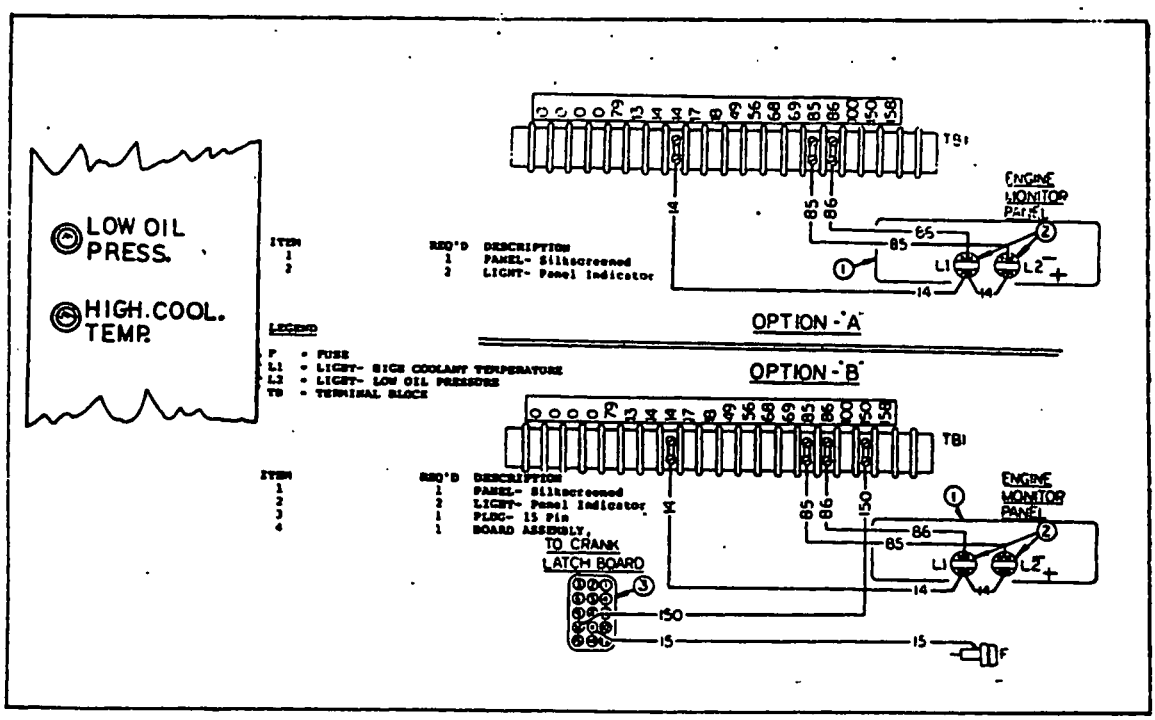


Figure 3.6-A. Engine Monitor Panel- Options "A" and "B"

3.6.3- HIGH COOLANT TEMPERATURE ADVISORY LIGHT (Figure 3.6-A)

Generator engines are equipped with a high coolant temperature switch and a low coolant level sensor. In the event of either a high coolant temperature or a low coolant level (or both), DC Control board Pin 12 and Wire #85 circuit will be connected to ground, to effect an engine shutdown. Connection of the circuit to ground will also connect the Wire #14 circuit to ground through the applicable switch or sensor, to turn the advisory light on. When the Wire #14 circuit goes dead on shutdown, the light will go out (DC Control board RELAY K2 de-energizes).

SECTION 3.7 - OPTION "C" ENGINE MONITOR PANEL

3.7.1- GENERAL (Figure 3.7-A)

The Option "C" Engine Monitor Panel mounts a bank of 5 engine fault advisory lights, a TEST switch and a RESET switch. The 5 advisory lights provide a visual indication of up to five engine fault operating parameters, as follows:-

1. Low Oil Pressure
2. High Coolant Temperature
3. Overcrank
4. Overspeed
5. RPM Sensor Loss

Option "C" units feature a Latch/Crank circuit board which provides a "latch" capability. That is, in the event of any one (or more) of the listed engine shutdown faults, the applicable light(s) will illuminate and remain on even after engine shutdown. With the fault thus "latched" (light ON), further cranking and attempts at startup are inhibited. To "unlatch" the condition(s) (turn the light out), press the panel RESET switch- the advisory light(s) will go out and further cranking will be possible.

To test the advisory lights and the latch feature, press the TEST switch. All lights should come on and a fault condition should latch. Press the RESET switch to extinguish all lights and unlatch the fault condition.

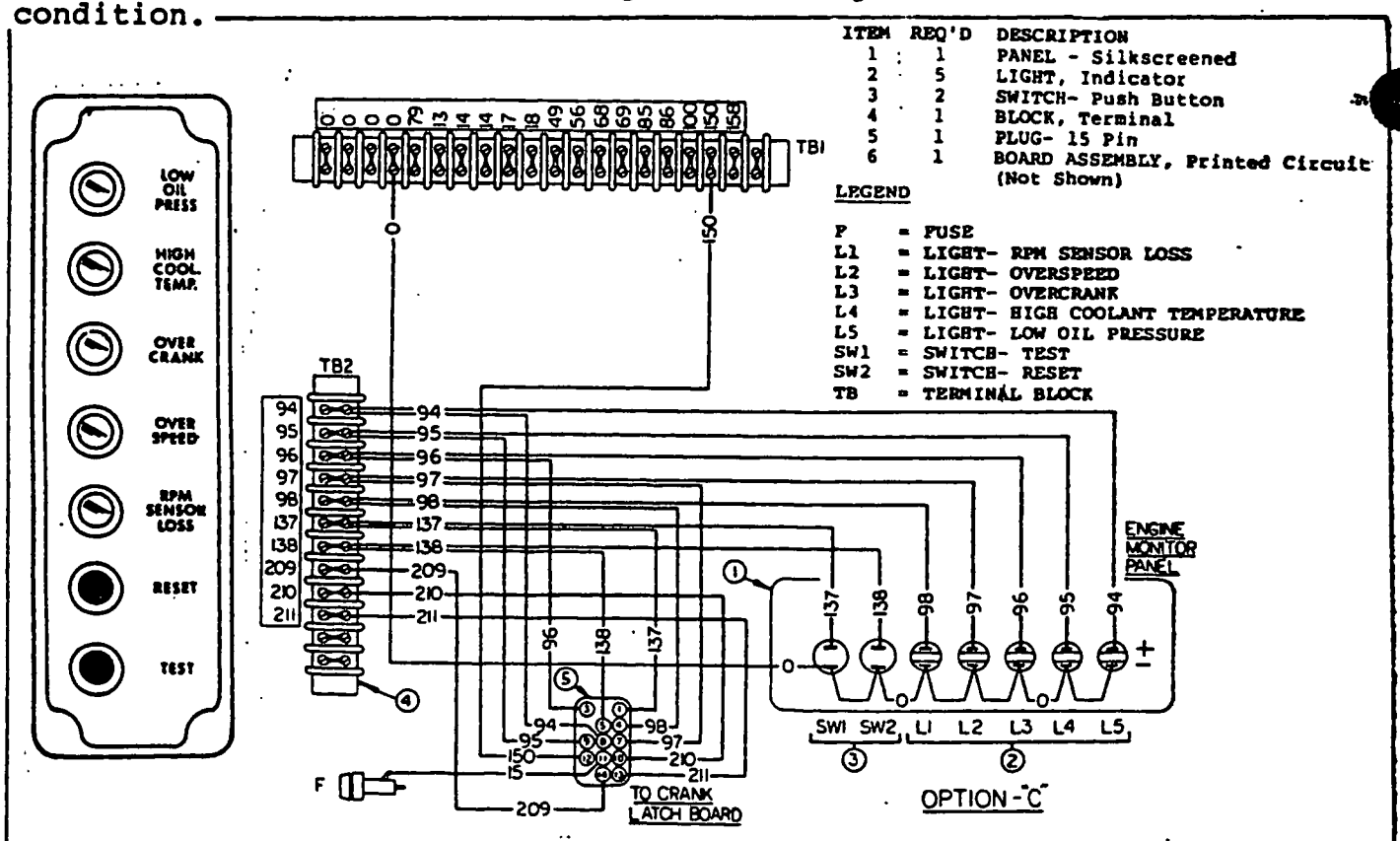


Figure 3.7-A. The Option "C" Engine Monitor Panel

3.7.2- LOW OIL PRESSURE ADVISORY LIGHT (Figure 3.7-A)

Should a low oil pressure condition occur, an automatic shutdown will follow and the applicable advisory light will latch on as follows:-

1. The LOW OIL PRESSURE fault will be "latched" (light ON) only if the engine has been operating above starter cutout speed (about 1000 rpm) for 3 seconds or longer when the fault occured.
2. A LOW OIL PRESSURE fault that occurs during cranking and below starter cutout speed will result in an automatic shutdown after a 1 second delay. However, the condition will not latch (light remains OUT), and the engine will continue to crank for any crank cycles remaining in its allotted 8 crank/no-crank cycles (automatic starts).
3. Should the LOW OIL PRESSURE light latch on, further cranking will be inhibited. To unlatch the fault, push the RESET switch in- engine will then crank for any cycles remaining in its 8-crank limit.
4. A LOW OIL PRESSURE condition can (in some instances) cause the OVERCRANK light to come on. This can happen if the low oil pressure fault occured at below starter cutout speed (1000 rpm). The condition will not latch, engine will crank for any cycles remaining in its 8-crank limit, and the OVERCRANK light will come on when all 8 cranks are used up.

3.7.3- HIGH COOLANT TEMPERATURE ADVISORY LIGHT (Figure 3.7-A)

If a HIGH COOLANT TEMPERATURE, a LOW COOLANT LEVEL, or BOTH, should occur an automatic shutdown and latching of the fault (light ON) will occur after a 1 second delay.

3.7.4- OVERCRANK ADVISORY LIGHT (Figure 3.7-A)

The Latch/Crank circuit board imposes an 8-crank limit on the system for automatically controlled engine starts. A potentiometer, located on the Latch/Crank board permits the time duration of each crank/no-crank cycle to be adjusted to 6-12 seconds. During an automatic start, if the engine has not started in 8 crank/no-crank cycles, cranking will automatically terminate and the OVERCRANK advisory light will come on.

3.7.5- OVERSPEED ADVISORY LIGHT (Figure 3.7-A)

In the event of an engine overspeed above approximately 68-70 Hertz, an automatic shutdown and latching of the fault (light on) will occur after a 1 second delay.

NOTE

Units manufactured prior to August 1984 used a Latch/Crank circuit board having an OVERSPEED adjustment potentiometer. Units manufactured after that date, with vertically positioned Engine Monitor Panel, have a Latch/Crank circuit board with a fixed OVERSPEED setting.

3.7.6- RPM SENSOR LOSS ADVISORY LIGHT (Figure 3.7-A)

Loss of RPM Sensor frequency signals to the DC Control circuit board will result in an automatic shutdown and a latched (light ON) condit-

ion after a 2 second delay (providing the engine is running above 1000 rpm (starter cutout speed).

SECTION 3.8 - THE OPTIONAL ANNUNCIATOR PANEL
(Units Manufactured After August 1984 Only)

3.8.1- GENERAL (Figure 3.8-A)

The optional Annunciator Panel is capable of anunciating up to 7 engine-driven generator operating parameters. The system is designed to monitor various sensing devices with normally open contacts and provide a +DC signal to an advisory light upon contact closure.

NOTE
The panel illustrated in Figure 3.8-A has one advisory light which does not follow the normally open contact rule. The LOW BATTERY VOLTAGE advisory light connects to a set of normally closed (NC) contacts on the 10 ampere "Float-Equalize" Battery Charger.

The Panel illustrated shows 7 advisory lights. This is a typical panel only, since other advisory lights are available. When the optional Annunciator Panel is used, an additional terminal block (61520) is mounted in the generator meter and control panel.

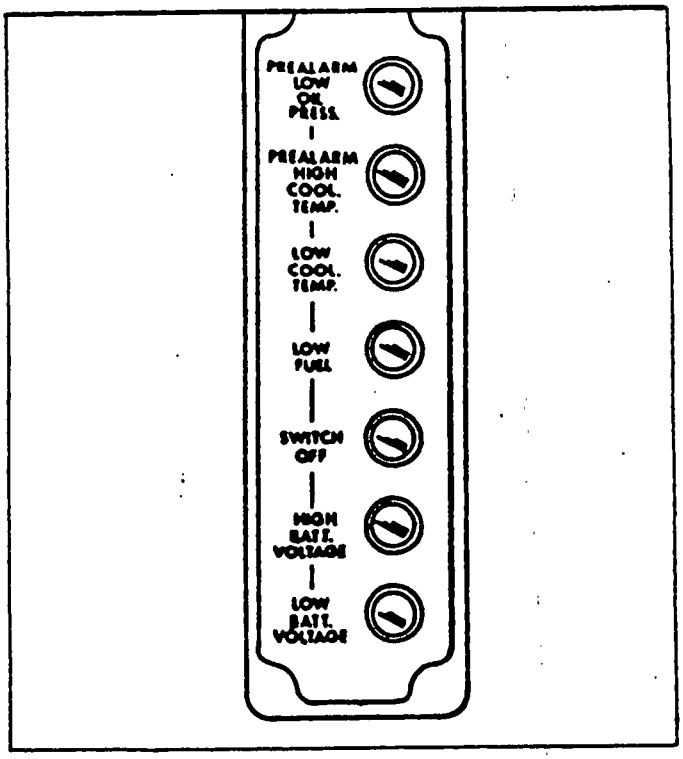


Figure 3.8-A. A Typical Optional Anunciator Panel

3.8.2- PREALARM LOW OIL PRESSURE (Figure 3.8-A, 3.8-B)

This light circuit is held open by a normally closed oil pressure switch which is held open by engine oil pressure. Switch contacts must close at a higher oil pressure value than the normal oil pressure switch, which is generally rated at approximately 15 psi. The +12 VDC for light operation is taken from Terminal 14 (electrically hot only while running).

3.8.3- PREALARM HIGH COOLANT TEMPERATURE (Figure 3.8-A, 3.8-B)

Light illuminates in advance of a high coolant temperature shutdown, connects to a set of normally open contacts that will close at a lower temperature than the normal high coolant temperature shutdown switch. The +12 VDC required for light operation is taken from the Wire #14 circuit.

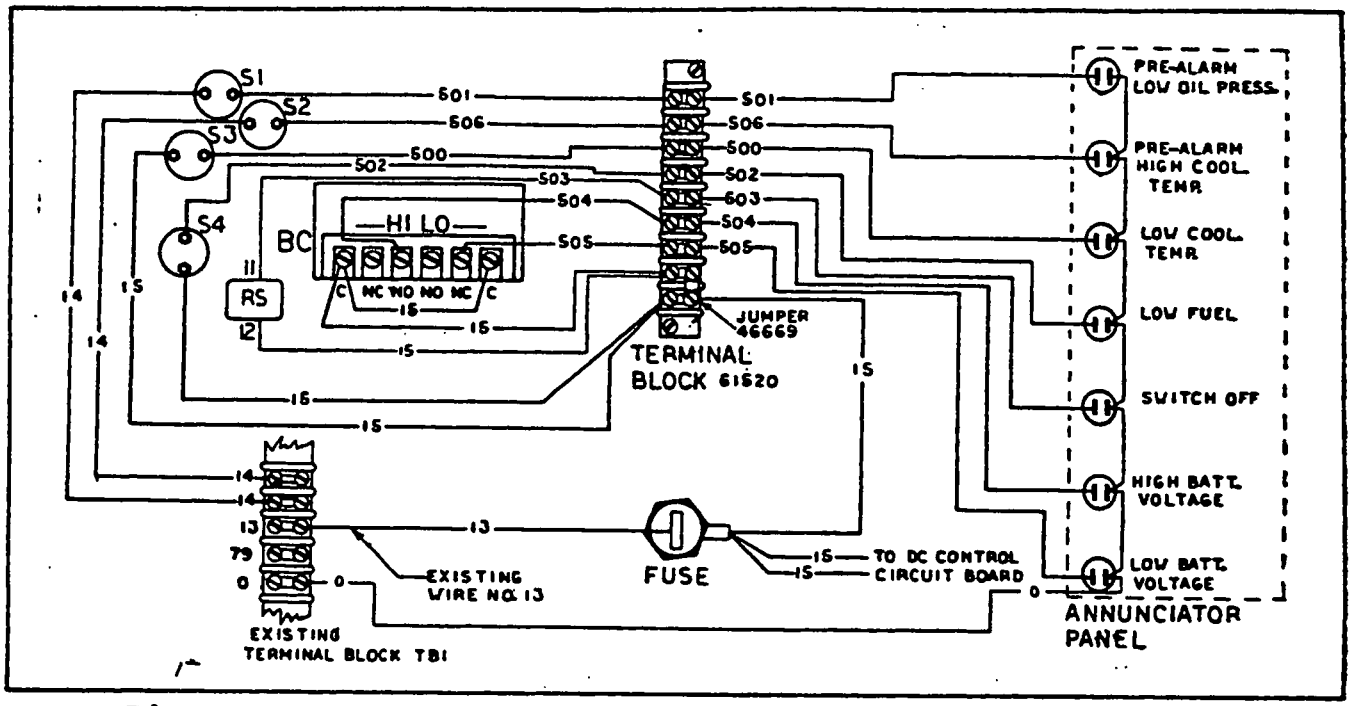


Figure 3.8-B. Optional Annunciator Panel Wiring Diagram

3.8.4- LOW COOLANT TEMPERATURE ADVISORY LIGHT (Figure 3.8-A, 3.8-B)

Light is generally useful when the generator unit mounts an ENGINE COOLANT HEATER, will come ON to warn of a failure of that heater. The light is connected to a set of normally open contacts that come ON when engine coolant temperature drops to an excessively low value (while NOT running). The +12 VDC for light operation is taken from Terminal #15 (battery voltage).

3.8.5- LOW FUEL ADVISORY LIGHT (Figure 3.8-A, 3.8-B)

The LOW FUEL light is connected to a fuel tank float which operates a set of contacts. If fuel level drops below a pre-established point, the contacts will close. Power for light operation is taken from Terminal 15 (battery voltage).

3.8.6- SWITCH OFF ADVISORY LIGHT (Figure 3.8-A, 3.8-B)

The SWITCH OFF light connects to a set of normally open contacts on the optional Manual/Off/Auto Switch. The light will come ON whenever

that switch is set to either its OFF or MANUAL position. Battery voltage for light operation is taken from Terminal 15.

3.8.7- HIGH BATTERY VOLTAGE ADVISORY LIGHT (Figure 3.8-A, 3.8-B)

Light will illuminate when the normally open contacts of a high battery voltage sensor close. The battery voltage sensor is located in the 10 ampere, float/equalize type battery charger. Connection of the light to the battery charger is accomplished by means of a terminal block in the charger. Power for light operation is taken from generator terminal 15, which must be interconnected with the battery charger's COMMON (C) terminal.

3.8.8- LOW BATTERY VOLTAGE ADVISORY LIGHT (Figure 3.8-A, 3.8-B)

This light is connected to a set of NORMALLY CLOSED (NC) contacts in the 10 ampere, float/equalize battery charger. Power for light operation is taken from generator terminal 15, which must be interconnected with the battery charger's NORMALLY CLOSED (NC) terminal.

PART 4

OPERATIONAL TESTS AND ADJUSTMENTS

Section 4.1 - **GENERATOR OPERATIONAL TESTING**
- 4.1.1 - General
- 4.1.2 - Generator Preparation Before Operational Testing
- 4.1.3 - Transfer Switch Manual Operation Test
- 4.1.4 - Generator Tests and Adjustments- All Units
- 4.1.5 - Automatic Operations- Options "B" and "C" Units Only

Section 4.2 - **ENGINE SPEED GOVERNOR ADJUSTMENTS**
- 4.2.1 - Adjusting the Universal Governor
- 4.2.2 - Adjustment of Early Production Mechanical Governor
- 4.2.3 - Electronic Isochronous Governor Adjustment

Section 4.3 - **GENERATOR CIRCUIT BOARD ADJUSTMENTS**
- 4.3.1 - General
- 4.3.2 - Crank Time Adjustment
- 4.3.3 - Preheat Time Adjustment
- 4.3.4 - AC Frequency Adjustment
- 4.3.5 - Overspeed Shutdown Adjustment
- 4.3.6 - Choke On/Off Time Adjustment

Section 4.4 - **VOLTAGE REGULATOR ADJUSTMENT**
- 4.4.1 - General
- 4.4.2 - Voltage Regulator Adjustment Procedure

Section 4.5 - **THROTTLE DROOP OVERRIDE POSITIONERS**
- 4.5.1 - General
- 4.5.2 - Positioner Operation
- 4.5.3 - Throttle Positioner Mounting
- 4.5.4 - Printed Circuit Board Installation
- 4.5.5 - Throttle Droop Override Positioner Initial Setup
- 4.5.6 - Final Adjustment

Section 4.6 -**CHECKOUT AND TESTING OF ENGINE SAFETY CONTROLS**
- 4.6.1 - General
- 4.6.2 - Operational Test of Low Oil Pressure Shutdown System
- 4.6.3 - Operational Test of High Coolant Temperature Shutdown System
- 4.6.4 - Operational Test of Low Coolant Level Shutdown System
- 4.6.5 - RPM Sensor Loss Operational Test
- 4.6.6 - Installation, Adjustment and Testing of the RPM Sensor

SECTION 4.1 - AC GENERATOR OPERATIONAL TESTING

4.1.1- GENERAL

This section discusses the operational testing of an installed generator set. Test procedures are stated in somewhat general terms, since differences may exist between specific generator sets and installations. Information pertaining to the testing, adjustment and evaluation of transfer switches, automatic controllers and other related accessories must be obtained from the instruction manual for the specific transfer switch, controler or accessory being tested. For best results, complete the operational test in the exact order given.

4.1.2- GENERATOR PREPARATION BEFORE OPERATIONAL TESTING

DANGER!
The generator and some related installed equipment are sources of dangerously high voltages. Always be sure to disconnect or turn off all power voltages at their source before working on or around this equipment.

CAUTION!
Prior to testing the generator, inspect the entire installation carefully. Installation requirements must be fully complied with. Local inspection requirements, the National Electric Code (NEC), and regulations established by the Occupational Safety and Health Administration (OSHA) must be fully complied with, as well as the manufacturer's recommendations.

NOTE
An INSTALLATION MANUAL FOR STANDBY ELECTRIC POWER SYSTEMS is available from Generac Corporation. Specify Manual Part Number 46622.

Before commencing any operational test of the generator set, make sure all installed components are ready for operation, as follows:-

Engine Lubrication:- Check engine crankcase oil level. Oil level must be at the engine dipstick FULL mark- DO NOT OVERFILL. Use the type and grade of oil recommended for the specific engine involved, as stated in the INSTRUCTIONS AND PARTS MANUAL for the specific generator set.

CAUTION!
The increased operating pressures and temperatures of DIESEL engines make it mandatory that higher grade oils be used with those engines. Gaseous fuel or gasoline engines require the use of engine lubricating oils specified "For Service SC, SD or SE". DIESEL ENGINES REQUIRE THAT OILS SPECIFIED "FOR SERVICE CC OR CD" BE USED.

Generator Set Lubrication:- As a rule, many generator sets have pre-lubricated, sealed Rotor bearings which require no additional lubrication for the life of the bearing. However, some units rated at 100 through 200 KW and driven by a 13.3 liter diesel engine are equipped with Rotor bearings which require periodic greasing. Refer to the INSTRUCTIONS AND PARTS Manual for the specific generator unit in-

volved to locate greasing procedures for units that require greasing. Units that require greasing are lubricated before leaving the factory and are ready for operation. Bearings on these units should be lubricated annually or at the intervals indicated in the INSTRUCTIONS AND PARTS Manual.

Engine Coolant:- Prior to operation, the engine cooling system must be properly filled with a 50-50 mixture of ethylene glycol base anti-freeze and soft water. Also add a high quality RUST INHIBITOR to the recommended coolant mixture. If unit is equipped with a closed recovery type cooling system, fill the COOLANT RECOVERY BOTTLE about half full with the same 50-50 mixture.

DANGER!
Ethylene glycol base anti-freeze is POISONOUS. Do NOT use mouth to siphon coolant mixture from radiator, coolant recovery bottle or any container.

NOTE
Some more commonly used rust inhibitors are CHROMATES, BORATES, NITRATES, NITRITES and SOLUBLE OIL. Do NOT use any CHROMATE BASE rust inhibitor with ethylene glycol base anti-freeze or the formation of chromium hydroxide ("green slime") will result. Formation of "green slime" will cause a low heat transfer rate and resultant overheating. Engines that have been operated with chromate base rust inhibitor must be chemically cleaned before adding ethylene glycol base anti-freeze. In addition, use of soluble oil as a rust inhibitor is NOT recommended, since heat transfer rate will be adversely affected if concentration of the soluble oil exceeds 1% by volume.

Fuel:- Check that an adequate supply of the recommended fuel is available to the generator engine, and that the fuel supply system installation is in strict compliance with all applicable codes.

Batteries:- Check that generator unit batteries are in good condition, fully charged, properly serviced with electrolyte fluid, and that battery cables are clean and tight.

Diesel Engine Fuel System:- Bleed the engine fuel system, if diesel engine unit is being used. See appropriate INSTRUCTIONS AND PARTS Manual for bleeding procedures.

Turbo-Charged Engines Only:- Bleed the turbo-charger oil lines. Lines must be free of air and full of oil before startup.

4.1.3 TRANSFER SWITCH MANUAL OPERATION TEST

Prior to initial startup of the installed generator set, test the transfer switch for proper manual operation as follows. This test applies to both manually and automatically controlled transfer switches. Refer to the INSTRUCTIONS AND PARTS Manual for the specific transfer switch, automatic controller or generator set involved for specific instructions.

DANGER!

Options "B" and "C" units when properly interconnected with an automatic CONTROLLER or TRANSFER SWITCH WITH INTEGRAL CONTROLLER will crank and start suddenly without warning as soon as the NORMAL (Utility) power source is turned off, fails, or is disconnected. To prevent possible injury that might be caused by such sudden startup, take one or more of the following actions:

1. Disconnect the generator battery cables.
2. Remove the Meter and Control Panel's 30 Ampere Fuse.
3. If the generator Meter and Control Panel is equipped with a Manual/Off/Auto Switch, set the Switch to MANUAL or OFF.
4. If an automatic Transfer Switch is used and is equipped with a SAFETY DISCONNECT SWITCH, set that Switch to MANUAL position.

1. Disconnect or turn OFF both the NORMAL (Utility) and the EMERGENCY (Generator) power at their source. **NO ELECTRICAL POWER MUST BE DELIVERED TO THE TRANSFER SWITCH TERMINALS FROM ANY HIGH VOLTAGE POWER SOURCE AT THIS TIME.**

DANGER!

Failure to disconnect or turn OFF both the NORMAL and EMERGENCY power voltages at their source may result in extremely dangerous electrical shock.

2. Manually position the manual or automatic Transfer switch to both its NORMAL (Utility) and EMERGENCY (Generator) positions. Make sure that positive Transfer Switch main contact movement occurs in both positions, and that the Transfer Switch actuates properly.
3. When completely satisfied that Transfer Switch operation is correct, set the Transfer Switch to its NORMAL (Utility) position.
4. Check the Transfer Switch data plate for Switch rated voltage and current. Both the NORMAL and EMERGENCY power source voltage/current ratings must be compatible with the Transfer Switch being used.
5. Connect (turn ON) the NORMAL (Utility) power source voltage to the Transfer Switch.

DANGER!

The transfer switch is now electrically hot. Use extreme care contact with high voltage terminals will result in extremely dangerous-possibly LETHAL electrical shock.

6. Use an accurate AC voltmeter to check linetoline and linetoneutral voltages (1Phase) or legtoleg and legtoneutral (3Phase) voltages at the transfer switch NORMAL (Utility) terminals.
7. Manually crank and start the generator engine, using the engine start/stop switch on the Meter and Control Panel. (If unit is equipped with an optional Manual/Off/Auto Switch, that Switch must be set to its MANUAL position prior to cranking. Also, if battery cables were disconnected or 30 ampere Fuse removed previously, they must be re-installed at this time.)
8. Use an acurate AC Voltmeter to check linetoline and linetoneutral (1Phase) or legtoleg and legtoneutral (3Phase) voltages at the Transfer Switch EMERGENCY (Generator) terminals.

9. Use an accurate AC Frequency Meter to check for correct generator frequency at the Transfer Switch EMERGENCY (Generator) terminals.

NOTE

If necessary, adjust the generator set engine governor and voltage regulator to the correct rated voltage and frequency, as specified on the generator data plate. Automatic transfer switches will respond only to their correct rated voltage and frequency, as specified on the transfer switch data plate. Generator and transfer switch rated voltage, current and frequency must be compatible.

4.1.4 GENERATOR TESTS AND ADJUSTMENTS ALL UNITS

1. When satisfied that NORMAL (Utility) and EMERGENCY (Generator) voltages at the transfer switch terminals are correct, inspect the generator set engine carefully for evidence of leakage (oil, fuel, coolant). GENERATOR AC OUTPUT VOLTAGE AND FREQUENCY MUST BE CORRECT BEFORE PROCEEDING.
2. Compare the AC frequency reading on the Meter and Control Panel's Frequency Meter to the external meter's reading. If readings are not the same, adjust the COARSE and FINE RPM ADJUST potentiometers on the DC Control circuit board to obtain identical readings on both meters. See Paragraph 4.3.4 in this Manual.
3. Apply a light electrical load to the generator, equal to about 25% of its rated wattage/amperage capacity. After 5 minutes, increase the electrical load to about 50% of unit capacity. Increase the electrical load to about 75% and then 100% of capacity after similar 5 minute intervals.
4. With electrical loads applied, check Voltage Regulator characteristics. If lights flicker or regulation is erratic, recheck Regulator adjustments.
5. Check the generator set for full load, hot run charactersitics. Units should run at least 15 minutes at full (100%) load. Monitor panel instruments during this period.
6. Place the generator into a "no-load" condition. Let the unit run for a few minutes at no-load, then shut the engine down manually.

4.1.5- AUTOMATIC OPERATIONS- OPTIONS "B" AND "C" UNITS ONLY

1. Check position of automatic Transfer switch- if necessary, place the Switch into its NORMAL (Utility) position.
2. **Units with Optional Manual/Off/Auto Switch Only**:- Place the 3-position switch into its AUTO position.
3. **Transfer Switch with Safety Disconnect Switch Only**:- Place that switch to its AUTO position.
4. On the automatic Controller or Transfer switch with integral automatic controller, set the Test Switch to TEST position. Refer to the Manual for the specific controller or transfer switch involved for specific instructions. Monitor all automatic operations, timing sequences, etc., during the test.
5. If necessary, or desired, adjust automatic Controller or transfer switch operating parameters and timing sequences. Retest automatic operation as often as necessary, until all adjustments are completed.
6. On the automatic controller or transfer switch with integral controller, set the Test/Normal switch back to NORMAL.

SECTION 4.2 - ENGINE SPEED GOVERNOR ADJUSTMENTS

4.2.1- ADJUSTING THE UNIVERSAL GOVERNOR (Figure 4.2-A)

CAUTION!

Use care during the governor adjustment procedure to avoid overspeeding the engine. If a new governor has been installed, initial generator startup and adjustments should be made with the carburetor throttle link disconnected from the Governor Lever. Complete initial startup and adjustments using hand throttle.

NOTE

Use the Governor BUMPER SCREW only to remove a no-load surge condition. If a no-load surge is encountered, turn the BUMPER SCREW in a little at a time until surge is removed. NEVER TURN THE BUMPER SCREW IN FAR ENOUGH TO INCREASE THE NO-LOAD SPEED.

The universal type governor illustrated in Figure 4.2-A was the latest production governor at the time of this writing. Adjust the governor as follows:-

1. Connect an accurate AC Voltmeter and Frequency Meter to the generator AC output leads or terminals.
2. Check that the GOVERNOR SPRING is under a slight tension- if necessary, adjust EYE SCREW until a slight tension is applied.
3. Start the generator engine and let it warm up, with no electrical loads applied.
4. Turn the BUMPER SCREW counterclockwise (out) until only 3 or 4 threads are engaged, then lock the BUMPER SCREW down.
5. Locate the SPEED CHANGE LEVER in a vertical position by turning the LOW SPEED STOP SCREW in.
6. Increase tension on GOVERNOR SPRING by turning EYE SCREW up until the connected AC frequency meter indicates a no-load frequency of 62 Hertz.
7. Check speed regulation by applying and removing an electrical load. If variation between no-load and full load is too great, back off the LOW SPED STOP SCREW about 4 turns. Then, turn the EYE SCREW back up to a no-load speed of 62 Hertz.
8. Repeat Steps (6) and (7) as necessary to obtain the desired performance and no-load speed of 62 Hertz.
9. With unit running at its no-load speed of 62 Hertz, check the connected AC Voltmeter. If the indicated voltage is not as listed in the following CHART, a Voltage Regulator adjustment is required.

GENERATOR RATED VOLTAGE	PHASE	FREQUENCY	DESIRED AC VOLTAGE	
			LINE-TO-NEUTRAL	LINE-TO-LINE
120/240	1	62	124	248
120/208	3	62	124	216
240/416	3	62	248	430
120/240	3	62	124	248
139/240	3	62	144	248
277/480	3	62	286	496

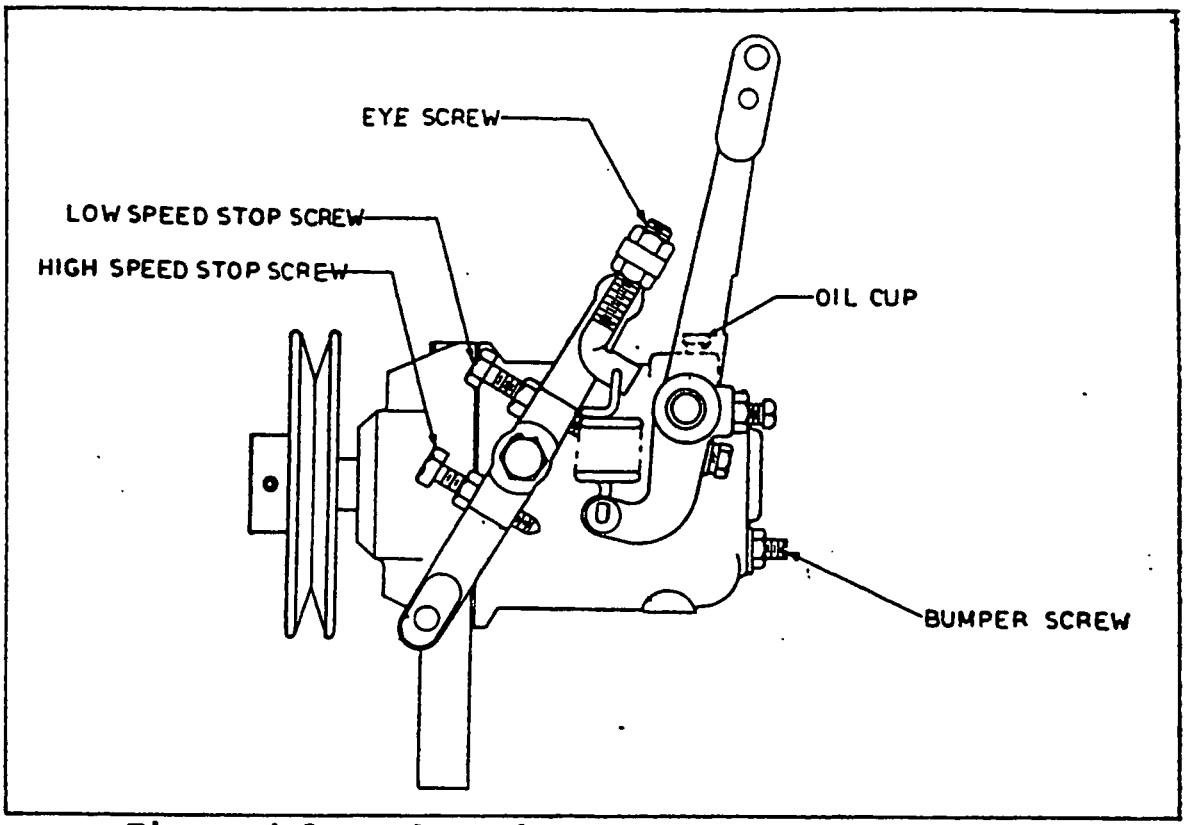


Figure 4.2-A. The Universal Type Mechanical Governor

4.2.2- ADJUSTMENT OF EARLY PRODUCTION MECHANICAL GOVERNOR (Figure 4.2-B)

1. Connect an accurate AC Voltmeter and Frequency Meter to the generator AC output leads or terminals.
2. Check that no electrical loads are connected to the generator.
3. Start the generator engine, let it stabilize and warm up.
4. Check the AC frequency reading- it should be approximately 62 Hertz at no-load. If AC frequency is correct, go to Step (8). If NOT correct, go to Step (5).
5. Turn the FREQUENCY SET adjustment to obtain a no-load frequency of 62 Hertz.
6. Apply an electrical load equal to about 75-100% of the unit's rated wattage/amperage capacity. If AC frequency droops lower than 58 Hertz, move the DROOP ADJUSTMENT downward.
7. Remove electrical loads from the generator set. If no-load surging occurs, move the BUMPER SCREW inward. If BUMPER SCREW adjustment affects frequency, back the SCREW out until no-load frequency returns to 62 Hertz.
8. Observe the connected Voltmeter reading. If voltage is not as listed in the CHART (Paragraph 4.2.1), a Voltage Regulator adjustment is required.

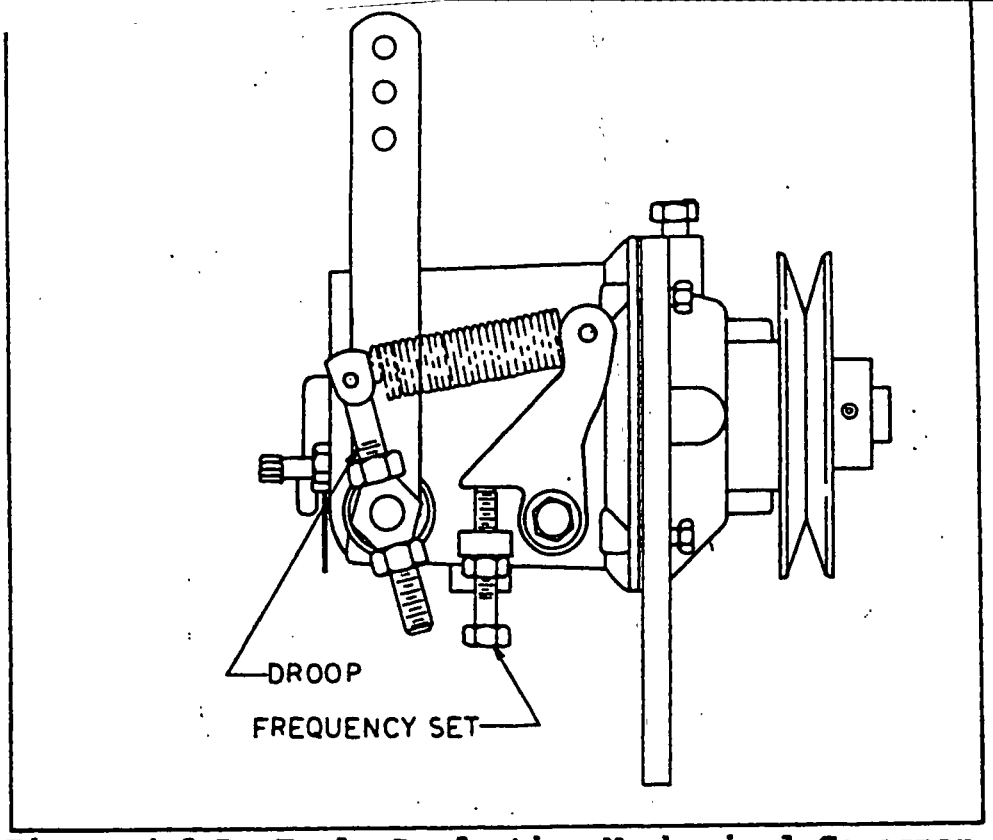


Figure 4.2-B. Early Production Mechanical Governor

4.2.3- ELECTRONIC ISOCHRONOUS GOVERNOR ADJUSTMENT (Figure 4.2-C)

The electronic isochronous governor consists of (a) a magnetic pickup, (b) speed controller, (c) an actuator. The magnetic pickup (similar to the RPM Sensor) is mounted on the engine flywheel housing. The SPEED CONTROLLER receives engine speed (frequency) signals from the pickup and, based on those signals, controls ACTUATOR movement. A +12 VDC input is available to the governor only with the engine running (Wire #14 circuit).

NOTE

The Controller SPEED adjustment is factory set to the correct speed. If new governor components have been installed, it may be necessary to turn the SPEED adjustment clockwise before the engine will start. The SPEED adjustment is a multi-turn potentiometer providing 20 turns (plus or minus 20%).

Adjust the Governor as follows:-

1. Set GAIN fully counterclockwise.
2. Connect an accurate AC Voltmeter and Frequency Meter to the generator AC output leads or terminals.
3. Start the generator engine, let it stabilize and warm up. Check that no electrical loads are connected to the generator.
4. On the Controller, adjust the SPEED potentiometer (at no-load) to obtain a frequency reading of 60-61 Hertz.
5. Adjus the GAIN slowly clockwise until the governor begins to hunt or becomes unstable. Then, turn the GAIN counterclockwise slowly until stability is obtained.

6. Upset the governor by tapping the ACTUATOR lever. Engine should return quickly to its commanded speed without hunting.
7. When correct no-load speed and operation is obtained, check the connected Voltmeter reading. If voltage is not correct as noted in the following CHART, a Voltage Regulator adjustment is required.

GENERATOR RATED VOLTAGE	PHASE	FREQUENCY	DESIRED AC VOLTAGE	
			LINE-TO-NEUTRAL	LINE-TO-LINE
120/240	1	60-61	120-122	240-244
120/208	3	60-61	120-122	208-211
240/416	3	60-61	240-244	416-423
120/240	3	60-61	120-122	240-244
139/240	3	60-61	139-142	240-244
277/480	3	60-61	277-485	480-488

NOTE

An INTEGRAL GAIN JUMPER is retained across the sped controller terminals #7 and #8. For most engines, best operation will be obtained with the jumper installed. For some applications, where engine response is slow or engine lag times too long, improved performance may be obtained by removing the jumper.

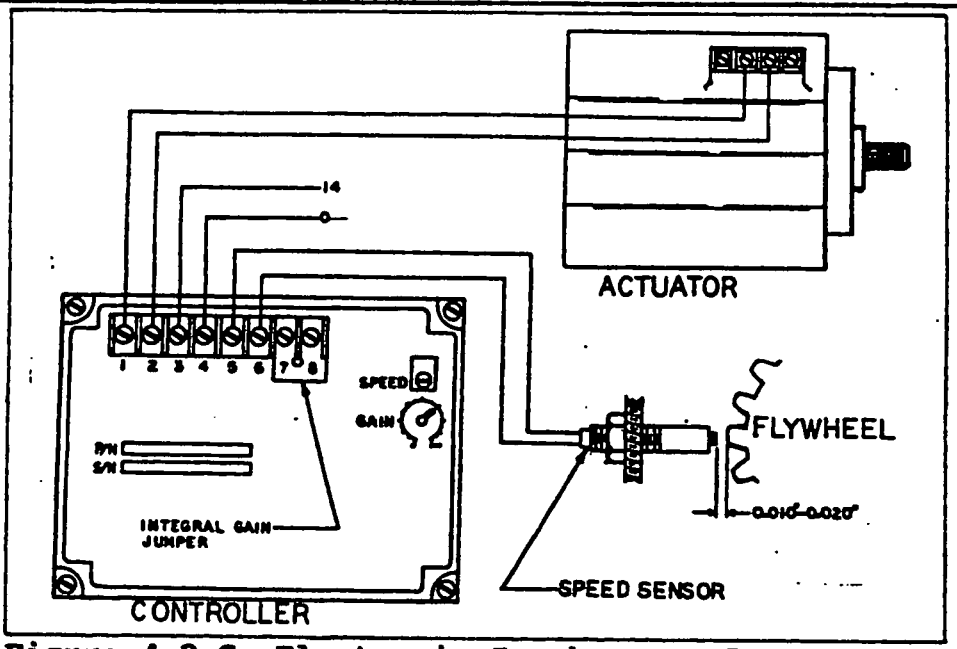


Figure 4.2-C. Electronic Isochronous Governor

SECTION 4.3 - GENERATOR CIRCUIT BOARD ADJUSTMENTS

4.3.1- GENERAL (Figures 4.3-A through 4.3-E)

Latch/Crank circuit boards installed on generator units produced prior to August 1984 are shown in Figures 4.3-A through 4.3-D. These circuit boards were used with diesel engine units requiring the PREHEAT function or with gas engine units that did not require PREHEAT. An adjustable potentiometer was provided on those early production circuit boards for adjustment of PREHEAT time.

Later production Latch/Crank boards are more universal in nature, being useable both on units requiring PREHEAT and with those that do not require PREHEAT. These newer boards provide the PREHEAT function from the start of engine cranking until the engine starts during automatically controlled starts (PREHEAT is not adjustable). The Latch/Crank board used on generators manufactured AFTER August 1984 is shown in Figure 4.3-E. When installed on a DIESEL engine unit, circuit board connector plug Pin 12 and Wire #150 deliver a +12 VDC to the Pre-heat Contactor (PHC) during automatic starts. Pin 12 and Wire #150 are not used on gas engine units.

NOTE

Later (post August 1984) Option "B" Crank circuit boards are NOT interchangeable with early (pre-August 1984) Crank circuit boards or with Option "C" Latch/Crank boards.

4.3.2- CRANK TIME ADJUSTMENT (Figures 4.3-A through 4.3-E)

During an automatically controlled engine start, the Latch/Crank circuit board permits up to 8 equal-duration crank/no-crank cycles until the engine starts (Option "B" and "C" units). Crank (and no-crank) times may be adjusted to any time duration between 6-12 seconds. For a 6 second crank (and no-crank) time duration, turn the CRANK TIME potentiometer fully counterclockwise afainst its stop- DO NOT USE EXCESSIVE FORCE AGAINST THE STOP. For a time of 12 seconds, turn the slotted potentiometer full clockwise against its stop- DO NOT FORCE. Crank and no-crank times between the 6 second minimum and 12 second maximum are linear.

4.3.3- PREHEAT TIME ADJUSTMENT (Figures 4.3-A through 4.3-D)

NOTE

Adjustment of PREHEAT time applies only to DIESEL engine generator units manufactured prior to August 1984. The circuit board used on diesel engine units manufactured AFTER that date does not provide a PREHEAT adjustment. Preheat on those later production units occurs from the start of cranking until the engine starts, during automatic starts.

Normal PREHEAT Adjustment:- For a PREHEAT time of 15 seconds, turn the slotted potentiometer fully counterclockwise against its stop- DO NOT FORCE. To PREHEAT for 30 seconds, turn the potentiometer fully clockwise against its maximum stop- DO NOT FORCE. Times between the minimum and maximum stops are linear.

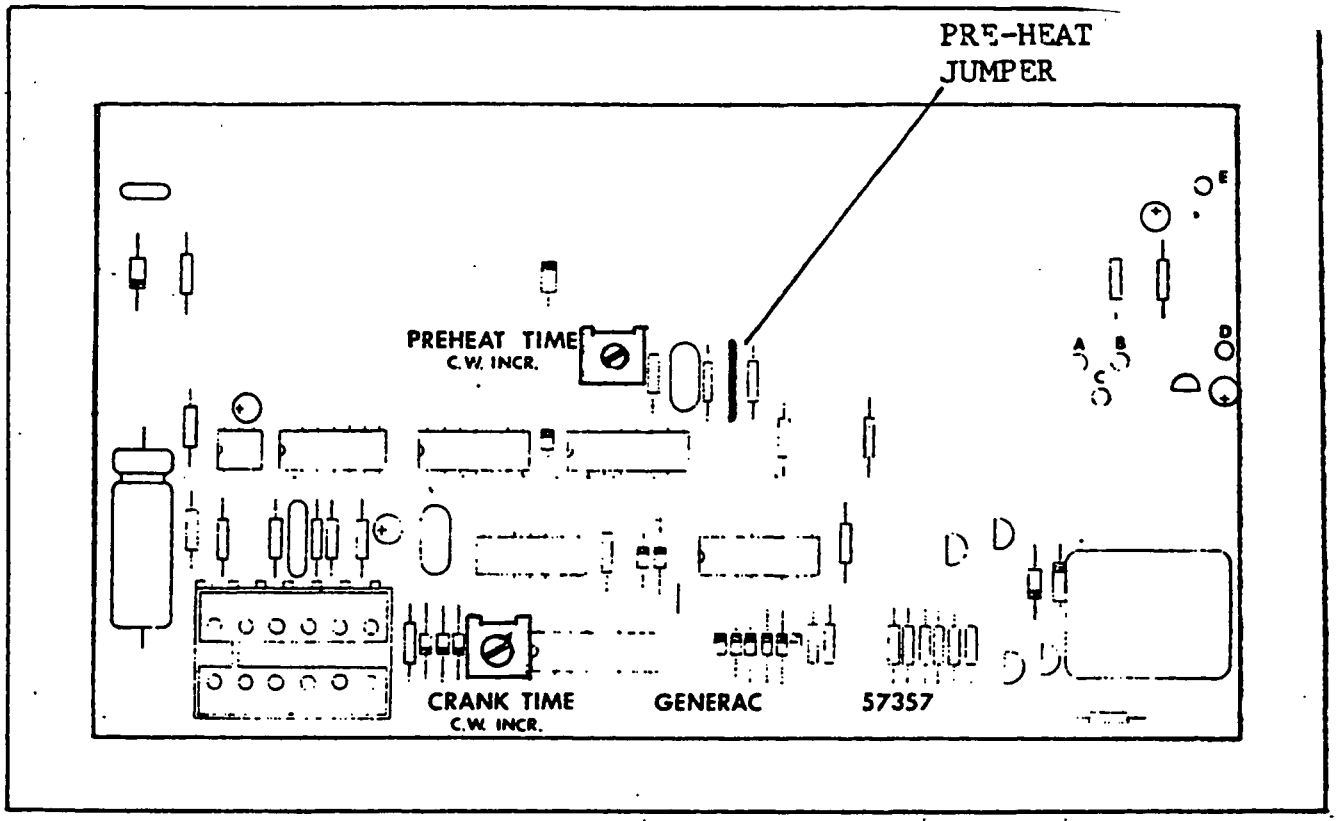


Figure 4.3-A. Option "B" Crank Circuit Board with Preheat (Units Manufactured Prior to August 1984)

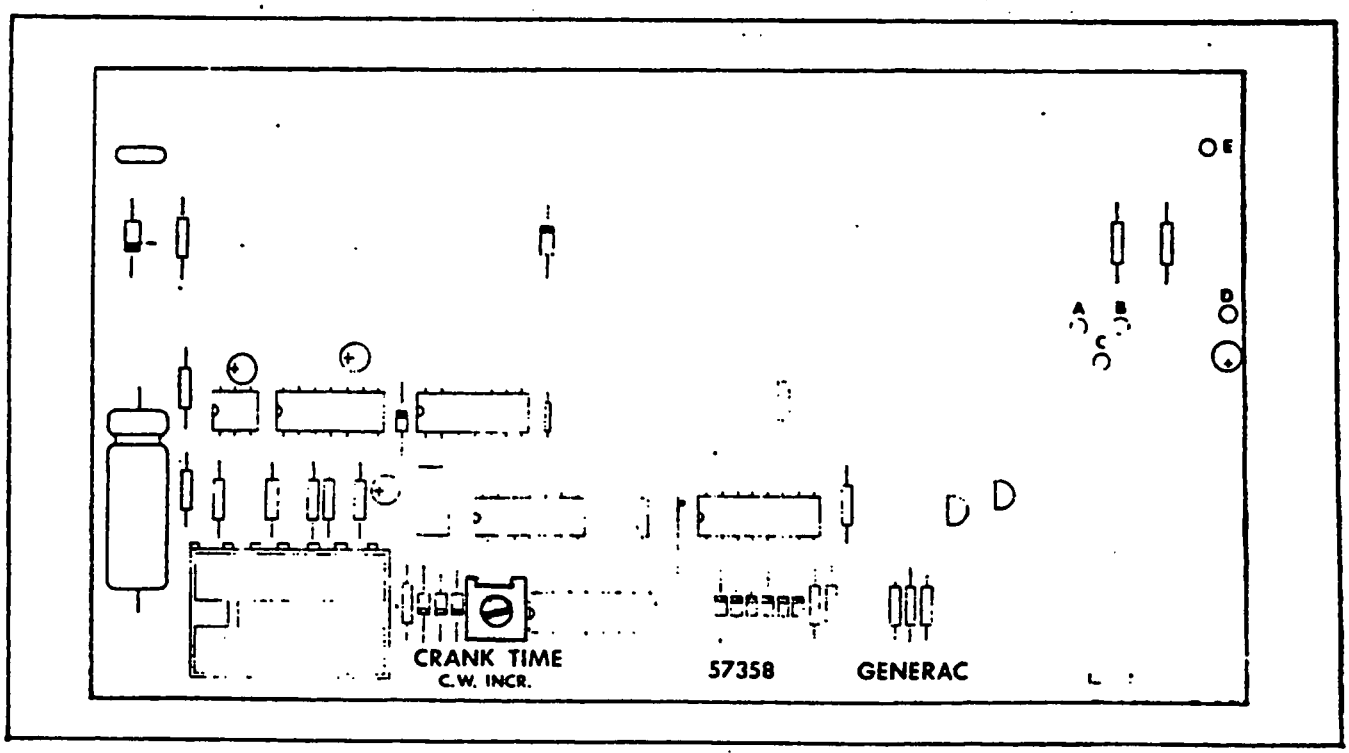


Figure 4.3-B. Option "B" Crank Circuit Board without Preheat (Units Manufactured Prior to August 1984)

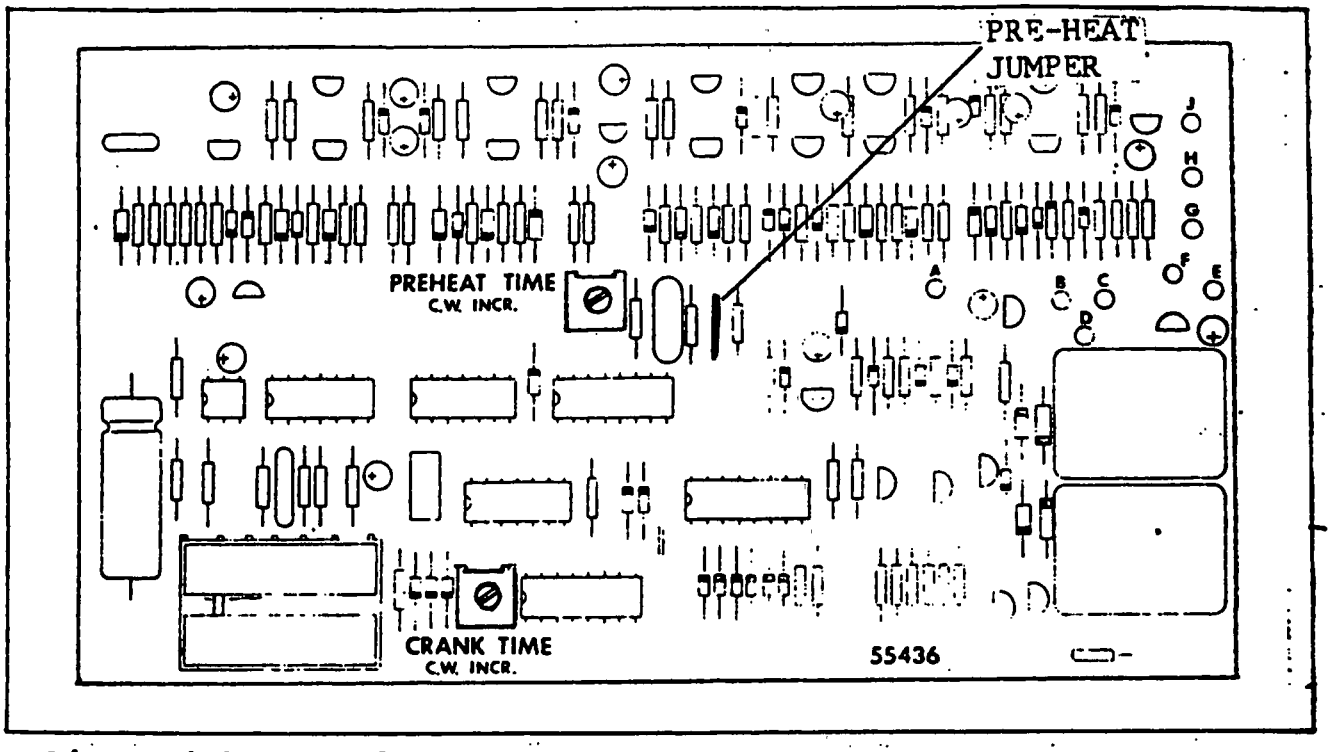


Figure 4.3-C. Option "C" Latch/Crank Circuit Board with Preheat (Units Manufactured Prior to August 1984)

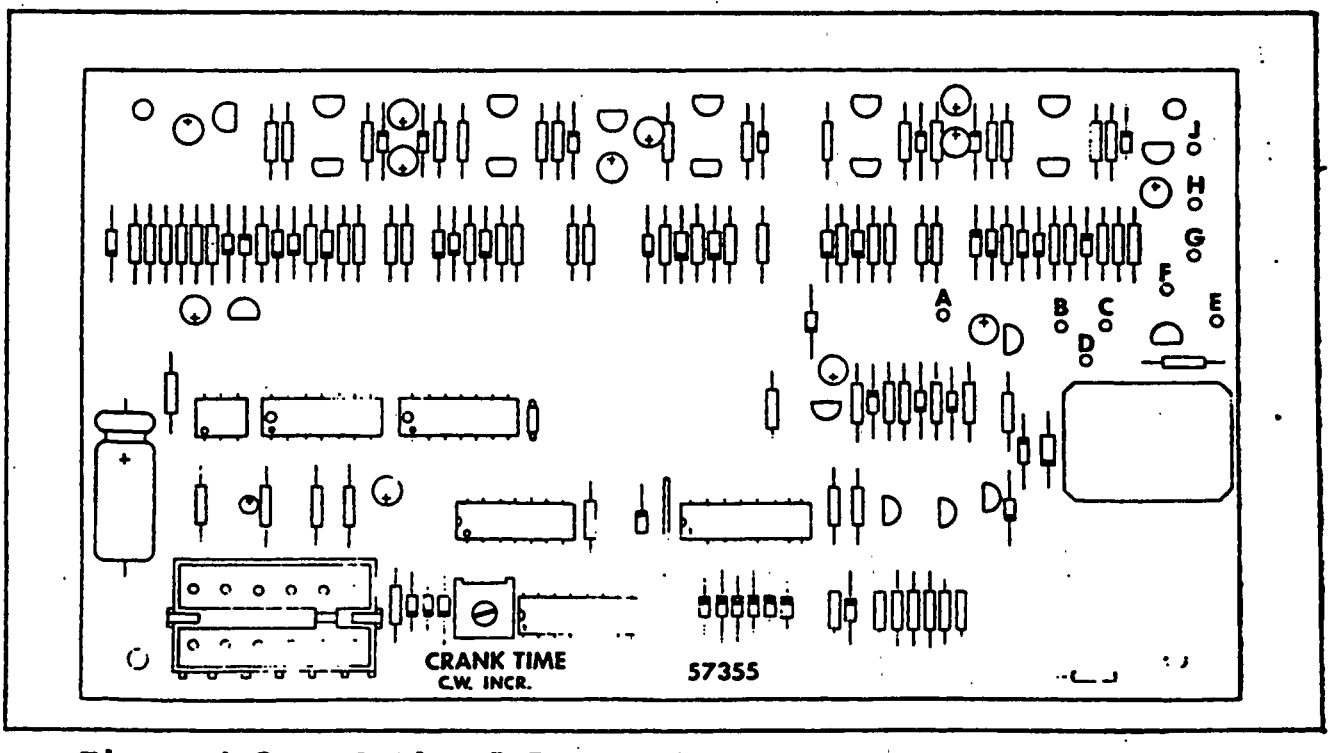


Figure 4.3-D. Option "C" Latch/Crank Board without Preheat (Units Manufactured After August 1984)

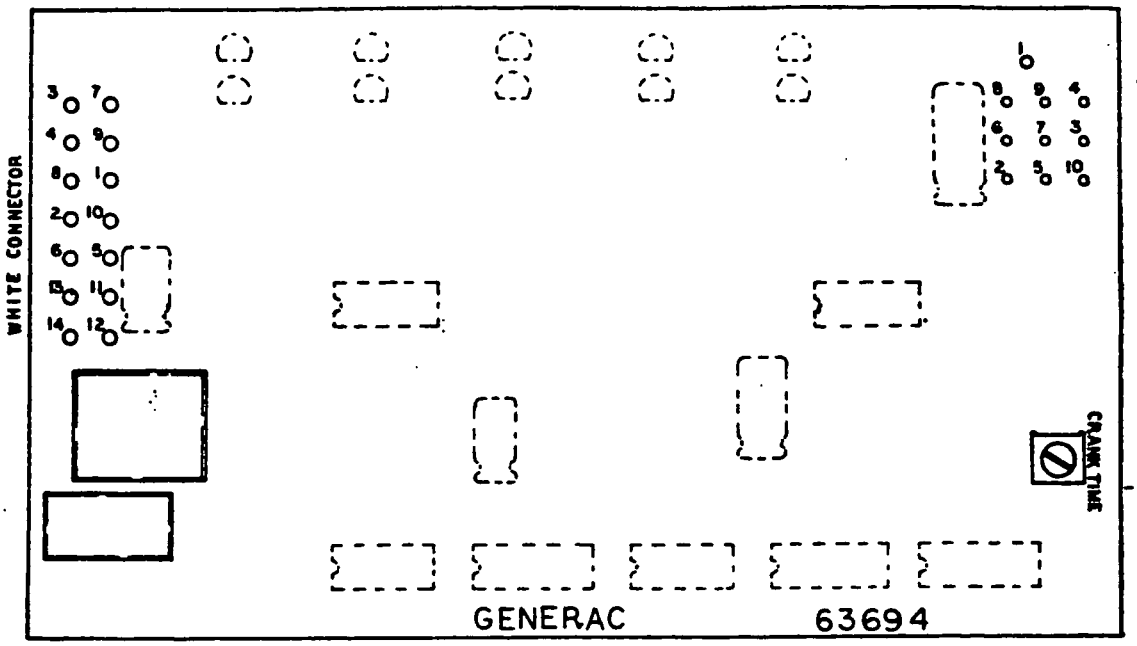


Figure 4.3-E. Option "C" Latch/Crank Board (Units Manufactured After August 1984)

NOTE

During an automatically controlled start of early production units (prior to August 1984), engine cranking and preheat will occur cyclically as follows:-

CRANK	**- 6 to 12 seconds**
NO-CRANK	**- 6 to 12 seconds**
CRANK	**- 6 to 12 seconds**
NO-CRANK	**- 6 to 12 seconds**
PREHEAT	**-15 to 30 seconds**

When Longer PREHEAT Time is desired:- Under extreme cold weather conditions, when a longer preheat time is desired, a PREHEAT time of 15 seconds (minimum stop) to 60 seconds (maximum stop) may be obtained by cuting the PREHEAT JUMPER wire on the circuit board. See Figures 4.3-A through 4.3-D).

4.3.4- AC FREQUENCY ADJUSTMENT (Figures 4.3-F, 4.3-G, 4.3-H)

NOTE

Also see Paragraphs 3.2.3 and 3.4.3 in this Manual.

Whenever a DC CONTROL CIRCUIT BOARD or a panel AC FREQUENCY METER is replaced, the panel AC FREQUENCY METER must be recalibrated as follows:-

1. Connect an accurate AC Frequency Meter and Voltmeter to the generator AC power output leads or terminals.
2. Start the generator engine and let it warm up and stabilize at NO-LOAD.

3. Check the reading on the externally connected frequency meter. If the indicated no-load frequency is incorrect, adjust the engine governor until a correct frequency is obtained.
4. Compare the connected frequency meter reading with that of the Meter and Control Panel frequency meter. Both readings should be identical.
5. If readings are NOT identical, adjust the COARSE RPM ADJUST potentiometer on the DC Control board until both readings are nearly the same. Then, adjust the FINE RPM ADJUST potentiometer until readings are the same.
6. When both readings are the same, apply a small amount of "pot locking" compound to the COARSE and FINE ADJUST potentiometers.
7. Check the VOLTAGE reading on the externally connected voltmeter. If AC output voltage is incorrect, adjust the Voltage Regulator.

4.3.5- OVERSPEED SHUTDOWN ADJUSTMENT (Figure 4.3-F, 4.3-G)

The OVERSPEED SHUTDOWN adjustment is provided only on DC Control boards used prior to August 1984. On units manufactured AFTER that date, the OVERSPED SHUTDOWN setting may be considered correct when the AC FREQUENCY adjustment is properly completed (Paragraph 4.3.4).

To adjust the overspeed setting on early production units, proceed as follows:-

1. Connect an accurate AC frequency meter to the generator AC output leads or terminals.
2. On the DC Control circuit board, turn the OVERSPEED potentiometer fully clockwise against its stop- DO NOT FORCE.
3. Start the generator engine, let it stabilize and warm up.
4. Check that no electrical loads are applied to the generator.
5. SLOWLY increase the engine speed governor setting until the connected AC frequency meter indicates 68-70 Hertz.
6. With the meter indicating 68-70 Hertz, SLOWLY turn the OVERSPEED potentiometer counterclockwise- about 1/8 turn at a time. Wait 2 seconds after each 1/8 turn increment. When an overspeed shutdown occurs, overspeed setting is correct.

CAUTION!
The 2 second wait between each 1/8 turn increment is necessary because of the 1 second delay between occurence of an overspeed and the actual engine shutdown.

4.3.6- CHOKE ON/OFF TIME ADJUSTMENT (Figure 4.3-F)

This adjustment is provided only on DC Control boards used with gasoline engine units manufactured prior to August 1984.

Engine carburetor Choke ON (closed) time will normally vary from 1/2 to 7 seconds, depending on ambient temperature, when the ON potentiometer is turned fully counterclockwise. Rotating the ON potentiometer full clockwise will add about 2 seconds to the ON (closed) time.

Choke OFF (open) time is fixed at about 1/2 second, when the OFF potentiometer is rotated fully counterclockwise. Turning the OFF pot full clockwise will add about 2 seconds to the OFF (open) time.

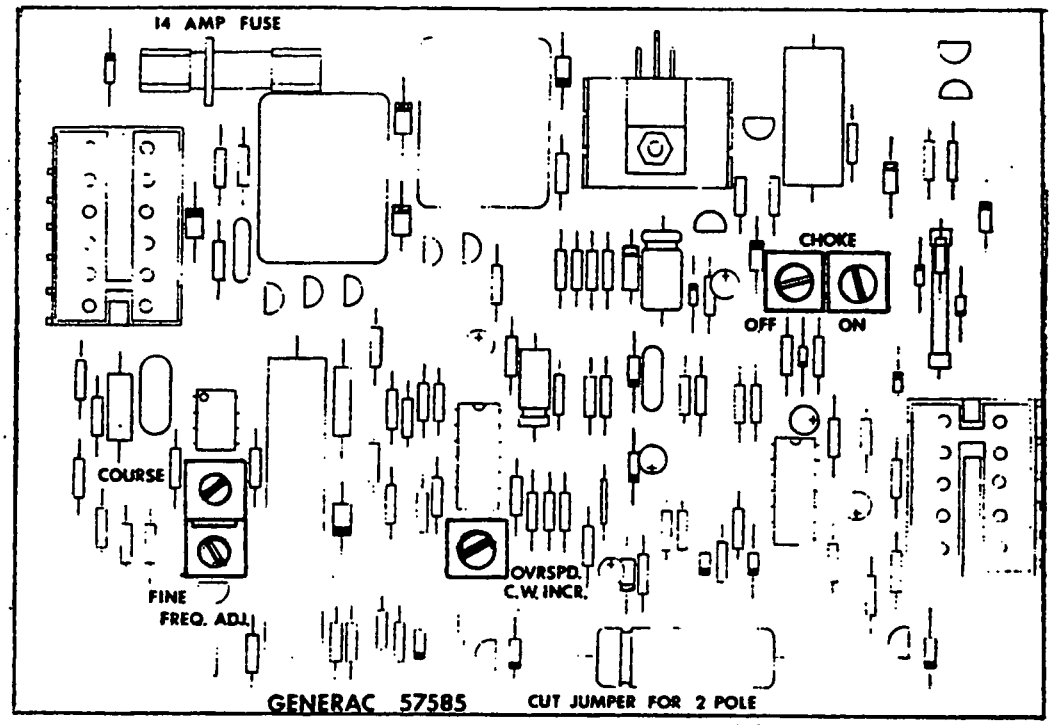


Figure 4.3-F. DC Control Circuit Board with Choke Function (Units Manufactured Prior to August 1984)

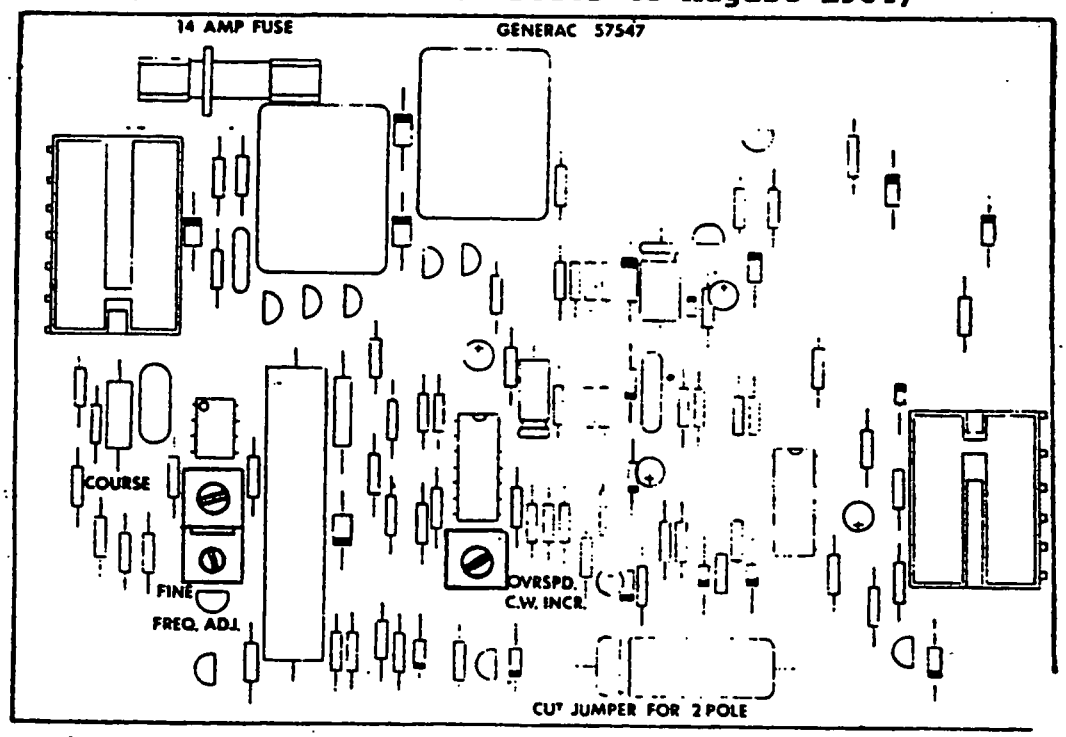


Figure 4.3-G. DC Control Circuit Board without Choke Function (Production Units Prior to August 1984)

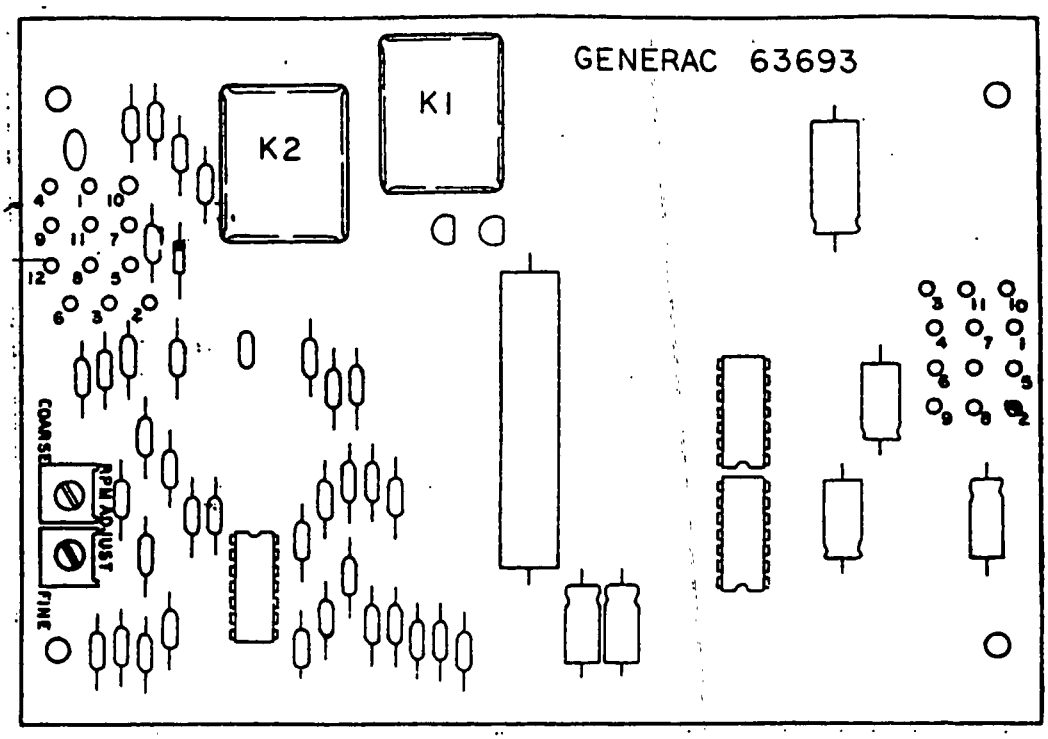


Figure 4.3-H. DC Control Circuit Board (Units Manufactured After August 1984)

SECTION 4.4 - VOLTAGE REGULATOR ADJUSTMENT

4.4.1- GENERAL (Figure 4.4-A)

NOTE
Also see Paragraphs 2.2.3, 2.2.4 and 3.3.1 in this Manual.

The solid state "Voltage-over-Frequency" type Regulator maintains an AC voltage that is directly proportional to frequency, at a 2 to 1 ratio. Three adjustable potentiometers are provided on the Regulator- GAIN, FEEDBACK and VOLTAGE SET.

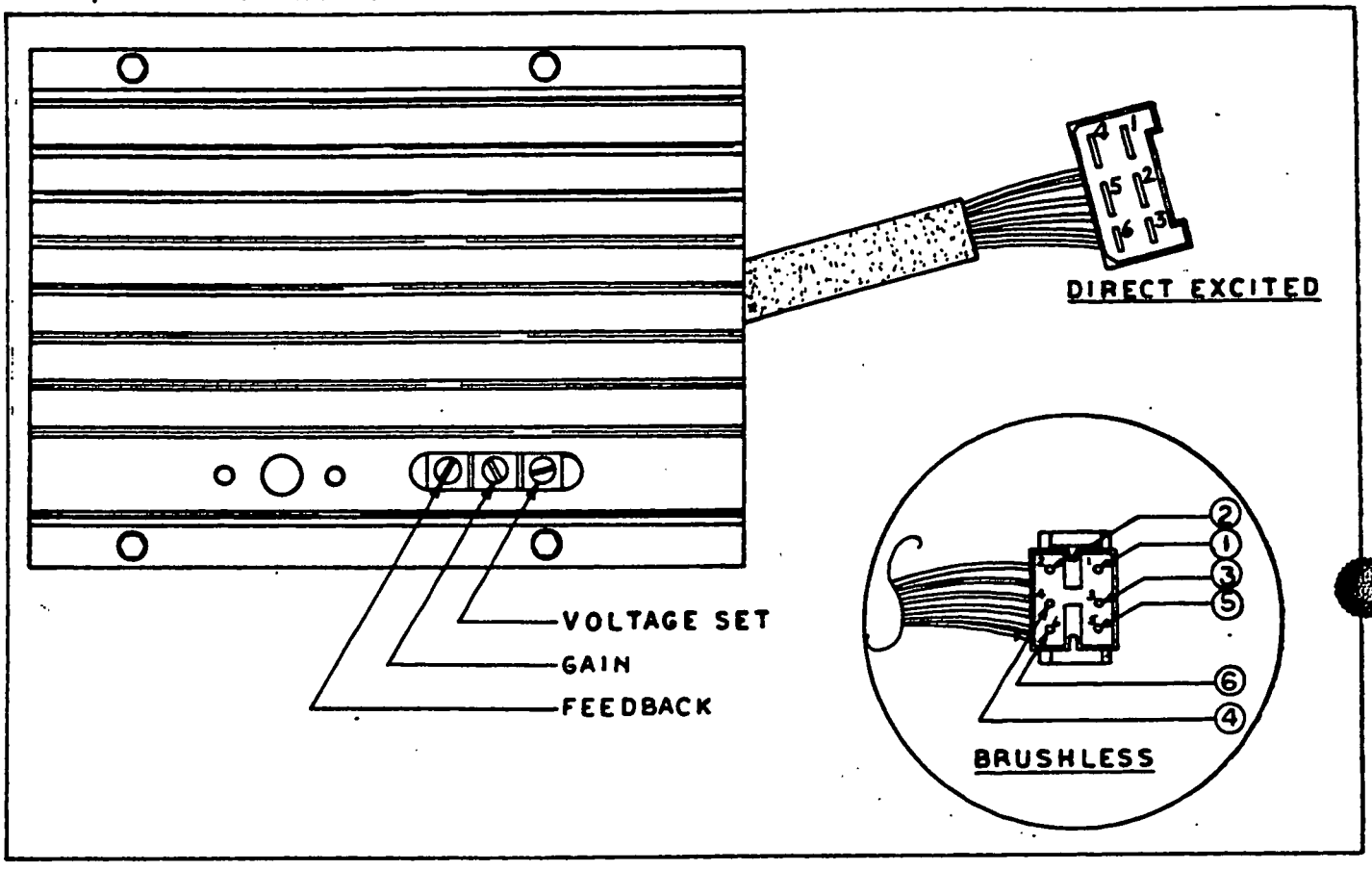


Figure 4.4-A. Voltage Regulator Adjustments

4.4.2- VOLTAGE REGULATOR ADJUSTMENT PROCEDURE (Figure 4.4-A)

1. Connect an accurate AC frequency meter to the generator's AC power output leads or terminals.
2. Connect an accurate AC voltmeter to the generator AC power leads or terminals.
3. Start the generator engine, let it stabilize and warm up.
4. Check the AC frequency meter reading (see Section 4.2, ENGINE SPEED GOVERNOR ADJUSTMENTS). If engine speed is not correct, adjust the engine governor until correct AC frequency is obtained.

CAUTION!
The engine governor MUST be properly adjusted before proceeding, or correct results will not be obtained.

5. Set the Voltage Regulator potentiometers as follows:-
   a. GAIN- Fully clockwise to maximum
   b. FEEDBACK- Fully counterclockwise to minimum
   c. VOLTAGE SET- At its mid-position
6. Check that the generator is running at its correct no-load frequency. Then, set the VOLTAGE SET potentiometer until the correct rated voltage is obtained (see Section 4.2).
7. If instability is indicated (lights flicker), slowly turn the FEEDBACK potentiometer until unit is stable.
8. recheck for correct rated voltage and (if necessary) readjust the VOLTAGE SET potentiometer to obtain the correct rated voltage (Section 4.2).
9. Apply an electrical load to the generator, equal to about 75-100% of its rated wattage/amperage capacity. Then, adjust the GAIN potentiometer (if necessary) to obtain the desired voltage droop under load.

SECTION 4.5 - THROTTLE DROOP OVERRIDE POSITIONERS

4.5.1- GENERAL (Figure 4.5-A)

The Model 8636 THROTTLE DROOP OVERRIDE POSITIONER is designed for use on the 2.2 liter diesel engine; the Model 8637 POSITIONER for use on the 3.0 liter diesel engine.

The POSITIONER helps to partially eliminate the normal engine speed droop that occurs when an electrical load is applied to a diesel engine-driven generator with mechanical governor. Where an rpm droop equal to about a 5 Hertz frequency can be expected with an unassisted mechanical governor under load, maximum engine speed droop with a POSITIONER installed will not exceed approximately 1 Hertz.

The THROTTLE DROP OVERRIDE POSITIONER consists of the following major components:-

1. **RPM SENSOR**- Also see Paragraphs 3.2.3 and 3.4.3. This magnetic pickup device is mounted on the engine flywheel housing, directly over the flywheel teeth. During engine operation, the SENSOR produces an electrical sine wave at each passage of a flywheel tooth. Thus, the sine wave frequency is directly proportional to engine operating speed.
2. **PRINTED CIRCUIT BOARD**- Receives engine speed (frequency) signals from the RPM Sensor and, based on those signals, transmits engine speed correction signals to a bi-directional MOTOR.
3. **BI-DIRECTIONAL MOTOR**- Receives engine speed correction signals from the Printed Circuit Board. An adjustable control link then transmits motor radial movement to the engine Fuel Injection Pump's Speed Control Lever. Minimum and maximum motor movement are limited by two micro-switches.
4. **WIRING HARNESS**- Interconnects the Motor and Printed Circuit Board.

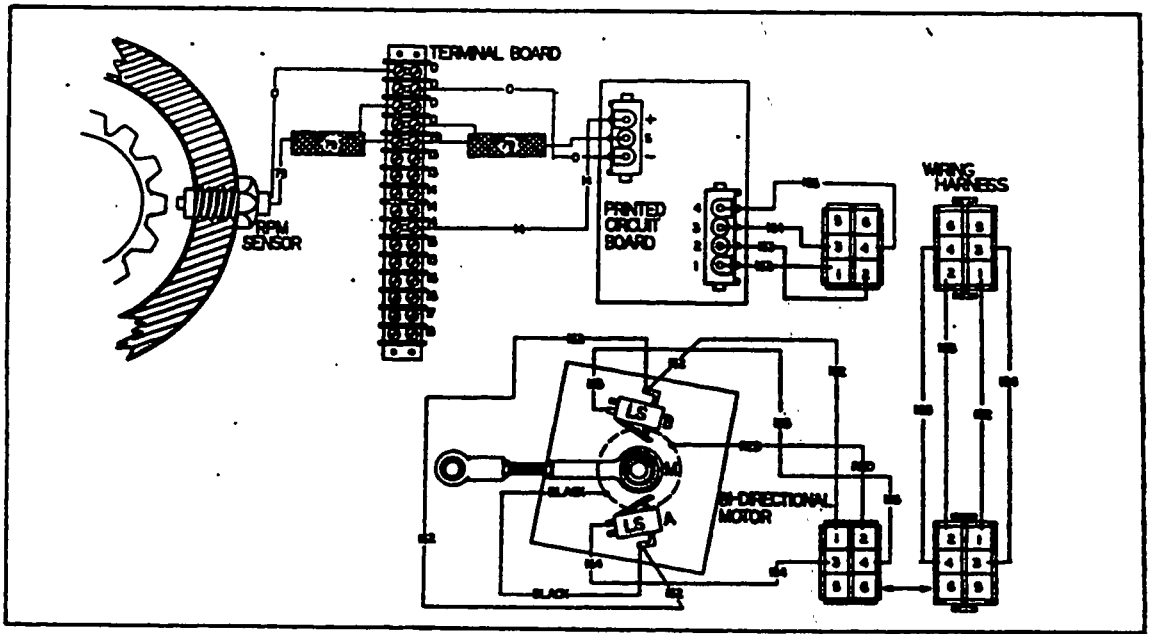


Figure 4.5-A. Throttle Droop Override Positioner Components

4.5.2- POSITIONER OPERATION (Figure 4.5-A)

1. Wire #14 from the engine DC Control circuit connects to the Printed Circuit Board terminal indicated by a (+). A +DC voltage is applied to Wire #14 and the (+) terminal only when the engine has started and is running.
2. Generator COMMON GROUND (Terminal and Wire #0) connect to the Printed Circuit Board terminal indicated by a (-).
3. Engine speed (frequency) signals from the engine RPM Sensor are delivered to the Circuit Board Terminal indicated by an (S), via Terminal and Wire #79.
4. Operating signals to the Override Positioner Bi-directional Motor are delivered from the Circuit Board receptacle indicated by the word MOTOR and via the Wiring Harness.

If RPM Sensor frequency signals to the Circuit Board indicate that the generator's AC output frequency is less than 0.5 Hertz OVER or 0.5 Hertz UNDER the unit's normal governed frequency, the Circuit Board takes no action. However, if the signals indicate that AC output frequency is greater than 0.5 Hertz UNDER or OVER the unit's normal governed AC frequency, the Circuit Board signals the bi-directional Motor to rotate. Motor rotation will then continue until the generator AC frequency output is within -0.5 to +0.5 Hertz of the normal governed frequency.

Two GREEN lights, labelled "-0.5" and "+0.5", are located on the Circuit Board. A YELLOW light is indicated by the word "UNDER" and a RED light by the word "OVER". These lights indicate UNDER and OVER frequency conditions as follows:-

1. **"-0.5" Light is ON**:- Generator AC frequency output is 0.5 Hertz or less below normal governed frequency (no corrective action taken)
2. **"+0.5" Light is ON**:- Generator AC frequency is 0.5 or less ABOVE the normal governed frequency (no corrective action)
3. **Yellow UNDER Light is ON**:- Generator AC frequency is 0.5 Hertz or more BELOW normal governed AC frequency (corrective action is taken)
4. **Red OVER Light is ON**:- Generator AC frequency is 0.5 Hertz or more ABOVE normal governed frequency (corrective action is taken)

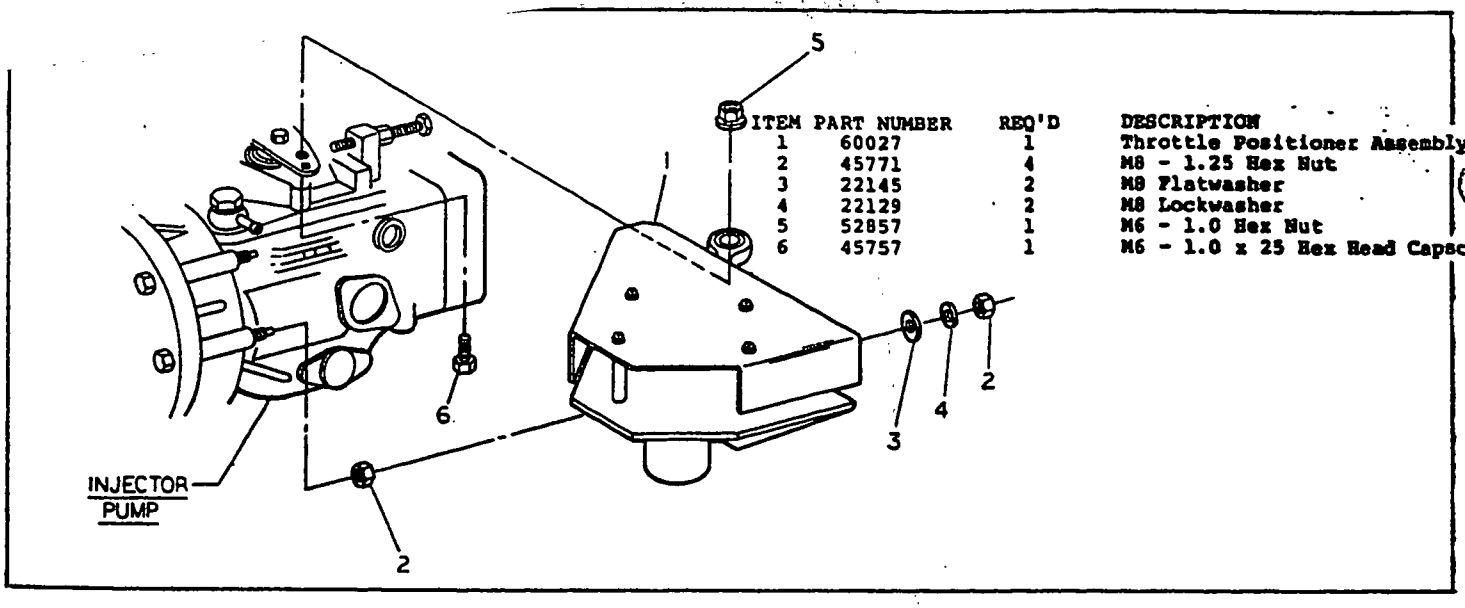
4.5.3- THROTTLE POSITIONER MOUNTING (Figure 4.5-B, 4.5-C)

Install the Throttle Positioner as illustrated in Figure 4.5-B for 3.0 liter diesel engines, as shown in Figure 4.5-C for 2.2 liter diesel engines. DO NOT CONNECT THE CONTROL LINK TO THE ENGINE SPEED CONTROL LEVER AT THIS TIME.

4.5.4- PRINTED CIRCUIT BOARD INSTALLATION (Figure 4.5-D)

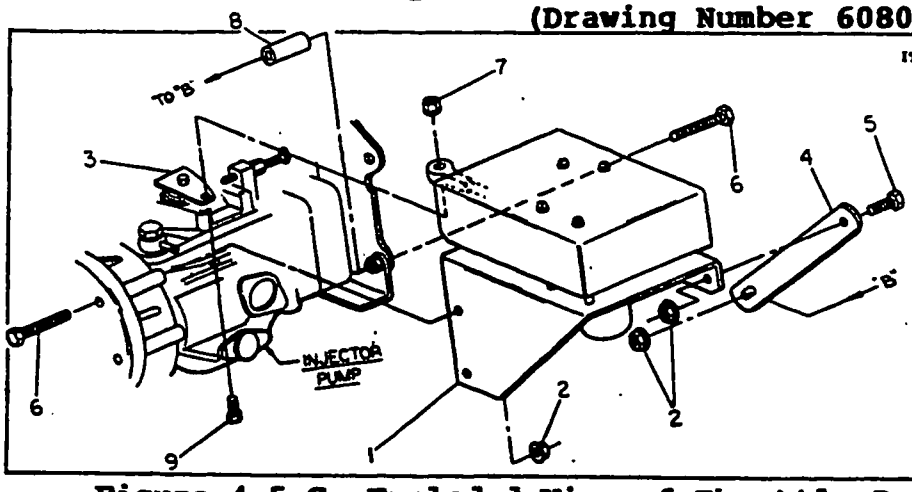
If installation of the Throttle Positioner is new, install the Printed Circuit Board (Part Number 60074) as follows:-

1. Remove the Meter and Control Panel cover.
2. Mark and drill four 0.187 inch diameter holes in the Meter and Control Panel as shown in Figure 4.5-C.
3. Install a Printed Circuit Board STANDOFF (Item 2) into each of the



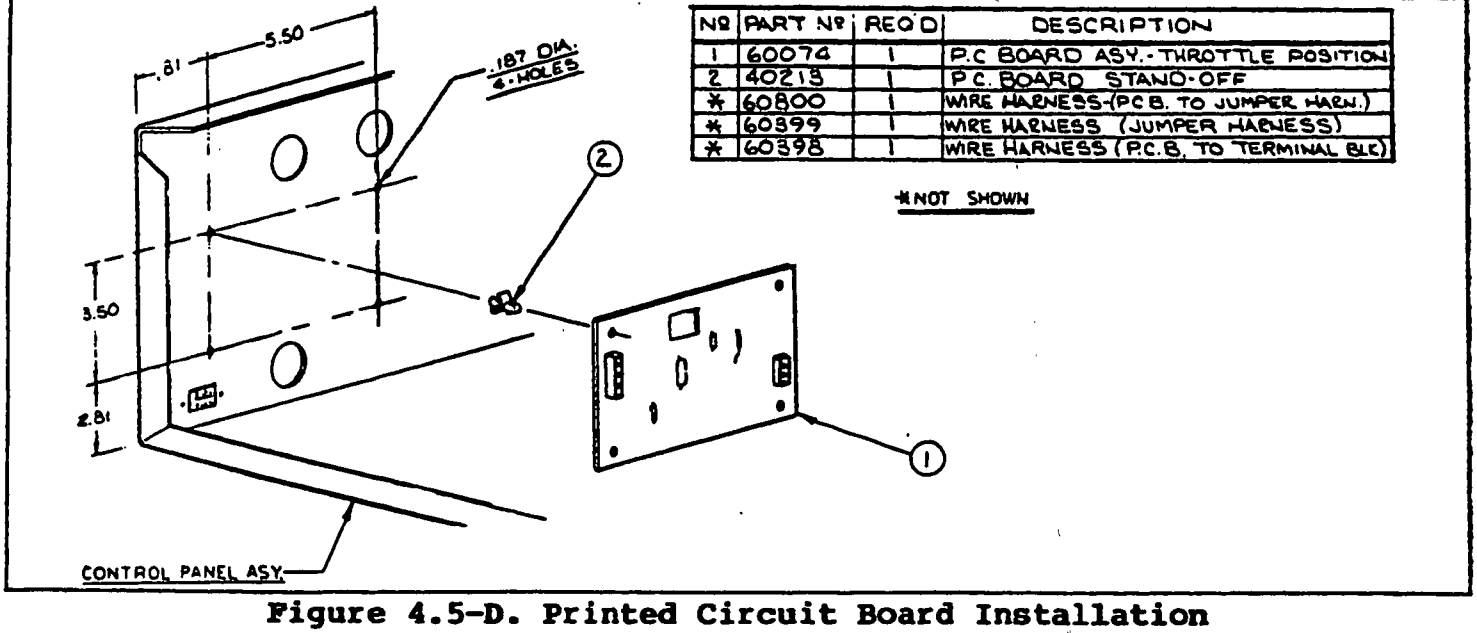
ITEM	PART NUMBER	REQ'D	DESCRIPTION
1	60027	1	Throttle Positioner Assembly
2	45771	4	M8 - 1.25 Hex Nut
3	22145	2	M8 Flatwasher
4	22129	2	M8 Lockwasher
5	52857	1	M6 - 1.0 Hex Nut
6	45757	1	M6 - 1.0 x 25 Hex Head Capscrew

Figure 4.5-B. Exploded View of Throttle Positioner 3.0 Liter Units (Drawing Number 60806)



ITEM	PART NUMBER	REQ'D	DESCRIPTION
1	60084	1	Throttle Positioner Assembly
2	52858	4	M8 - 1.25 Hex Nut Flange
3	60087	1	Governor Arm - Rework
4	60801	1	Support Bracket
5	39253	1	M8 - 1/25 x 20 Hex Head Capscrew
6	51730	3	M8 - 1.25 x 60 Hex Head Capscrew
7	52857	1	M6 - 1.0 Hex Nut Flange
8	55252	1	Spacer 1.25 Long
9	45757	1	M6 - 1.0 x 25 Hex Head Capscrew

Figure 4.5-C. Exploded View of Throttle Positioner 2.2 Liter Units (Drawing Number 60805)



Nº	PART Nº	REQ'D	DESCRIPTION
1	60074	1	P.C BOARD ASY.-THROTTLE POSITION
2	40219	1	P.C. BOARD STAND-OFF
*	60800	1	WIRE HARNESS-(P.C.B. TO JUMPER HARN.)
*	60399	1	WIRE HARNESS (JUMPER HARNESS)
*	60398	1	WIRE HARNESS (P.C.B. TO TERMINAL BLK)

*NOT SHOWN

Figure 4.5-D. Printed Circuit Board Installation

drilled holes as shown.
4. Install the PRINTED CIRCUIT BOARD (Item 1) onto the four STANDOFFS as shown.
5. Connect one WIRE HARNESS to the 3-pin connector on the Circuit Board and to the panel terminal block. Wires #0, 79 and 14 attach to terminals #0, 79 and 14 respectively.
6. Connect second WIRE HARNESS to the Circuit Board 4-pin connector. Route this Harness to the panel exterior and connect it to the 6-pin connector of the Jumper Harness.
7. Connect the remaining 6-pin connector of the Jumper Harness to the 6-pin Connector of the Throttle Positioner assembly.

4.5.5- THROTTLE DROOP OVERRIDE POSITIONER INITIAL SETUP
(Figure 4.5-E, 4.5-F)

1. Check that the Override Positioner link rod is NOT connected to the engine Speed Control Lever.
2. Connect an accurate AC frequency meter to the generator's AC output terminals.
3. Start the generator engine.
4. See Figure 4.5-E. Turn the LOW SPEED and HIGH SPEED STOP SCREWS away from the SPEED CONTROL LEVER, to prevent interference.
5. Manually position the SPEED CONTROL LEVER to obtain an AC frequency of about 60-61 Hertz.
6. With engine speed at 60-61 Hertz, the SPEED CONTROL LEVER should be parallel with the edge of the Fuel Injection Pump. If Lever is NOT parallel, loosen the SPEED CONTROL LEVER PIVOT NUT and rotate the LEVER until it is parallel. Finally, tighten the PIVOT NUT.

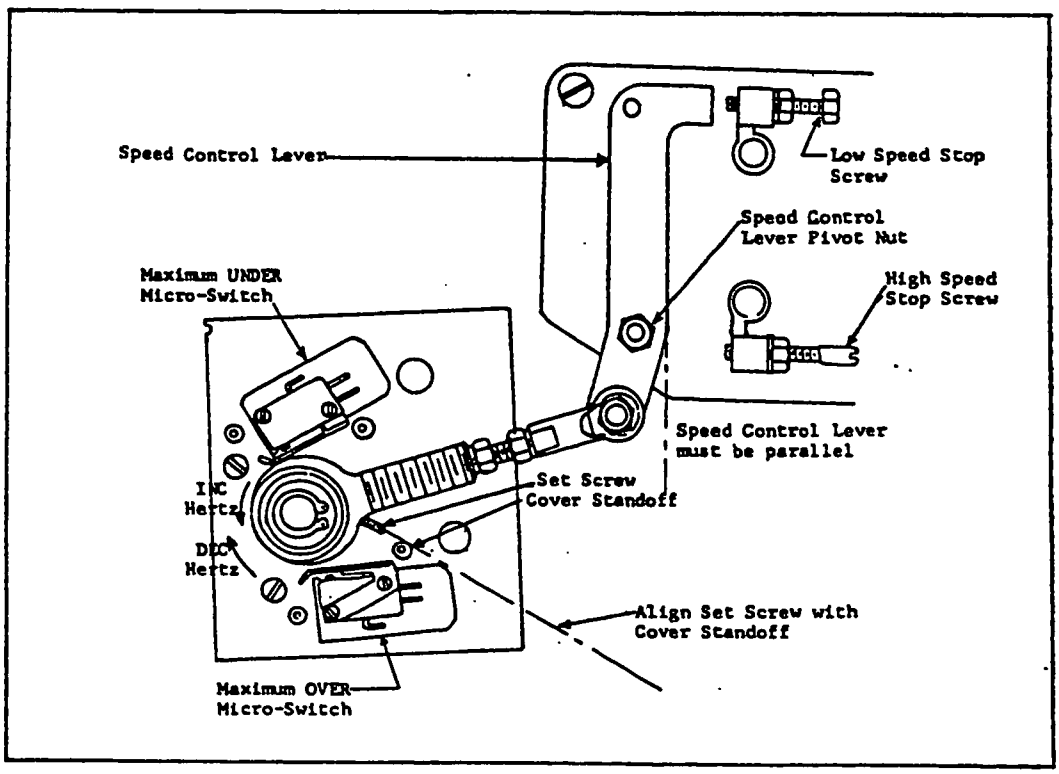


Figure 4.5-E. Initial Setup of Throttle Positioner Assembly

7. See Figure 4.5-F. Turn the RPM COARSE adjustment on the Printed Circuit Board until the SET SCREW (Figure 4.5-E) is aligned with the COVER STANDOFF as shown.
8. With the SPEED CONTROL LEVER parallel and positioned to provide an AC frequency of 60-61 Hertz, and with the SET SCREW positioned as outlined in Step (7), adjust the length of the THROTTLE POSITIONER LINK so that the LINK-TO-SPEED CONTROL LEVER CAPSCREW can be installed easily through both the LINK and the SPEED CONTROL LEVER.
9. With frequency meter indicating 60-61 Hertz, SPEED CONTROL LEVER parallel, SET SCREW properly positioned, and SPEED CONTROL LEVER CAPSCREW installed, retain the CAPSCREW with an M6 FLANGED NUT.

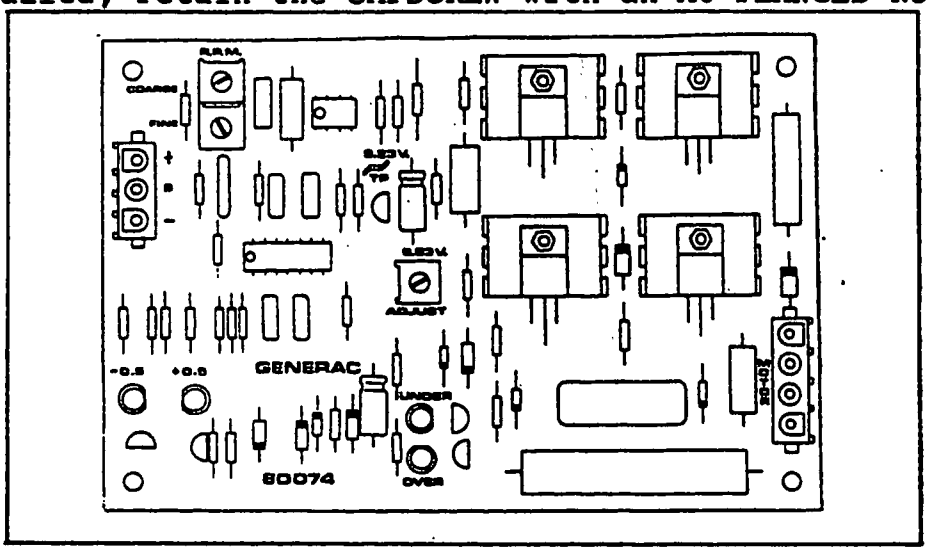


Figure 4.5-F. Throttle Positioner Printed Circuit Board

4.5.6- FINAL ADJUSTMENT (Figure 4.5-F)

1. On the PRINTED CIRCUIT BOARD, disconnect the wiring harness from the receptacle indicated by the word "MOTOR".
2. Set a DIGITAL Volt-Ohm-Milliammeter (VOM) to a scale greater than 10 VDC. If the VOM has a polarity switch, set the switch to "+DC".
3. Connect the POSITIVE (+) VOM test lead to the Circuit Board test point identified by a "9.23V TP". Connect the COMMON (-) test lead to the NEGATIVE (-) side of the Capacitor wire (just above the 9.23V ADJUST potentiometer).
4. With the engine running, adjust the "9.23V ADJUST" potentiometer to obtain a VOM reading of 9.23 Volts DC.
5. Set the engine Fuel Injection Pump governor to obtain an AC output frequency of 60-61 Hertz WITH NO ELECTRICAL LOADS CONNECTED TO GENERATOR.
6. With no electrical loads applied to generator, observe the Circuit Board lights. If engine speed droop error is greater than the range of -0.5 to +0.5 the aplicable UNDER or OVER light should be on. Turn the COARSE RPM ADJUST potentiometer until the UNDER/OVER lights go out and the -0.5 or +0.5 light comes on.
7. When the -0.5 or +0.5 light comes on, slowly turn the FINE RPM ADJUST potentiometer until the mid-point between -0.5 and +0.5 light on condition is reached. This is the point where, with one of the lights on, a slight turn of the FINE RPM ADJUST potentiometer will cause the other light to come on.

8. Reconnect the wiring harness to the Circuit Board's MOTOR receptacle.
9. Recheck the adjustment by applying a load to the generator. Start with a light load and gradually increase the load. Under a light load, GREEN light should come on but the motor should take no action. As the load is increased to the point where speed droop error exceeds -0.5 to +0.5 hertz, the RED or YELLOW light should come on and motor movement to correct the error should start.

SECTION 4.6 - CHECKOUT AND TESTING OF ENGINE SAFETY CONTROLS

4.6.1- GENERAL

Engine safety controls include those devices and circuits which, when activated by an engine fault condition, will result in an automatic engine shutdown. Safety controls installed on GENERAC generator sets include the following:-

1. **Low Engine Oil Pressure Shutdown Circuit**
2. **High Engine Coolant Temperature Shutdown Circuit**
3. **Low Engine Coolant Level Shutdown Circuit**
4. **RPM Sensor Loss Shutdown Circuit**

NOTE

It is recommended that all engine safety controls be tested following generator set installation and AT LEAST every 6 months thereafter. No electrical loads should be applied to the generator during tests of safety controls.

4.6.2- OPERATIONAL TEST OF LOW OIL PRESSURE SHUTDOWN SYSTEM (Figure 4.6-A)

1. Set a Volt-Ohm-Milliammeter (VOM) to its "Rx1" scale and zero the meter.
2. Locate the Low Oil Pressure Shutdown Switch on engine. Disconnect Wire #86 from the Switch terminal- do NOT permit the Wire #86 terminal end to contact any metal part.
3. With generator shut down, connect one VOM test lead to the Oil Pressure Switch Wire #86 terminal, the other test lead to a clean frame ground. Meter needle should swing all the way upscale (continuity).
4. Start the generator engine- no electrical loads must be connected.
5. Connect VOM test leads as outlined in Step (3)- no upscale movement of the VOM needle should be noted.
6. Hold the Wire #86 terminal end firmly into contact with a clean frame ground. Engine should shut down and Engine Monitor Panel advisory lights should operate as follows:-
   a. Option "A" and "B" Units"- LOW OIL PRESS Light may flash momentarily but will go out as soon as the Wire #14 circuit is deactivated on shutdown. Light should remain ON while cranking with Wire #86 terminal end at frame ground.
   b. Option "C" Units:- LOW OIL PRESS Light should illuminate and remain ON after shutdown. Engine cranking should be inhibited while light is ON. To "unlatch" the fault (light out), push Monitor Panel RESET switch in.
7. When test is complete, reconnect Wire #86 to the Low Oil Pressure Switch.

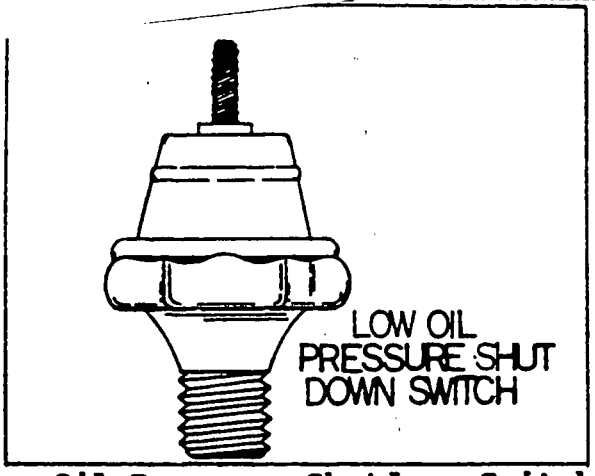


Figure 4.6-A. Low Oil Pressure Shutdown Switch (Typical)

4.6.3- OPERATIONAL TEST OF HIGH COOLANT TEMPERATURE SHUTDOWN SYSTEM (Figure 4.6-B, 4.6-C, 4.6-D)

A. **Testing with High Coolant Temperature Switch Removed:-** Note the "R" terminal on Switch to which Wire #85 connects. Disconnect Wire #85 from the terminal, then remove the Switch and test as follows:-

1. See Figure 4.6-B. Immerse the Switch in a 50-50 mixture of ethylene glycol base anti-freeze and soft water as shown.
2. Set a Volt-Ohm-Milliammeter (VOM) to its "Rx1" scale and zero the meter. Connect one VOM test lead to the Switch "R" terminal, from which Wire #85 was removed, the remaining test lead to the Switch housing. No upscale movement of the VOM needle should be noted.
3. Place an accurate thermometer into the fluid mixture.
4. Heat the fluid mixture- at approximately 246-266 degrees F., the VOM needle should move upscale (continuity).
5. Remove the fluid mixture from its source of heat and allow to cool. As temperature of fluid decreases below about 246-266 degrees F., the VOM needle should drop all the way downscale (infinity).

Replace the Switch if test results are not as outlined above.

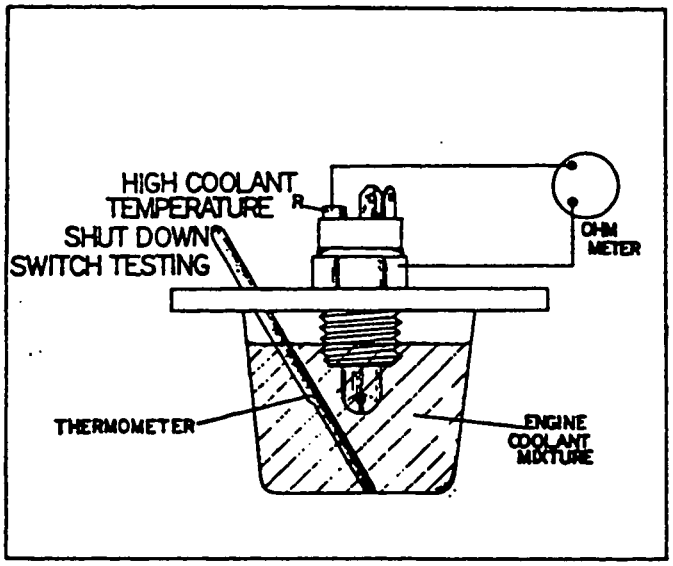


Figure 4.6-B. High Coolant Temperature Switch Testing

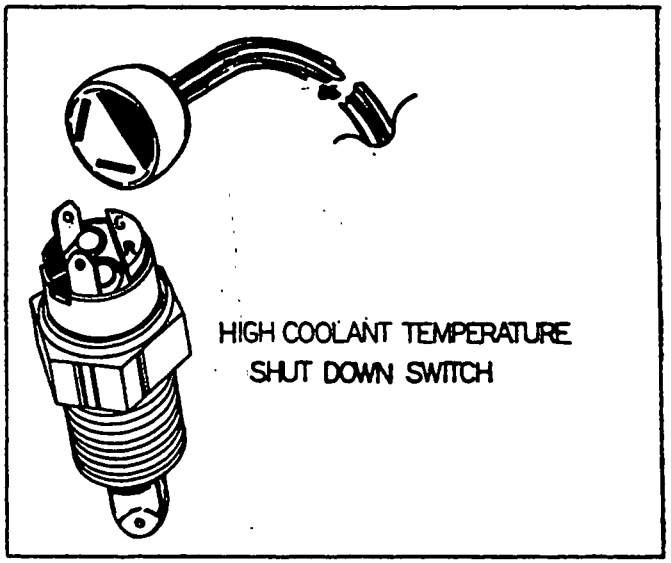


Figure 4.6-C. Typical High Coolant Temperature Switch

Operational Testing with High Coolant Temperature Switch Installed:-

1. On the generator engine, locate the High Coolant Temperature Shutdown Switch. Disconnect the Wire #85 terminal end from the Switch terminal.
2. Set a Volt-Ohm-Milliammeter to its "Rx1" scale and zero the meter. Connect one VOM test lead to the Wire #85 Switch terminal, the remaining test lead to a clean frame ground. No upscale movement of the meter needle should be observed (infinity).
3. Check that no electrical loads are connected to the generator set, then start the generator engine.
4. With engine running, hold terminal end of Wire #85 firmly against a clean frame ground. After about a 1 second delay, engine should shut down.
5. **Option "A" and "B" Units"**- HIGH COOL. TEMP Light may flash momentarily but will go out as soon as the Wire #14 circuit is deactivated on shutdown. Light should remain ON while cranking with Wire #85 terminal end in contact with frame ground.

Option "C" Units:- HIGH COOL. TEMP Light should latch ON. Engine cranking should be inhibited while light is ON. To "unlatch" the condition, push RESET switch in.

4.6.4- OPERATIONAL TEST OF LOW COOLANT LEVEL SHUTDOWN SYSTEM (Figure 4.6-D, 4.6-E)

On early production generator units, the Low Coolant Level Sensor was installed in a Thermostat Adapter Housing on the engine. On later production units, the sensor may be installed in the radiator.

Testing of the Low Coolant Level Shutdown system may be completed as follows:-

A. **Low Coolant Level Sensor Testing**:- Remove wire from Sensor Terminal, then remove the Sensor. Connect a test harness to the Sensor terminals and to a fully charged 12 volts battery. Then, connect a DC Voltmeter to the Sensor terminals. See Figure 4.6-D. Initially, the Voltmeter should indicate approximately 7-11 Volts DC. After approximately 15 seconds, as the Sensor becomes hot, Voltmeter reading should drop off to less than 5 Volts DC. Replace the sensor, if test results are not exactly as outlined.

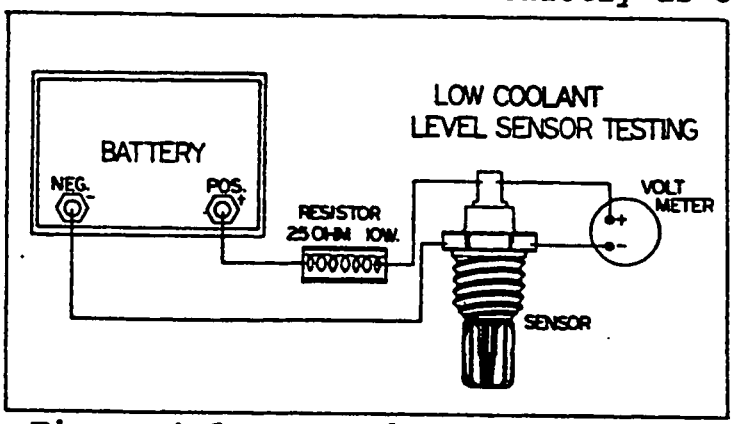


Figure 4.6-D. Testing the Low Coolant Level Sensor

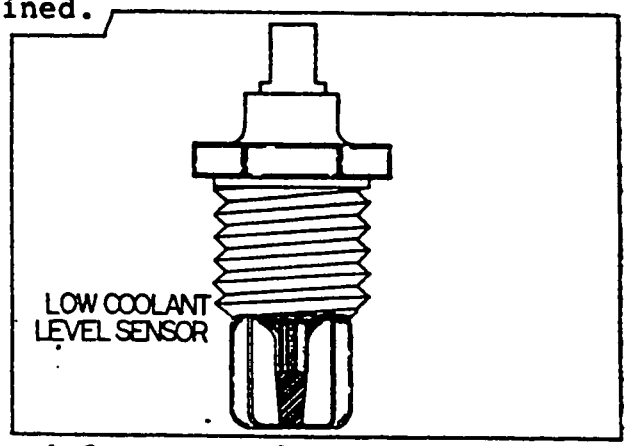


Figure 4.6-E. A Typical Low Coolant Level Sensor

B. Operational Test of Low Coolant Level Shutdown System:- Disconnect Wire #85 from the Sensor terminal. Make sure that terminal end of the wire is not touching any metal part. Then, perform an operational test of the system as follows:-

1. Start the generator engine.
2. Make sure that no electrical loads are connected to the generator.
3. With engine running, hold the terminal end of Wire #85 (previously removed from the Sensor terminal) firmly into contact with a clean frame ground. Engine should shut down after about a 1 second delay.
   Option "A" and "B" Units:- HIGH COOL. TEMP Light on Monitor Panel may flash momentarily but will go out as soon as the Generator Wire #14 circuit de-energizes on shutdown. Light should remain ON while cranking engine with Wire #85 terminal grounded.
   Option "C" Units:- HIGH COOL. TEMP. Light should latch ON. Engine cranking should be inhibited while light is on. To unlatch the fault and reset the system, push the RESET switch in.
4. When test is completed, reconnect Wire #85 to the proper Sensor terminal.

4.6.5- RPM SENSOR LOSS OPERATIONAL TEST

To perform an operational test of this system, proceed as follows:-

1. Gain access to the Meter and Control Panel interior by removing the Panel top cover or one of its sides.
2. Start the generator engine, let it stabilize on-speed.
3. **Units Manufactured Prior to August 1984:-** In the Meter and Control Panel, locate the 16-terminal Terminal Block (TB4). Locate Terminal #79 on that Terminal Block.
   Units Manufactured After August 1984:- Locate the 20-terminal Terminal Block (TB1), and Terminal #79 on that Terminal Block.
4. Carefully disconnect Wire #79 from Terminal #79- do not contact any other terminal with screwdriver or Wire #79 terminal end. With Wire #79 disconnected an automatic engine shutdown should occur after a 2 second delay.

4.6.6- INSTALLATION, ADJUSTMENT AND TESTING OF THE RPM SENSOR (Figure 4.6-F)

A. Installation and Adjustment:- A threaded hole is provided on the engine FLYWHEEL HOUSING for SENSOR installation. Thread the Sensor into the FLYWHEEL HOUSING until SENSOR tip just contacts a tooth of the FLYWHEEL gear- DO NOT USE EXCESSIVE FORCE. Then, turn the SENSOR counterclockwise 1/2 to 3/4 turn and tighten the LOCK NUT. **DO NOT ROTATE THE ENGINE WHILE MAKING THIS ADJUSTMENT.**

B. Testing the RPM Sensor:- Gain access to the Meter and Control Panel interior. Connect an accurate digital AC Voltmeter across Terminals #79 and 0. At engine CRANKING speed, the Voltmeter should indicate approximately 0.4 Volt AC. Use an acurate Ohmmeter to test RPM Sensor resistance- meter should indicate about 130 Ohms (plus or minus 10%). If resistance is within limits but voltage output is slightly low, voltage may be increased by adjusting the Sensor closer to the flywheel- DO NOT LOCATE THE SENSOR CLOSER THAN 1/2 TURN FROM FLYWHEEL.

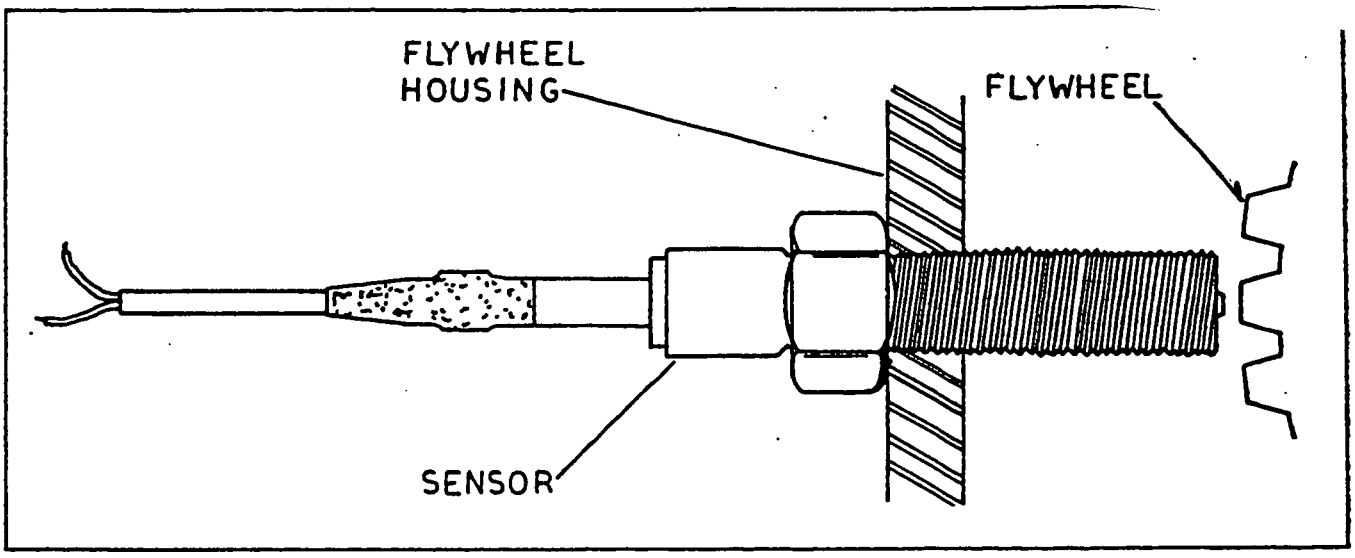


Figure 4.6-F. The RPM Sensor (Typical)

PART 5

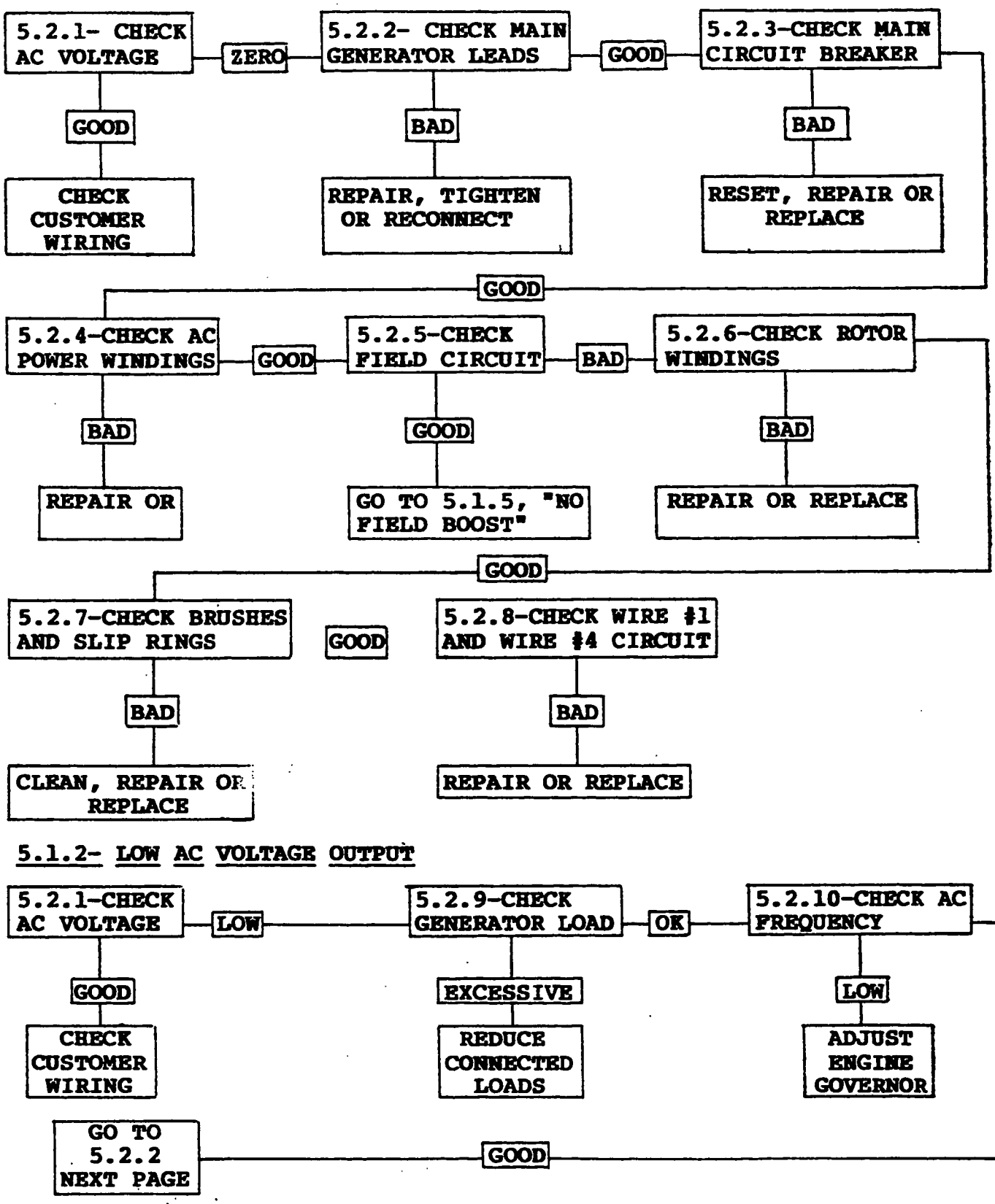
TROUBLESHOOTING AND DIAGNOSTIC TESTS
AC POWER SECTION
DIRECT EXCITED BRUSH TYPE UNITS

Section 5.1 - **TROUBLESHOOTING FLOW CHARTS**
- 5.1.1 - No AC Voltage Output
- 5.1.2 - Low AC Voltage Output
- 5.1.3 - High AC Voltage Output
- 5.1.4 - Fluctuating AC Voltage Output
- 5.1.5 - No Field Boost

Section 5.2 - **DIAGNOSTIC TESTING**
- 5.2.1 - Check AC Voltage
- 5.2.2 - Check Main Generator Leads
- 5.2.3 - Check Main Circuit Breaker
- 5.2.4 - Check AC Power Windings
- 5.2.5 - Check Field Circuit
- 5.2.6 - Check Rotor Windings
- 5.2.7 - Check Brushes and Slip Rings
- 5.2.8 - Check Wire #1 and #4 Circuit
- 5.2.9 - Check Generator Load
- 5.2.10- Check AC Frequency
- 5.2.11- Check Voltage Regulator Sensing Voltage
- 5.2.12- Check Voltage Adjust Potentiometer
- 5.2.13- Check Voltage Regulator Sensing Leads
- 5.2.14- Check DPE Output
- 5.2.15- Check Field Circuit Breaker
- 5.2.16- Check DPE Windings
- 5.2.17- Check Thermal Protector
- 5.2.18- Bypass the Thermal Protector
- 5.2.19- Check Field Boost Voltage
- 5.2.20- Check Field Boost Wire #4 for Open/Shorted Condition
- 5.2.21- Check Field Boost Diode
- 5.2.22- Check Field Boost Resistor
- 5.2.23- Check Control Relay CR1

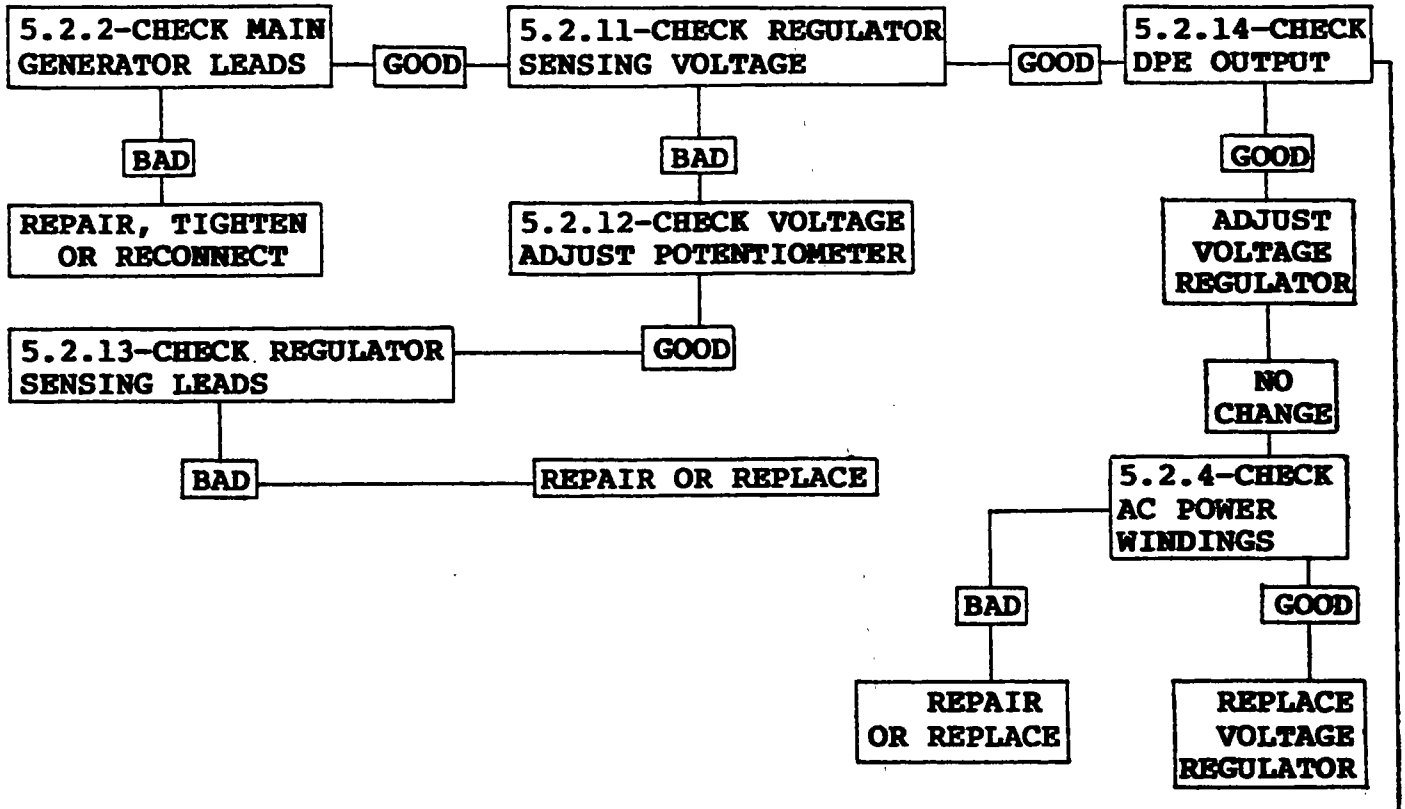
SECTION 5.1 - TROUBLESHOOTING FLOW CHARTS

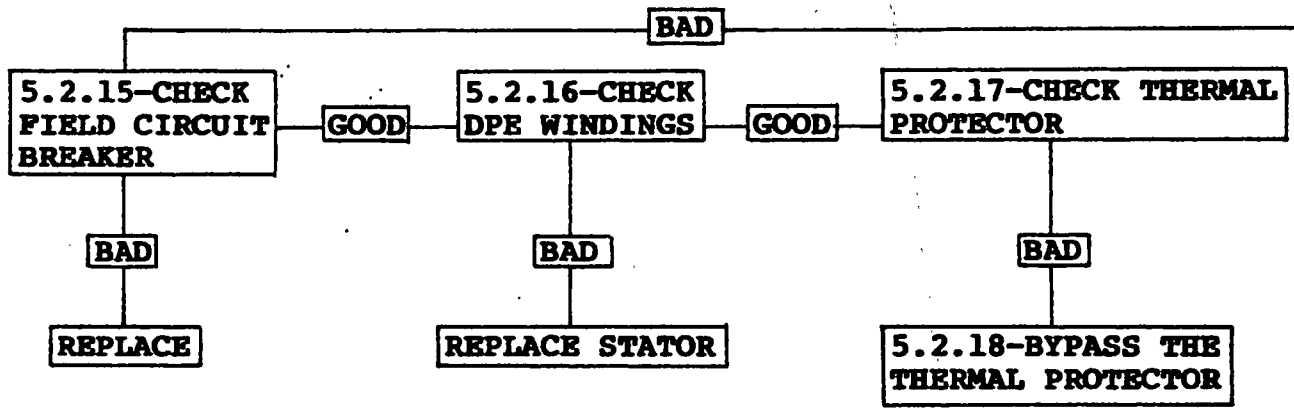
5.1.1- NO AC VOLTAGE OUTPUT



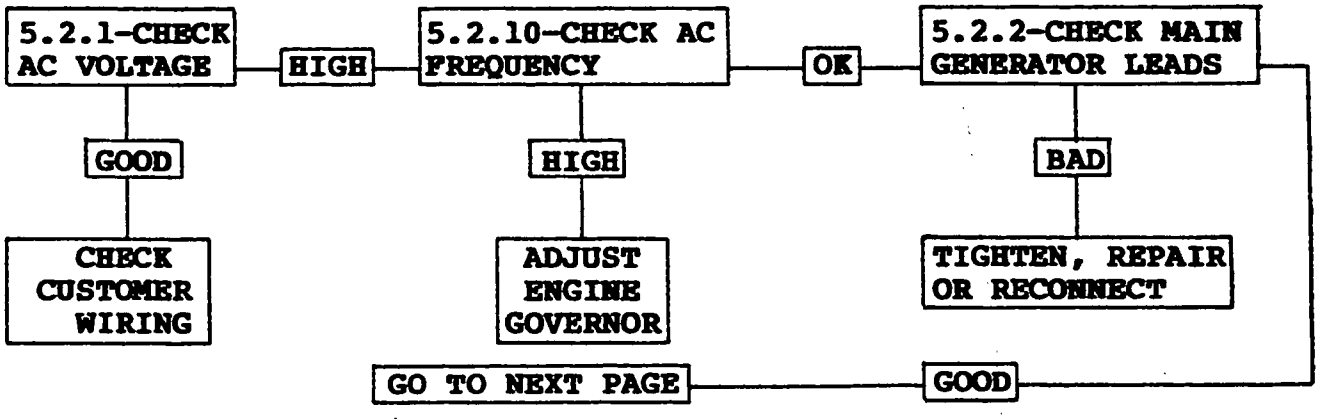
5.1.2- LOW AC VOLTAGE OUTPUT

5.1.2- LOW AC VOLTAGE OUTPUT (Cont'd)

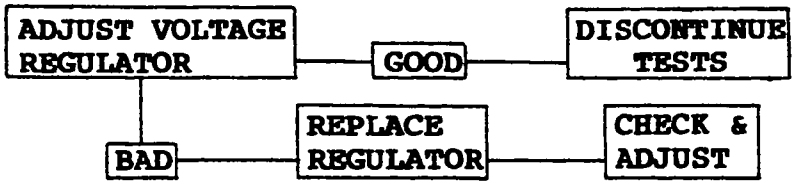




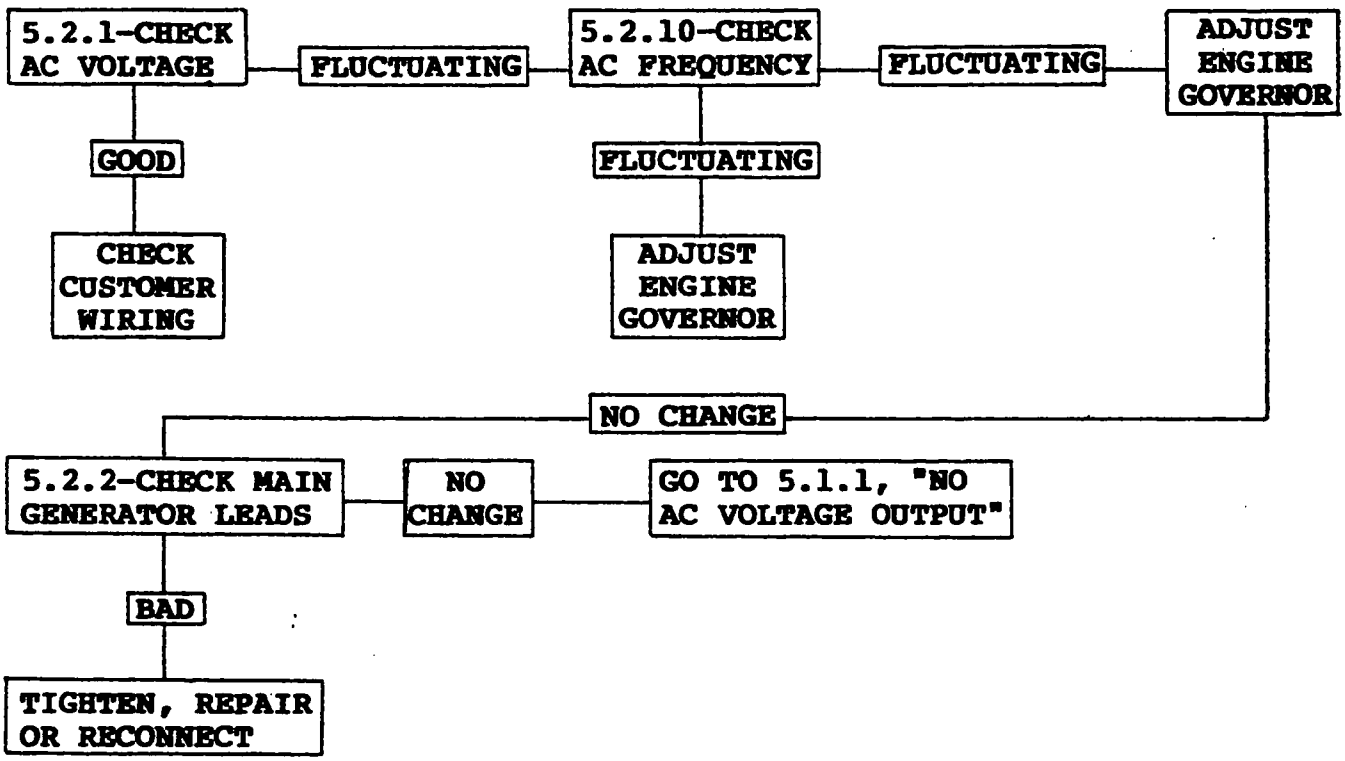
5.1.3- HIGH AC VOLTAGE



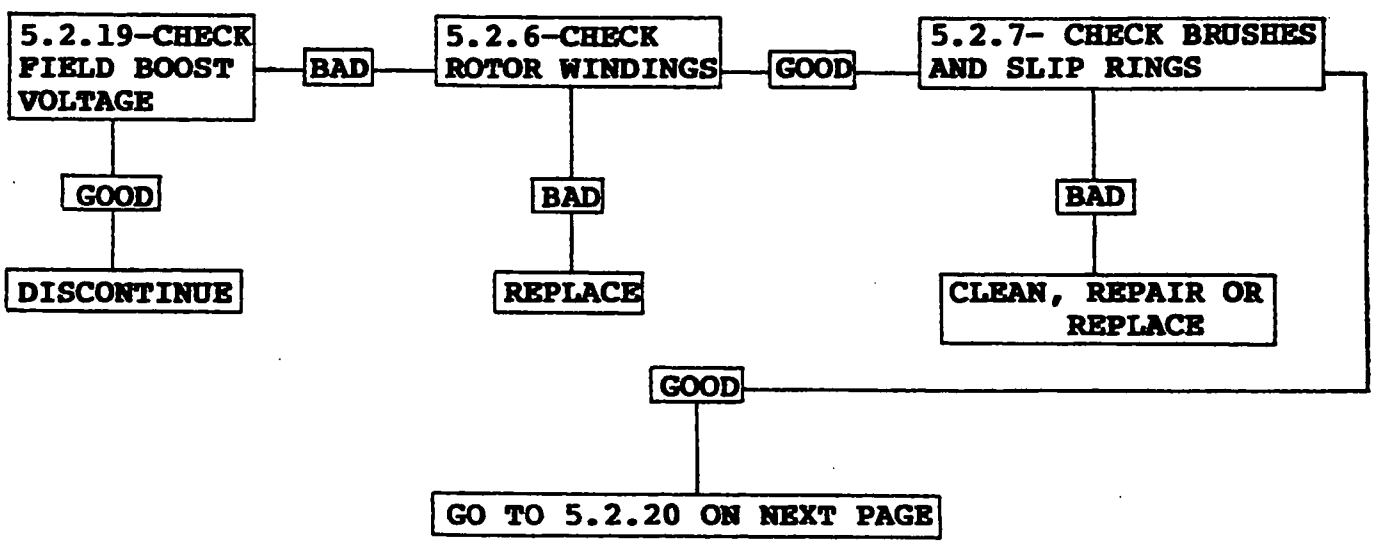
5.1.3- HIGH AC VOLTAGE (Cont'd)



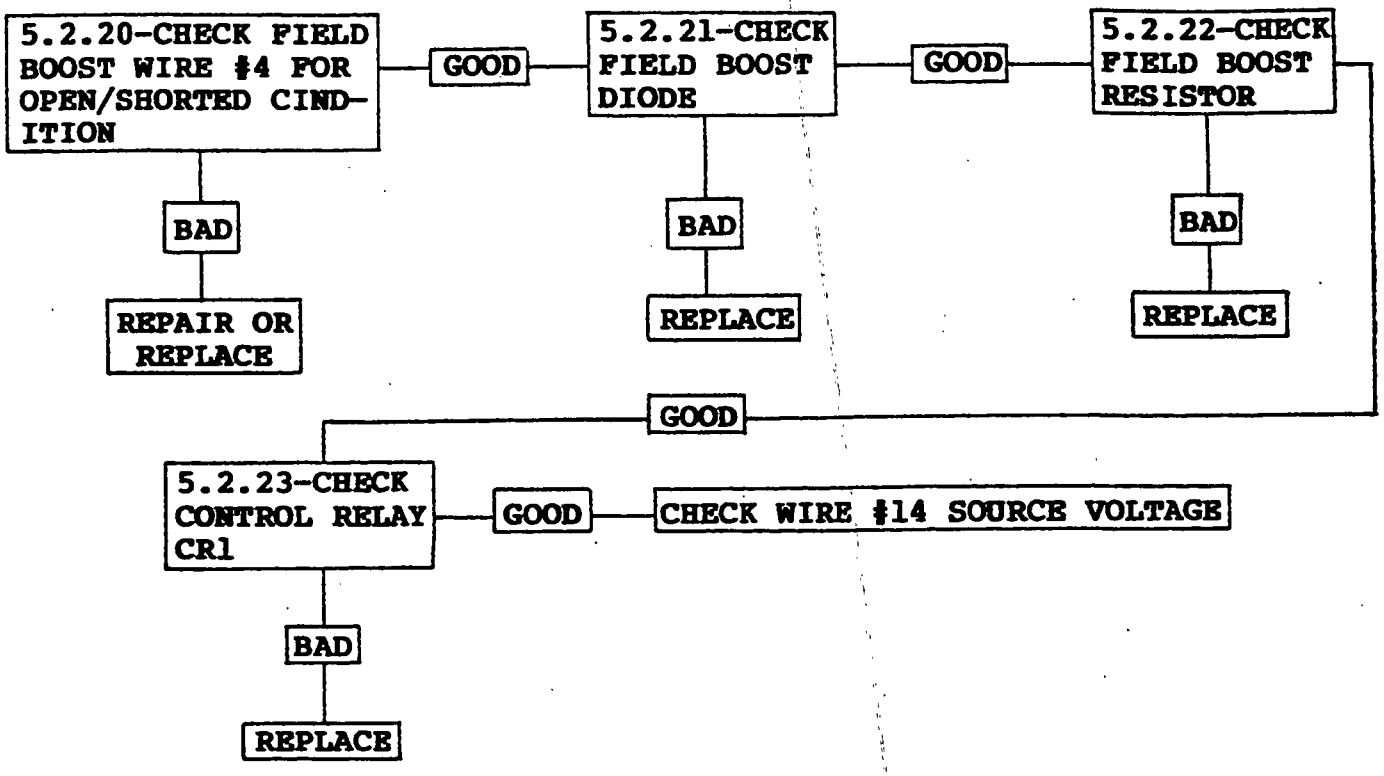
5.1.4- FLUCTUATING AC VOLTAGE



5.1.5- NO FIELD BOOST



5.1.5- NO FIELD BOOST (Cont'd)



SECTION 5.2 - DIAGNOSTIC TESTING

DANGER!

Extremely high and dangerous voltages are present at generator leads and terminals while the unit is running. Use extreme care to help avoid dangerous- possibly LETHAL- electrical shock. Dangerous voltages are present even with the Voltage Regulator disconnected. GENERATOR TESTING MUST BE ACCOMPLISHED ONLY BY QUALIFIED PERSONNEL.

5.2.1- CHECK AC VOLTAGE

Gain access to the generator AC Connection (Lower) Panel interior. Connect an accurate AC Voltmeter to the generator main customer connection terminals (E1, E2, E3, 00). Start the generator engine, let it stabilize and warm up. For single phase units, read the line-to-line and line-to-neutral voltages; for 3-phase units, read the leg-to-leg and leg-to-neutral voltages.

RESULTS:- 1. Voltage checks GOOD..... Check Customer Connections
2. No or extremely low Voltage..... See 5.1.1
3. Low Voltage Indicated..... See 5.1.2
4. High Voltage Indicated..... See 5.1.3
5. AC Voltage Fluctuates..... See 5.1.4

NOTE

A condition in which the generator is producing APPROXIMATELY one-half its rated AC output voltage generally indicates (a) loss of stator excitation (DPE) winding output to the Regulator, (b) loss of sensing voltage to the Regulator, or (c) Voltage Regulator failure. All 3 of those problems will result in loss of excitation current flow to the Rotor (Field), except that FIELD BOOST current flow will continue to produce the approximately one-half rated output.

5.2.2- CHECK MAIN GENERATOR LEADS

Check Main generator leads (E1, E2, E3 and 00) for broken, loose or disconnected connections. Also check that leads are properly connected. If the unit is a 12-wire reconnectable 3-phase type, check that Wires S1 through S12 are properly connected. See Section 2.3, AC CONNECTION SYSTEMS.

5.2.3- CHECK MAIN CIRCUIT BREAKER

If the generator unit is equipped with a main circuit breaker, check that the breaker contacts are closed. Also check for continuity across the breaker with its contacts closed. Reset breaker to ON, repair or replace as necessary.

5.2.4- CHECK AC POWER WINDINGS

Use an accurate Ohmmeter to check the stator AC Power windings for an OPEN or SHORTED condition. Refer to the SCHEMATIC/WIRING DIAGRAM for the generator being tested for test points to be used for each AC Power coil. See Paragraph 1.4 at front of Manual for nominal

resistance value.
Check for continuity with the Ohmmeter set to its "Rx1" scale. When all windings have been tested for continuity, set the meter to its "Rx10,000" or "RxlK" scale and zero the meter. Then, test for a shorted condition by connecting the meter test probes across each stator coil or winding lead and frame ground.

If desired, the minimum insulation resistance of the stator may be tested with a Megohmmeter. Calculate the minimum insulation resistance (in MEGOHMS) as follows:-

$$\text{Minimum Insulation Resistance in MEGOHMS} = \frac{\text{GENERATOR RATED VOLTAGE}}{1000} + 1$$

Connect ALL stator leads together. Make sure leads are not touching the generator frame. Connect one Megohmmeter test lead to the stator leads, the remaining test lead to frame ground (on the stator can). Any reading less than the calculated minimum indicates an unacceptably low generator insulation resistance. Clean, dry, repair or replace the stator as necessary.

5.2.5- CHECK FIELD CIRCUIT (Figure 5.2-A)

Gain access to the generator Meter and Control Panel interior. Disconnect the Voltage Regulator connector plug. Then, locate FEMALE Pins #1 and #4 to which Wires #1 and #4 attach. With an Ohmmeter set to its "Rx1" scale and properly zeroed, connect the positive (+) meter test probe to Voltage Regulator FEMALE connector plug Pin #4 (Wire #4), the remaining test probe to FEMALE Pin #1 (Wire #1). See Section 1.4 for nominal Rotor winding resistance.

Now, set the Ohmmeter to its "Rx10,000" or "RxlK" scale and again zero the meter. Connect the meter positive (+) test probe to the Voltage Regulator connector plug's FEMALE Pin #4, the other test probe to a clean frame ground on the stator can. No upscale movement of the meter needle should be indicated.

RESULTS:- 1. Field Circuit Tests GOOD..... Go to Paragraph 5.2.9
2. OPEN or SHORTED condition Indicated..... Go to Paragraph 5.2.6

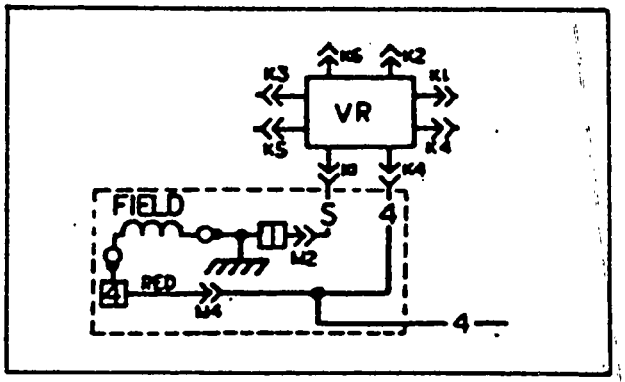


Figure 5.2-A. The Field Circuit

5.2.6- CHECK ROTOR WINDINGS (Figure 5.2-A)

Gain access to the Rotor Slip Rings. Set an Ohmmeter to its "Rx1" scale and zero the meter. If meter has a Polarity Switch, set it to "+DC". Connect the positive (+) meter test lead to the positive (+) Slip Ring (nearest the Rotor bearing). Connect the common (-) test lead to the other Slip Ring. Meter should indicate Rotor winding resistance (see Section 1.4 at front of Manual).

Remove the Brush Holder mounting screw that retains the grounding wire #0. Then, set the Ohmmeter to its "Rx10,000" or "Rx1K" scale and zero the meter. Connect the positive (+) meter test lead to the positive (+) Slip Ring (nearest the Rotor bearing), the common (-) test lead to a clean frame ground. No upscale movement of the meter needle should be noted. Any upscale movement of the needle indicates a shorted condition.

If desired, the minimum insulation resistance of the Rotor may be checked using a Megohmmeter.

RESULTS:- 1. Rotor Windings check good..... Go to 5.2.7
2. OPEN or SHORTED condition..... Replace Rotor Assembly

Reinstall ground wire and Brush Holder screw before proceeding.

5.2.7- CHECK BRUSHES AND SLIP RINGS (Figure 5.2-A)

Inspect Brushes and Slip Rings carefully. Replace any Brush that is cracked, chipped, broken or otherwise defective. Check that Brushes are riding properly on Slip Rings and are properly retained in their Brush Holder. If Slip Rings are dirty or tarnished (oxidized), they may be cleaned with fine sandpaper- DO NOT USE ANY METALLIC GRIT TO CLEAN SLIP RINGS. After cleaning, be sure to remove all sandpaper residue.

5.2.8- CHECK WIRE #1 AND #4 CIRCUIT (Figure 5.2-A)

Use an Ohmmeter to check the Wires #1 and #4 circuits for an OPEN or SHORTED condition. Repair or replace any defective wiring.

5.2.9- CHECK GENERATOR LOAD

Use a "clamp-on" ammeter to check current flow (in AMPERES) through each one of the generator load leads with electrical loads connected and turned ON. If load current is greater than the generator's data plate rating, load must be reduced. Excessive load current will result in a voltage drop, as well as high internal generator temperatures.

5.2.10- CHECK AC FREQUENCY

When AC output voltage is high or low, AC frequency should also be checked since the Voltage Regulator will maintain a voltage that is in direct proportion to frequency. That is, if both voltage and frequency are proportionally high, low or fluctuating, check engine speed governor settings.

5.2.11- CHECK VOLTAGE REGULATOR SENSING VOLTAGE (Figure 5.2-B)

If sensing voltage from the Stator AC power leads to the Voltage Regulator is lost, the Regulator will "shut down". That is, the Regulator will no longer provide a regulated DC excitation current flow to the Rotor (Field) windings and Stator AC output voltage to connected loads will be the result of FIELD BOOST input to the Rotor only. Field Boost alone will produce an AC output voltage of APPROXIMATELY one-half the generator unit's rated voltage.

In the Meter and Control Panel, disconnect the Voltage Regulator connector plug. Connect an accurate AC Voltmeter to FEMALE connector plug Pin #5 (Wire #S15) and to FEMALE connector plug Pin #3 (Wire #89). Start the generator and check the sensing voltage reading on the Voltmeter.

RESULTS:- 1. No Sensing Voltage Indicated..... Go to Paragraph 5.2.12
2. Sensing Voltage WAS Indicated..... Go to Paragraph 5.2.14

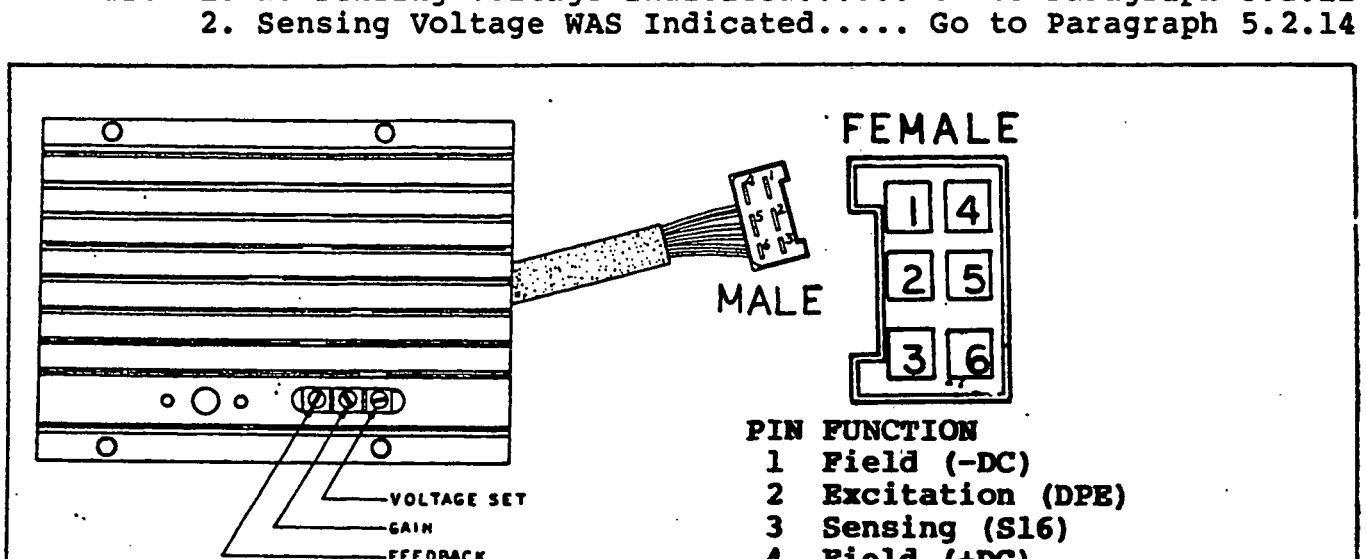


Figure 5.2-B. Voltage Regulator

5.2.12- CHECK VOLTAGE ADJUST POTENTIOMETER

An AC output voltage that is within plus or minus 5 percent of the nominal rated voltage may be adjusted to the nominal rated voltage by means of the Meter and Control Panel's Voltage Adjust Potentiometer. An OPEN condition in that potentiometer will produce the same results as an OPEN condition in the Regulator Sensing circuit.

Connect the test probes of an accurate Ohmmeter across the Voltage Adjust Potentiometer terminals, to which Wires #S16 and #89 attach. Slowly rotate the Potentiometer knob clockwise and counterclockwise while observing the Ohmmeter reading. Meter needle should increase smoothly from a relatively low resistance to a higher resistance as the knob is turned (potentiometer is rated at 2.25 Watts, 10K-Ohms). Erratic movement of the meter needle or dropoff to zero at any point in the knob rotation is cause for replacement.

5.2.13- CHECK VOLTAGE REGULATOR SENSING LEADS

Use an Ohmmeter to check the Voltage Regulator sensing leads (S15, S16 and #89) for an OPEN or SHORTED condition. Repair or replace any defective sensing circuit wiring.

5.2.14- CHECK DPE OUTPUT (Figure 5.2-C)

Inside the Meter and Control Panel, disconnect the Voltage Regulator connector plug. Connect an accurate AC Voltmeter to FEMALE connector plug Pins #2 (Wire #2) and #6 (Wire #6). Start the generator engine. The Voltmeter should indicate an AC Voltage, the Stator DPE (Excitation) Winding output voltage.

RESULTS:- 1. AC Voltage NOT indicated..... Go to Paragraph 5.2.15
2. AC Voltage WAS indicated..... Go to Paragraph 5.2.19

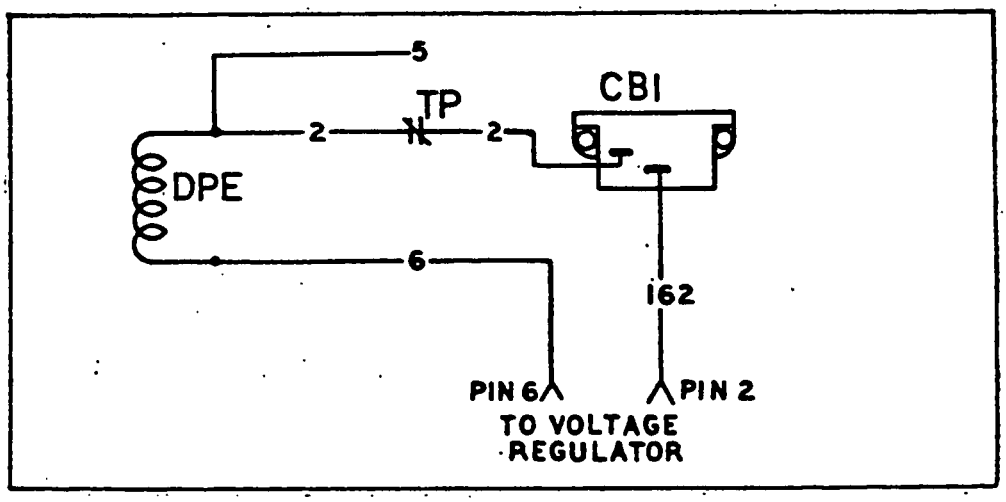


Figure 5.2-C. The DPE (Excitation) Circuit

5.2.15- CHECK FIELD CIRCUIT BREAKER (Figure 5.2-C)

With generator NOT running, connect an accurate Ohmmeter across the Field Circuit Breaker wire terminals. Meter should indicate continuity. If continuity is NOT indicated, replace the Field circuit breaker.

5.2.16- CHECK DPE WINDING (Figure 5.2-C)

Wires running through an opening in the floor of the Meter and Control Panel attach to a connector plug in the AC Connection (Lower) Panel. Stator DPE (Excitation) Winding output Wires #2 and #6 from the Voltage Regulator connect to the Lower Panel connector plug. Early units (manufactured prior to August 1984) have a 10-pin connector plug, while later units (made AFTER August 1984) have a 15-pin connector plug.

Units with 10-pin Connector Plug in Lower Panel:- Connect an accurate Ohmmeter to MALE connector plug Pins #6 (Wire #2) and #8 (Wire #6), in the AC Connection Panel.

...es with 15-pin Connector Plug:- Connect Ohmmeter to MALE connector plug Pins #3 (Wire #2) and #6 (Wire #6).

The Ohmmeter should indicate the Stator DPE (Excitation) Winding resistance. See Section 1.4 at front of this Manual. If meter needle does NOT swing upscale an OPEN condition is indicated.

After testing for an OPEN condition, check for a SHORTED condition with Ohmmeter set to its "Rx10,000" or "RxlK" scale.

RESULTS:- 1. Circuit tests GOOD..... Go to Paragraph 5.2.19
2. OPEN or SHORTED condition..... Go to Paragraph 5.2.17

If desired, minimum insulation resistance of the Stator DPE (Excitation) Windings may be checked, using a Megohmmeter.

5.2.17- CHECK THERMAL PROTECTOR (Figure 5.2-C)

In the AC Connection (Lower) Panel, locate unattached Wire #5 which comes out of the Stator Assembly and hangs loose in the Lower Panel. This is the Thermal Protector BYPASS lead. Connect one Ohmmeter test probe to the stripped end of Wire #5, the remaining test probe to MALE connector plug Pin #6 (Wire #6) of 15-pin plug or to Pin #8 (Wire #6) of the 10-pin connector plug in AC Connection Panel. Meter should indicate DPE Winding resistance (see Paragraph 1.4).

RESULTS:- 1. OPEN or SHORTED condition indicated in Paragraph 5.2.16, but NOT in Paragraph 5.2.17..... Go to Paragraph 5.2.18
2. OPEN/SHORTED condition in BOTH 5.2.16 and 5.2.17.... Test Stator DPE Winding and Wires #2 and #6 further. Repair or replace any shorted wires or Stator Assembly as necessary.

5.2.18- BYPASS THE THERMAL PROTECTOR (Figure 5.2-C)

If Thermal Protector tests indicate that it is OPEN or SHORTED, it may be electrically bypassed as follows:-

1. In the AC Connection (Lower) Panel, cut Wire #2 and strip end of wire.
2. Connect stripped ends of Wires #2 and #5 and retain securely with a wire nut.
3. Wire nut and tape the unused end of Wire #2 that comes out of the Stator can into the AC Connection Panel.

5.2.19- CHECK FIELD BOOST VOLTAGE (Figure 5.2-D)

A loss of Field Boost current flow to the Rotor (Field) windings may or may not result in loss of AC voltage output from the Stator AC Power Windings. In effect, the Field Boost circuit "flashes the Field" when the generator engine is started (as soon as Wire #14 circuit becomes electrically hot). If adequate residual magnetism is available in the Rotor, Stator voltage will be generated even if Field Boost output is lost. If adequate residual magnetism is NOT available, loss of Field Boost output will result in a loss of AC voltage output.

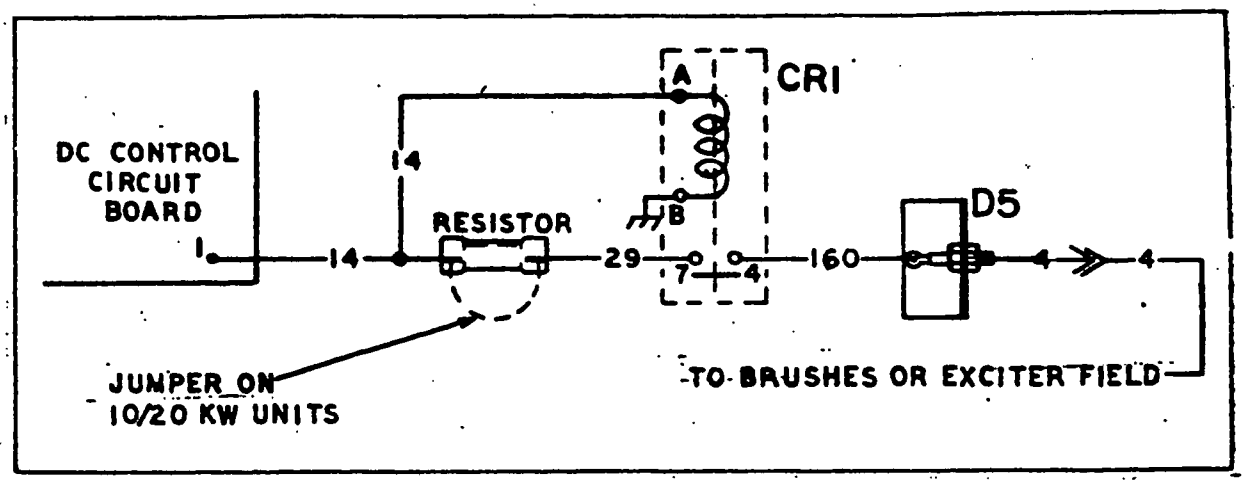


Figure 5.2-D. The Field Boost Circuit

Normally, with Field Boost current available to the Rotor and with no Excitation (DPE) circuit output to the Rotor, the generator will produce APPROXIMATELY one-half the unit's rated AC voltage. Test the Field Boost circuit as follows:-

1. Disconnect the DPE (Excitation) circuit output to the Rotor by disconnecting the Voltage Regulator connector plug.
2. Connect an accurate AC Voltmeter to the Main generator leads (E1, E2, E3 and 00). Measure line-to-line voltage for single phase units, leg-to-leg voltage for 3-phase units.
3. Start the generator engine.
4. Check AC Voltage output. If voltage is approximately one-half the rated voltage of the unit, the Field Boost system is functioning.

RESULTS:- 1. About one-half rated voltage indicated.. Any problem is NOT in the Field Boost circuit. Retest other circuits.
2. No Voltage indicated..... Go to Paragraph 5.2.20

5.2.20- CHECK FIELD BOOST WIRE #4 FOR OPEN/SHORTED CONDITION (Figure 5.2-D)

Use an acurate Ohmmeter to test Field Boost Wire #4 for an OPEN and a SHORTED condition. Repair or replace Wire as necessary.

5.2.21- CHECK FIELD BOOST DIODE (Figure 5.2-D)

Connect the positive (+) test probe of an Ohmmeter to the stud (Wire #160) end of the Field Boost Diode (in the Meter and Control Panel). Connect the common (-) test probe to the terminal (Wire #4) end of the Diode. Observe the meter reading. Then, reverse the test leads, i.e., connect positive (+) test lead to Terminal (Wire #4) end of Diode and common (-) test lead to Stud (Wire #160) end of Diode. Meter needle should swing upscale and indicate forward resistance of Diode at one polarity only, should drop al the way downscale (infinity) at the opposite polarity. Replace Diode if test results are not exactly as indicated.

5.2.22- CHECK FIELD BOOST RESISTOR (Figure 5.2-D)

NOTE
Some smaller generators, such as 15 and 20 KW units, may incorporate a "jumper wire" across the Field Boost Resistor. Refer to the Schematic/Wiring Diagram for the specific unit involved.

With generator running, connect the positive (+) test probe of a DC Voltmeter to the Wire #14 terminal of the Field Boost Resistor and the common (-) terminal to a clean frame ground. Battery voltage should be indicated.

Now, connect the positive (+) DC Voltmeter test probe to the Wire #29 terminal of the Resistor and the other terminal to frame ground. Approximately one-half battery voltage should be indicated (see NOTE above).

Replace the Field Boost Resistor if defective.

5.2.23- CHECK CONTROL RELAY CR1 (Figure 5.2-D)

Locate the Control Relay in the Meter and Control (Upper) Panel. The Relay is energized during generator startup by Wire #14 voltage. When energized, its normally open contacts #4 and #7 close to deliver +12 VDC to the Field Boost circuit. Test the Relay as follows:-

1. Unplug the Relay from its receptacle.
2. Connect an Ohmmeter across Relay Pins #4 and #7- the meter should indicate INFINITY.
3. Connect Relay Terminal B to the negative (-) terminal of a 12 volts battery and Relay Terminal A to the positive (+) terminal of the battery. The Ohmmeter connected across Pins #4 and #7 should swing upscale (continuity).

If the Relay tests GOOD, check Wire #14 from Terminal A for OPEN/SHORTED condition. Also check Wire #0 (ground) from Relay Terminal B.

PART 6

TROUBLESHOOTING AND DIAGNOSTIC TESTS
AC POWER SECTION
BRUSHLESS GENERATOR UNITS
(Except Generator Types SD-100 Through SD-200 and SD-101 through SD-201)

Section 6.1 - **TROUBLESHOOTING FLOW CHARTS**
- 6.1.1 - No AC Voltage
- 6.1.2 - Low AC Voltage
- 6.1.3 - High AC Voltage
- 6.1.4 - Fluctuating AC Voltage

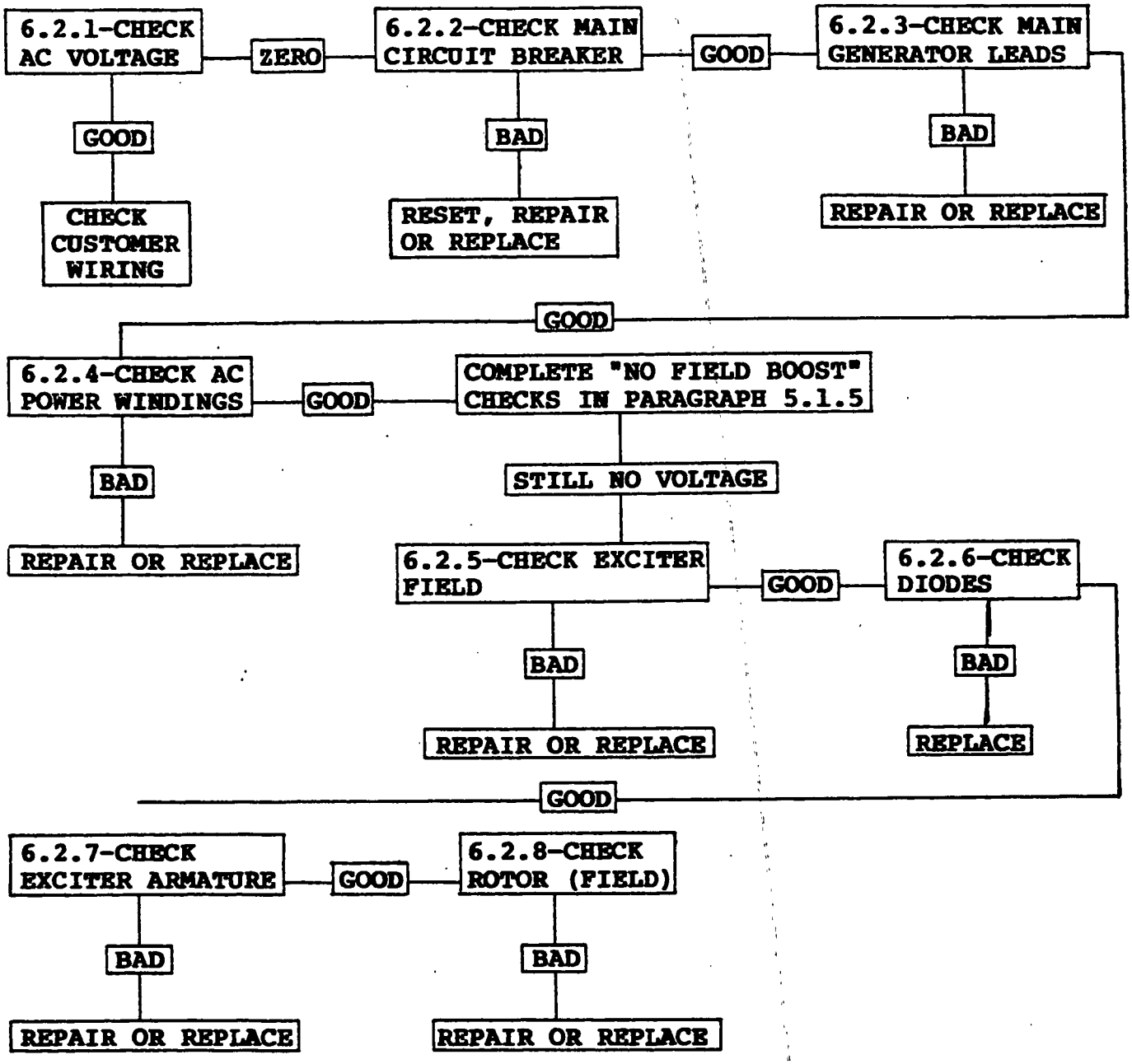
Section 6.2 - **DIAGNOSTIC TESTING**
- 6.2.1 - Check AC Voltage
- 6.2.2 - Check Main Circuit Breaker
- 6.2.3 - Check Main Generator Leads
- 6.2.4 - Check AC Power Windings
- 6.2.5 - Check Exciter Field
- 6.2.6 - Check Diodes
- 6.2.7 - Check Exciter Armature
- 6.2.8 - Check Rotor (Field)
- 6.2.9 - Check Generator Load
- 6.2.10- Check AC Frequency
- 6.2.11- Check Regulator Sensing Voltage
- 6.2.12- Check DPE Output
- 6.2.13- Check Voltage Adjust Potentiometer
- 6.2.14- Check Sensing Leads
- 6.2.15- Check Field Circuit Breaker
- 6.2.16- Check DPE Windings
- 6.2.17- Check Thermal Protector
- 6.2.18- Bypass the Thermal Protector

NOTE

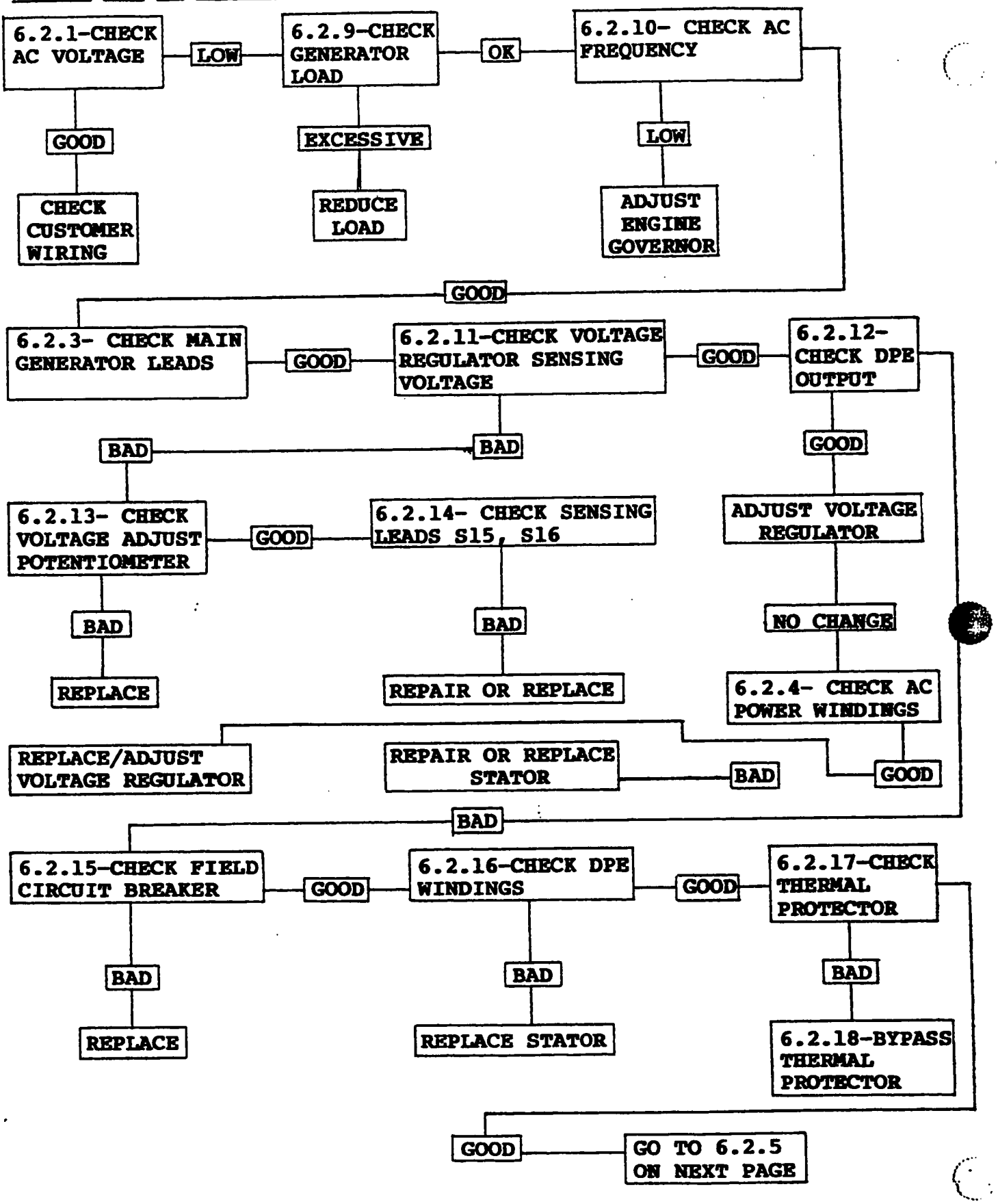
FOR FIELD BOOST TESTING PROCEDURES, SEE PART 5 OF THIS MANUAL.

SECTION 6.1 - TROUBLESHOOTING FLOW CHARTS

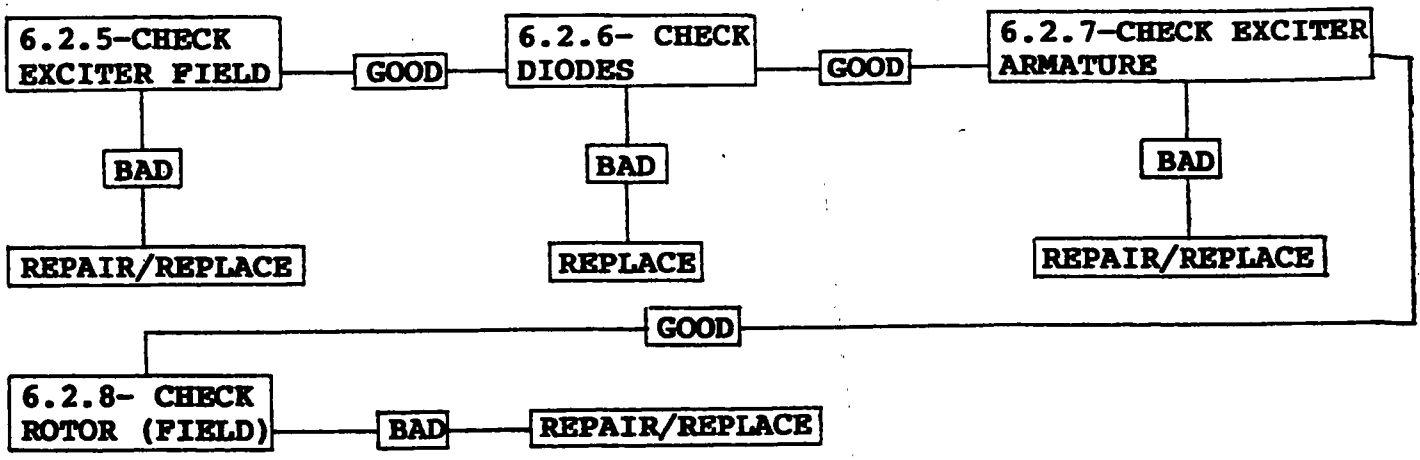
6.1.1- NO AC VOLTAGE



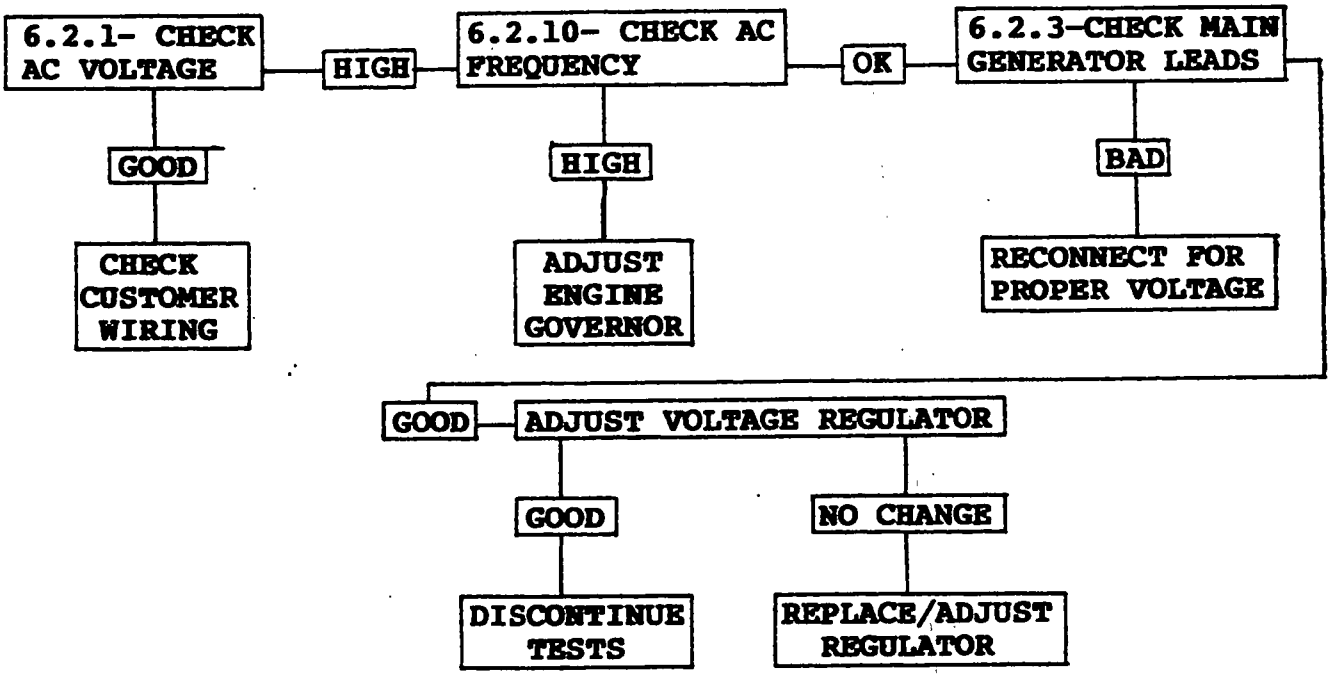
6.1.2- LOW AC VOLTAGE



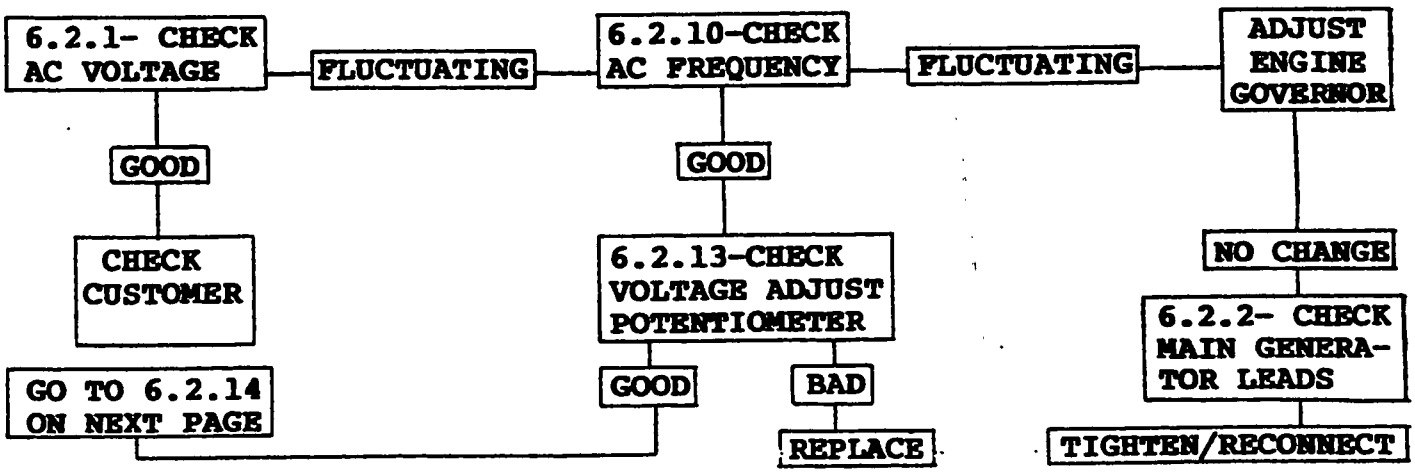
6.1.2- LOW AC VOLTAGE (Cont'd)



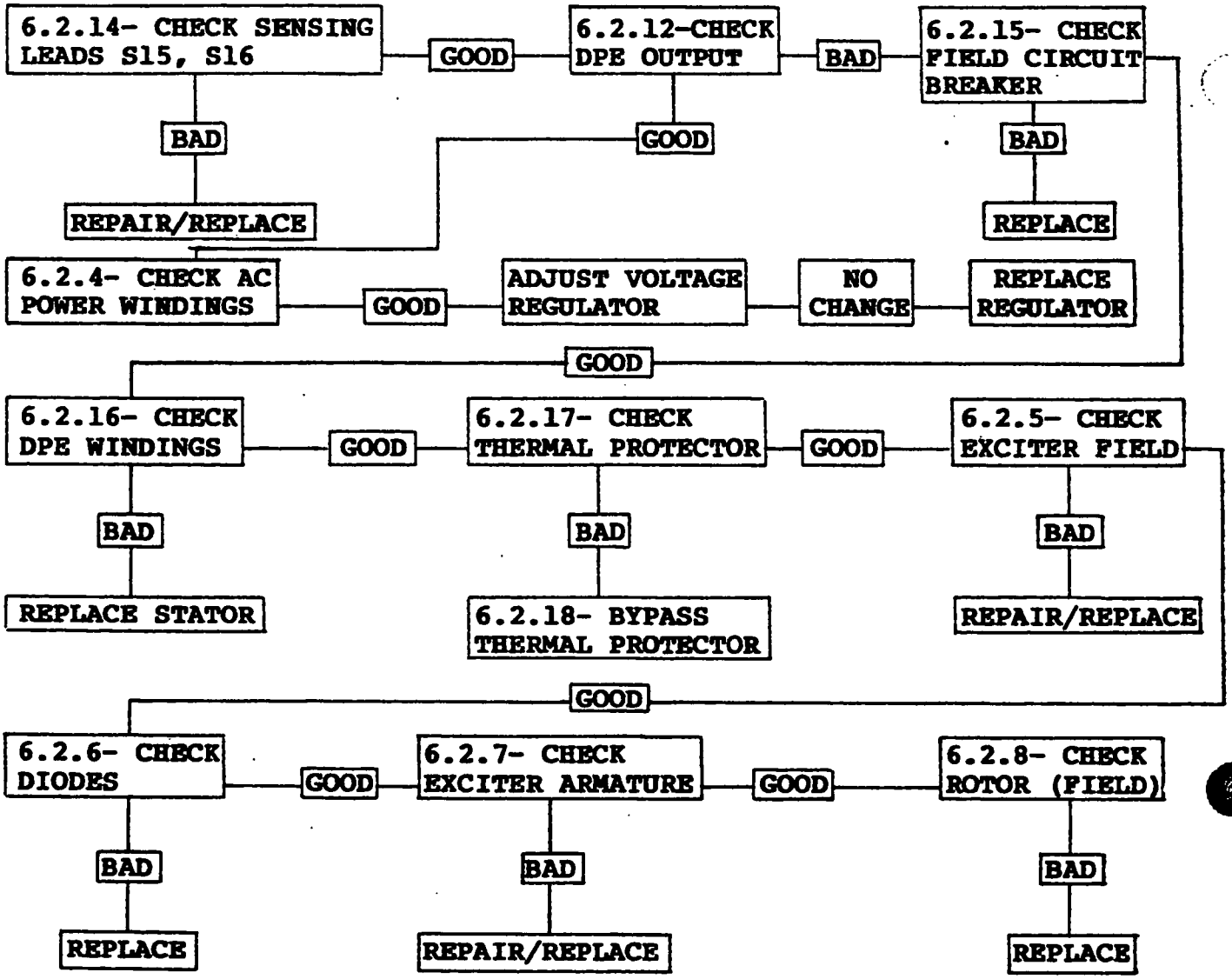
6.1.3- HIGH AC VOLTAGE



6.1.4- FLUCTUATING AC VOLTAGE



6.1.4- FLUCTUATING AC VOLTAGE (Cont'd)



6.1.5- NO FIELD BOOST

Refer to Part 5 of Manual for Field Boost troubleshooting and testing procedures.

SECTION 6.2 - DIAGNOSTIC TESTING

6.2.1- CHECK AC VOLTAGE

Connect an accurate AC Voltmeter to generator AC Connection Panel Terminals E1, E2, E3, 00 as required to read line-to-line or line-to-neutral voltage (1-phase units) or leg-to-leg and leg-to-neutral voltages (3-phase units). Start the generator engine, let it stabilize and warm up. Then, read voltages as required.

The following facts may be used in troubleshooting when AC output voltage is known:-

1. If the actual AC output voltage is within plus or minus 5 percent of the nominal rated voltage, use the panel Voltage Adjust Potentiometer to adjust the output voltage.
2. The Voltage Regulator maintains an AC output voltage that is directly proportional to AC frequency. AC frequency is directly proportional to engine speed. Thus, if voltage and AC frequency are correspondingly high or low, the engine governor may require adjustment.
3. Should sensing signals from the Stator AC Power leads to the Voltage Regulator be lost (Wires S15 and S16), the Regulator will "shut down" and the regulated excitation current flow to the Rotor (Field) will then drop to zero. Only the Field Boost current flow to the Rotor will then be available.
4. Loss of Stator excitation (DPE) winding output to the Voltage Regulator will mean a loss of excitation current flow to the Rotor. Only Field Boost current will then be delivered to the Rotor.
5. Field Boost current alone (without excitation current) will provide an AC output equal to APPROXIMATELY one-half the generator's rated voltage.

6.2.2- CHECK MAIN CIRCUIT BREAKER

Check that the main line circuit breaker is set to ON or CLOSED. Also check for continuity across the closed breaker contacts.

6.2.3- CHECK MAIN GENERATOR LEADS

Inspect main generator leads (E1, E2, E3, 00) for proper connections, tightness, condition, etc. If the unit is a 3-phase, 12-wire reconnectable type, also check that "S" leads are properly connected for correct voltage (see Section 2.3).

6.2.4- CHECK AC POWER WINDINGS

Use an Ohmmeter to check the Stator AC Power windings for both an OPEN and SHORTED condition. Refer to the applicable Wiring Diagram/Schematic for the specific unit involved for Power winding test points.

If desired, the Stator minimum insulation resistance may be checked using a MEGOHMMETER. Connect the ends of all Stator AC Power Winding

leads together. Connect one Megohmmeter test lead to the AC Power Winding leads, the other test lead to a clean frame ground on the Stator can. Minimum insulation resistance may be computed using the following formula:-

$$\text{Minimum Insulation Resistance (In MEGOHMS)} = \frac{\text{Generator Rated Voltage}}{1000} + 1$$

6.2.5- CHECK EXCITER FIELD (Figure 6.2-A)

In the Meter and Control Panel, disconnect the Voltage Regulator connector plug. Set an Ohmmeter to its "Rx1" scale and zero the meter. Connect the positive (+) meter test probe to FEMALE connector plug Pin #4 (Wire #4), the common (-) test probe to FEMALE connector plug Pin #1 (Wire #1). Meter should indicate the Rotor winding resistance (see Paragraph 1.4 at front of Manual).

RESULTS:- If meter indicates an OPEN condition, check Wires #1 and #4 between Exciter Field and Voltage Regulator for an OPEN. Repair or replace wire(s), if necessary. If Exciter Field is OPEN, repair or replace as necessary.

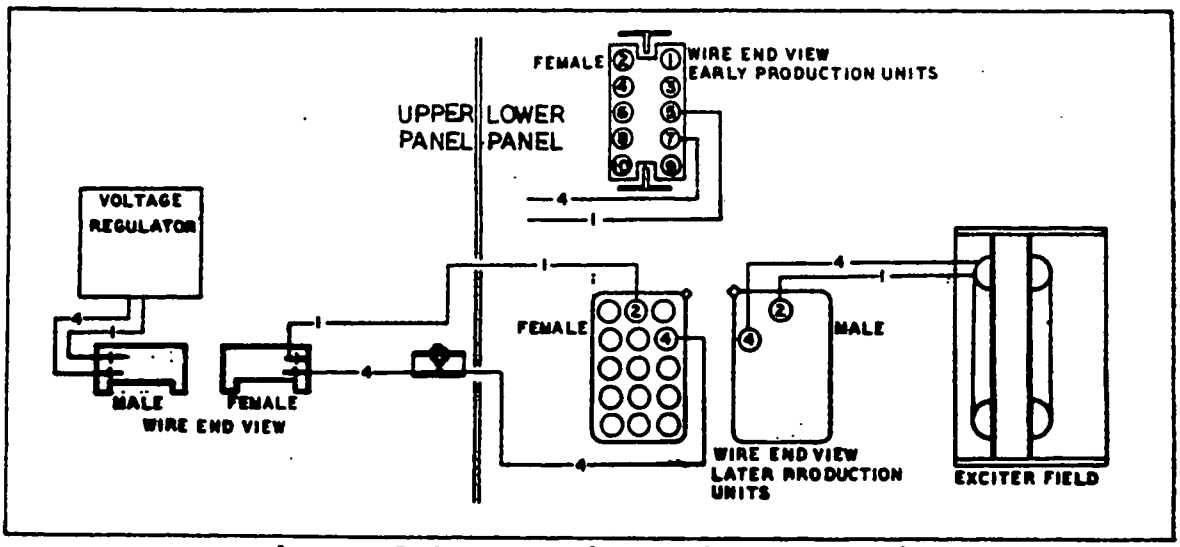


Figure 6.2-A. Exciter Field Circuit

6.2.6- CHECK DIODES (Figure 6.2-B)

Inside the AC Connection (Lower) Panel, gain access to the Exciter and Diode Plate Assembly. There are six diodes (rectifiers) mounted on the Diode Plate. Note that 3 of the diodes have a polarity that is opposite the polarity of the other 3 diodes and are NOT interchangeable. Test all six of the Diodes as follows:-

1. Set an Ohmmeter to its "Rx1" scale and zero the meter. If the meter has a polarity switch, set it to "+DC".
2. Connect the positive (+) meter test probe to the stud end of one of the diodes, the common (-) test probe to the diode terminal end. Observe the meter reading.
3. Now, reverse the meter test leads- that is, connect the common (-)

...to the diode stud end, the positive (+) test lead to its terminal end. Again, observe the meter reading.
4. Repeat Steps (2) and (3) for the remaining five diodes.

RESULTS:- Ohmmeter needle should swing upscale and indicate the forward resistance of each diode at one polarity only, should drop all the way downscale (infinity) at the opposite poilarity. Replace any diode that does NOT check good.

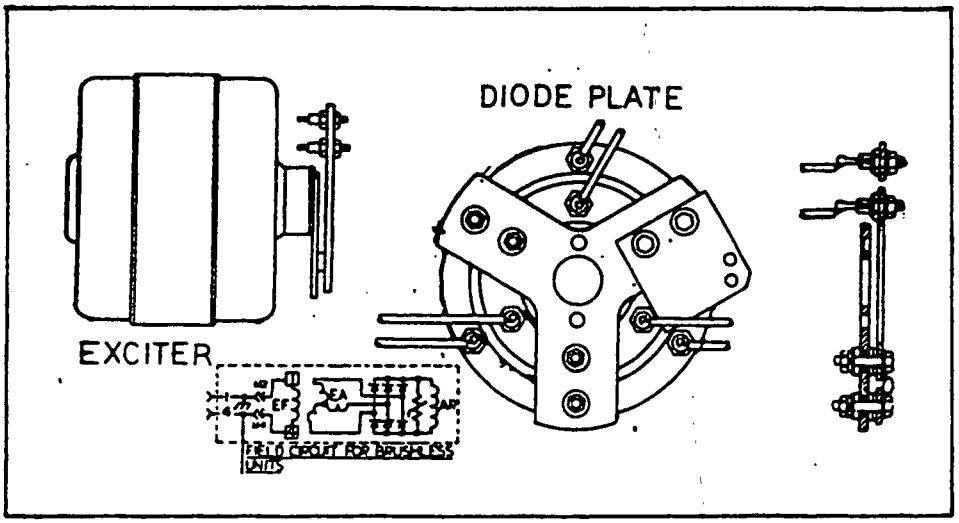


Figure 6.2-B. Diode Plate Assembly and Exciter Circuit

6.2.7- CHECK EXCITER ARMATURE (Figure 6.2-B)

Set an accurate Ohmmeter to its "Rx1" scale and zero the meter. Connect the meter test leads across two of the diodes on the diode plate, at the diode terminal ends and observe the meter. Repeat test with meter test leads connected across the terminal ends of the remaining two pairs of diodes. In each case, the meter should indicate the resistance of the Exciter Armature windings. Now, set the meter to its "Rx10,000" or "Rx1K" scale and zero the meter. Test for a SHORTED condition by connecting one meter test probe to a diode terminal end and the remaining test probe to a clean frame ground. No upscale movement of the meter needle should be observed.

6.2.8- CHECK ROTOR (FIELD)- (Figure 6.2-B)

Set an Ohmmeter to its "Rx1" scale and zero the meter. Connect the meter test probes across the diode plates. Meter should indicate the resistance of the Rotor (Field) windings.

6.2.9- CHECK GENERATOR LOAD

Use a "clamp-on" ammeter to test the current flow (amperes) to generator loads. Load current should not be greater than the generators rated (data plate) current. Excessive load current will result in a voltage drop and excessive internal generator temperatures. If necessary, reduce connected loads to bring load current within data plate limits.

6.2.10- CHECK AC FREQUENCY

Connect an accurate AC frequency meter across the main generator leads. Operate the engine and observe the indicated frequency. Also see Paragraph 6.2.1.

6.2.11- CHECK REGULATOR SENSING VOLTAGE (Figure 6.2-C)

See Paragraph 5.2.11 in this Manual.

RESULTS:- 1. Sensing Voltage checked GOOD..... Go to 6.2.12
2. No Sensing Voltage..... Go to 6.2.13

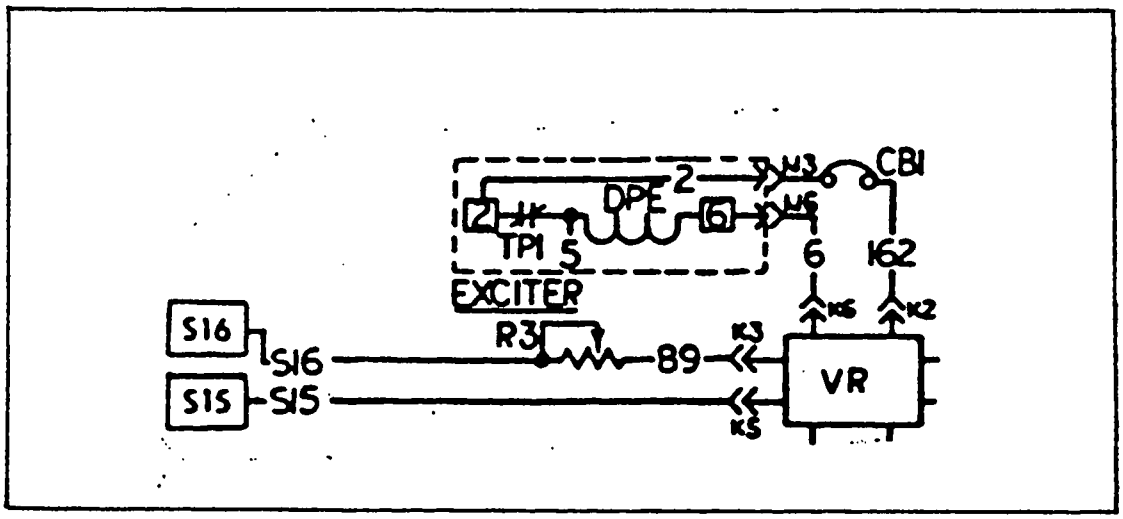


Figure 6.2-C. Voltage Regulator, Sensing and DPE Circuits

6.2.12- CHECK DPE OUTPUT (Figure 6.2-C)

Connect an AC Voltmeter to Voltage Regulator FEMALE connector plug pins #2 (Wire #2) and #6 (Wire #6). Start the generator engine and observe the voltage reading.

RESULTS:- 1. A DPE output voltage was indicated in 6.2.12, sensing voltage was good in 6.2.11, but AC output voltage is about one-half the unit's rated voltage..... Replace Voltage Regulator
2. No DPE output voltage..... Go to 6.2.15

6.2.13- CHECK VOLTAGE ADJUST POTENTIOMETER (Figure 6.2-C)

See Paragraph 5.2.12.

6.2.14- CHECK SENSING LEADS (Figure 6.2-C)

See Paragraph 5.2.13.

6.2.15- CHECK FIELD CIRCUIT BREAKER (Figure 6.2-C)

See Paragraph 5.2.15.

6.2.16- CHECK DPE WINDINGS (Figure 6.2-C)

See Paragraph 5.2.16.

6.2.17- CHECK THERMAL PROTECTOR (Figure 6.2-C)

See Paragraph 5.2.17

6.2.18- BYPASS THE THERMAL PROTECTOR (Figure 6.2-C)

See Paragraph 5.2.18.

"FOR FIELD BOOST TEST PROCEDURES, SEE PART 5 OF THIS MANUAL"

PART 7

TROUBLESHOOTING AND DIAGNOSTIC TESTING

AC POWER SECTIONS

BRUSHLESS GENERATORS WITHOUT A STATOR EXCITATION WINDING

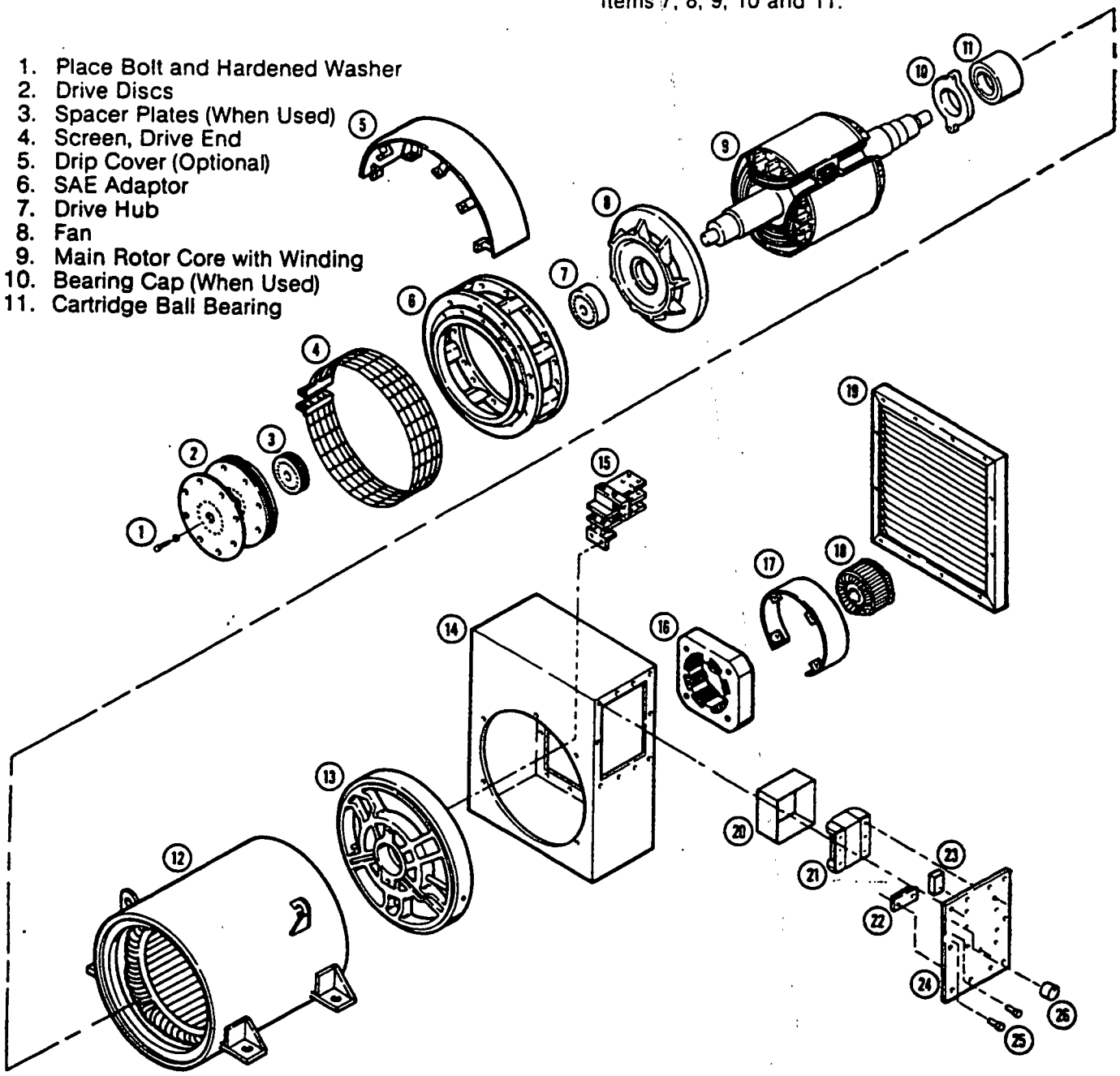
GENERATOR TYPE NUMBERS	
SD-100	SD-101
SD-130	SD-131
SD-150	SD-151
SD-180	SD-181
SD-200	SD-201

Section 7.1 - **TROUBLESHOOTING FLOW CHARTS**
- 7.1.1 - No AC Voltage Output
- 7.1.2 - Low AC Voltage Output
- 7.1.3 - High AC Voltage Output
- 7.1.4 - Fluctuating AC Voltage

Section 7.2 - **DIAGNOSTIC TESTING**
- 7.2.1 - Check AC Voltage
- 7.2.2 - Check Main Generator Leads
- 7.2.3 - Check Regulator Sensing Voltage
- 7.2.4 - Check Sensing Leads S15, S16 and 89
- 7.2.5 - Check Voltage Adjust Potentiometer
- 7.2.6 - Check Regulator Excitation Voltage
- 7.2.7 - Check Excitation Circuit Wiring
- 7.2.8 - Check Sensing Transformer
- 7.2.9 - Flash the Field
- 7.2.10- Inspect Exciter and Diode Plate Assembly
- 7.2.11- Test Diodes
- 7.2.12- Test Surge Protector
- 7.2.13- Test Exciter Field
- 7.2.14- Test Exciter Armature
- 7.2.15- Test Rotor
- 7.2.16- Test Stator Windings
- 7.2.17- Check AC Frequency
- 7.2.18- Check Generator Load
- 7.2.19- Adjust Voltage Adjust Potentiometer
- 7.2.20- Adjust Voltage Regulator

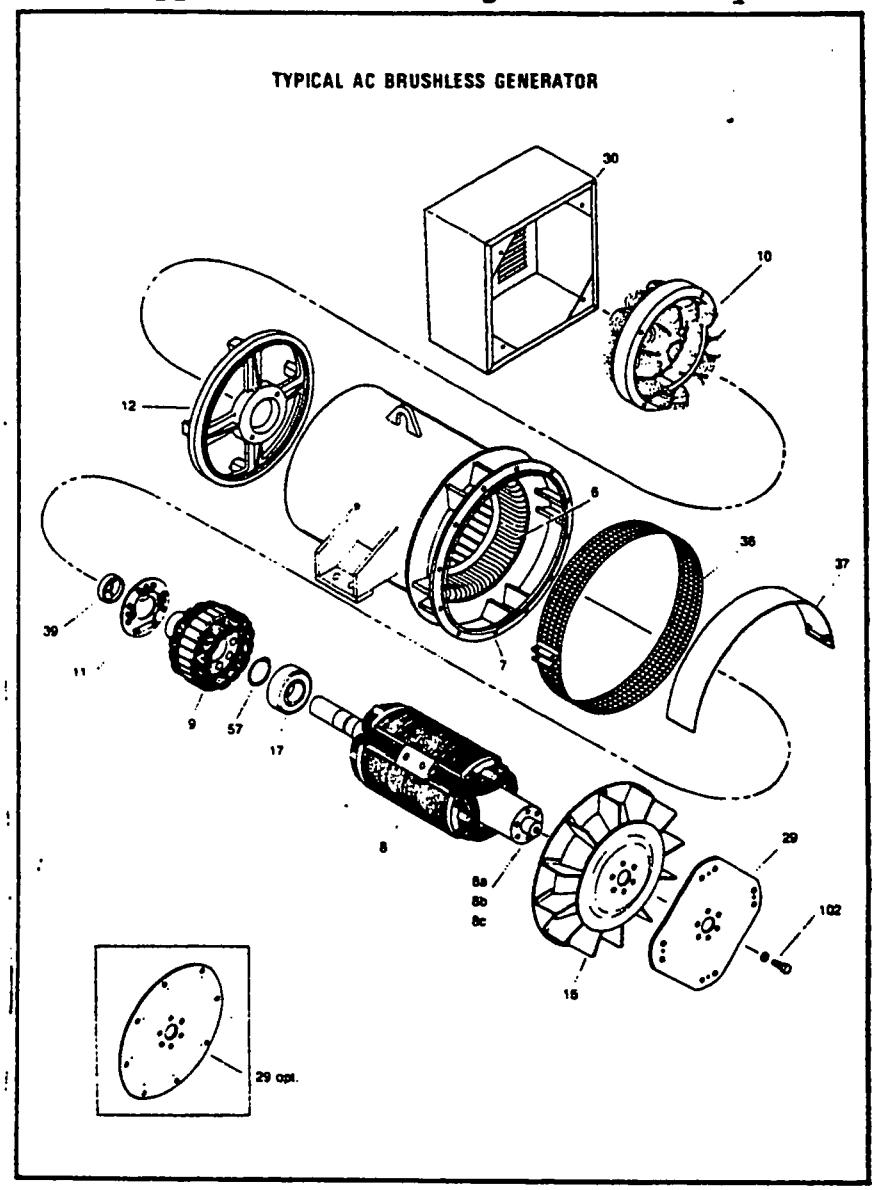
EXPLODED VIEW OF A TYPICAL BRUSHLESS GENERATOR
Types SD-100 through SD-200 and SD-101 through SD-201)

NOTE: Complete Main Rotor Assembly consists of items 7, 8, 9, 10 and 11.



1. Place Bolt and Hardened Washer
2. Drive Discs
3. Spacer Plates (When Used)
4. Screen, Drive End
5. Drip Cover (Optional)
6. SAE Adaptor
7. Drive Hub
8. Fan
9. Main Rotor Core with Winding
10. Bearing Cap (When Used)
11. Cartridge Ball Bearing
12. Main Stator and Frame Assembly with Winding
13. Front End Bracket
14. Conduit Box
15. Buss Bar Assembly (When Used)
16. Exciter Stator Assembly with Winding
17. Lead Shield
18. Exciter (Rotor) Armature and Rectifier Assembly with Winding
19. Louvered Conduit Box Cover
20. Regulator Enclosure
21. Voltage Regulator
22. Terminal Block
23. Exciter Field Circuit Breaker
24. Regulator Panel
25. Fuses and Fuse Holders
26. Voltage Adjust Rheostat

EXPLODED VIEW OF A TYPICAL BRUSHLESS GENERATOR
Types SD-100 through SD-200 Only

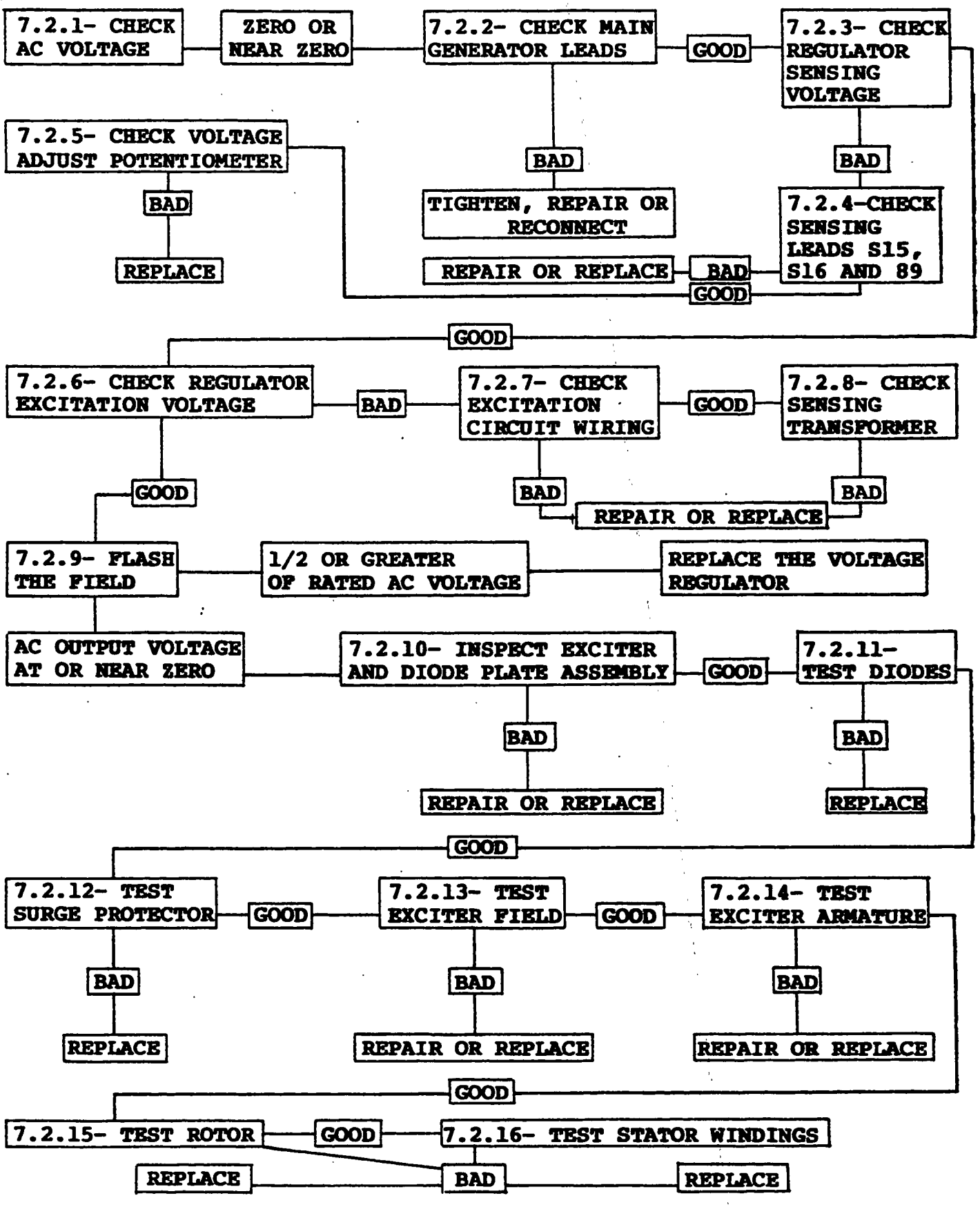


Item	Name
6	Stator & Coil
7	Main Frame
8	Rotor
8a	Rotating Coil
8b	Bolt, Rotating Coil
8c	Shaft
9	Exciter Armature
10	Exciter Field
11	Rotating Rectifier Assm.
12	End Frame, Exciter End
13	End Frame, Drive End
15	Fan
17	Bearing, Exciter End

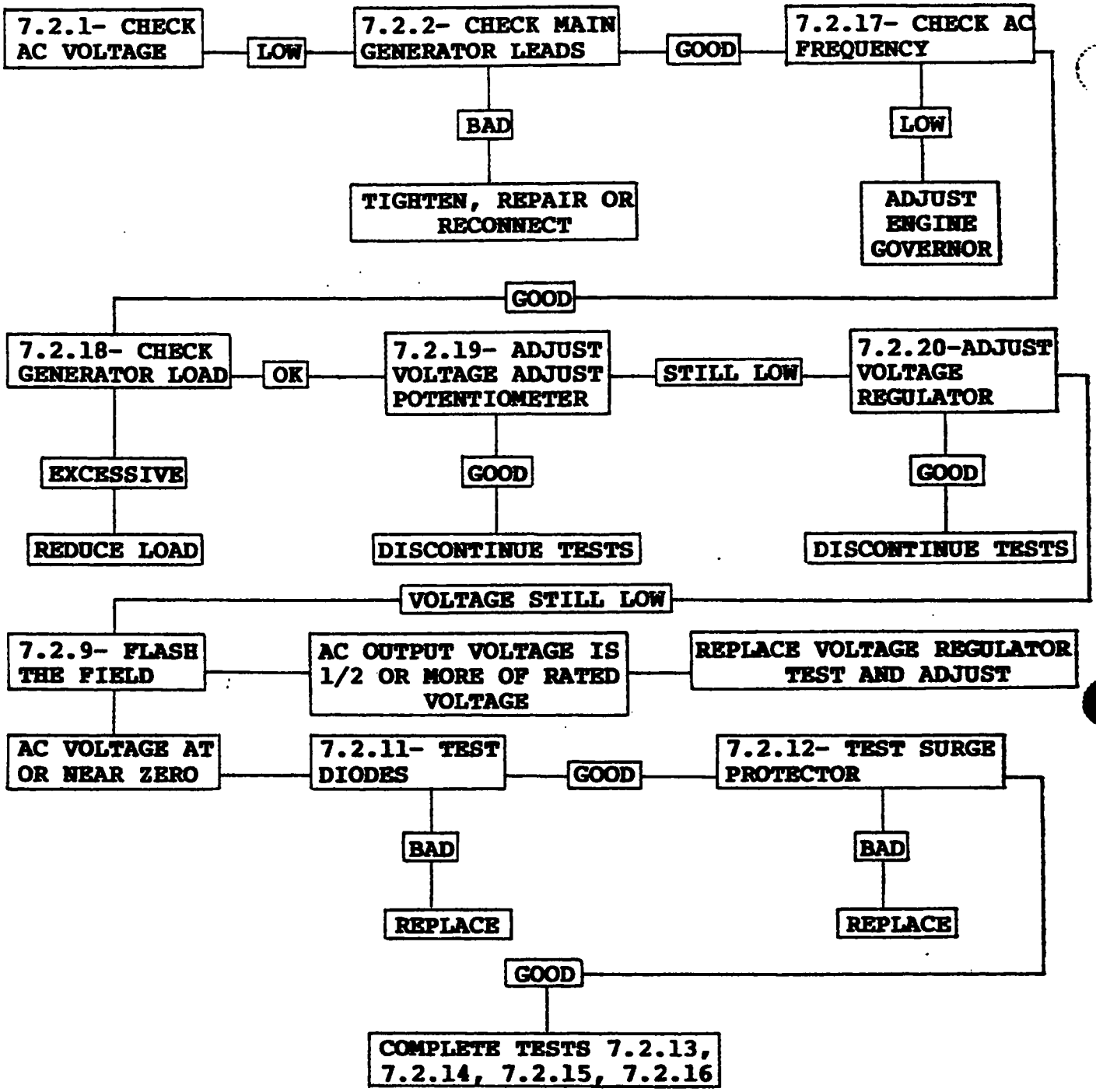
Item	Name
18	Bearing, Drive End
19	Bearing Cap, Inside, Exciter End
21	Bearing Cap, Inside, Drive End
22	Bearing Cap, Outside, Drive End
27	Spacer, Housing
28	Spacer, Shaft
29	Driving Disc Assm
30	Connection Box
31	Connection Box Cover
36	Cover Band, Screen, Exhaust
37	Cover Band, Dripproof, Exhaust
39	End Cap
40	Lead Protection Cover

Item	Name
44	Eyebolt
57	Snap Ring
69	Fan Hub
71	Key, Exciter Armature
73	Key, Drive End, Shaft
100	Bolt, Exciter Field
101	Bolt, End Frame, Exc. End
102	Bolt, Drive Disc
103	Bolt, Cover Band
104	Bolt, End Cap
106	Bolt, Bearing Cap, Exc. End
130	Bolt, Fan Mounting
137	Bolt, End Frame, Drive End
138	Bolt, Bearing Cap, Drive End

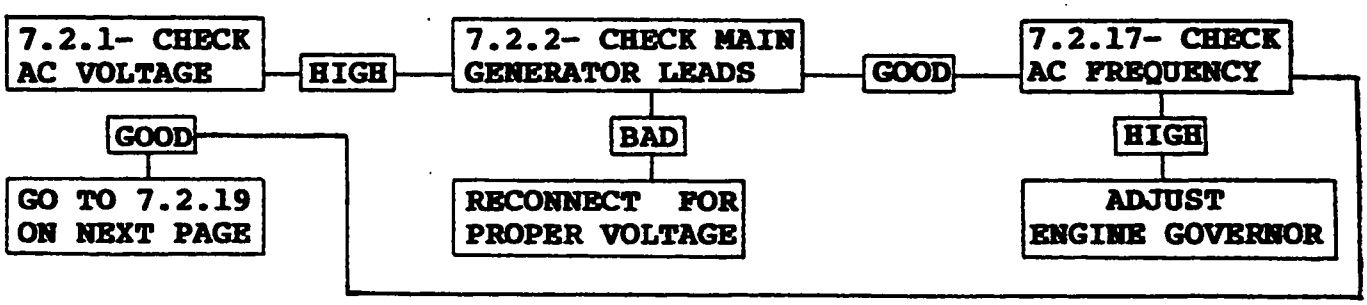
AC VOLTAGE OUTPUT



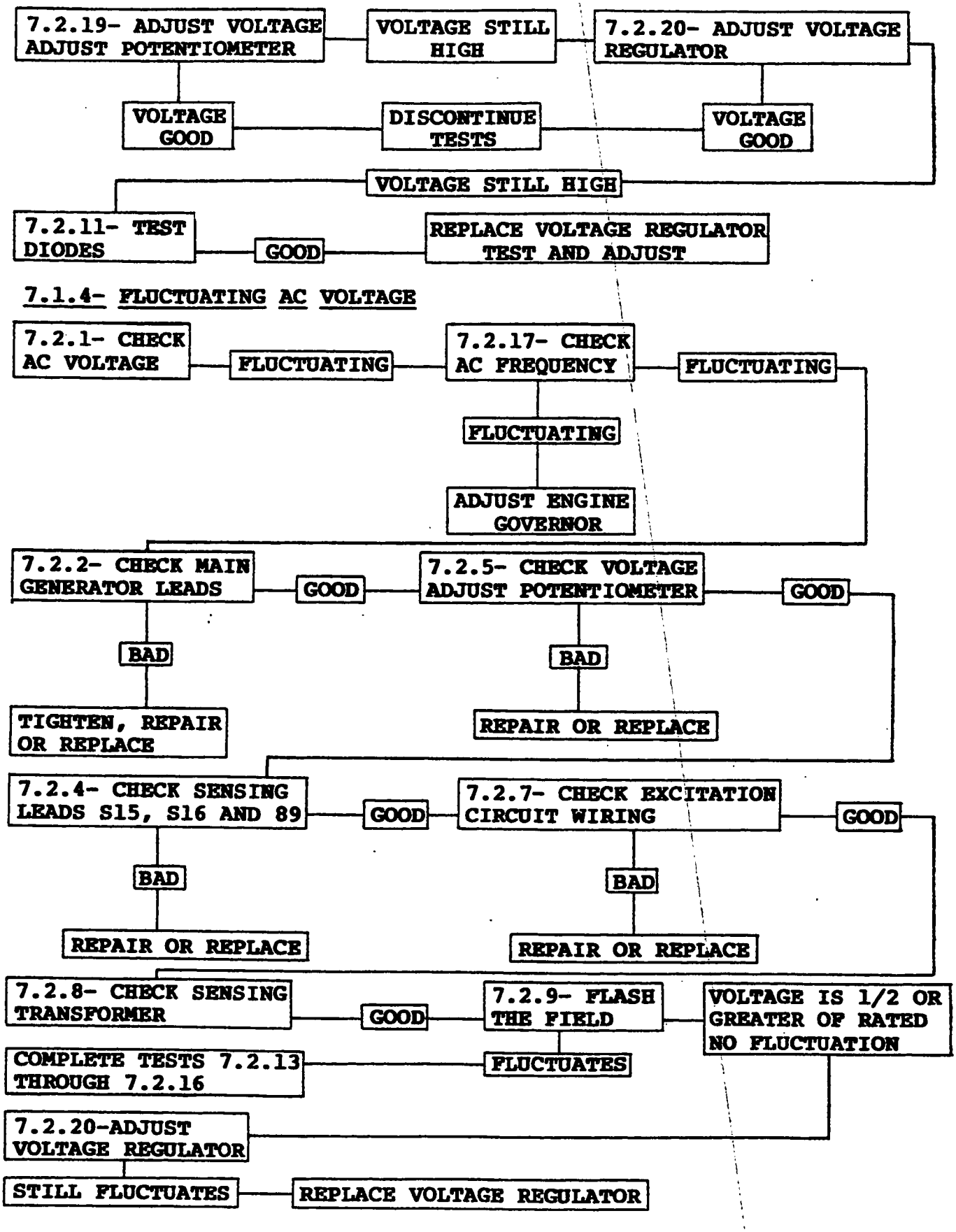
7.1.2- LOW AC VOLTAGE OUTPUT



7.1.3- AC OUTPUT VOLTAGE IS HIGH



... OUTPUT VOLTAGE IS HIGH (Cont'd)



7.1.4- FLUCTUATING AC VOLTAGE

SECTION 7.2 - DIAGNOSTIC TESTING

7.2.1- CHECK AC VOLTAGE

When the Meter and Control Panel Voltmeter indicates a problem, connect an external AC Voltmeter to the main generator leads to verify the voltage. For single phase units, connect the Voltmeter to read line-to-line or line-to-neutral voltages as desired. For 3-phase units, leg-to-leg or leg-to-neutral voltages must be read.

If any one of the following voltage problems is indicated, refer to Section 7.1, TROUBLESHOOTING FLOW CHARTS:-

1. No AC Output Voltage
2. Low AC Output Voltage
3. High AC Output Voltage
4. Fluctuating AC Voltage

Follow the steps in the TROUBLESHOOTING FLOW CHARTS in the exact order indicated.

7.2.2- CHECK MAIN GENERATOR LEADS

Carefully inspect the main generator leads inside the AC Connection (Lower) Panel. Check for loose, damaged, broken or improperly connected leads. Main generator leads must be properly connected or an incorrect AC output voltage will result. Refer to the appropriate SCHEMATIC/WIRING DIAGRAM.

7.2.3- CHECK REGULATOR SENSING VOLTAGE (Figure 7.2-A)

Inside the generator Meter and Control Panel, disconnect the Voltage Regulator connector plug. Locate FEMALE connector plug Pin #3 to which Wire #89 connects, and FEMALE Pin #5 to which Wire S15 connects. Connect an accurate AC Voltmeter across these two connector plug pins. Start the generator engine. The AC Voltmeter should indicate at least 5 Volts AC (or greater).

RESULTS:- 1. Sensing Voltage Checks GOOD..... Go to Paragraph 7.2.6
2. Sensing Voltage Checks BAD..... Go to Paragraph 7.2.4

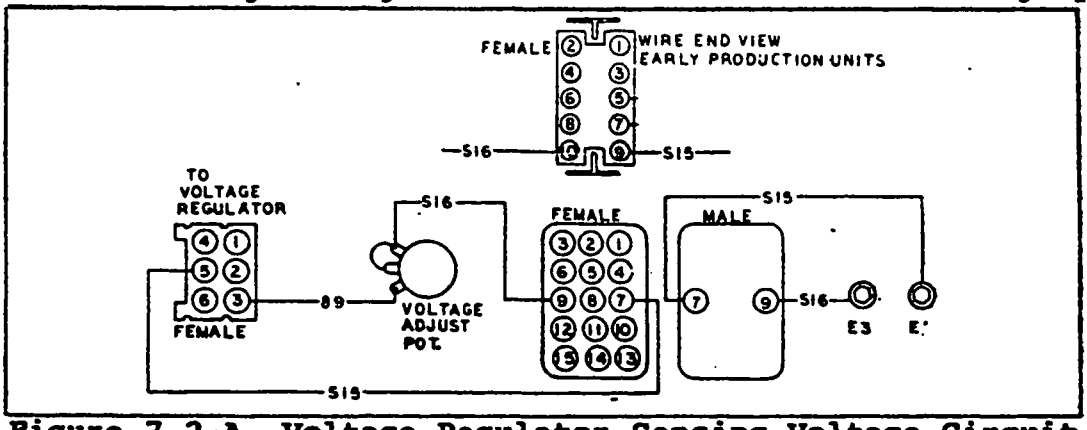


Figure 7.2-A. Voltage Regulator Sensing Voltage Circuit

CHECK SENSING LEADS S15, S16 AND 89 (Figure 7.2-A)

Units Manufactured After August 1984:- Wire #89 runs from the Voltage Regulator FEMALE connector plug Pin #3 to the Voltage Adjust Potentiometer. From the Voltage Adjust Potentiometer, Wire #S16 runs through the Meter and Control Panel Floor to a 15-pin connector plug inside the AC Connection (Lower) panel and connects to Pin #9 of that plug. From Pin 9, Wire #S16 is routed to the main AC connection terminal or circuit breaker. Wire #S15 is routed from FEMALE Pin #5 of the Regulator to Pin #7 of the 15-pin connector plug and then to the main AC connection terminal or circuit breaker.

Units Manufactured PRIOR TO August 1984:- Wire #89 runs from Voltage Regulator FEMALE connector plug Pin #3 to the panel Voltage Adjust Potentiometer. Wire #S16 is routed from the panel Voltage Adjust Potentiometer to Pin #10 of a 10-pin plug inside the AC Connection (Lower) panel and then to the main AC connection terminal or circuit breaker. Wire #S15 is routed from Regulator FEMALE Pin #5 to Pin #9 of the 10-pin plug, and then to the main AC connection terminal or circuit breaker.

Use an accurate Ohmmeter to test Wires #S15, S16 and S15 for an open or shorted condition. Repair or replace any defective wires.

7.2.5- CHECK VOLTAGE ADJUST POTENTIOMETER (Figure 7.2-A)

The panel Voltage Adjust Potentiometer permits adjustment of AC Voltage within plus or minus 5 percent. If voltage is HIGH, turn the adjustment knob counterclockwise to decrease voltage. If voltage is LOW, turn the knob clockwise to increase voltage.

A zero or fluctuating AC output voltage may also be caused by a defective Voltage Adjust Potentiometer. Inspect the Wire #89 and S16 wire connections at the Potentiometer terminals, make sure connections are properly made and tight. Connect the test leads of an accurate Ohmmeter across the Potentiometer terminals, then rotate the knob slowly clockwise and counterclockwise while observing the meter reading. Resistance should increase and decrease as the knob is rotated first in one direction then the other. Any sharp dropoff or rise in resistance while rotating the knob indicates a defective potentiometer.

7.2.6- CHECK REGULATOR EXCITATION VOLTAGE (Figure 7.2-B)

Generator units rated at 100 through 200 KW and driven by a 13.3 liter diesel engine do NOT have a Stator Excitation (DPE) winding. Unregulated AC excitation current is taken from the AC Power windings and reduced to a voltage value that is compatible with the Voltage Regulator by a Sensing Transformer. High voltage generators (416-480 VAC) require a jumper across Transformer terminals H1 and H3. Low voltage units (208-240 VAC) require two jumpers, across Transformer terminals H2 to H4 and H1 to H3. Proper connection of these jumpers ensures a Transformer secondary winding output of 120 VAC, whether a high or low voltage is delivered to the Transformer primary winding.

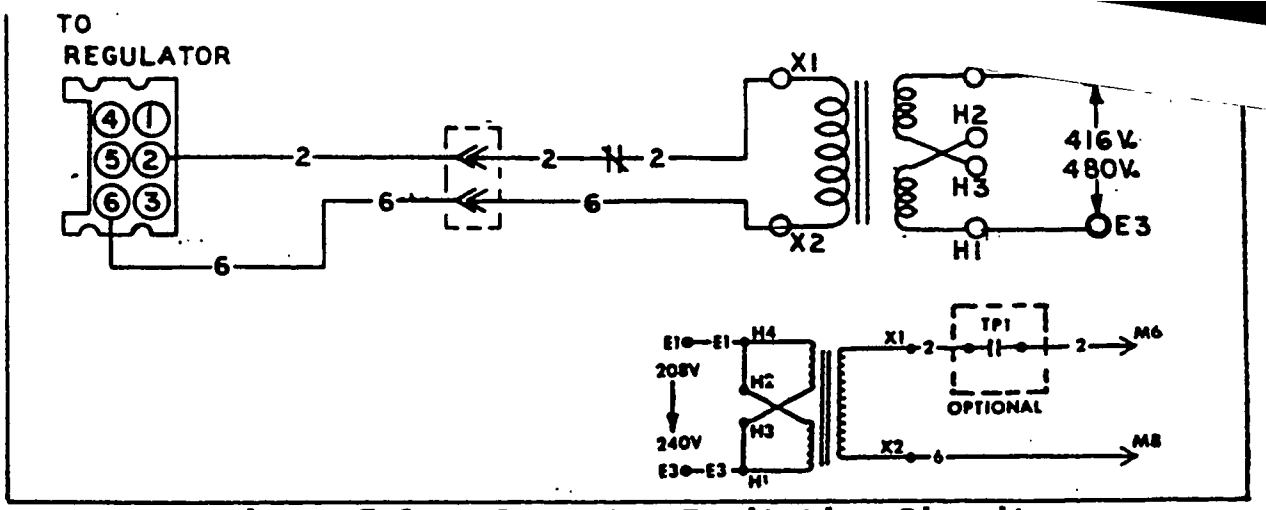


Figure 7.2-B. Generator Excitation Circuit

Inside the Meter and Control Panel, disconnect the Voltage Regulator connector plug. Connect an accurate AC Voltmeter to Regulator connector plug FEMALE Pins #2 (Wire #2) and #6 (Wire #6). Start the generator engine. With engine running, note the AC Voltmeter reading. A small AC voltage should be indicated on the meter (about 1-1/2 to 5 Volts depending on the unit's rated AC voltage and the residual magnetism in the field).

RESULTS:- 1. A Small Voltage Was Indicated..... Go to Paragraph 7.2.9
2. NO Voltage was Indicated..... Go to Paragraph 7.2.7

7.2.7- CHECK EXCITATION CIRCUIT WIRING (Figure 7.2-B)

SHUT DOWN THE GENERATOR ENGINE. Then, use an accurate Ohmmeter to test Excitation Circuit wiring for an open or shorted condition. Repair or replace any open or shorted wires.

7.2.8- CHECK SENSING TRANSFORMER (Figure 7.2-B)

Check Transformer for proper wiring connections and correct installation of terminal jumpers. Reconnect wires and terminal jumpers as required.

GENERATOR ENGINE MUST BE SHUT DOWN. Use an accurate Ohmmeter to check the Transformer primary and secondary windings for an OPEN or SHORTED condition as follows:-

1. Disconnect wires from Transformer terminals and remove terminal jumpers, to prevent interaction.
2. Connect Ohmmeter test leads across Transformer terminals "H1" and "H3"- resistance should be 3.0 Ohms (plus or minus 20%).
3. Connect Ohmmeter test leads across terminals "H2" and "H4"- reading should be 3.0 Ohms (plus or minus 20%).
4. Connect meter test leads across Transformer terminals "X1" and "X2" - reading should be 0.7 Ohms (plus or minus 20%).
4. Connect meter test leads to the Transformer body (ground), and to terminals "H2", "H1", and "X1" one at a time. As the test lead is connected to each of the terminals, note the meter reading. Anu upscale movement of the meter needle indicates a SHORTED condition and requires Transformer replacement.

THE FIELD (Figure 7.2-C)

Inside the Meter and Control Panel, disconnect the Voltage Regulator connector plug. Locate FEMALE connector plug Pins #1 (Wire #1) and #4 (Wire #4). Connect the POSITIVE, POS or (+) post of a 12 volts storage battery to FEMALE connector plug Pin #4. Connect the NEGATIVE, NEG, or (-) post of the battery to FEMALE Pin #1. Start the generator engine. With the generator running at its rated speed, read the AC Voltage output of the unit on a Voltmeter.

RESULTS:- 1. A stable AC output voltage is obtained that is one-half the unit's rated voltage (or greater)..... Adjust Voltage Regulator, if problem persists replace the Regulator
2. AC Voltage is at or near zero.... Go to Paragraph 7.2.10

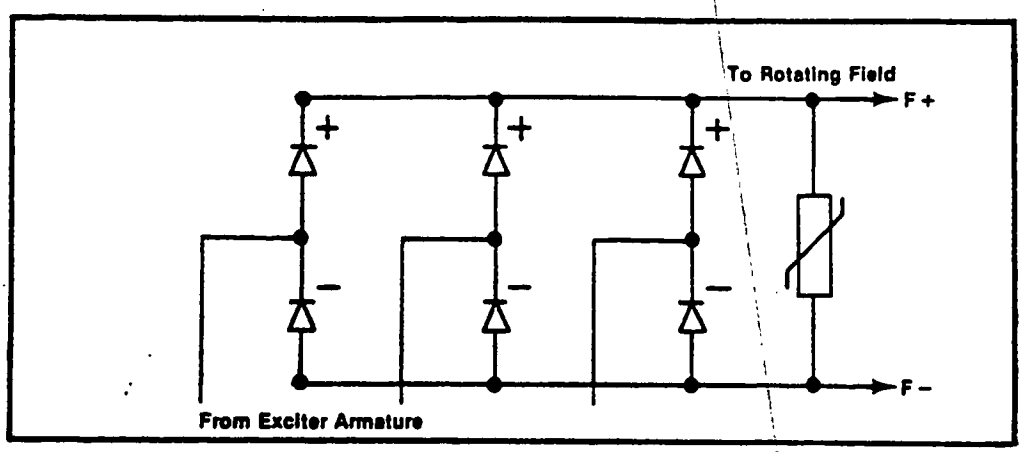


Figure 7.2-C. The Field Circuit

7.2.10- INSPECT EXCITER AND DIODE PLATE ASSEMBLY (Figures 7.2-C, 7.2-D, 7.2-E)

Inspect the rotating exciter for loose or broken lead wires. Make sure all six diode (rectifier) connections are secure, as well as all other wires on the diode plate. Repair, replace or tighten as necessary.

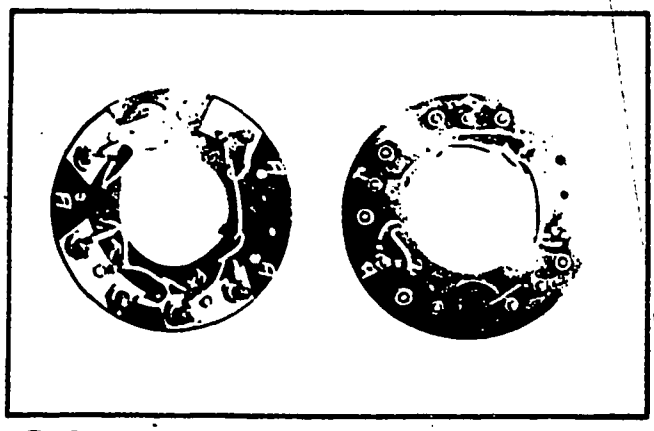


Figure 7.2-D. A Typical Diode Plate Assembly (Type SD-100 through SD-200 Generators)

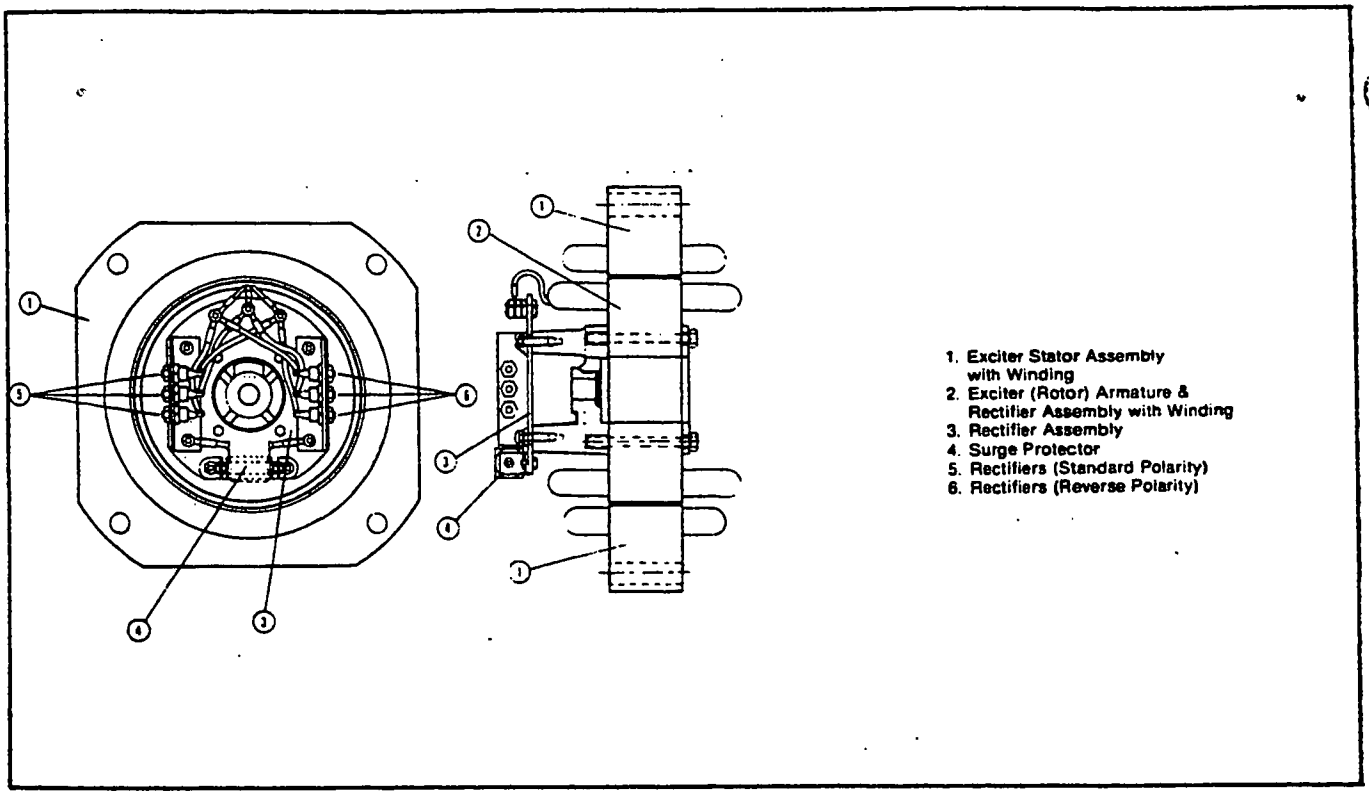


Figure 7.2-E. A Typical Exciter Armature, Stator and Rectifier (Used on Some Type SD-100 through SD-200 and ALL SD-101 through SD-200 Generators)

7.2.11- TEST DIODES (Figure 7.2-C, 7.2-D, 7.2-E)

Test each diode (rectifier) with an Ohmmeter. Remove the bolted lead wire from one diode at its terminal stud. Test the resistance between the diode STUD and TERMINAL end. Note the reading, then reverse the Ohmmeter test probes - at one polarity, the resistance should be low and at the opposite polarity resistance should be high. Repeat this procedure until all six diodes have ben tested. Replace any diode that does not pass this test. Tighten diodes with No. 10-32 thread to 11-19 inch-pounds. Tighten diodes with 1/4-28 thread to 21-29 inch-pounds.

NOTE
Two different types of diodes are used with different polarities. When replacing diodes, be sure to install the correct diodes.

RESULTS:- Replace any diode that does not pass the test.

7.2.12- TEST SURGE PROTECTOR (Figures 7.2-C, 7.2-D, 7.2-E)

Disconnect one of the surge protector leads. Use an Ohmmeter to read the resistance between the terminal from which the lead was disconnected and the other terminal. Reverse the Ohmmeter test probes (reverse the polarity) and repeat the test. A HIGH resistance should be obtained at both polarities.

1. Resistance HIGH at both polarities..... Go to 7.2.13
2. Resistance LOW at one or both polarities... Replace Surge Protector

7.2.13- TEST EXCITER FIELD

Use an Ohmmeter to test the Exciter Field coil for an OPEN or SHORTED condition. If open or shorted, repair or replace the necessary component. (NOTE:- This component may be called an EXCITER STATOR on some drawings.)

7.2.14- TEST EXCITER ARMATURE

Test the Exciter Armature for OPEN or SHORTED condition. If necessary, repair or replace the defective component.

7.2.15- TEST ROTOR

Test Rotor (Field) windings for OPEN or SHORTED condition. Replace Rotor if open or shorted.

7.2.16- TEST STATOR WINDINGS

Use an Ohmmeter to test Stator AC Power windings for OPEN or SHORTED condition. Repair or replace any open or shorted Stator Assembly.

If desired, the MINIMUM INSULATION RESISTANCE of the Stator may be tested using a MEGOHMMETER. Use the following formula to determine the minimum insulation resistance of a stator:-

$$\text{MINIMUM INSULATION RESISTANCE} = \frac{\text{GENERATOR RATED VOLTAGE}}{1000} + 1$$

Connect ALL stator leads together. Make sure any other stator leads are NOT touching the unit frame. Connect one Megohmmeter test probe to the stator leads, the remaining test probe to a clean frame ground on stator can. Read the minimum insulation resistance in megohms. A reading less than the calculated minimum indicates an unacceptably low insulation resistance.

7.2.17- CHECK AC FREQUENCY

Connect an accurate AC Frequency Meter to the main generator leads or terminals. Start the engine, let it stabilize and warm up. Check the AC frequency reading. See Section 2.2.5.

7.2.18- CHECK GENERATOR LOAD

Use a "clampon" ammeter to check load current. Load current should NOT be greater than the rated maximum continuous load current from the unit's DATA PLATE. Overloading the generator will result in a voltage drop and excessive internal generator temperatures.

7.2.19- ADJUST VOLTAGE ADJUST POTENTIOMETER

See Paragraph 7.2.5.

7.2.20- ADJUST VOLTAGE REGULATOR

Refer to section 4.4.