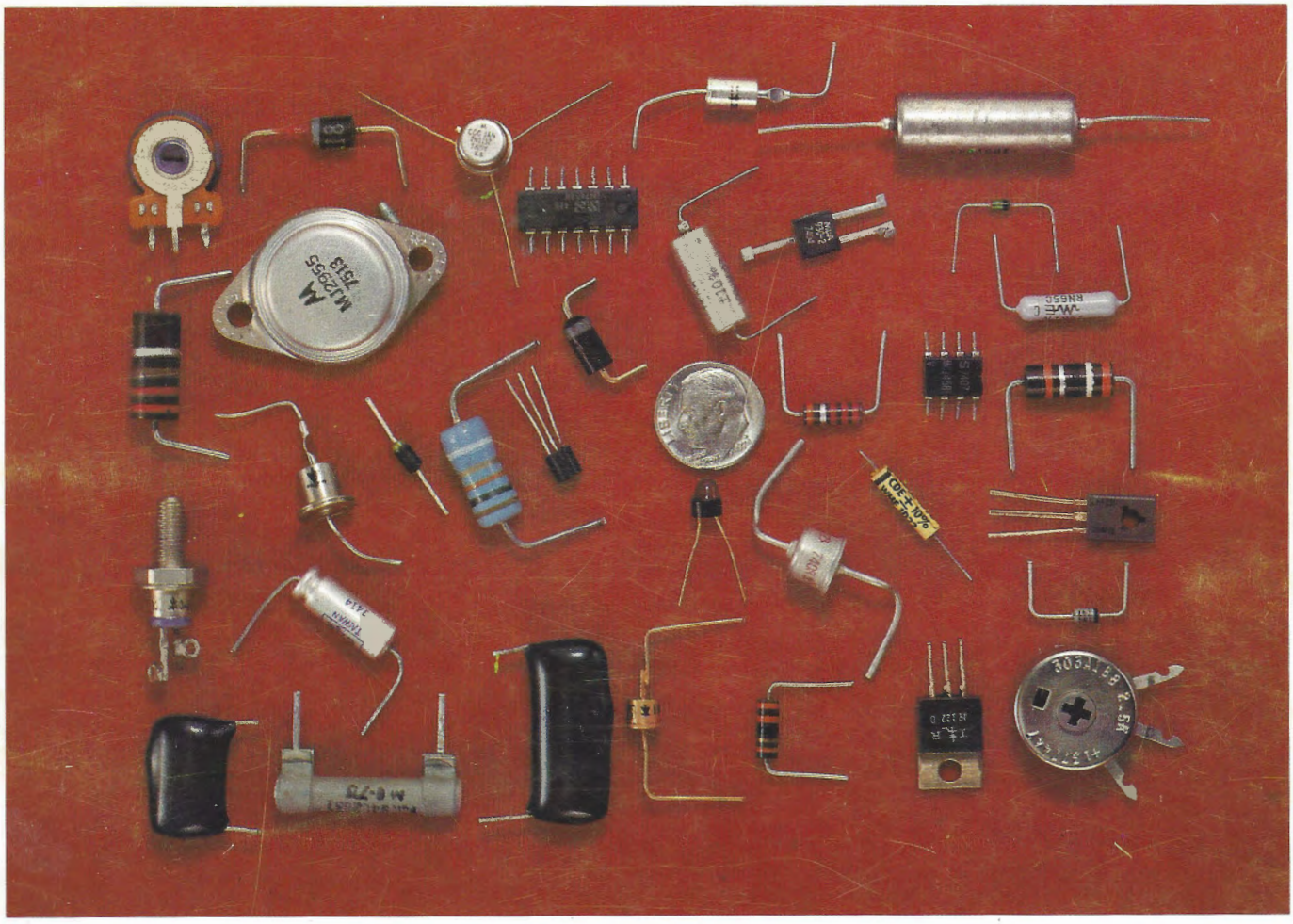
Onan®



ONAN CONTROLS TRAINING MANUAL

Onan Plant

The Onan plant is located in the suburb of Fridley on the north side of Minneapolis. The move to this facility was commenced in October of 1968 and completed in the spring of 1969. The facility covers almost 15 acres and employs approximately 1600 people at this time.

Aerial View

This aerial view of the Onan facility shows how the three-story administration building, the engineering building and the manufacturing plant are all interconnected. The physical design of the structure also represents the organizational design of the corporation: administration, engineering and manufacturing are all working together to provide top quality products and service to Onan customers.

New Onan Plant

The new Onan plant is located in Huntsville, Alabama. Production at the plant was started in late 1974. The plant contains 465,390 square feet of floor space which covers almost 11 acres and employs approximately 450 people at this time. One unique aspect is the fact that the Onan Jet Star can taxi right up to the front door from the Madison county airport complex.

"ONAN" CONTROLS
TRAINING MANUAL

TABLE OF CONTENTS

INTRODUCTION

Every Onan engine and/or engine generator set is designed and built for specific use or applications. By this we mean that units are specifically designed for uses such as recreational vehicles, marine water cooled units, refrigerated trucks, fire and rescue use, garden tractors and fork lifts, construction equipment and tools and often unique custom built applications such as floor scrubbers, skid loaders, ditch diggers, etc. A complete line of controls is available, each custom built to match their products. These controls may be manual, electric, remote, automatic or special adaptation.

The contents of this training manual are assembled with the idea of providing the service personnel with a complete step-by-step analysis of the operation of each type of control from start to stop. The controls covered will be representative of the complete line for all types of controls used with standard Onan units for most applications.

When dealing with controls, a service person should have a thorough knowledge of basic electronics, terminology and schematic symbols and interpretation. He or she must also understand the basic differences of each type of control, know how to make all checks, adjustments and troubleshooting, all within a reasonable amount of time and expense for the owner's sake and as general good business practice.

In essence, the controls do just exactly what the title says they do—they control! Some of the things they control are starting, start disconnect, running, stopping, battery charging and ignition. Many additional emergency safety features built into many Onan models are electrically controlled such as Lopko, Hwtko, Hetko, engine overspeed, etc. Each of these features will be explained when applicable to any control.

In using this training manual the student should become familiar with all types of Onan controls, their operation, various component functions in the different systems (including the latest in "solid state controls"), and troubleshooting.

Appropriate schematics and wiring diagrams will be used and explained along with block diagrams or flow charts to illustrate what happens in each cycle of the unit's operation. A slide set is available to aid the instructor in teaching the material covered in the text of this manual. Again, this manual covers strictly "class A" controls on Onan-built models ranging in size from 1 through 25 kW.

Safety should be of utmost concern when working with controls involving high current or voltage or both. Pay attention to all warning and cautions wherever they appear in the manual and be sure and read the safety precautions which follow.

SAFETY PRECAUTIONS

Throughout this manual you will notice Flags containing WARNINGS and CAUTIONS which alert you to a condition that is potentially dangerous to the operator, service personnel or the equipment itself if certain safety precautions are ignored.

WARNING **Onan uses this symbol throughout this manual to warn of possible serious personal injury.**

CAUTION **This symbol refers to possible equipment damage.**

First and foremost is to protect against electric shock!

When working on, with or near electrical equipment, *move slowly!*

Make sure your feet are firmly placed for good balance.

Don't lunge after falling tools.

Remove all electric power and ground all high voltage points before removing protective covers or shields or touching any components and wiring.

Use rubber insulative mats placed on dry wooden platforms over floors which are metal or concrete before working on any electrical equipment. Don't wear damp clothing or wet shoes or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on controls.

Don't work on controls when mentally or physically fatigued.

Keep left hand in your pocket while investigating live electrical equipment.

Don't take unnecessary risks and don't work alone.

Use extreme caution when working with any electrical components. High voltages can cause injury or death.

Don't tamper with or remove any interlocks or built-in safety devices.

Follow all state and local electrical codes.

Don't touch any electrical equipment while standing on metal floors, damp concrete or other well grounded surfaces.

Before performing any maintenance on the set, disconnect the battery to prevent accidental starting of the set. A direct short across the battery terminals can cause an explosion. Connect the ground lead *last!*

The real measure of a shocks' intensity lies in the amount of current (amperes) forced through the body, and NOT the voltage potential. A current of 100 milliamperes (1/10 amp) across the heart is lethal.

If a person is knocked out by an electrical shock, it's impossible to know how much current passed through the bodies' vital organs. Cautiously move shock victim to a safer area and begin artificial respiration immediately!

Know all first aid measures for treating victims of electrical shock. Immediate treatment is essential in all cases.

Remember—the more you know about electrical equipment and controls, the more heedless and less cautious you're apt to become.

Keep a fire extinguisher available. Make sure the type of fire extinguisher is correct for the area it is used in. For most types of fires, an extinguisher rated ABC by the NFPA is available which is suitable for use on all types of fires except alcohol. Water itself is the best substance to use on fires of this nature.

Use extreme care when making any adjustments on equipment while it is running or having protective shields removed.

DEFINITION, FUNCTION AND EXPLANATION OF SYMBOLS USED IN ONAN WIRING DIAGRAMS

As a general rule most of the information as shown in Onan pictorial wiring diagrams and schematics follows the current industry standards for symbols used throughout the diagrams. However, there are certain cases and some special items which require symbols found only on Onan units. These will be explained separately on the following pages. The information given in this section will help the student who is totally unfamiliar with the Onan line get acquainted faster. First, some general notes which apply to all Onan wiring diagrams:

1. All electrical circuits are shown in the "off" (de-energized position) unless otherwise noted.
2. The shape and terminals as shown in pictorial views are usually a "top view."
3. All components are identified by description as well as part number on older-style Onan drawings.
4. On newer-style Onan drawings, all components are identified by reference number. The referenced numbers are then identified in the parts list as to part number and part description. A parts list is usually shown in the upper left hand corner or side.
5. All diagrams usually show both pictorial and schematic diagrams.
6. On pictorial views—the components are shown as located in actual position whenever possible.
7. On pictorial views—dotted lines indicate the physical confines of the actual part.
8. All tie points and connections are shown as is on the pictorial view.
9. Electrical polarity is shown at any point where reversal of same could damage the component such as diodes, transistors, etc.
10. All diagrams show the use of each component in the circuit (such as voltage-sensitive relays and regulators, resistors, capacitors, diodes, etc.) but normally don't show enough internal circuitry to be sufficient for all testing that may be necessary in troubleshooting. Separate component wiring diagrams for internal circuitry are available upon request.

    When ordering these separate diagrams always specify part number and description for the following components:

    Start-disconnect relays
    Engine monitor relays
    Cycle cranking relays
    Automatic amplifier relays
    Voltage sensitive relays

11. All resistor values are given in ohms and watts. Condensers, transformers and meters are described by their electrical characteristics.
12. All adders or optional items such as LOPKO, HWTKO, OVERSPEED, ELECTRIC CHOKE, FUEL PUMPS and SOLENOIDS are normally shown as connected by dotted lines and designated by the term "when used" in the parts list.
13. The following suggestions are intended to be used as helpful service tips.
    a. Service personnel should tag wires to assure proper reconnections.
    b. Take photographs of more complex wiring before disconnecting wires.
    c. Use the correct wiring diagram for your model and follow the connections shown on the diagram.
    d. Double check all wiring and connections before starting or applying power.

NOTES

DICTIONARY OF BASIC ELECTRICAL TERMS AS APPLIES TO ONAN UNITS AND CONTROLS

VOLT: Force required to force one ampere through a resistance of one ohm. EMF, Potentila unit of electrical pressure (effort) E.

AMPERE: Current flowing in a given time under a force of one volt, when there is a resistance of one ohm in the circuit.

OHM: Unit of opposition to current flow. The amount of resistance in the circuit when there is one volt of force and one ampere of current flowing.

WATT: Unit of electrical power. The amount of energy supplied to the circuit when one volt is forcing one ampere through one ohm of resistance. Volts x amperes = watts.

MILLIVOLT: 1/1000 of a volt.

KILOWATT: 1000 watts (one kW).

MILLIAMPERE: 1/1000 of an ampere.

AMPERE-HOUR: The quantity of electricity that passes any point in a circuit in one hour when the current is one ampere.

AMPERE-TURN: Is one ampere flowing through one turn of a coil. Ampere-turns of a coil determine the strength of its magnetic field.

KILOVOLT AMPERES (kVA): Volts x Amperes of a generator at less than 100% power factor, divided by 1000.

CIRCUIT: The course followed by an electric current passing from its source through a succession of conductors, through a load, and back to its starting point.

SERIES CIRCUIT: A circuit in which the current has only one path to take.

PARALLEL CIRCUIT: A circuit where the parts are so connected that the current divides between them according to the individual resistances of each current path.

CIRCUIT BREAKER: An automatic switch that opens its circuit upon detecting excess current. Replaces a fuse.

RESISTANCE: Name given to that opposition which is offered to different materials to the flow of current.

DIRECT CURRENT (DC): The current always flows in the same direction.

ALTERNATING CURRENT (AC): Electricity that flows in one direction, then in the reverse direction through its conductors. The current reverses at regular intervals as each wire becomes positive (+) then negative (-), *reversing polarity typically 60 times per second.*

CONDUCTANCE: The ability or ease with which a conductor passes electricity.

MAGNETISM: The property possessed by certain substances (especially iron or steel) by which they exert forces of attracting or repelling.

OHM'S LAW: The statement expressing the relationship existing among the three quantities involved in the electrical circuit, the current, pressure, and resistance. Electrical formula is

$$I = \frac{E}{R} \qquad A = \frac{V}{R} \qquad V = A \times R \qquad R = \frac{V}{A}$$

POSITIVE TERMINAL: The terminal from which current (as ordinarily conceived) flows in the external circuit.

NEGATIVE TERMINAL: The terminal to which current flows (as ordinarily conceived) in the external circuit.

SHORT-CIRCUIT: A low resistance connection between two sides of a circuit, such that the current from the source is allowed to return to source without passing through devices which it is normally intended to flow through. A short circuit may also be defined as a breakdown of insulation between opposite polarity circuit conductors.

INSULATOR: Any material which has a very high resistance to current flow. Examples are rubber, glass, varnish, wood, porcelain, etc.

RHEOSTAT: A resistor arranged so that its effective resistance can be readily varied.

METER SHUNT: A resistor of proper resistance value and current carrying capacity connected across the moving coil for each particular current range of an ammeter. Usually made of manganin or constantin.

CONDUCTOR: Any material which conducts current readily. Has low resistance. Examples are copper, aluminum, silver, gold, carbon and electrolyte.

VOLTAGE DROP: The voltage required to force current through the resistance of line wires or the power consuming device.

SOLENOID: Coil with a movable core. Example would be a start solenoid.

NEUTRAL WIRE: Grounded wire of a 3-wire, 120/240 volt wiring system. White wire.

LINE LOSS: The power (watts) used in the line wires of any system, due to resistance of wires and current through them.

OHMMETER: An instrument for measuring electrical resistance in which a pointer indicates directly the number of ohms in the resistance under measurement; used on a de-energized (dead) circuit. Has its own power supply.

HOT: A conductor not at ground potential.

POLARITY: The distinction between positive and negative wires or terminals.

GROUNDING WIRE: Usually green in color and used to ground electrical equipment and prevent electrical shock.

OPEN CIRCUIT: Break in a circuit path or conductor so that no current can flow.

GROUND: Breakdown of insulation on a conductor so current can go to earth, frame of generator, conduit or other means to ground.

ALTERNATOR: A machine that generates AC current. In battery charging alternators, the generated AC is internally changed to DC current (rectified) before reaching the terminals.

BRUSH: A carbon (or copper) spring loaded sliding contact, bearing on a commutator (or slip ring) and carrying current to (or from) the rotating part of the motor (or generator).

CONDENSOR (or CAPACITOR): Component that stores electric charges. In effect, it also conducts AC but will block DC.

FUSE: A ribbon of fusible metal that burns and opens its associated circuit on detecting excess current.

RECTIFIER: A device, solid-state or vacuum tube, which converts AC to DC.

RELAY: A switch, activated by a small current in its coil. Big relays are called contactors.

DEFINITION AND FUNCTION OF COMPONENTS IN ONAN CONTROLS INCLUDING SOLID STATE

REVERSE CURRENT PROTECTION: Disconnects the battery from the generator when the set is stopped. It allows battery charging current to flow only towards battery and not reverse flow back into the generator. Newer models have a reverse current diode in place of this relay which performs the same functions.

START-DISCONNECT RELAY: This relay disconnects the start circuit when the engine starts to run and the generator builds up to approximately 1/2 its rated output in DC voltage. Some newer models have a solid state circuit in place of this relay.

START IGNITION RELAY: This relay supplies ignition voltage to coil when "start" button (or start circuit) is energized and engine is cranking.

STOP RELAY (IGNITION RELAY): This relay removes ignition voltage to coil when "stop" button (or stop circuit) is de-energized.

STOP/START RELAY: This relay is usually a combination of both "Stop" and "Start" relays. It performs the functions of two separate relays as used in other controls, the start ignition and stop relays.

START SOLENOID RELAY: This system connects the battery to the generator starting windings for cranking the engine on exciter-cranked units.

CRANKING LIMITER: This device is used mostly on units 30 kW and larger in size. If used on a smaller unit it is usually tied in with an automatic demand type system. It is a thermal device to disconnect the starting circuit if unit cranks for 45-90 seconds and fails to start.

CHARGE DISCONNECT RELAY: This relay prevents the battery from being charged from two separate sources at the same time (main engine generator or generator set). Generator set charging circuit is disconnected when main engine generator is charging.

MANIFOLD HEATER SOLENOID: Connects battery to manifold heaters and glow plugs for preheating on diesel engines.

FUEL SOLENOID: This solenoid connects the battery to an electric valve when cranking engine for starting. This turns on gas supply, LPG, gasoline, etc. When the engine is stopped it automatically shuts off fuel supply.

EMERGENCY STOP RELAY: Shuts engine down when any of the emergency safety devices operate. These safety devices are LOPKO, HATKO, HWTKO, or OSKO.

For purposes of clarification, a definition of a Relay and a Solenoid will be given to illustrate the difference and use of each:

RELAY: A device which operates electromagnetically by the current in one circuit, causes contacts to close or open to control the current in another circuit.

SOLENOID: A solenoid relay in which the contacts are closed by the action of a solenoid operated plunger. The solenoid itself consists of multi-turn coils of wire uniformly wound on a cylindrical form which operates like a bar magnet when used for carrying DC.

The safety devices mentioned in conjunction with the emergency stop relay above, will be explained individually as follows.

LOPKO: This abbreviation stands for Low Oil Pressure Cut Out. This optional accessory item shuts the engine down when a low oil pressure condition exists. It also allows the engine to start while oil pressure is building up during cranking. On 2-wire starting control units with automotive starters, there is a 15 second delay to allow engine to crank and start while oil pressure builds up.

HATKO: This abbreviation stands for High Air Temperature Cut Out. This optional accessory switch closes and shuts the engine down when the ambient air temperature reaches 240° F and opens to allow restarting at 195° F ambient temperature.

HWTKO (Marine): This abbreviation stands for High Water Temperature Cut Out. This switch senses block temperature and corresponding cooling water temperature and opens to shut engine down when temperature reaches 230° F. It will close when temperature drops to 190° F and allows restarting. The operational temperature limits vary for each switch according to its unit application.

Battery Charge Rate Adjustment Methods

There are five main methods and systems used on Onan units for battery charging and voltage regulation. These are:

FIXED OR ADJUSTABLE RESISTORS: Charge Rate is predetermined by resistance value or may be physically moved to vary the rate between 1-3 amps.

RHEOSTAT: A variable resistor which is manually adjusted to control charge rate.

TWO STEP VOLTAGE REGULATOR: Provides a high charge rate until battery voltage rises to approximately 14.5 volts. The regulator senses this voltage and disconnects a resistor which reduces the charge rate to 2-3 amps. Both rates are controlled by the use of resistors in the circuit.

SEPARATE BATTERY CHARGER: Use of a separate trickle charger to maintain starting batteries as necessary.

SOLID STATE REGULATOR: Uses rectifiers, diodes, and dropping resistor from an existing low voltage AC circuit.

Heaters and Starting Aids

OIL BASE HEATERS: Keeps engine oil warm during cold temperatures for faster, easier starting.

WATER HEATERS: Can be tank type, water jacket or freeze plug, for keeping water warm during cold temperatures and can be used with normal anti-freeze solution. This type of heater also makes engine starting faster and easier besides being good for unattended standby type units.

CARBURETORS AND CYLINDER HEADS: For carburetor use, air preheaters prevent icing caused by high humidity and low temperatures. The cylinder head heater is placed between engine head cooling fins and plugged into line voltage for 1/2 hour before starting engine.

OSKO: This abbreviation stands for Overspeed Cut Out. The purpose of this device is to shut the engine down if the engine RPM exceeds its normal running speed by a fixed predetermined amount. On units with a centrifugal mechanical switch system, overspeed shutdown occurs at 2100 RPM. On newer models using a rotating disk and a magnetic pickup system, overspeed shutdown occurs at 2010 RPM + or - 10 RPM.

GENERATOR AND CONTROL SPACE HEATERS: These heaters are 120 watt, 120 volt heaters powered by commercial line power, which help to reduce excessive humidity inside generator frames and control cabinets.

GLOW PLUGS AND MANIFOLD AIR PREHEATERS: These are used on Onan Diesel engines for heating engine cylinder area and engine intake air to the cylinders for cold weather starting because of the high compression ignition system used on many diesel engines of all sizes.

Control Switches

START AND STOP SWITCH: Used to start and stop engine.

MANIFOLD HEATER AND GLOW PLUG SWITCH: To manually provide current to heater to "preheat" air and cylinders on Onan-built diesel engines.

CENTRIFUGAL SWITCH FOR ENGINE OVERSPEED: Magnetically held—refer to OSKO under safety devices.

CENTRIFUGAL SWITCH FOR "J" SERIES IGNITION: Consists of spring-loaded weights to disconnect starter and lock in the ignition circuit on gasoline engines when engine speed reaches approximately 900 RPM.

CENTRIFUGAL SWITCH FOR "J" SERIES DIESELS: Same as "J" series gasoline except that in diesel application, switch operation completes circuit to energize start-disconnect run relay too de-energize starter and keep fuel solenoid energized.

HAND CRANK AND ELECTRIC START SWITCH: Used to provide ignition for manual starting. Engine cannot be stopped electrically when switch is in hand crank position. In hand crank position, allows ignition current to bypass ignition relay.

REMOTE START/STOP SWITCH: Unit can be started remotely and separately from the set itself; any number of remote switches can be used and distance from the set itself is not a limiting factor.

ROTARY SHORELINE TRANSFER SWITCH: Ship to shore manual load transfer control used on marine applications.

START AND STOP SWITCH: This is a single-pole, double throw, momentary contact switch used on 3-wire start models which connects #1 and #3 to start and #1 and #2 to stop.

HI/LO CHARGE RATE SWITCH: Selects the rate of charge from the generator charging circuit predetermined by the value of the circuit components.

WARNING **Fire extinguishers should be conveniently located when electrical components are being cleaned and dried. Oil vapors and gases from solvents may be flammable or explosive when mixed with air. Be careful—the gases may be irritating to the eyes, throat, or nose. Observe good safety practices at all times while cleaning, drying, and testing electric equipment.**

STARTING METHODS AND COMPONENT FUNCTIONS

All Onan units feature one or more methods of starting systems and controls on all "Class A" units. In the following five types of controls, there are three types of starting systems used most commonly on Onan units. The starting methods are:

1. Manual start on smaller single cylinder units using a starter rope or recoil starter. The starting system used with this method is a flywheel magneto system. Stopping is accomplished by grounding the magneto with a stop button.
2. Electric starting features start and stop controls at the set itself using start and stop switches. On generating sets the starting system utilizes exciter cranking windings from the set along with a separate battery for power. On industrial engines an automotive type bendix drive or solenoid shift starter motor is used powered by a separate battery.
3. The third starting method is the remote start with electric starting system as detailed above but with optional start/stop switches which allows the convenience of starting the set without having to be at the location of the set itself. Any number of these optional start-stop stations may be wired in with no limitation on distance or location or the number of remote starting stations being used.
4. The automatic load demand control system is a "closed system" which is completely self contained and automatic and utilizes no other power supply. This system automatically starts the set when the first load is switched on and shuts off the set when the load is switched off. Can be used in both 50 and 60 hertz generator sets.
5. The automatic load transfer controls are used with standby generator sets mostly. In case of a power failure, this control starts and stops the set and takes over the load until prime power is returned. These AT's are used only with remote start generating sets.

Types of Ignition Systems

1. The flywheel magneto is manually started with rope or recoil starter. It is stopped by grounding out the magneto voltage through a switch. This system can be modified or adapted to electric or remote starting for Onan "AJ" and "AK" generator sets.

   This flywheel magneto system utilizes the engine flywheel area for the magnets. Onan also used purchased magnetos on many older units in which the magneto was completely contained in a box separate from the flywheel. This system usually had an isolated stop circuit.
2. The battery ignition uses a battery with starting accomplished by use of separate cranking windings in the generator and disconnected as generator builds up speed to approximately half of its rated output through a start disconnect relay. The stop circuit isolates the battery from the coil through a stop or ignition relay. Some models feature a combination start/stop relay which supplies ignition voltage to the coil for starting and removes ignition voltage to coil when stop button or switch is turned off.
3. The automotive electric starter utilizes a battery to run a bendix or solenoid shift type starter motor through a switch. The stop circuit isolates the battery from the ignition coil through a relay. There is a separate relay for starting and for the start disconnect circuit after generator reaches half its normal rated output.

STANDARD TERMINAL BLOCKS IN "ONAN" CONTROLS

There are three main types of standard terminal blocks used with two main types of ignition systems and one adapter available for use with Onan controls. These are:

1. **REMOTE START:** For Class "A" Gasoline models.

   Terminals are marked B+ (Battery)

   Terminal #1 is Ground
   Terminal #2 is Stop
   Terminal #3 is Start

   Connect terminals 1 and 3 for starting and 1 and 2 for stopping. The B+ terminal is used with "HA" and "LT" controls.

2. **REMOTE START:** For Class "A" Diesel models.

   Terminals are marked B+ (Battery)

   Terminal #1 is Ground
   Terminal #2 is Stop
   Terminal #3 is Start
   Terminal "H" is for pre-heat circuits.

   Connect terminals 1 and 3 for starting and 1 and 2 for stopping. The B+ terminal is for positive battery connection. This terminal block is used on Class "A" Onan Diesel "J" series ONLY.

3. **TWO WIRE START:** For Class "B" 30 kW and larger models.

   Terminals are marked as follows:

   Terminal marked B+ is for
   Positive Battery Connection
   Terminal marked RMT is for
   Remote Start Connections
   Terminal marked GND is the
   ground terminal
   Terminal marked AL is for
   optional Alarm Circuit Connections.

   Connect terminals marked B+ and RMT for starting and open these same terminals for stopping. This unit is used with 2-wire start sets.

4. **THREE WIRE START:** For Solid State Control #611-1094 (Power Drawer Models)

   Terminals are marked as follows:

   Terminal #1 is Ground
   Terminal #2 is Stop
   Terminal #3 is Start

   Connect terminals 1 and 3 for starting and 1 and 2 for stopping.

5. **THREE WIRE START:** For Solid State Control #611-1086 (all models except RV sets).

   Terminals are marked as follows:

   Terminal #1 is Ground
   Terminal #2 is Stop
   Terminal #3 is Start

   NOTE: This uses a four to three wire adapter.

6. **FOUR WIRE START:** For Solid State Control #611-1086 (Recreational Vehicle Models Only)

   Terminals are marked as follows:

   Terminal #16 is Start
   Terminal #15 is B+ (Battery)
   Terminal #14 is Stop
   Terminal #13 is Ground

   Connect terminals 15 and 16 for starting and terminals 13 and 14 for stopping.

CONTROL—OPERATING SEQUENCE FOR 2.7 kW "AJ" CONTROL #611-1106

Starting Circuit

Pushing start switch S3 to the right allows battery current to flow through start solenoid K1; start switch S3, to negative battery terminal (ground). K1 start solenoid main contacts close, supplying current to the choke E1 and generator. This causes the generator to act as a direct current motor and cranks the engine. K1 start solenoid (I terminal) ignition contacts close supplying current to ignition coil T1 and fuel solenoid K2. When engine starts, release the start switch.

Engine Stop Circuit

To stop engine, push start-stop switch S3 to the left. This disables the points and prevents ignition.

Low Oil Pressure Shut Down (LOPKO)

The low oil pressure switch S2 opens to allow the ignition system to operate if sufficient oil pressure (5 to 7 lbs) is available during cranking and running. The low oil pressure switch S2 closes on loss of oil pressure to ground the ignition points and stop the engine.

Choke Circuit

The choke heater element E1 connects to generator DC output. When the engine is running the DC output from the generator energizes the heater, which in turn relaxes the bi-metal spring to open the choke vane in the carburetor. This takes several minutes before the choke vane is fully open.

Battery Charging Circuit

The charge rate is approximately one ampere and is fixed by the value of resistor R1 in series with diode CR1. The generator current flows through the resistor R1, diode CR1 and charges the battery. The diode CR1 polarity prevents the battery from discharging into the ignition and generator.

Emergency Start-Stop Operation

In an emergency situation, the control box can be by-passed to start or stop the unit. To start, use a 12 inch lead to jumper start solenoid K1-S terminal to ground momentarily. After engine starts, remove jumper. To stop, use the same jumper to connect the point box terminal to ground. Remove after engine stops.

Remote Start-Stop Switch

This switch can be connected to terminals 1 and 3 for starting and terminals 1 and 2 for stopping. This may be a single pole, double throw momentary switch, either direction, rated at 5 amperes. This switch can be remotely connected with up to 100 feet of #18 gauge wire.

Battery Condition Meter

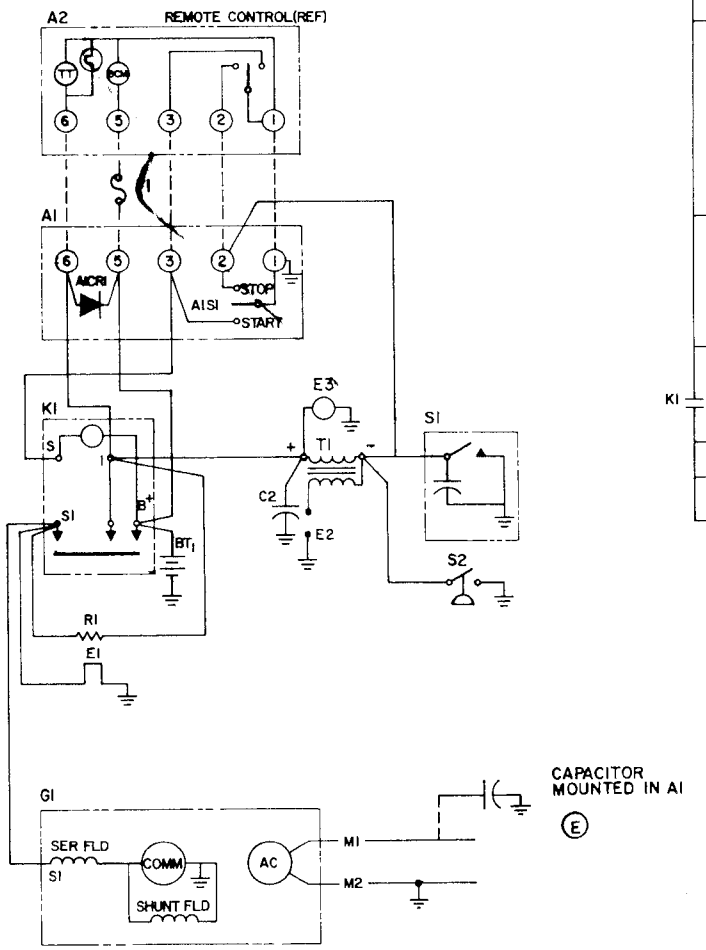
A battery condition meter can be connected to terminals 1 (-) and 5 (+). Terminal 5 is battery positive up to 15 volts.

Running Time Meter

A remote running time meter can be connected to terminals 1 (-) and 6 (+) to indicate the total running time of the engine generator set.

611-1106 |C

WIRING DIAGRAM



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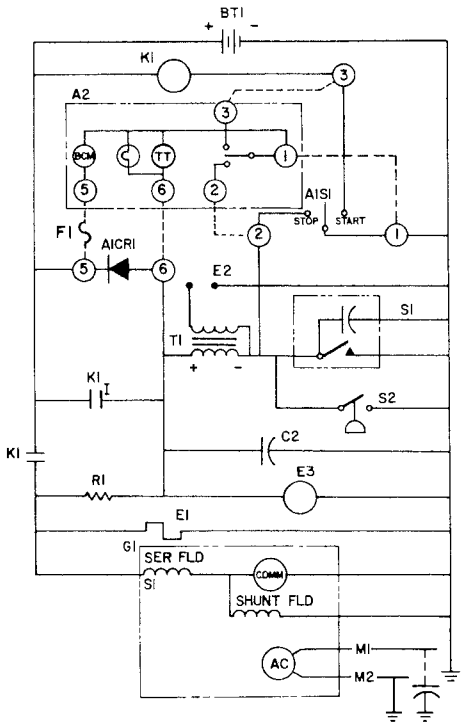


NOTE:
1. FUSE (5 AMP) TO BE SUPPLIED BY CUSTOMER TO PROTECT AGAINST ACCIDENTAL GROUNDING

PARTS LIST

REF. DES.	QTY.	DESCRIPTION
A1	1	CONTROL ASSY - GEN SET
A1CR1	1	DIODE ASSY (REF)
A1S1	1	SWITCH - TOGGLE (REF)
BT1	1	BATTERY - 12V
C2	1	CAPACITOR
E1	1	CHOKE - ONAN
E2	1	SPARK PLUG
E3	1	SOLENOID - FUEL (REF)
G1	1	GENERATOR
K1	1	SOLENOID - START
R1	1	RESISTOR ASSY (REF) 10 ± 5% OHMS 45W
S1	1	BREAKER & CAP ASSY
S2	1	SWITCH - LOW OIL PRESS (REF)
T1	1	COIL - IGNITION
F1		
A2	1	DELUXE REMOTE CONTROL (REF)
	1	STANDARD REMOTE CONTROL (REF)

2.7 AJ
611-1106

AJ CONTROL TROUBLESHOOTING
#611-1106

CRANKS SLOWLY	CRANKS - NO START	FAILS TO CRANK	RUNS A SHORT TIME	RUNS AND STOPS	STOPS	ELECTRO-MECHANICAL AND CONTROL TROUBLESHOOTING GUIDE PROBABLE CAUSE	STEP
•		•				Bad Battery Connection	1
•		•				Low Battery	2
	•	•				Faulty Start Solenoid	3
	•					Faulty Fuel Solenoid	4
	•				•	Faulty Ignition	5
	•					Faulty Low Oil Pressure Switch	6
			•	•	•	Faulty Choke	7
	•		•		•	Low Oil Level	8
				•		Governor Out of Adjustment	9

1. Clean and tighten all battery and cable connections.
2. Check specific gravity. Recharge or replace battery if necessary.
3. Push start switch. Check K1-I terminal voltage to ground. Check K1-S1 contacts to ground. Battery voltage should appear at these terminals; if not, replace solenoid.
4. Fuel solenoid must open during cranking and running. Check by removing flexible fuel hose from carburetor and crank engine. If fuel solenoid is open, fuel will pulsate out of this hose. If it does not, the fuel solenoid and fuel pump must be checked separately to determine defective part.

WARNING **Use extreme care for this test. Direct fuel flow into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.**

5. Check to see if points open and close during cranking. If they do not open and close, adjust and set points. Plug and plug wires must be in good condition. Voltage at ignition coil negative terminal (-) must alternate from +12 volts to zero volts as points open and close during engine cranking.
6. Remove wire lead from low oil pressure switch. With proper oil level in engine, crank and run engine. Replace wire lead to low oil pressure switch. Engine must continue to run when the wire lead is re-connected. If it does not, replace low oil pressure switch.
7. With engine not running, check choke vane movement by pushing choke lever arm. Choke must be in closed position with cold engine, and must be free to move against bi-metal spring. As engine warms up, bi-metal spring relaxes and allows choke vane to open fully. The lever will pulsate as engine warms up. See *Adjustment* section.
8. Check oil level. If low or empty, refill to proper level.
9. Readjust governor.

NOTES

CONTROL—OPERATING SEQUENCE FOR IDLEMATIC CONTROL #601-0087 "AJ" AND "AK" MODELS

Starting and Ignition Circuit

The IPL sets are magneto ignition and pull rope or recoil starting. The ignition system consists of a magneto coil and point set fastened to the gearcase cover and a set of magnets fastened to the inside of the blower wheel. The ignition must be correctly timed for proper operation of the engine. A magneto adjusting gauge simplifies ignition timing. When the engine is started, the magnets passing across the coil of the magneto cause a voltage to be induced in the coil. When the ignition breaker points open, the circuit is broken to the coil causing a magnetic field to collapse inducing a high voltage in the secondary winding and firing the spark plug. When the stop button on the blower housing is pressed, it grounds the magneto coil preventing the high voltage buildup in the secondary, the spark plug does not fire and the engine stops.

Normal Operation

When the engine is running at 3600 RPM, it is supplying 120 volts to the load. The load current from M1 passes through the primary of the transformer to the load receptacle, through the load and back to the M2 terminal of the generator. With a 100 watt load connected to the generator, the current to the transformer primary is sufficient to produce a high enough voltage in the secondary of the transformer and causes the relay to energize. When it energizes, its contacts open breaking the circuit to the idle solenoid. This relieves the opposing tension on the governor spring and allows the governor to operate and bring the engine to 3600 RPM.

No Load Operation

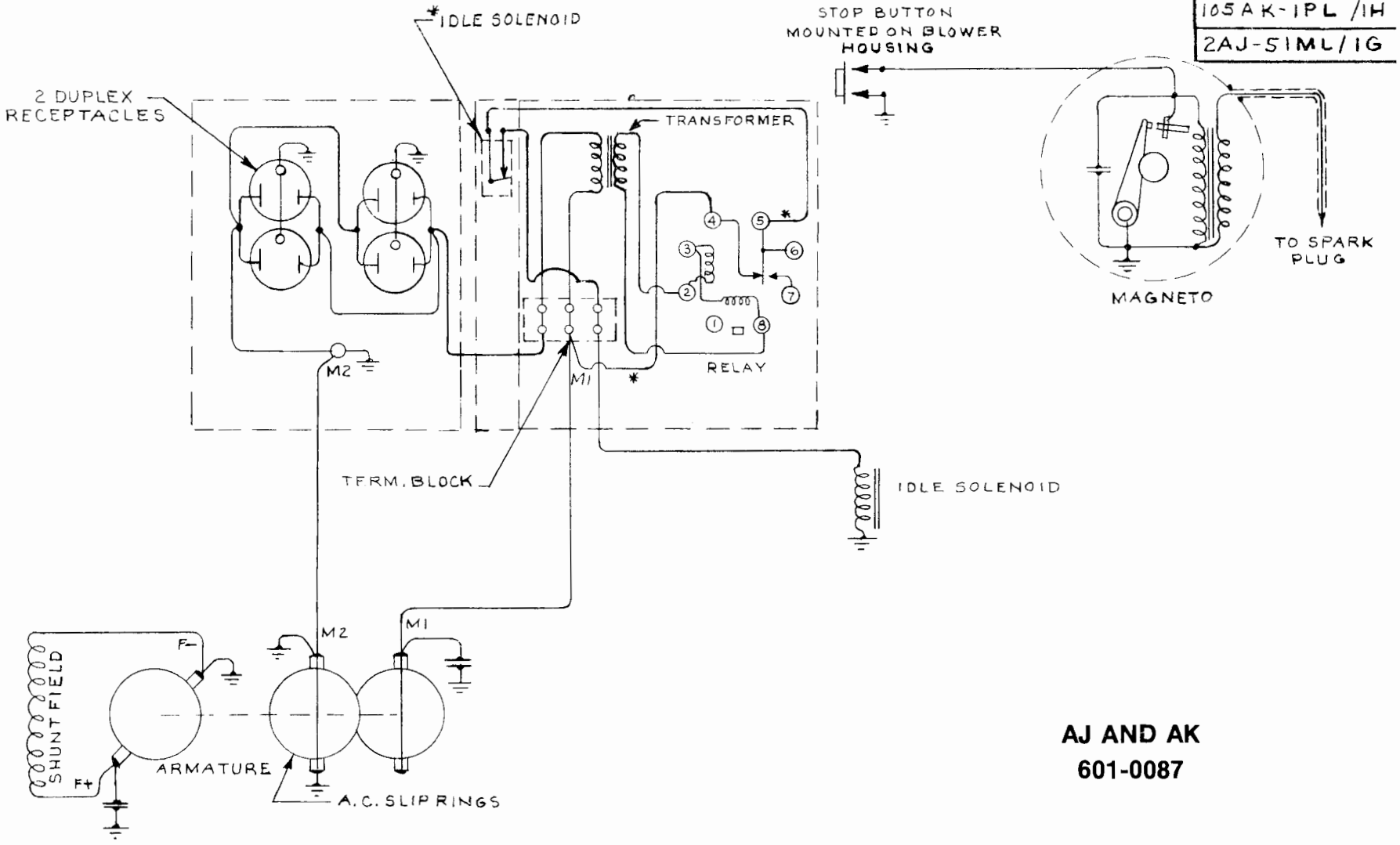
When load is removed from the generator, no current flows to the primary of the transformer and no voltage is produced in the secondary; thus, the relay de-energizes. When its contacts close, the idle solenoid energizes causing the set speed to reduce to approximately 1800 RPM. The idlematic control can be de-activated by operating the idle solenoid switch. Opening this switch breaks the circuit to the idle solenoid causing it to be de-energized and the governor will take over and the set accelerates to its 3600 RPM governed speed.

Troubleshooting

If the engine fails to start, check the spark at the plug. If the rubbing block on the breaker points has worn and the points fail to open, the engine will not fire. If the unit fails to accelerate to 3600 RPM when a 100 watt load is applied, check the relay. It may have fused contacts or a burned out coil. Be sure there is voltage available at the AC brushes. Pulling the relay from its socket should cause the generating set to accelerate to 3600 RPM.

601B87

2AJ-51PL/1G	205AJ-1PL/1G
	105AK-1PL/1H
	2AJ-51ML/1G



AJ AND AK
601-0087

CONTROL—OPERATING SEQUENCE FOR STANDARD "CCK" CONTROL AND STANDARD "LK" CONTROL #611-0176

Starting Circuit

One end of the start solenoid operating coil is connected internally to the battery terminal. The other end of the coil is connected to terminal 3 of the control block. From terminal 3, a wire connects to the start side of the start-stop switch. When the switch is placed in the start position, current from the battery positive terminal flows through the start solenoid to terminal 3, to the start-stop switch, to ground and back to the battery. This energizes the start solenoid, closing the high current contacts within the solenoid. Battery current flows through these closed contacts to the series field (cranking windings) through it to the shunt field and the armature. This causes the generator to act as a direct current motor and cranks the engine.

Ignition Circuit

When the start solenoid closes, current flows from the S1 terminal to the 1-ohm, 25-watt resistor, to the generator side of the reverse current relay, to the 30-ohm, 5-watt resistor, to the upper portion of the start-stop switch to the coil of the stop relay, to ground. The ignition (stop) relay energizes, closing its contacts and supplying ignition current to the coil. Current from the battery flows through the ammeter to the contacts of the stop relay, to the Hytempco resistor (1.72-ohm, 25-watt) to the coil, through the ignition breaker points to ground.

Engine Starting

With the generator acting as a motor and cranking the engine and with ignition current supplied, if fuel is available at the carburetor, the engine will start.

Voltage Build-up and Start-Disconnect Circuits

When the engine starts, it accelerates to governed speed. The armature rotating in the magnetic field produced by residual magnetism has a voltage produced in its windings. This voltage is applied to the shunt field causing an electro magnetic field to be produced. This electro magnetic field combines with the residual magnetic field and produces an overall strong field and an increase in armature voltage. This voltage increases to approximately 18 volts. This Direct Current is then used for excitation and to supply battery charging current. This voltage is also used to operate a start-disconnect relay on some engine controls or the start switch is released and it returns to its center "OFF" position and breaks the start solenoid coil circuit.

Battery Charging

The direct current voltage produced by the DC windings of the armature causes a current through the series field to the S1 terminal of the start solenoid to the two charge resistors. One is the fixed value low charge resistor, and the other is the adjustable rate high charge resistor. Battery charging current flows from the low charge resistor to the generator terminal of the reverse current relay. From this terminal current also flows up to the 30-ohm, 5-watt resistor and supplies the current to maintain the stop relay coil energized and its contacts closed to supply ignition current.

Battery charging current also flows to the adjustable resistor and to the normally closed contacts of the two step voltage regulator, through the contacts to a terminal point and down to the generator terminal of the reverse current relay. Current through the series coil and shunt coil cause the reverse current relay to close. The contacts closing complete the battery charging circuit through that relay to the charge ammeter, through it to the battery terminal on the start solenoid and to the battery.

This provides battery charging current. If the battery is in a low charge state, the charging current will be in the area of 7-1/2 amperes until the battery has returned to a near normal charge state. When this happens, the battery voltage and generator voltage are quite close and the two step voltage regulator coil energizes causing its contacts to open. This coil remains energized while the generator is running. The battery charging current drops to approximately 2-1/2 amperes when the two step voltage regulator operates. This removes the adjustable charge resistor from the circuit.

Unit Stopping

To stop the set, move the switch handle to the stop position. This "shorts out" the power to the stop (ignition) relay coil, causing it to de-energize and its contacts to open, breaking the ignition circuit.

Electric—Hand Crank Switch

The manual start-electric start switch makes starting with a pull rope or recoil starter easier. When the switch is in the manual start position, it parallels the contacts of the stop relay and supplies ignition current directly to the ignition coil without the stop relay being energized. The set cannot be electrically stopped, with this switch in the manual start position.

Easy Checks

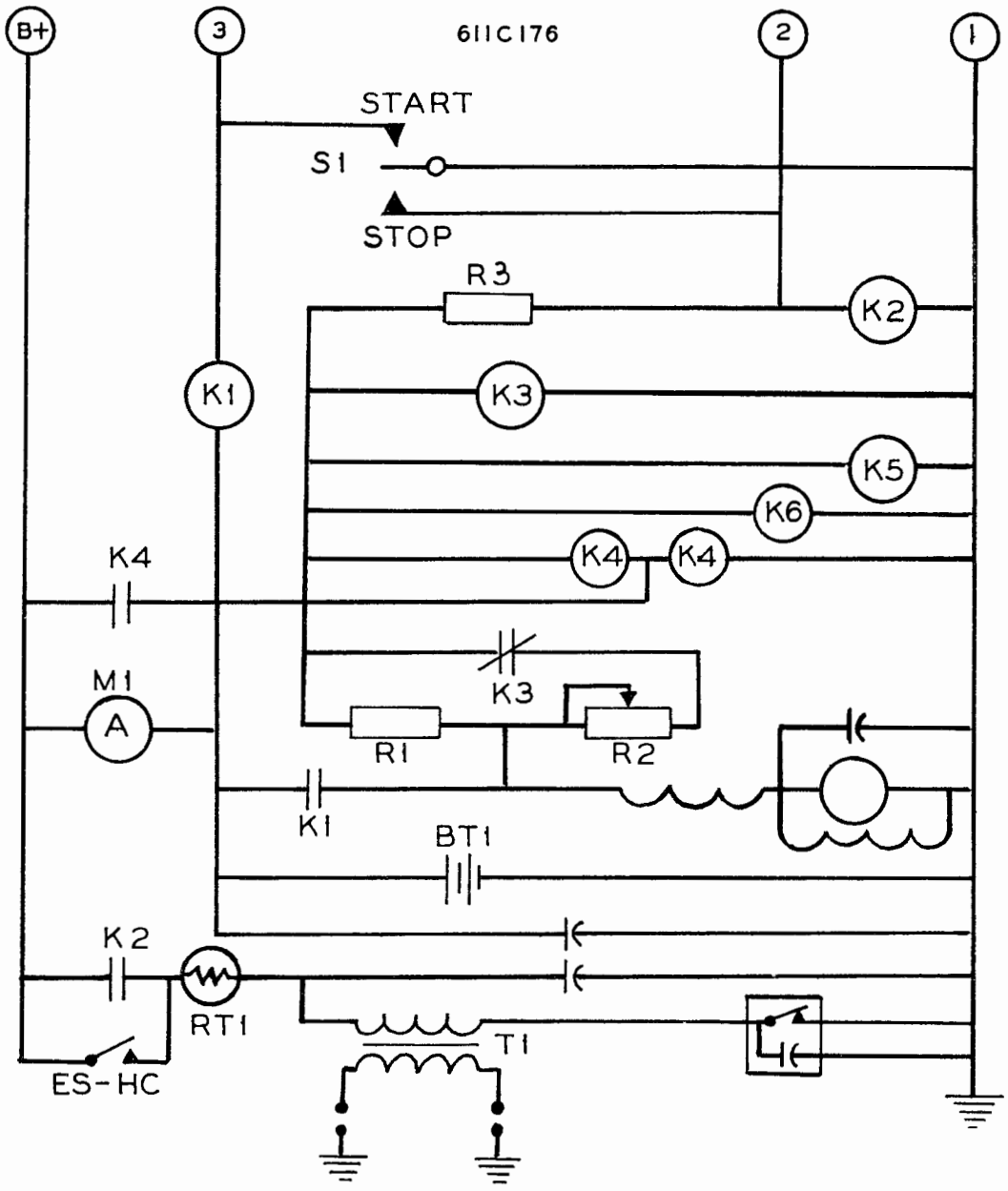
Grounding terminal 3, on the terminal block with a jumper, will energize the start solenoid and supply current to the generator. With fuel supplied to the engine, the unit should start. Grounding terminal 2, at this block, will stop the set. These are easy checks to determine if control components are operating.

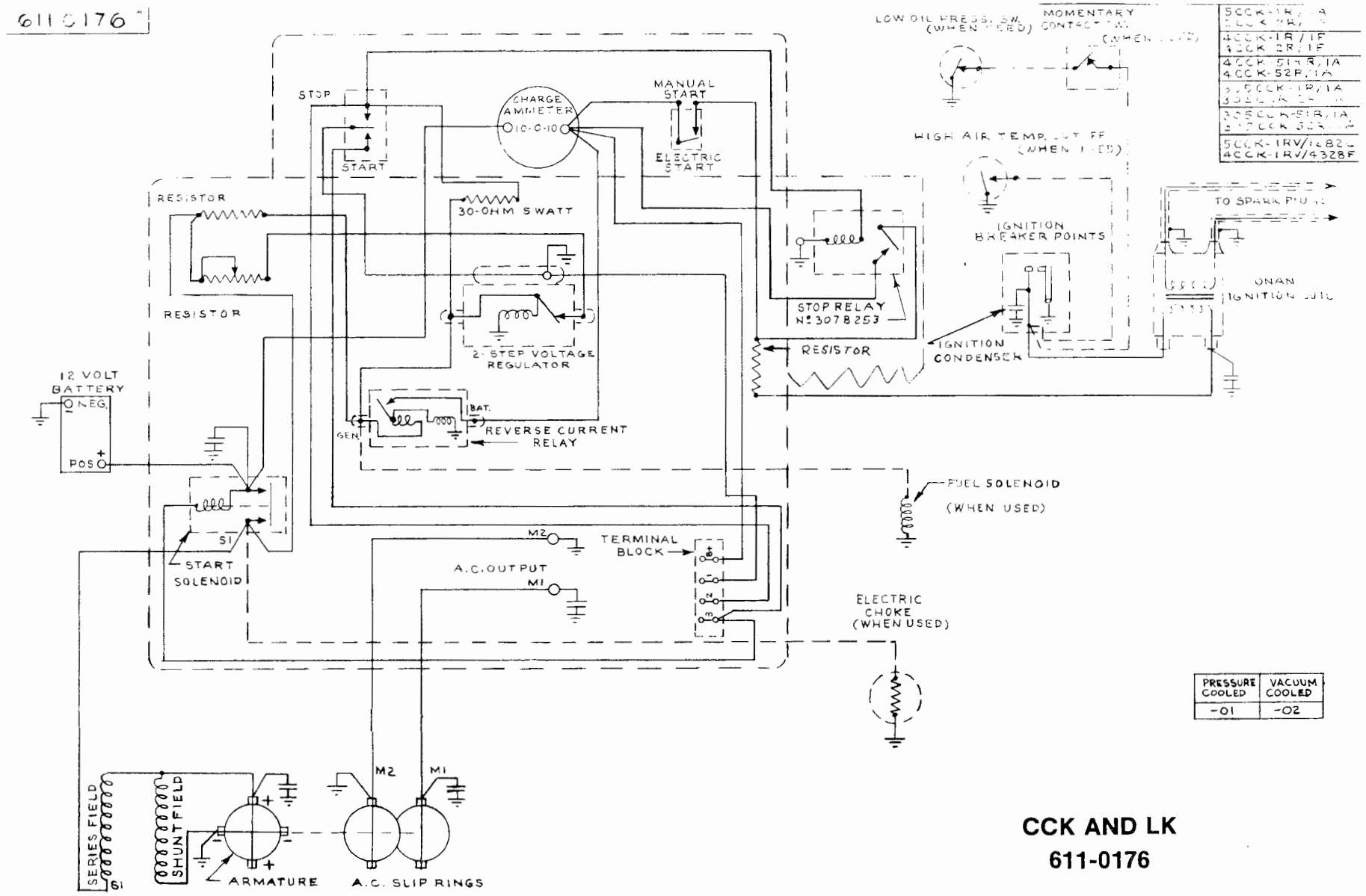
When the set starts, observe the ammeter to check the charge rate. It should be in the area of 7-1/2 amperes. If it is indicating approximately 5 amperes, this indicates the low charge rate resistor has burned out. If it is indicating 2-1/2 amperes, then the high charge resistor is burned out. The ammeter should drop to an indication of approximately 2-1/2 amperes after a short period of time. If it drops to 0, it indicates an open low charge resistor.

Should problems be experienced with the fuel solenoid failing to energize, remove the lead from the generator terminal of the reverse current relay and place it on the supply side of the Hytempco ignition resistor (1.72-ohm, 25-watt). This will assure higher pick up voltage.

The control used on the "LK" Series of sets for mobile applications, wiring diagram 610-0266, is the same as the 611-0176 "CCK" control; with the exception that the Hytempco ignition resistor is not used on "LK" Series controls. The mobile "LK" uses a 12-volt ignition coil.

CCK AND
LK SCHEMATIC

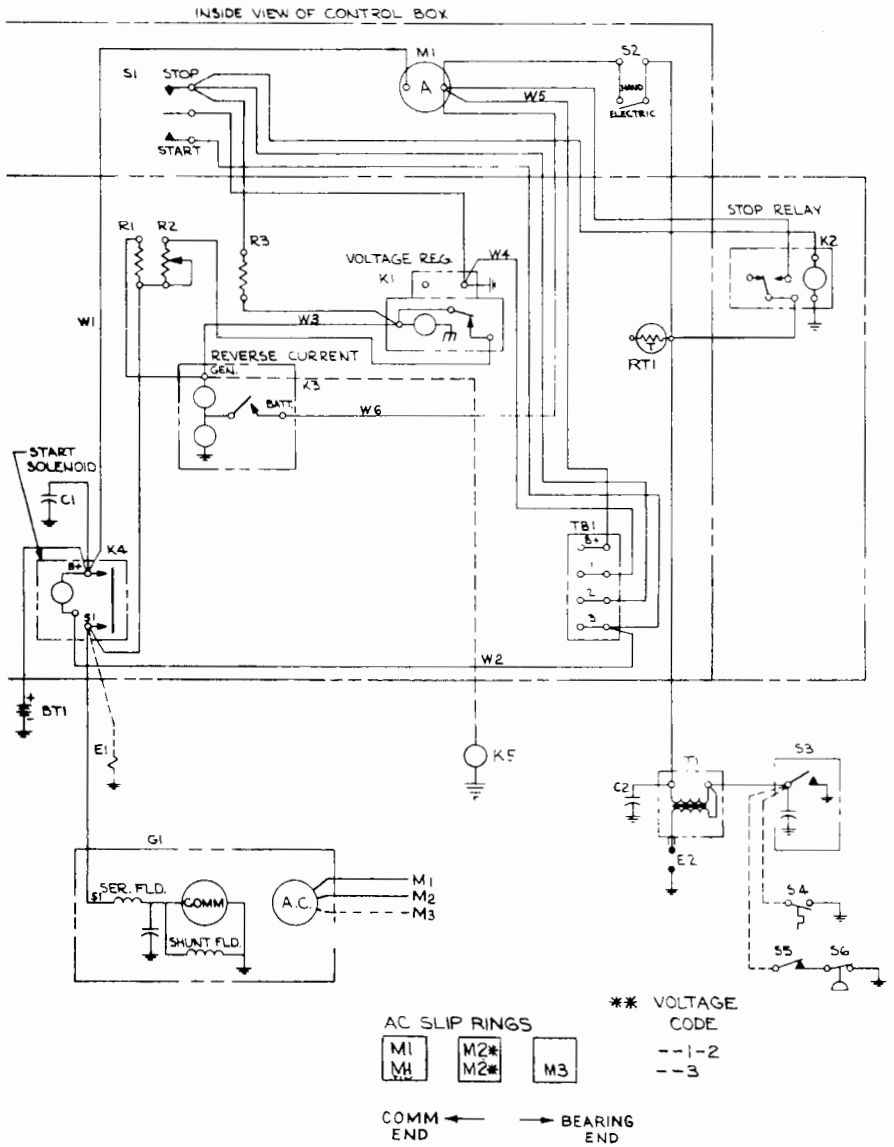




CCK AND LK
611-0176

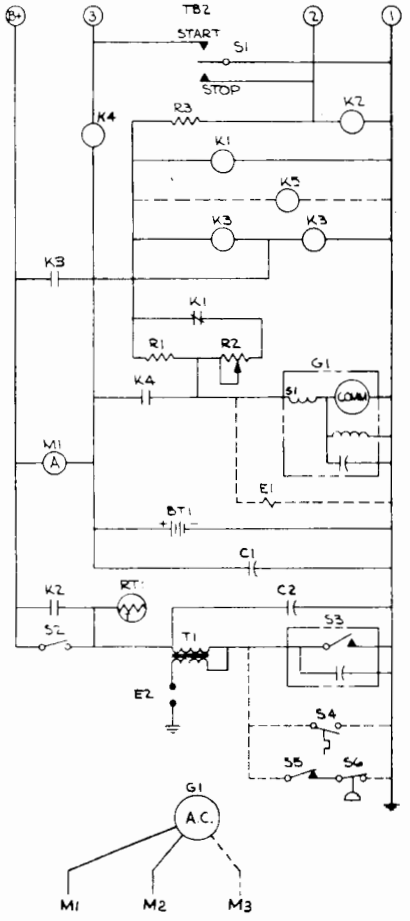
610C266

WIRING DIAGRAM



NOTE:
* GROUNDED AC LEAD; OTHERS HAVE .1 MFD CAPACITOR TO GROUND IN GEN.

SCHEMATIC DIAGRAM



PARTS LIST

REF DES	QTY	DESCRIPTION
C1	1	CAPACITOR ASSY 1.0 MFD
K1	1	RELAY - 2 STEP VOLTAGE REG
K2	1	RELAY & LEAD ASSY - STOP
	1	RELAY - STOP
K3	1	RELAY - REVERSE CURRENT
K4	1	RELAY - START SOLENOID
M1	1	AMMETER - CHARGE 10-0-10
	1	RESISTOR & LEAD ASSY
R1	1	RESISTOR, 1 Ω, 25W
R2	1	RESISTOR 1 Ω, 50W
	1	SWITCH ASSY - RMT START
S1	1	SWITCH - STOP START
R3	1	RESISTOR, 30 Ω, 5W
	1	SWITCH & RESISTOR ASSY
S2	1	SWITCH - HAND ELEC START
RT1	1	RESISTOR, 1.72 Ω, 25W
TB1	1	TERMINAL BLOCK
	1	MARKER STRIP
W1	1	LEAD ASSY
W2	1	LEAD ASSY
W3	1	LEAD ASSY
W4	1	LEAD ASSY
W5	1	LEAD ASSY
W6	1	LEAD ASSY
	1	CONTROL BOX & PANEL ASSY
	1	MTG BRACKET
	1	COVER
	1	ENDPLATE
	1	SILK SCREEN
	1	SILK SCREEN

PARTS LIST (ENG-GEN) 9920019

BT1	1	BATTERY 12 VOLT
C2	1	CAPACITOR 9.1 MFD
* E1	1	ELECTRIC CHOKE
E2	1	SPARK PLUGS
G1	1	GENERATOR
* K5	1	FUEL SOLENOID
S3	1	BREAKER & CAP ASSY
* S4	1	SWITCH - HIGH AIR TEMP.
* S5	1	SWITCH
* S6	1	SWITCH - LOW OIL PRESS.
T1	1	IGNITION COIL - (ONAN)

* WHEN USED

LK
610-0266

NOTES

CONTROL—OPERATING SEQUENCE FOR "CCK" MOTOR HOME CONTROL #611-0914 AND "LK" MOTOR HOME CONTROL #610-0313

Starting Circuit

One end of the start solenoid operating coil is connected internally to the battery terminal. The other end of the coil is connected to terminal 3 of the control block. From terminal 3, a wire connects to the start side of the start-stop switch (S1). When the switch is placed in the start position, current from the battery positive flows through the start solenoid coil to terminal 3, to the start-stop switch (S1), to ground and back to the battery. This energizes the start solenoid (K-4) closing the high current contacts within the solenoid. Battery current flows through these closed contacts to the series field (cranking winding) through it to the shunt field and the armature. This current flows through the shunt field and the armature to ground. This causes the generator to act as a direct current motor and cranks the engine.

Ignition Circuit

When the start solenoid relay (K4) closes, current flows from the S1 terminal to the 1-ohm, 25-watt resistor, to the battery side of the 2-step voltage regulator, to the 30-ohm, 5-watt resistor (R3), to the stop side of the start-stop switch (S1), to the coil of the stop relay (K2) and to ground. This relay energizes, closing its contacts and supplying ignition current to the coil. Current from the battery flows to B+ on terminal block, to the contacts of the stop relay (K2), to the ignition coil, through the ignition breaker points to ground. On "CCK" units, ignition current passes through a Hytempco resistor (1.72 ohms, 25-watt) (RT1) before the ignition coil.

Engine Starting

With the generator acting as a motor and cranking the engine and with ignition current supplied; if fuel is available at the carburetor, the engine will start.

Voltage Build-up and Start Disconnect Circuit

When the engine starts, it accelerates to governed speed. The armature rotating in the magnetic field produced by residual magnetism has a voltage produced in its windings. This voltage is applied to the shunt field causing an electro-magnetic field to be produced. This electro-magnetic field combines with the residual magnetic field and produces an over-all strong field and an increase in armature voltage. This voltage increases to approximately 18 volts. This Direct Current is then used for excitation and to supply battery charging current. This voltage is also used to operate a start-disconnect relay on some engine controls or the start switch is released and it returns to the center "OFF" position and breaks the start solenoid coil circuit.

Battery Charging Circuit

The Direct Current voltage produced by the DC windings of the armature causes a current through the series field to the S1 terminal of the start solenoid relay, to the two charge resistors (R1 and R2). One is the fixed value low charge resistor and the other is the adjustable rate high charge resistor. Battery charging current flows from R1 to the battery terminal of the 2-step voltage regulator relay. From this terminal current also flows up to the 30-ohm, 5-watt resistor (R3) and supplies the current to maintain the stop relay coil (K2) energized and its contacts closed to supply ignition current.

Battery charging current also flows to the adjustable resistor (R2) and to the normally closed contacts of the two step voltage regulator, through the contacts to the battery terminal and to CR1 charge diode, through it to the battery terminal on the start solenoid relay and to the battery. This provides battery charging current. If the battery is in a low charge state, the charging current will be in the area of 7-1/2 amperes until the battery has returned to a near normal charge state. When this happens, the battery voltage and generator voltage are quite close and the two-step voltage regulator coil energizes, causing its contacts to open. This coil remains energized while the generator is running. The battery charging current drops to approximately 2-1/2 amperes when the two step voltage regulator operates. This removes the adjustable resistor from the circuit.

Unit Stopping

To stop the set, move the switch handle to the stop position. This "shorts out" the power to the stop relay (K2—ignition relay) coil causing it to de-energize and its contact to open, breaking the ignition circuit.

Electric-Hand Crank Switch

The manual start-electric start switch (S2) makes starting with a pull rope or recoil starter easier. When the switch is in the manual start position, it parallels the contacts of the stop relay (K2) and supplies ignition current directly to the ignition coil without the stop relay (K2) being energized. The set cannot be stopped, electrically with this switch in the manual start position.

Easy Checks

Grounding terminal 3 on the terminal block (TB1), with a jumper, will energize the start solenoid and supply current to the generator. With fuel supplied to the engine, the unit should start. Grounding terminal 2 at this block, will stop the set. These are easy checks to make to determine if control components are operating. Placing switch S2 in the hand crank position, bypasses stop relay K2.

The control used on the "CCK" motor home applications is the same as the control used on the "LK" motor home applications with two exceptions!

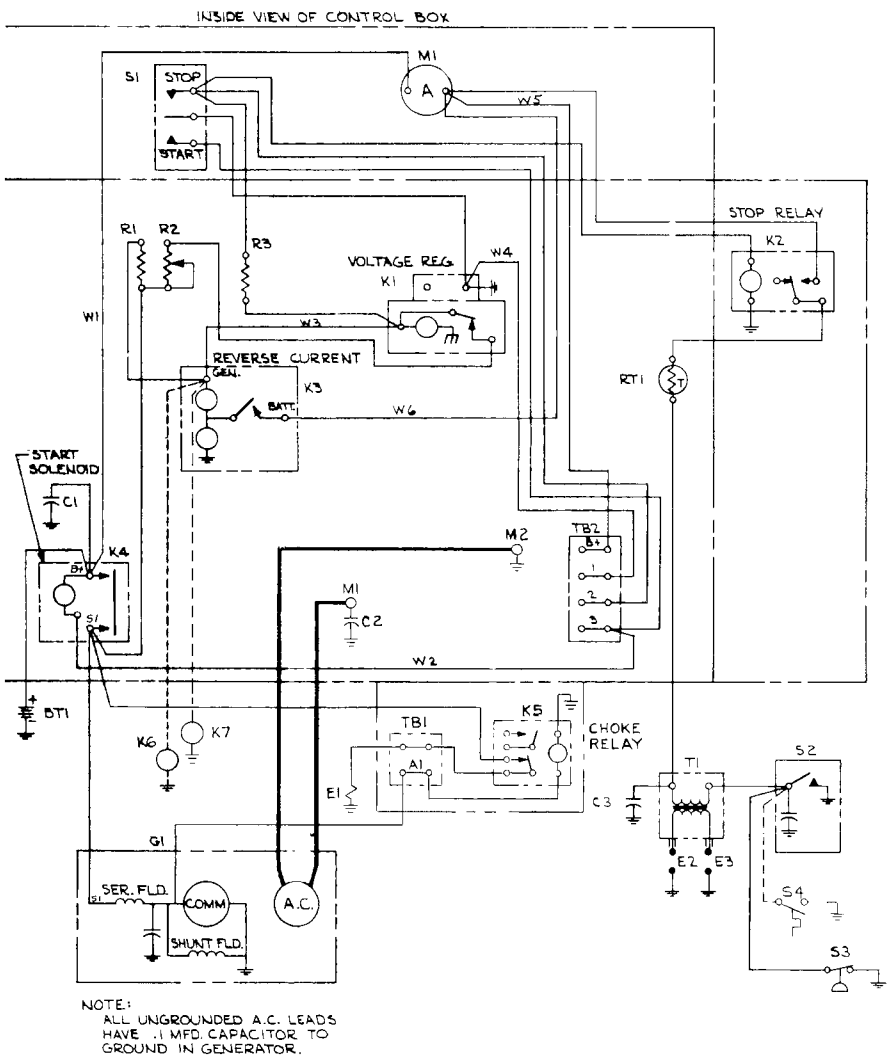
1. The Hy-tempco ignition resistor (RT1) is only used on "CCK" series units.

2. The electrical schematic component designation for a similar component performing the same electrical function, may vary between the two controls.

EXAMPLE: Start Solenoid Relay is (K4) in the "CCK" control #611-0914; and (K1) in the "LK" control #610-0313. The part number (307-1046) is the same for both as is the electrical function. This is only one example and there are a few others.

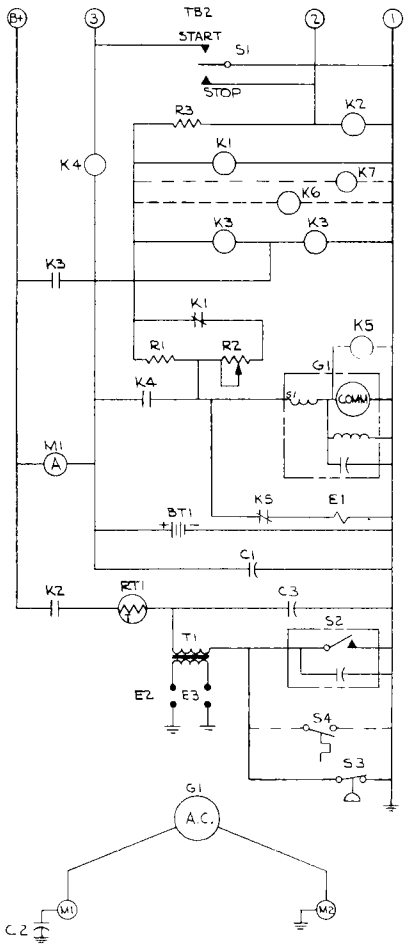
611C914

WIRING DIAGRAM



NOTE:
ALL UNGROUNDED A.C. LEADS HAVE .1 MFD. CAPACITOR TO GROUND IN GENERATOR.

SCHEMATIC DIAGRAM



REF. DES.	QTY.	DESCRIPTION
C1	1	CAPACITOR ASSY 1.0 MFD
C2	1	CAPACITOR ASSY 0.1 MFD
K1	1	RELAY-2 STEP VOLTAGE RGLTR
	1	RELAY & LEAD ASSY
K2	1	RELAY-STOP
K3	1	RELAY-REVERSE CURRENT
K4	1	RELAY-START SOLENOID
	1	RELAY & BOX ASSY
K5	1	RELAY-CHOKE
TB1	1	TERMINAL BLOCK
	1	RELAY & TERM BOX
M1	1	AMMETER-CHARGE 10-0-10
	1	RESISTORS & LEAD ASSY
R1	1	RESISTOR-1 OHM, 25 W
R2	1	RESISTOR-1 OHM, 50 W ADJ
	1	RESISTOR & LEAD ASSY
RT1	1	RESISTOR-HYTEMCO 1.72 OHM, 25 W
	1	SWITCH ASSY-RMT START
S1	1	SWITCH-STOP START
R3	1	RESISTOR-30 OHM, 5 W
TB2	1	TERMINAL BLOCK
	1	MARKER STRIP
	2	TERMINAL
	1	FASTENER-PAPER
	1	CONTROL BOX & PANEL ASSY
	1	BRACKET-CONTROL BOX MTG
	1	COVER-
	1	ENDPLATE
	1	SILKSCREEN
	1	BUTTON-DOT
W1	1	LEAD ASSY
W2	1	LEAD ASSY
W3	1	LEAD ASSY
W4	1	LEAD ASSY
W5	1	LEAD ASSY
W6	1	LEAD ASSY
		(ENG GEN)
BT1	1	BATTERY-12V
C3	1	CAPACITOR, 0.1 MFD (SPEC J)
E1	1	CHOKE-SISSON
E2,3	2	SPARK PLUG
G1	1	GENERATOR
* K6	1	PUMP-FUEL
S2	1	BREAKER & CAP ASSY
* K7	1	SOLENOID-GAS
* S4	1	SWITCH-HIGH AIR TEMP
S3	1	SWITCH-LOW OIL PRESS
T1	1	COIL-IGN(ONAN)

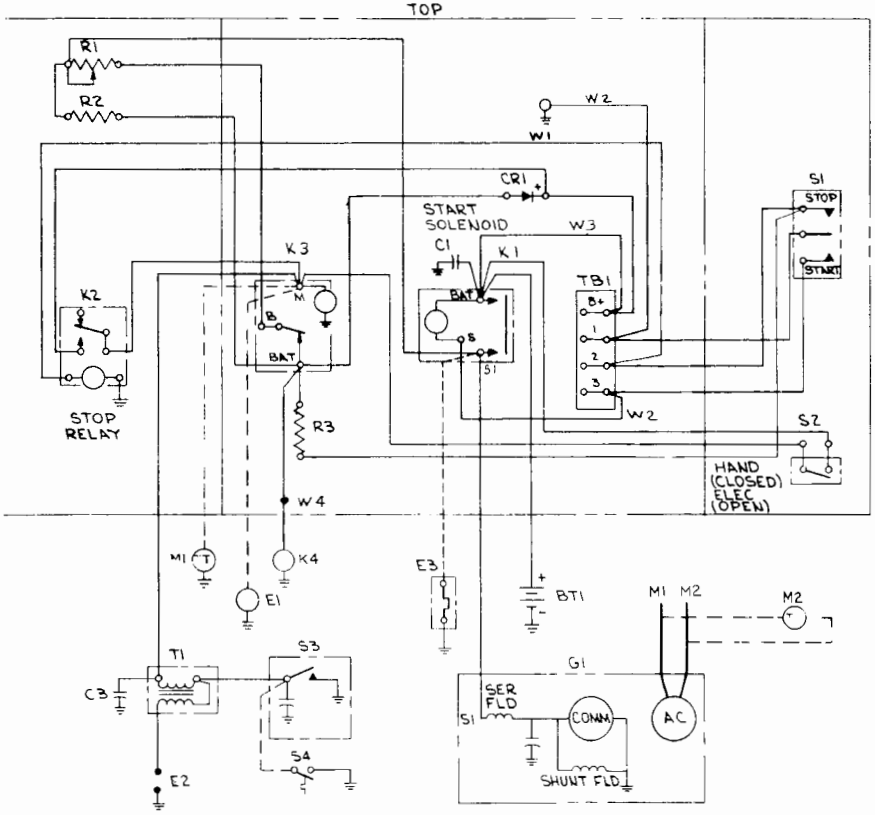
611C914

* WHEN USED

CCK MOBILE UNIT
611-0914

610C313

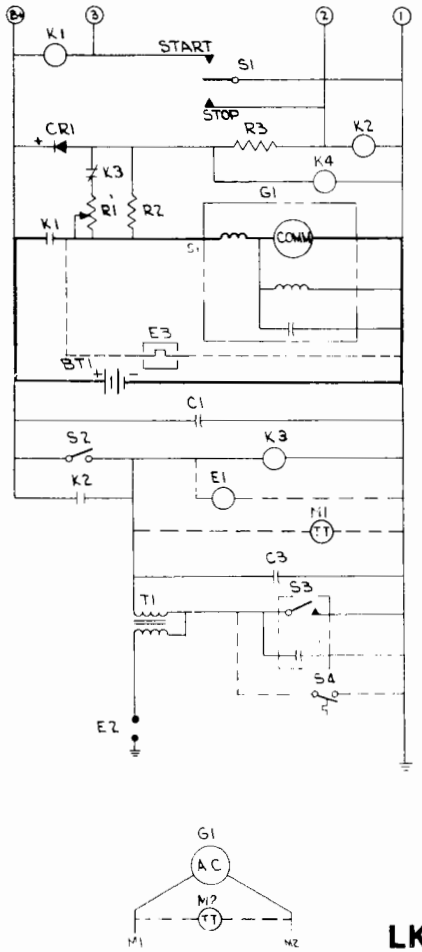
WIRING DIAGRAM
INSIDE VIEW OF BOX TOP



NOTE:
UNLESS OTHERWISE NOTED ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION

NOTE
M2 IS GROUNDED AC LEAD
M1 HAS A 1 MFD CAPACITOR TO GROUND IN GENERATOR

SCHEMATIC



PARTS LIST

REF. DES.	QTY.	DESCRIPTION
C1	1	CAPACITOR ASSY
	1	DIODE ASSY
CR1	1	DIODE-REVERSE CURRENT
	1	HEAT SINK
K1	1	RELAY-START SOLENOID
	1	RELAY & LEAD ASSY-STOP
K2	1	RELAY-STOP
K3	1	RELAY-2 STEP VOLTAGE
	1	RESISTOR ASSY
R1	1	RESISTOR-ADJ. 1 OHM, 50 W
R2	1	RESISTOR-FIXED 1 OHM, 25 W
	1	SWITCH ASSY-RMT START
S1	1	SWITCH-START STOP
R3	1	RESISTOR 30 OHM 5 W
	1	SWITCH & LEAD ASSY
S2	1	SWITCH (HAND ELECT START)
TB1	1	TERMINAL BLOCK
	1	MARKER STRIP
W1	1	LEAD ASSY 16
W2	2	LEAD ASSY 8
W3	1	LEAD ASSY 12
W4	1	LEAD ASSY 22
	1	CONTROL BOX
	1	COVER
	1	SILKSCREEN
	1	TERMINAL
	3	GROMMET
		(ENG-GEN)(REF)
BT1	1	BATTERY-12 VOLT
C3	1	CAPACITOR 0.1 MFD
+ E1	1	FUEL PUMP
E2	1	SPARK PLUG
+ E3	1	CHOKE ELECT
G1	1	GENERATOR
S3	1	BREAKER & CAP ASSEMBLY
+ S4	1	SWITCH-HIGH AIR TEMP
T1	1	IGNITION COIL (DNAN)
+ K4	(F) 1	SOLENOID-FUEL (GAS)
	(S) 1	SOLENOID FUEL (GASOLINE)
+ M1	1	METER-RUNNING TIME, 12 VDC
+ M2	1	METER-RUNNING TIME, AC

610C313

+ WHEN USED

LK MOBILE UNIT
610-0313

CONTROL—OPERATING SEQUENCE FOR STANDARD SOLID STATE CONTROL #611-1086

Starting and Ignition Circuit

Switch A1S2 is a rocker type switch. Pressing this to the start position closes it. Battery current is supplied through the hand crank - electric start switch A1S1, through diode CR1, through switch A1S1 to the primary of the ignition coil T1, to the breaker points to ground and back to the battery. (The ignition coil requires about 4 volts minimum to operate.)

The fuel pump and fuel solenoid are energized at the same time as the ignition circuit. From a connection point at the coil primary, current flows to the fuel pump (E1) fuel solenoid (K-2) to ground and back to the battery. (The fuel pump requires 5.5 volts minimum to operate.)

When A1S2 is closed current is also supplied from the battery, through the switch, through transistor A1Q2 to the coil of Relay K1 (START SOLENOID) to ground and back to the battery. (Relay K1 requires 4.5 V minimum to operate.) Relay K1 energizes and its contacts close connecting the battery to the generator. (Generator requires 7.0 volts or more to crank.) If the battery has sufficient capacity, the generator acts as a DC motor and cranks the engine. If proper coil voltage and fuel are available, the engine starts and accelerates to governed speed. Relay K1 also energizes the choke coil (E-4 sisson choke) to close the choke.

Start Disconnect Circuit

When the engine starts and comes up to speed generator DC voltage starts to build up. Generator DC voltage is supplied to charge resistor G1R1 through both sections—3.8 ohms and 8.3 ohms. When this voltage reaches the same value as battery voltage both sides of A1CR5 are at the same potential. This causes CR5 to stop conducting and it shuts off shutting off transistor A1Q2. This de-energizes the start solenoid (K1) and breaks the starting circuit.

At the same time ignition current is supplied from the generator, through the charge resistor (G1R1) to CR2 diode, to the ignition coil, fuel pump and fuel solenoid (K2).

Battery Charging Circuit

There are two steps of battery charging—either a high or low rate. The high rate is transistor controlled and the low rate is a fixed 1.56 amp steady rate. The low charge circuit is continuous from A1 of the generator, through the 8.3 ohm side of G1R1 charge resistor, through CR3 and to the battery. This circuit supplies the ignition, fuel pump and fuel solenoid current also.

The high charge circuit is through the 3.8 ohm side of the G1R1 charge resistor through Q1 transistor, through CR3 diode and to the battery. This circuit supplies about 3.7 amps charge current. The high and low charge circuits combined provide about 5.26 amps during high charge periods.

Each time the unit is started the high charge circuit is energized. If the battery is close to full charge—indicated by battery voltage—this circuit is de-energized or shut off by turning transistor Q1 off.

High Charge Circuit Control

Q4 and Q5 form a trigger circuit to control Q3 and then Q1. R5 and R8 form a voltage divider and control the trigger point of Q5. Q5 turns off at about 13 volts and on at about 15 volts.

Because the battery voltage drops when cranking, the high charge circuit turns on. The high charge circuit turns off when normal battery voltage is reached. Whenever battery voltage drops below 13 volts, the high charge circuit turns back on.

When battery voltage drops to about 13 volts, Q5 turns off, Q4 turns on and turns Q3 on. Q3 turns Q1 on and the high charge circuit is re-energized and the battery receives higher charging current.

When the battery voltage comes up to about 15 volts, Q5 turns on, Q4 turns off which turns Q3 off. Q3 turns Q1 off and opens the high charge circuit.

Stopping

The generating set stops when switch A1S2 is pushed to the stop position. This switch grounds out the point side of the coil preventing a make and break of the ignition primary, cutting off spark to the plugs. At the same time the battery is prevented from discharging through the generator by CR3 diode.

Miscellaneous

CR9 is a blocking diode in the Hi Air temperature switch circuit. CR8 is a blocking diode in the Low Oil Pressure switch circuit.

C1 and C2 capacitors filter out the interference caused by commutation. This is necessary to prevent the high battery circuit from energizing when the battery is at or near full charge.

R12 and CR7 form a stabilizing circuit for Q5 and Q4 due to generator voltage variation.

R7 is a current limiting resistor and speeds up the switching time of Q4.

CR6 diode compensates the trigger circuit to change the trigger voltage point to follow battery temperature-voltage requirements.

G1CR11 diode is to assure adequate current—with reversed battery connections—to blow fuse F1 to prevent burning out the control board.

To assure satisfactory operation of the generating set be sure battery cables are of sufficient size to reduce voltage drop to minimum. If in doubt, increase cable size. Generator requires 7 volts minimum to crank.

Terminal 17 and 18 are ammeter connection points. Remove jumper (W1) when connecting ammeter.

Terminal 12 is for the LOP indicating light.

Terminal 11 is for the HET indicating light.

Terminal 10 is for Generator run indicating light and Running Time Meter.

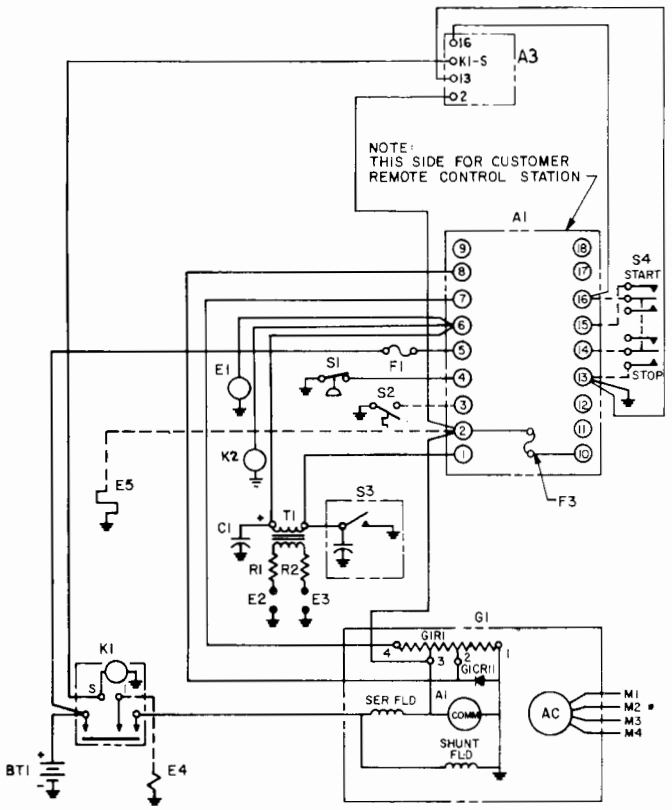
Optional—Control Start Disconnect

300-1227 can be added to the control to assure starting circuit disconnect. The control senses generator DC voltage buildup and shuts off the start solenoid coil circuit. It fastens to the PC board base and requires some circuit changes.

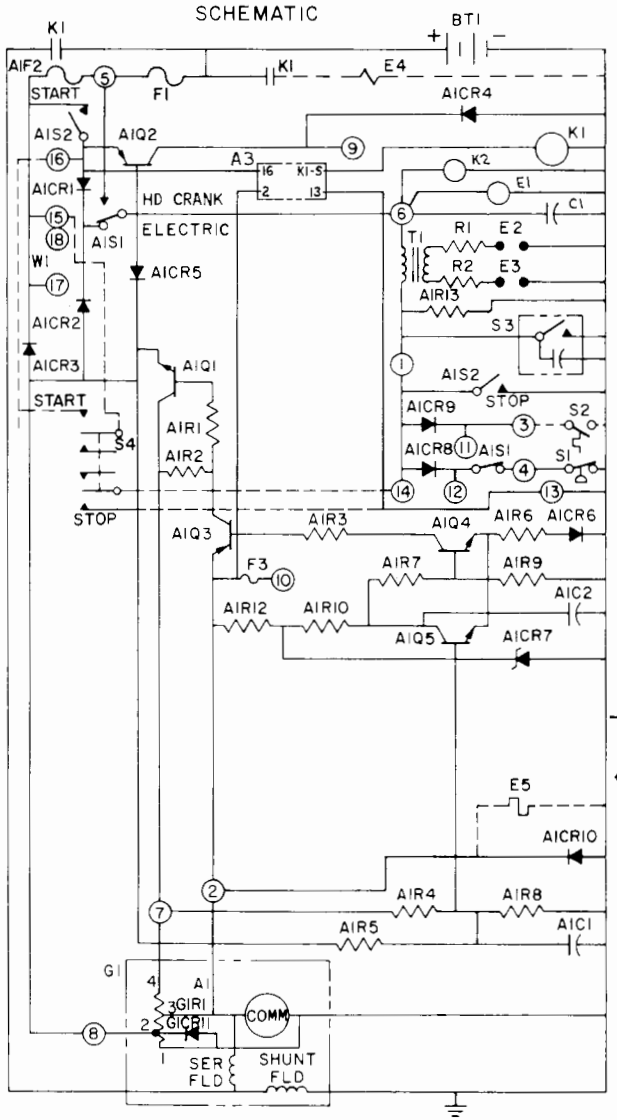
Control 611-1090 is the same as 611-1086 with the exception of the 4 to 3 wire adapter. The adapter has 4 terminals on one end which connect to identical terminals on the control board. There are 4 terminals on the other end marked 3, 2, 1 and B+. These connect to the old switch where #3 grounds to start and #2 grounds to stop. Two relays are used to accomplish starting and stopping. K2 completes the circuit #15 to #16 when #3 terminal is grounded. K1 completes the circuit #14 to #13 when terminal #2 is grounded. B+ is for use of the generator set with an HA demand control.

611C1086

WIRING DIAGRAM



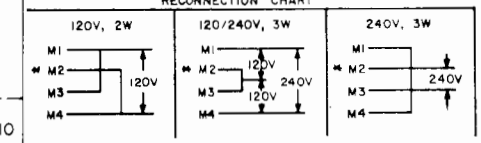
SCHEMATIC



PARTS LIST

REF. DES.	QTY.	DESCRIPTION
	1	CONTROL ASSY
A1	1	CONTROL-GEN SET ASSY
A2	1	CONTROL-START ADAPTER (4 TO 3 WIRE)
S4	1	SWITCH-START STOP (CUSTOMER REMOTE)
W1	1	WIRING HARNESS
F3	1	HOLDER ASSY - FUSE
	1	FUSE
A3	1	CONTROL-DISC ADPTR
	PARTS	LIST ENG GEN (REF)
BT1	1	BATTERY-12 VDC
C1	1	CAPACITOR-0.1 MFD
E1	1	PUMP-FUEL (WHEN USED)
E2, E3	2	SPARK PLUG
E4	1	CHOKE-SISSON (WHEN USED)
E5	1	CHOKE-ONAN (WHEN USED)
G1	1	GENERATOR
GICR11	1	DIODE-3A
GIR1	1	RESISTOR
K1	1	RELAY-START SOLENOID
F1	1	HOLDER ASSY - FUSE
K2	1	SOLENOID - FUEL
R1	1	LEAD ASSY-HI TENSION
R2	1	LEAD ASSY-HI TENSION
RT1	1	RESISTOR-HYTEMCO 1.720, 25W
S1	1	SWITCH-LOW OIL PRESS
S2	1	SWITCH-HIGH AIR TEMP (WHEN USED)
S3	1	BREAKER & CAP ASSY
S4	1	SWITCH-REMOTE START STOP
T1	1	COIL-IGNITION

RECONNECTION CHART



* GROUNDED AC LEAD

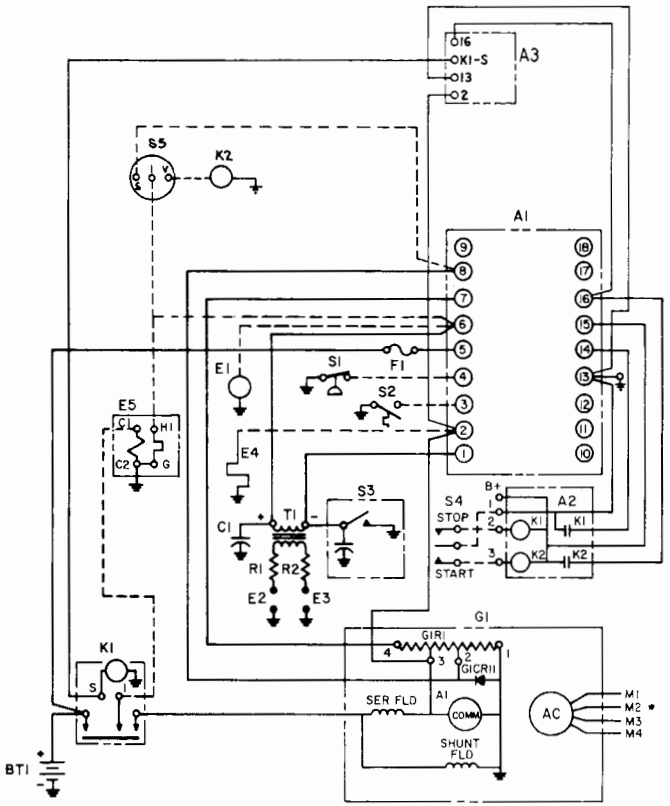
DASH NO	CHOKE	MODEL	WIRING HARNESS	CONTROL ASSY
-01	SISSION CHOKE	CCK,NH	338D640	300D1000
-02	ONAN CHOKE	CCK	338D691	300D1000
-03	NO CHOKE GAS CARB	CCK,NH	338D0774	300D1108
-04	NO CHOKE HATKO GAS	CCK,NH	338D0775	300D1108
-05	SISSION CHOKE HATKO	CCK,NH	338D0778	300D1000

STANDARD SOLID STATE CONTROL

611-1086

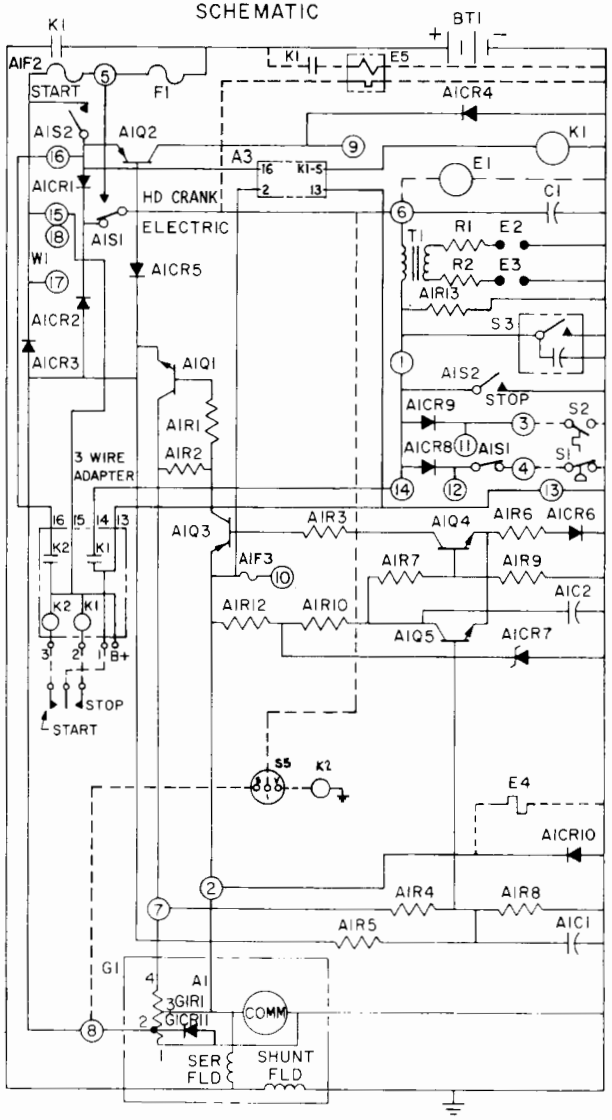
611-1090 C

WIRING DIAGRAM



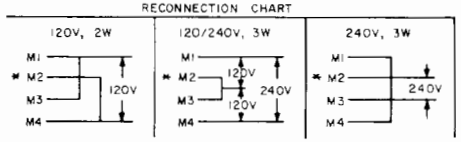
DASH NO	CHOKE	MODEL	WIRING HARNESS	
-01	ONAN CHOKE	CCK	338-0682	D
-02	NO CHOKE, GAS VALVE	CCK	338-0719	D
-03	THERMAL MAG C, LOPKO	NH	338-0718	D
-04	NO CHOKE, GAS, LOPKO, HATKO	CCK	338-0722	D
-05	NO CHOKE GAS VALVE, HATKO	CCK	338-0723	D
-06	ONAN CHOKE, LOPKO	CCK	338-0724	D
-07	ONAN CHOKE, HATKO, F. PUMP	CCK	338-0729	D
-08	F.PUMP, CHOKE, HATKO, LOPKO	CCK	338-0731	D
-09	ONAN CHOKE, HATKO.	CCK	338-0732	D
-10	LOPKO, NO CHOKE	CCK, NH	338-0738	D
-11	ONAN CHOKE, HATCO, LOPKO	CCK	338-0739	D
-12	THER MAG C, LOPKO, HATKO	NH	338-0743	D

SCHEMATIC



PARTS LIST		
REF. DES.	QTY.	DESCRIPTION
	1	CONTROL ASSY
A1	1	CONTROL-GEN SET ASSY
A2	1	CONTROL-START ADAPTER (4 TO 3 WIRE)
A3	1	CONTROL-DISC ADPTR
W1	1	WIRING HARNESS
	PARTS	LIST ENG GEN (REF)
BT1	1	BATTERY-12 VDC
C1	1	CAPACITOR-0.1 MFD
E1	1	PUMP-FUEL OR GAS VALVE
E2, E3	2	SPARK PLUG
E4	1	CHOKE-ONAN (WHEN USED)
E5	1	CHOKE-THERMO MAG (WHEN USED)
G1	1	GENERATOR
GICR11	1	DIODE-3A
GIR1	1	RESISTOR
K1	1	RELAY-START SOLENOID
K2	1	FUEL-SOLENOID
F1	1	HOLDER ASSY-FUSE
R1	1	LEAD ASSY-HI TENSION
R2	1	LEAD ASSY-HI TENSION
S1	1	SWITCH-LOW OIL PRESS
S2	1	SWITCH-HIGH AIR TEMP (WHEN USED)
S3	1	BREAKER & CAP ASSY
S4	1	SWITCH-START STOP (CUSTOMER REMOTE)
S5	1	SWITCH-VACUUM (FUEL SOLENOID)
T1	1	COIL-IGNITION

RECONNECTION CHART



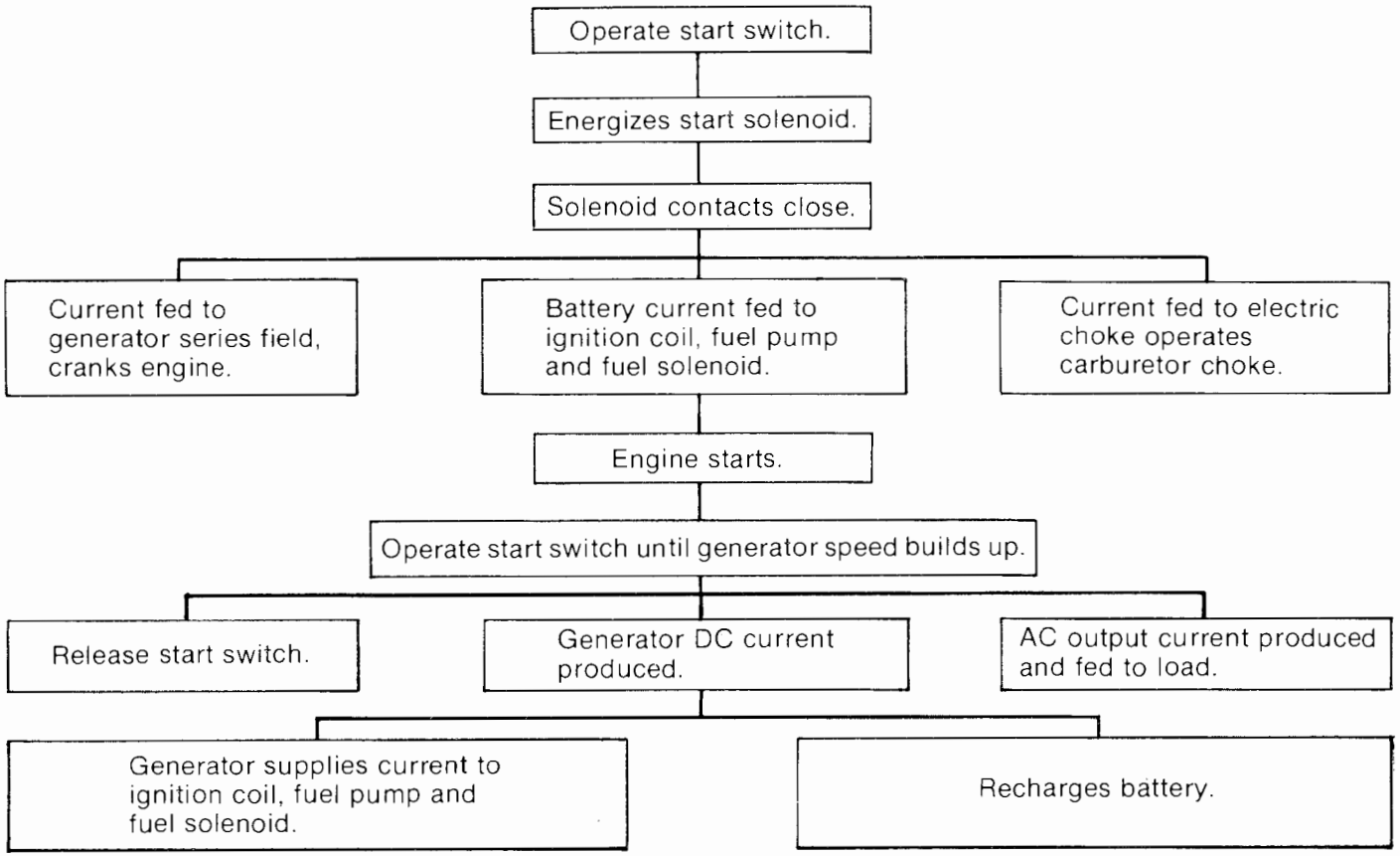
* GROUNDED AC LEAD

AC SLIP RINGS — ** VOLTAGE CODE

COMM END		BEARING END		
M4	M3	M2*	M1	3C 120/240V, 1PH
M3	M2	MO*	M1	4 120/208V, 3PH
M3	M2	MO*	M1	5D 120/240V, 3PH
M3	M2	MO*	M1	7 220/380V, 3PH
M3	M2	MO*	M1	4X 277/480V, 3PH
M3	M2	MO*	M1	7X 240/416V, 3PH

611-1090
SOLID STATE CONTROL WITH START DISCONNECT

CCK "RV" SERIES UNITS



SEQUENCE OF OPERATION

NOTES

CONTROL—OPERATING SEQUENCE FOR POWER DRAWER MODELS "BF" AND "NH" #611-1094

Starting and Ignition Circuit

Pushing start switch S3 allows battery current to flow through the start solenoid K1, K2 contacts and start switch S3 to negative battery terminal (ground). K1 start solenoid contacts close supplying current to starter motor, choke E1 and ignition (stop) relay K3. K3 relay contacts close and supply power to the ignition coil and electric fuel pump. The engine cranks and with fuel and ignition supplied, the engine starts.

Start-Disconnect Circuit

When the starting RPM increases, the alternator produces a voltage great enough to energize the start-disconnect relay K2. K2 relay contacts close to hold ignition relay K3 energized, and the normally closed contacts of the start-disconnect relay K2 open to de-energize start solenoid K1. K3 ignition relay contacts maintain current to the ignition coil and electric fuel pump to keep the engine running.

Unit Stopping

Pushing stop switch S3 shorts out stop relay K3. K3 stop relay de-energizes and its contacts open to remove power from the electrical fuel pump and ignition coil. Resistor R2 prevents a short circuit of the supply to Stop relay K3 during the time the stop switch S3 is held closed as the engine slows to a stop.

Low Oil Pressure Shutdown (LOPKO)

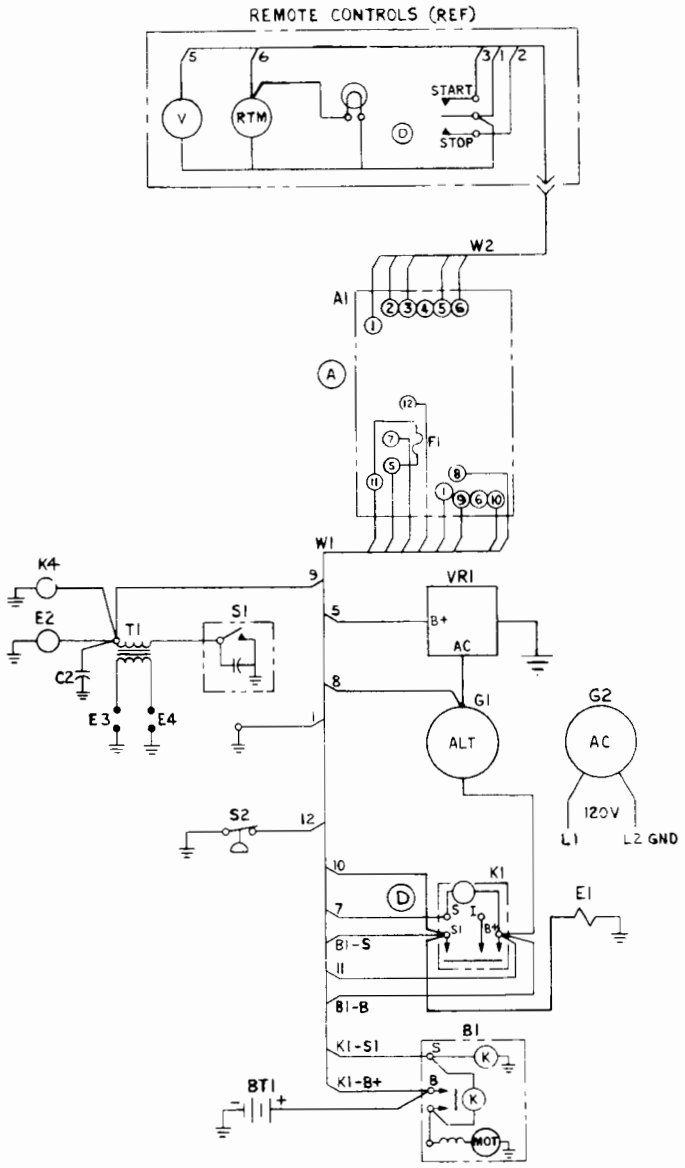
This control has a built-in time delay of 2 to 4 seconds for a low oil pressure shutdown. If a low oil pressure condition occurs, the low oil pressure switch S2 closes to charge capacitor C3 through resistor R3. When the voltage on capacitor C3 matches the voltage of the voltage divider circuit R5 and R6, unijunction transistor Q1 "turns on" to trigger CR8. CR8 turns on to de-energize stop relay K3. K2 contacts open as the engine stops and CR8 turns off.

Battery Voltage Sensing

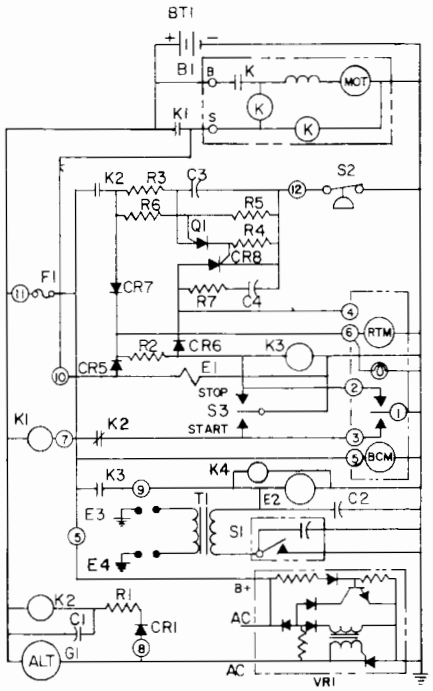
The battery voltage sensing portion of the voltage regulator determines whether to allow the voltage regulator to turn "on" or "off" by the charge condition of the battery. To check charging, connect a DC voltmeter from B+ of the regulator to ground. A reading of 14.1 to 14.5 volts indicates charge circuit good.

611C1094

WIRING DIAGRAM



SCHEMATIC



NOTE:
1. MIN START DISCONNECT= 675 RPM.

PARTS LIST		
REF. DES.	QTY.	DESCRIPTION
	1	CONTROL ASSY-GEN SET
A1	1	CONTROL-HOT HOME
B1	1	STARTER-SOLENOID SHIFT
BT1	1	BATTERY-12 VOLT
C2	1	CAPACITOR
E1	1	CHOKE
E2	1	FUEL PUMP
E3,4	2	SPARK PLUG
G1	1	ALTERNATOR
G2	1	GENERATOR
K1	1	SOLENOID-START
S1	1	BREAKER & CAP ASSY
S2	1	SWITCH-LOW OIL PRESS
K4	1	SOLENOID - FUEL
T1	1	COIL-IGNITION
VR1	1	VOLTAGE REGULATOR
W1	1	WIRING HARNESS-GEN SET
W2	1	WIRING HARNESS-REMOTE

BF
NH **POWER DRAWER**

611-1094

CONTROL—OPERATING SEQUENCE FOR BF "RV" MOTOR HOME CONTROL #611-1127

Starting Circuit

A1 is the generator set control assembly. Optional items are A2, the deluxe remote control which has a running time meter and battery condition indicator. A3 is a standard remote control utilizing only a generator run indicating light and the start-stop switch.

The control is the standard three wire type. Starting is done by grounding terminal 3 and stopping by grounding terminal 2. Terminal 1 connects directly to a ground point. A fuse is placed in line with terminal 5 and 6 to protect the circuits in the event of a fault between the standard control and a deluxe or standard remote control located in another area. F1 and F2 are 5 amp fuses.

Placing S1 in the start position permits a current flow from battery to the B+ terminal of the solenoid, through the solenoid to terminal 3, to the start switch to terminal 1 and to ground. This causes the coil on relay K1 to energize closing the high current contacts within it and the auxiliary contacts. When the high current contacts close, the battery is connected to the cranking windings of the generator producing a motor effect which cranks the engine. At the same time a circuit is established through the auxiliary contacts to terminal 6 of the control, to the plus side of the ignition coil, through it to the breaker points to ground establishing ignition circuit. Beginning with Spec "B" models the auxiliary contacts on the start solenoid K1 were eliminated and replaced by a separate crank ignition relay K2. With the Start switch S1 in the start position, relay K2 (crank ignition) energizes to supply ignition current during the cranking period ONLY. When running, ignition current is supplied through the battery charging resistor R1 and fuse F2. Refer to schematic #611-1127. All other circuits in this control function the same as Spec "A" models. Refer to schematic #611-1123. In addition, power is supplied to the fuel solenoid (E4 on Spec "A" models and E5 on Spec "B" and later models) causing it to open and allowing fuel to the carburetor, by energizing the fuel pump (E5 on Spec "A" models and E4 on Spec "B" and later models. A running time meter is energized to provide a continuous record of hours of operation.

When the engine starts and reaches governed speed; releasing the start switch allows it to go to the center off position breaking the K1 and K2 coil circuit. This breaks the starting circuit and start ignition circuit.

A low oil pressure cutout switch (S3) is placed in the breaker point side of the ignition coil. In the event of a low oil pressure condition it would close grounding the breaker point side of the ignition coil thus cutting off ignition power and shutting the engine down.

Ignition Circuit

When the engine starts and accelerates to governed speed, the battery charging circuit is energized through resistor R1, to CR1 to the battery, charging it. Also, from R1, power is supplied to fuel pump and ignition coil to maintain these devices in operation.

Stopping Circuit

Placing switch S1 in the stop position places a ground on the breaker point side of the ignition coil preventing a make and break of ignition circuit thus eliminating the spark at the plugs shutting the engine down. Start and stop can be readily accomplished at the engine control, the deluxe remote control or the standard remote control.

Troubleshooting

Failure of battery charge resistor R1 or loss of connections in the charging circuit will cause an ignition failure and engine shutdown.

Should the start solenoid (K1) fail to close when the start switch (S1) is placed in the correct position, a fast check can be made to determine if it's a faulty solenoid or switch. Place a wire jumper on the F terminal of K1 to a good ground point. If the solenoid now energizes the fault is in the start switch or its circuit. If starting is not accomplished through one of the remote switches, a fast check can be made through the use of a jumper by grounding terminal 3 at the engine control or at the remote control to determine complete circuit. If the starting is accomplished in this manner but not through the switch, it indicates a faulty switch. Stop circuit can be tested

in the same way by jumpering from terminal 2 of the standard control or the deluxe or standard remote control.

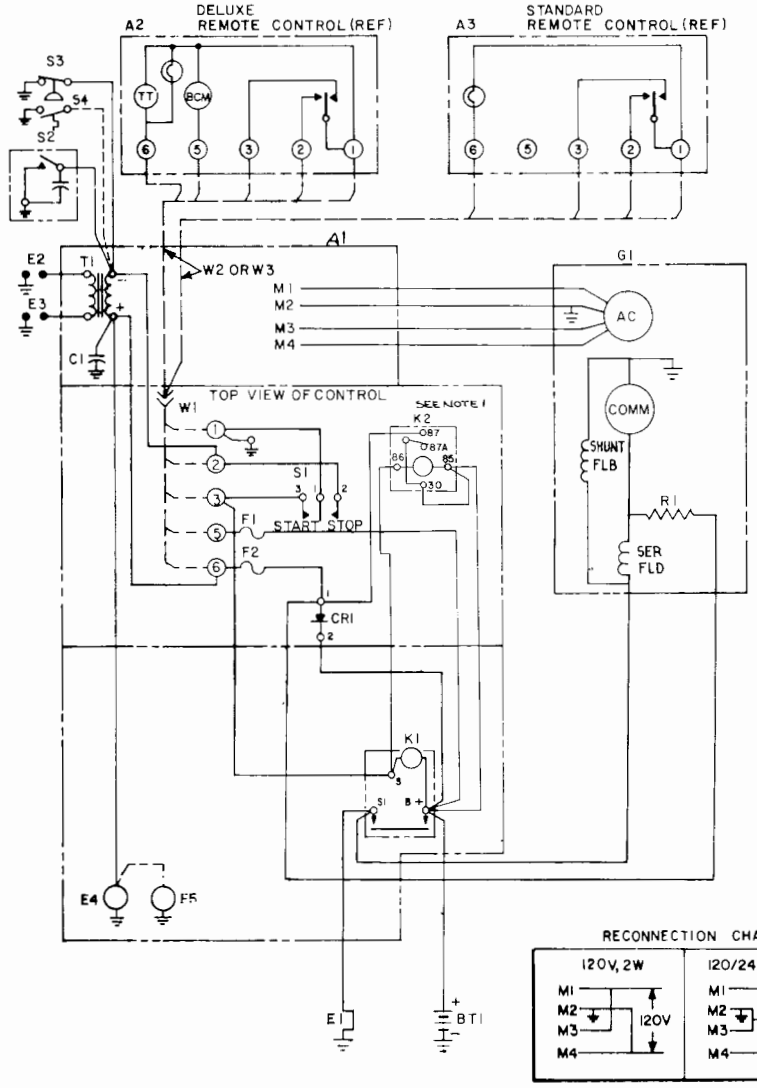
On Spec "B" models (Schematic 611-1127) Crank Ignition relay K2 operation can be tested by checking voltage from relay terminal 4 to ground while cranking unit. Battery voltage should appear at this terminal (4). If not, check for voltage at relay terminals 1 and 2 of K2. If battery voltage is present at terminals 1 and 2 of K2, but not at terminal 4 of K2, replace relay K2. If not voltage appears at terminals 1 and 2 on relay K2 while cranking, check wiring between Start solenoid K1 and Crank Ignition Relay K2.

A fuel pump (E4) and fuel solenoid (E5) can be tested for operation by placing a jumper from B+ out of the battery to the plus side of the ignition coil (T1). If the fuel solenoid (E5) is good, a click should be heard when this jumper is connected. A chattering of the fuel pump should indicate it is functioning.

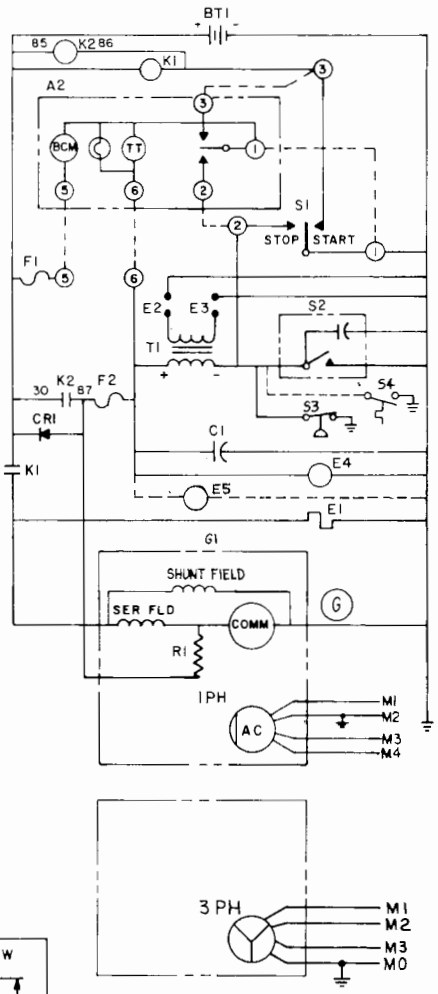
If the unit cranks but will not start, and battery voltage is present at the plus terminal of the ignition coil (T1), disconnect the lead to the low oil pressure switch (S3) to be sure it is not remaining closed due to a fault.

611-1127 [C]

WIRING DIAGRAM



SCHEMATIC



RECONNECTION CHART

120V, 2W	120/240V, 3W
M1 M2 M3 M4 120V	M1 M2 M3 M4 120V 120V 240V

		PARTS LIST			
	REF. DES.	PART NO.	DRW SIZE	QTY	DESCRIPTION
(P)	A1	300-1570	D	1	CONTROL ASSY -01,-05
		300-1437	D	1	CONTROL ASSY -02
(F)		300-1515	D	1	CONTROL ASSY -03
(L)		300-1533	D	1	CONTROL ASSY -04
(N)					
	ALL PART NO'S BELOW ARE REF. ONLY				
	A2	300-0986	B	1	DELUXE REMOTE CONTROL
	A3	300-0985	B	1	STANDARD REMOTE CONTROL
	BT1			1	BATTERY 12V
	C1				CAPACITOR
	CR1	305-0235	A	1	RECTIFIER
	E1			1	CHOKE-ONAN
	E2,E3			2	SPARK PLUG
	E4			1	FUEL PUMP
(E)	E5			1	SOLENOID - FUEL (WHEN USED)
(J)	F1,2	321-0174	-	2	FUSE (5 AMP, 32V)
	G1			1	GENERATOR
	K1	307-1498	B	1	SOLENOID - START
(R)	K2	309-1575	P	1	RELAY - IGNITION
	R1	353-0057	A	1	RESISTOR - FIXED (BF)
		353-0060	A	1	RESISTOR - FIXED (NH & CCK)
	S1			1	SWITCH - START - STOP
	S2			1	BREAKER & CAP ASSY
	S3	309-0237	P	1	SWITCH - LOW OIL PRESS
(H) *	S4			1	SWITCH - HIGH AIR TEMP
	T1			1	COIL - IGNITION
OPTION	W1	338-0958	B	1	WIRING HARNESS (CONN - REMOTE)
OPTION	W2	338-0959	C	1	WIRING HARNESS (CABLE - REMOTE CONTROL) (10 FEET LONG)
OPTION	W3	338-0960	C	1	WIRING HARNESS (CABLE - REMOTE CONTROL) (30 FEET LONG)

(S) NOTE:
1. K2 OLD RELAY CONNECTIONS ARE 1, 2, 3 & 4.
#1 WOULD BE THE SAME AS #85
#2 WOULD BE THE SAME AS #30
#3 WOULD BE THE SAME AS #86
#4 WOULD BE THE SAME AS #87

BF "RV" BEGIN SPEC B
611-1127

CONTROL—OPERATING SEQUENCE FOR BFA (SPEC A) BGA (SPEC A) AND NH (SPEC K) MOTOR HOME UNITS - SCHEMATIC #611-1135

This control is very similar to the 611-1127 RV controls in operation except for changes to the Starting-Ignition and low oil pressure (LOPKO) circuits. All current twin cylinder RV motor home units listed above use the 611-1135 control.

Starting, Stopping, Ignition and Lopko Circuits

When the start switch (S1) is placed in the start position, relay K2 (Crank Ignition) energizes to supply ignition current during the cranking period ONLY. When running, ignition current is supplied through K3 (Ignition Run) relay. All other circuitry in this control functions the same as described in the 611-1127 control theory of operation except for the low oil pressure circuit operation. S3 (low oil pressure switch), closes when oil pressure reaches 8-10 lbs during cranking. The generator supplies current through dropping resistor R1 to relay K3 (Ignition Run) through the LOPKO switch (S3) to ground to keep K3 energized. K3 contacts complete the running ignition circuit. Placing start-stop switch (S1) in the stop position grounds power to K3. K3 de-energizes and its contacts open breaking the ignition circuit.

In the event of a low oil pressure condition (below 10 lbs when running), S3 will open, interrupting current through K3 and shutting down the set.

When the engine starts and accelerates to governed speed, the battery charging circuit is energized through resistor R1, through CR1 to the battery, charging it. Power is also supplied from R1 to the fuel pump and ignition coil through F2 to maintain these devices in operation.

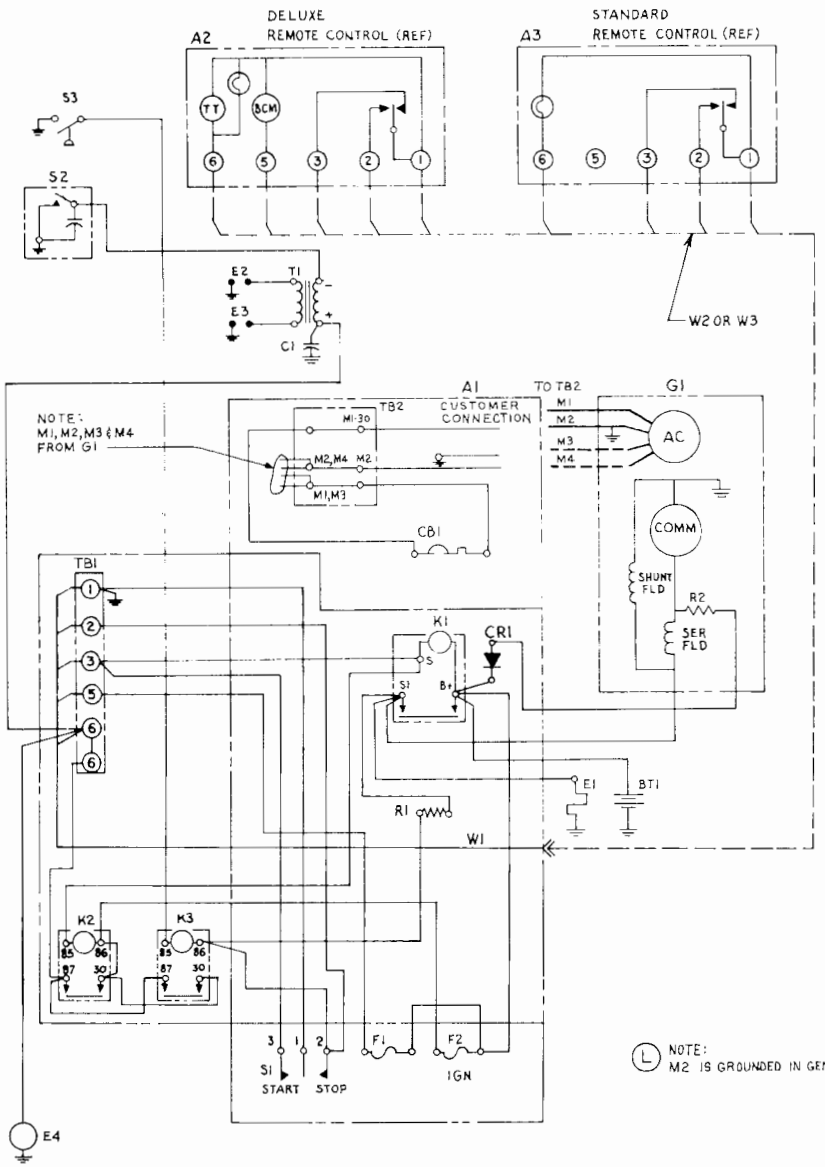
CONTROL—OPERATING SEQUENCE FOR 3.0AJ "RV" MOTOR HOME UNIT (BEGIN SPEC P) - SCHEMATIC #611-1140

This control functions the same as the 611-1135 control used on the twin cylinder sets except that this unit is a single cylinder.

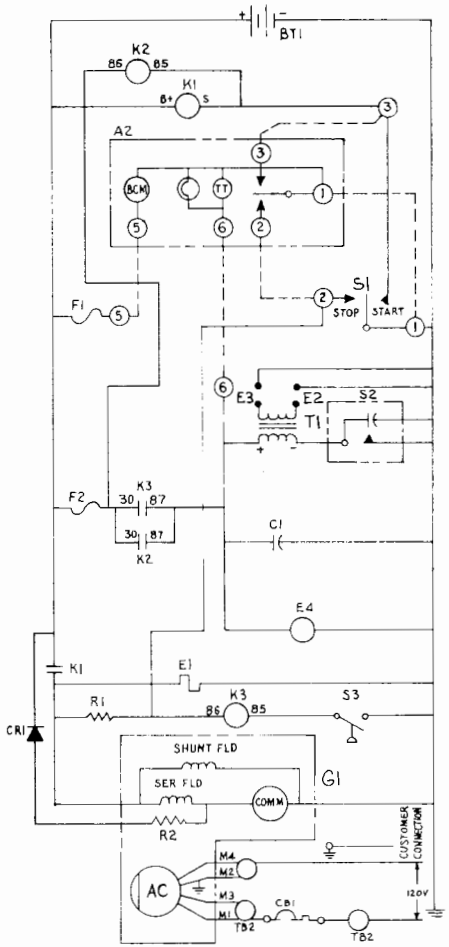
When the engine starts and reaches governed speed; releasing the start switch (S1) allows it to go to the center off position breaking the K1 and K2 coil circuits. This breaks the starting and ignition circuits.

611-1135 DWG SIZE C

WIRING DIAGRAM



SCHEMATIC

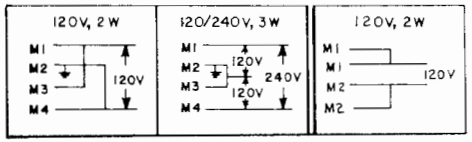


L NOTE:
M2 IS GROUNDED IN GENERATOR

PARTS LIST

REF DES	PART NO	DWG SIZE	QTY	DESCRIPTION
A1	300-1601	D	1	CONTROL ASSY. (-01) 30AMP
	300-1602	D	1	CONTROL ASSY (-02) 40 AMP
	300-1603	D	1	CONTROL ASSY (-03) 50 AMP
	ALL PART NOS LISTED BELOW ARE REF ONLY			
A2	300-0986	B	1	DELUXE REMOTE CONTROL
A3	300-0985	B	1	STANDARD REMOTE CONTROL
BT1			1	BATTERY - 12V
C1	312-0050	A	1	CAPACITOR
CR1	357-0030	P	1	RECTIFIER (BATT. CHARGING)
E1			1	CHOKE - ONAN
E2, 3			2	SPARK - PLUG
E4	149-1542		1	FUEL PUMP
F1, 2	321-0175	P	2	FUSE HOLDER
	321-0174		2	FUSE - 5 AMP 32V
G1			1	GENERATOR
K1	307-1498	B	1	START SOLENOID
K2	307-1575	P	1	RELAY - CRANK IGNITION
K3	307-1575	P	1	RELAY - RUN IGNITION
R1	304-0431	P	1	RESISTOR - 150 ohm 5W
R2				RESISTOR
S1	308-0383	A	1	SWITCH - START, STOP
S2			1	SWITCH - BREAKER & CAP ASSY
S3			1	SWITCH - LOW OIL PRESS
T1	166-0643	C	1	COIL - IGNITION
TB1	332-0699	A	1	TERMINAL BLOCK
TB2	332-0254	A	1	TERMINAL BOARD
	98-3331	B	1	SILKSCREEN - WD (REF)
CB1	320-0544	C	1	CIRCUIT BREAKER 30 AMP (-01)
	320-0547	C	1	CIRCUIT BREAKER 40 AMP (-02)
	320-0548	C	1	CIRCUIT BREAKER 50AMP (-03)
W1	338-1078	C	1	WIRING HARNESS (CONN-REMOTE)
W2	338-1080	C	1	WIRING HARNESS (CABLE-REMOTE CONTROL) (10 FEET LONG)
W3	338-1081	C	1	WIRING HARNESS (CABLE-REMOTE CONTROL) (30 FEET LONG)

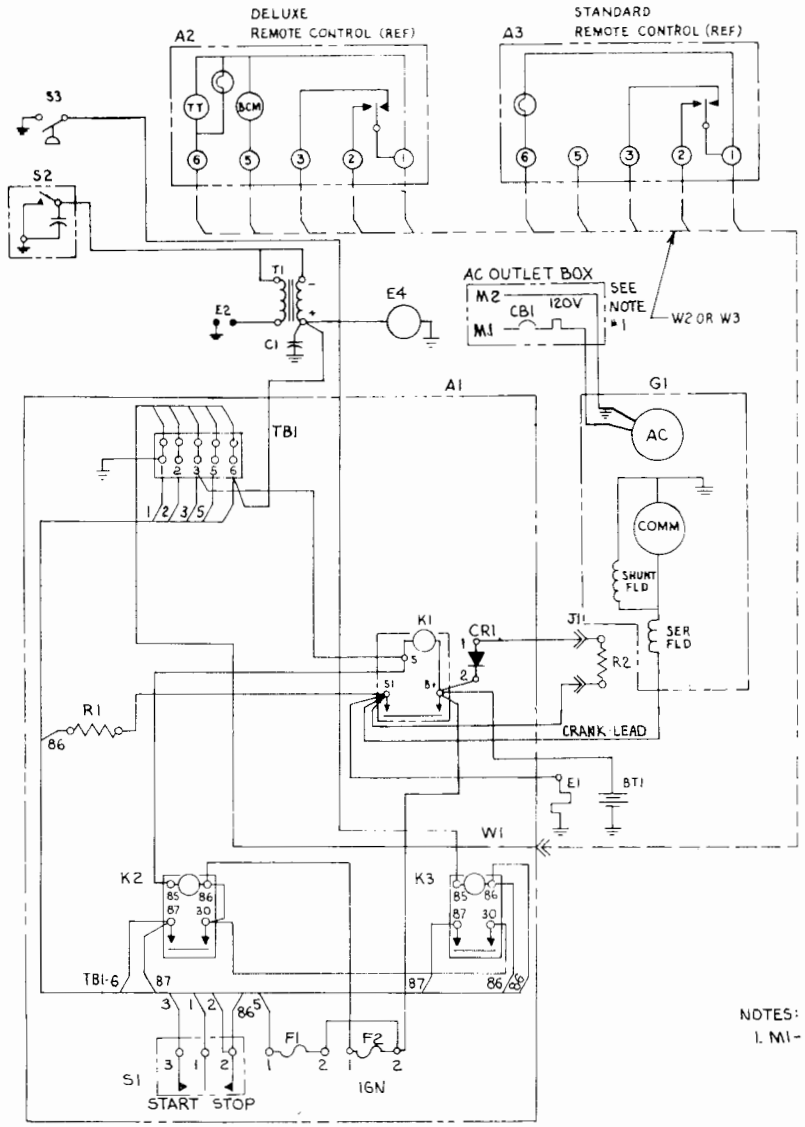
5.0BGA, 6.5 NH RECONNECTION CHART — 4.0 BFA



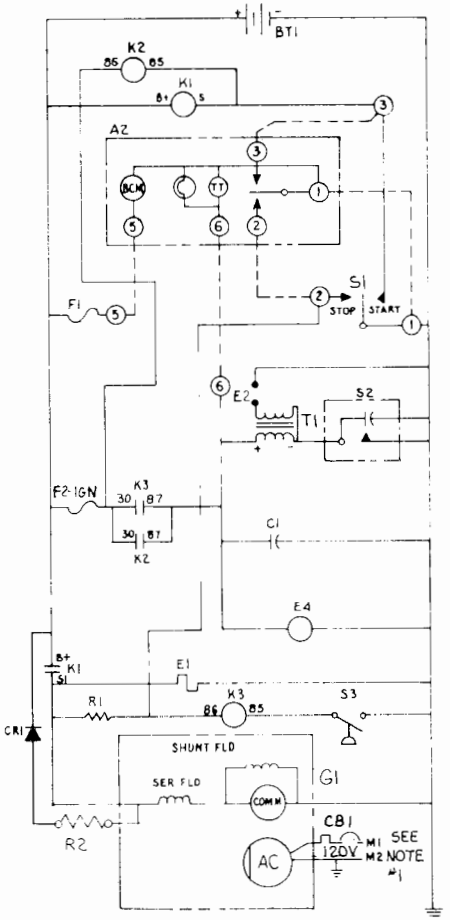
BFA, BGA AND NH RV SETS

611-1140 [C]

WIRING DIAGRAM



SCHEMATIC



NOTES:
1. M1 - BLACK, M2 - WHITE

PARTS LIST				
REF DES	PART NO	DWG SIZE	QTY	DESCRIPTION
A1	300-1584	C	1	CONTROL ASSY
	ALL PART NOS LISTED BELOW ARE REF ONLY			
A2	300-0986	P	1	DELUXE REMOTE CONTROL
A3	300-0985	B	1	STANDARD REMOTE CONTROL
BT1			1	BATTERY - 12V
C1	312-0050	A	1	CAPACITOR
CR1	357-0030	P	1	RECTIFIER (BATT. CHARGING)
CB1	320-0544	C	1	30AMP CIRCUIT BRK
E1			1	CHOKE - QNAN
E2			1	SPARK - PLUG
E4	307-1302	A	1	SOLENOID FUEL SHUT OFF
F1, 2	321-0175	P	2	FUSE HOLDER
	321-0174	P	2	FUSE - 5 AMP 32V
G1			1	GENERATOR
K1	307-1498	B	1	START SOLENOID
K2	307-1575	P	1	RELAY - CRANK IGNITION
K3	307-1575	P	1	RELAY - RUN IGNITION
R1	304-0735	P	1	RESISTOR - 175 ohm 5W
R2	353-0050			RESISTOR - 10 OHM .45 W
S1	308-0383	A	1	SWITCH - START STOP
S2			1	SWITCH - BREAKER & CAP ASSY
S3			1	SWITCH - LOW OIL PRESS
T1	166-0278	C	1	COIL - IGNITION
TB1	332-0604	A	1	TERMINAL BLOCK
	98-3358	A	1	SILKSCREEN - WD
J1	508-0200	A	1	BUSHING - TERMINAL
W1	338-1111	C	1	WIRING HARNESS (CONN-REMOTE)
W2	338-1080	C	1	WIRING HARNESS (CABLE-REMOTE CONTROL) (10 FEET LONG)
W3	338-1081	C	1	WIRING HARNESS (CABLE-REMOTE CONTROL) (30 FEET LONG)

WHEN USED

3.0AJ RV SET
(Begin Spec P)

CONTROL TROUBLESHOOTING

PROBLEM	PROBABLE CAUSE	REMEDY
FAILS TO CRANK	1. Bad Battery Connection	1. Clean and tighten all battery and cable connections.
	2. Low Battery	2A. Check specific gravity. Recharge or replace battery if necessary.
		2B. Reverse current diode (CR1) may be shorted or open causing a drain on the battery. R2 may be open.
	3. Faulty Start Solenoid (K1)	3. Check start solenoid "S" terminal voltage to ground. When battery voltage is present at start solenoid "B+" terminal then battery voltage should also appear at "S" terminal; if not, replace start solenoid.
	4. Faulty Start Switch	4. Jumper switch (TB1 #3 terminal) to ground. If *Solenoid Energizes, Replace Switch.*
CRANKS SLOWLY	1. Bad Battery Connection	1. See 1 above (FAILS TO CRANK)
	2. Low Battery	2. See 2 above (FAILS TO CRANK)
CRANKS BUT WON'T START	1. Blown Fuse (F2)	1. Replace fuse (F2) on control.
	2. Faulty Fuel Solenoid Or Fuel Pump **On later models, fuel solenoid is an integral part of fuel pump.**	2. Fuel solenoid must open during cranking and running. Check by removing steel line from carburetor and crank engine. If fuel solenoid is open, fuel will pulsate out of this line. If it does not, the fuel solenoid and fuel pump must be checked separately to determine defective part. **WARNING** **Use extreme care for this test. Direct fuel flow into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.**
	3. Faulty Ignition	3. Check to see if points open and close during cranking. If they do not open and close, adjust and set points. Plug and plug wires must be in good condition. Voltage at ignition coil negative terminal (-) must alternate from +12 volts to zero volts as points open and close during engine cranking.
	4. Inoperative Choke	4. With engine not running, check choke vane movement by pushing choke lever arm. Choke must be in closed position with cold engine, and must be free to move against bimetal spring. As engine warms up, bi-metal spring relaxes and allows choke vane to open fully. The lever will pulsate as engine warms up. See ADJUSTMENT section.
	5. Faulty Crank Ignition Relay (K2)	5. Check voltage from relay terminal "87" to ground while cranking unit. Battery voltage should appear at this terminal. If not check for voltage at relay terminals "86" and "30". If battery voltage is present at terminals "86" and "30", but not at 87, jumper terminal 85 to ground, if no voltage is present, replace relay. If no voltage appears at terminals 86 and 30 on relay while cranking, check wiring between start solenoid (K1) and crank ignition relay (K2).
UNIT STARTS, BUT STOPS IMMEDIATELY AFTER RELEASING START SWITCH S1	1. Resistor R1 may be open. 2. S3 Low oil pressure switch may be defective. 3. Run Ignition Relay K3. 4. Low Oil Level.	1. Check voltage on both sides of R1. With set running voltage should be 24-32 volts DC on generator side. K3 side should be 8-16 volts. 2. Check S3. Switch should close with set running at 10 lbs. minimum oil pressure. Check by jumpering (K3) terminal #85 to ground while cranking. 3. Check voltage at terminal #86 of K3. Should be 8-16 volts depending on load. 4. Check oil level. If low or empty, refill to proper level.
UNITS RUNS THEN STOPS	1. Low Oil Level	1. See 4 above.
UNITS RUNS BUT SURGES	1. Stuck Choke	1. See 4 above (CRANKS BUT WON'T START)
	2. Governor Not Adjusted Properly	2. Readjust governor.
UNITS STOPS	1. Faulty Ignition	1. See 3 above (CRANKS BUT WON'T START)
	2. Out of Fuel	2. Refill fuel tank.
	3. Low Oil Level	3. See 1 above
REMOTE RUNNING TIME METER OR GENERATOR LAMP INOPERATIVE	1. Blown Fuse (F1)	1. Replace F1 fuse on control.

OPERATING SEQUENCE FOR CONTROL #300-1185
SOLID STATE IDLEMATIC

Function

The control is designed to reduce engine speed during a no load condition from nominal 3600 to approximately half speed or 1800 RPM. On a load application, the control will then allow the engine governor to assume speed control and accelerate back to its nominal 3600 RPM.

Operation

When load is removed from the generating set, SCR6 turns off removing the short from capacitor C1. C1 and R1 provide a RC time constant to delay "turn on" of SCR2 (20-40 seconds) when load is removed. When capacitor C1 has reached a preselected charge level, then zener CR4 conducts and turns SCR2 on. When SCR2 is turned on, a circuit is completed from ground through the solenoid coil through SCR2 through switch S1 back to the generator and ground energizing the shutdown or slowdown solenoid. The engine speed drops to approximately 1800 RPM. As long as no load is applied to the generating set, this RPM will be maintained by the solenoid overriding the governor.

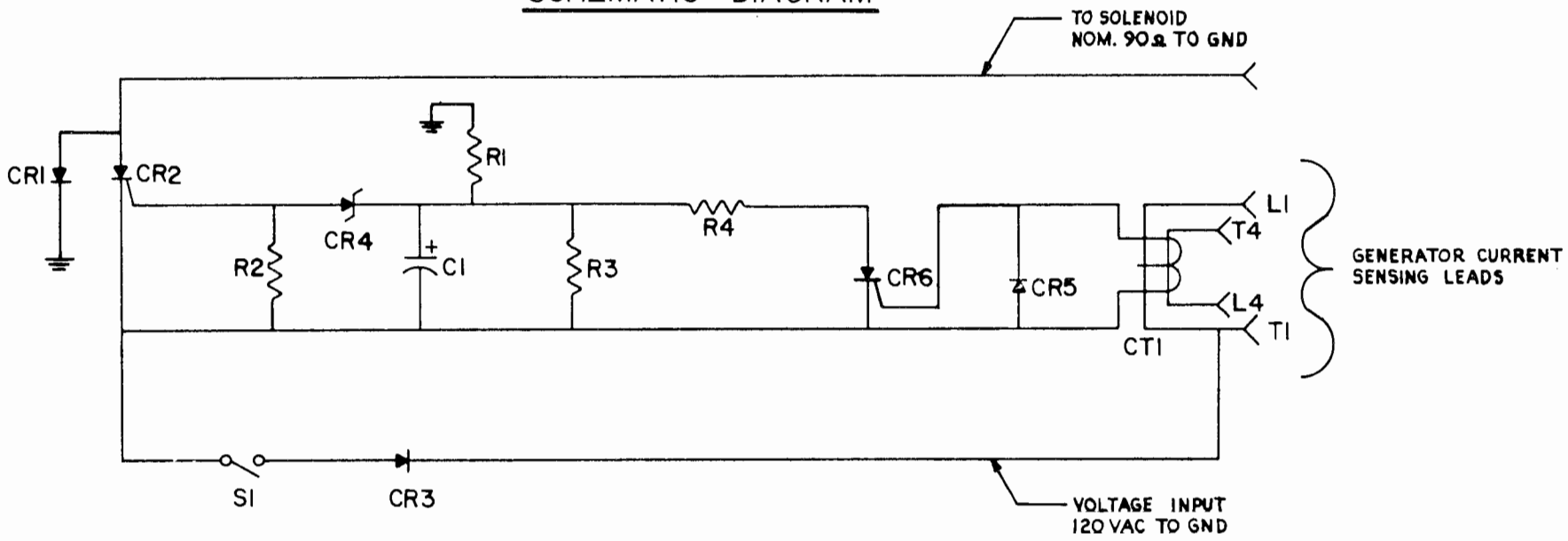
Load Application

When load is applied to the generating set, an output is produced at current transformer CT1 which gates SCR6 (turns it on) shorting out the signal to SCR2. This causes SCR2 to turn off and the solenoid de-energizes and allows the engine to speed up to 3600 RPM. The generator set will continue to run at 3600 RPM until the 30-40 second time interval has passed with no load or as long as a load is placed on the generating set..

Continuous 3600 RPM

To disable the control and maintain generator set speed at 3600 RPM, turn switch S1 to the off position which breaks the solenoid circuit and de-activates the control. Should SCR2 short, the control will operate to maintain the 1800 RPM. Should this occur, disconnect the solenoid or open switch S1. Should SCR6 short out, the generating set will run at a continuous 3600 RPM. CR3 is a blocking diode. CR5 is a discharge diode for the current transformer.

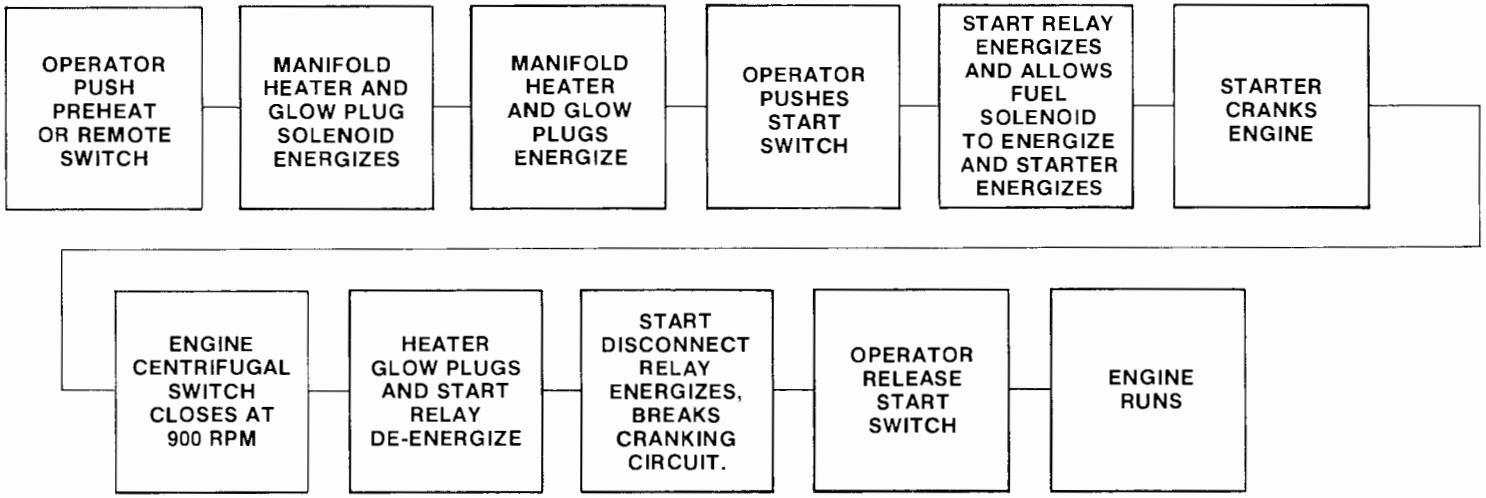
SCHEMATIC DIAGRAM



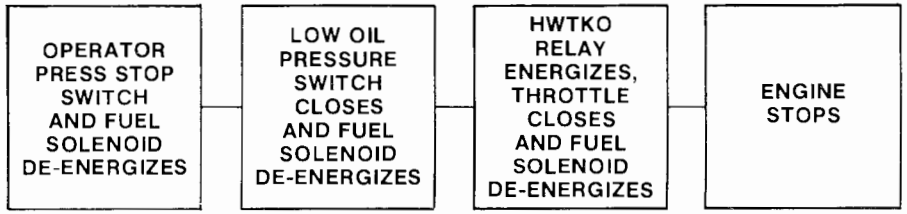
300-1185
IDLE MATIC

"J" SERIES UNITS

STARTING SEQUENCE-DIESEL POWERED UNITS



STOPPING SEQUENCE DIESEL



Starting Sequence

The starting and stopping sequence shows the manual, mechanical, and electrical events required for satisfactory start, run and stop cycles.

OPERATING SEQUENCE FOR DIESEL GENERATING SET CONTROL #612-4792

Starting Circuit

The common practice for placing "Onan" Class "A" controls into operating condition is by grounding certain components. The switch is used to place this ground on the affected components.

Moving the handle of the manifold heater switch S12 to the preheat position causes a current flow from B+, through the coil of manifold heater solenoid K13 to ground and back to battery negative terminal. This causes manifold heater relay K13 to energize and closes its contacts to supply power to the manifold intake heater and glow plugs. If the preheat circuit is controlled by a load transfer control, this relay is energized by the grounding of terminal "H." The length of preheat can be selected through the use of a relay or through manually holding heater switch S12 on.

After the preheat period has passed, the load transfer control will cause terminal 3 to be grounded energizing the starting circuit. The starting circuit can also be energized by placing start-stop switch S11 in the start position. This allows battery current to flow from the B+ through start solenoid relay coil K11, through the closed contacts of the start-disconnect and fuel solenoid relay K12, through the start switch S11, to the center terminal to ground and to the battery causing start solenoid K11 to energize. K11 start solenoid energizes and causes its main contacts to close, connecting the battery through the cranking motor. At the same time the main contacts of K11 are closed, an auxiliary circuit is also completed from start solenoid K11 through the contacts of the emergency time delay relay K14, to the fuel solenoid K1, and to the battery. The fuel solenoid K1 is a two coil unit with a pickup coil and a holding coil. This relay energizes to take pressure off the control arm of the fuel injection pump and allows the metering sleeve to be positioned so fuel is supplied to the injectors so the engine can fire, start and run.

When the engine has started and accelerated to approximately 900 RPM, the centrifugal disconnect switch S1 closes. When switch S1 closes, battery current flows through its contacts, through resistor R11, through the coil of the start-disconnect and fuel solenoid relay K12 to the battery. This causes the K12 relay to energize and breaks the circuit to the start solenoid relay K11 causing the start solenoid K11 to de-energize and remove the cranking motor from the battery. At the same time, another set of K12 contacts close supplying power from the charging circuit or the battery through the normally closed contacts of emergency relay K14 to the fuel solenoid K1. This keeps relay K1 (fuel solenoid) energized and allows the governor to control the fuel injection pump.

The engine governor will maintain engine speed at approximately 1860 RPM (62 cycles) or a fairly constant speed with load added.

Voltage Buildup

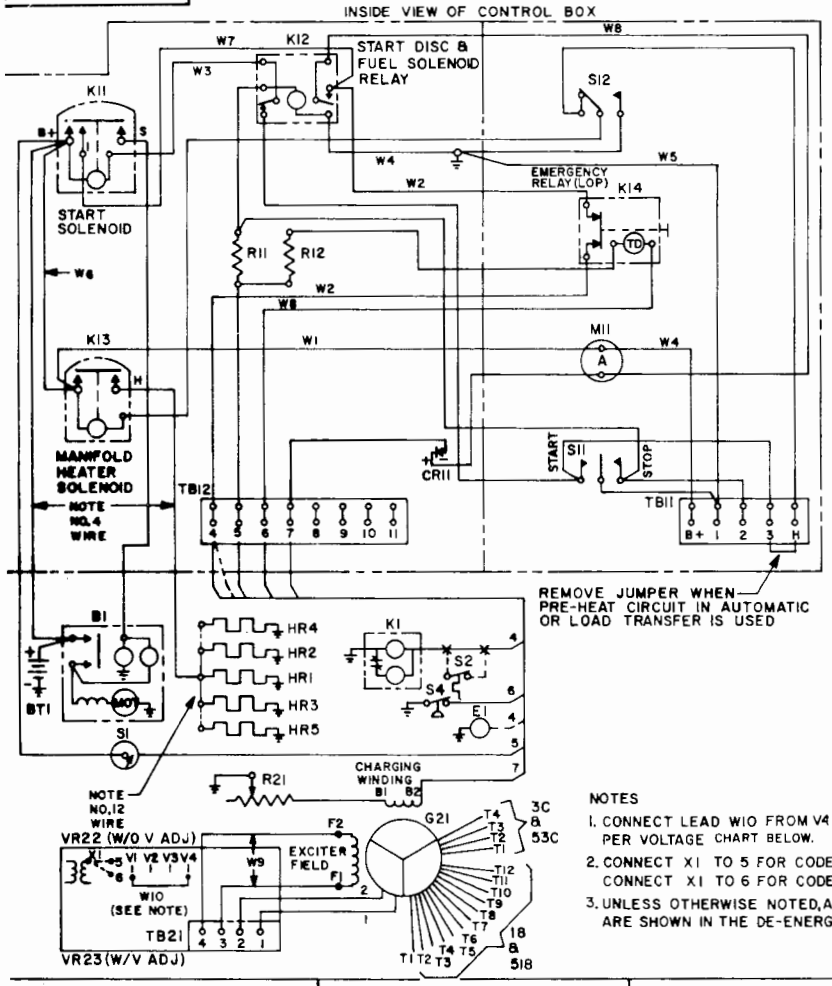
One pole face on the exicter field assembly has a permanent magnet imbedded in it. This is installed at the time the lamination stack is assembled. This permanent magnet aids in the voltage build-up in the exciter. The residual magnetism of the pole pieces plus the permanent magnet in the one pole, causes a high residual voltage to be produced. This produces, in the three phase exciter rotor, a voltage which is rectified by a network of three positive and three negative diodes to the generator rotor for field excitation. The voltage produced in the stator is supplied to the voltage regulator which controls the turn on point of the SCR's and in turn controlling field current. When the generator's voltage reaches the control point, the voltage regulator maintains field current to hold essentially constant output voltage.

Battery Charging Circuit

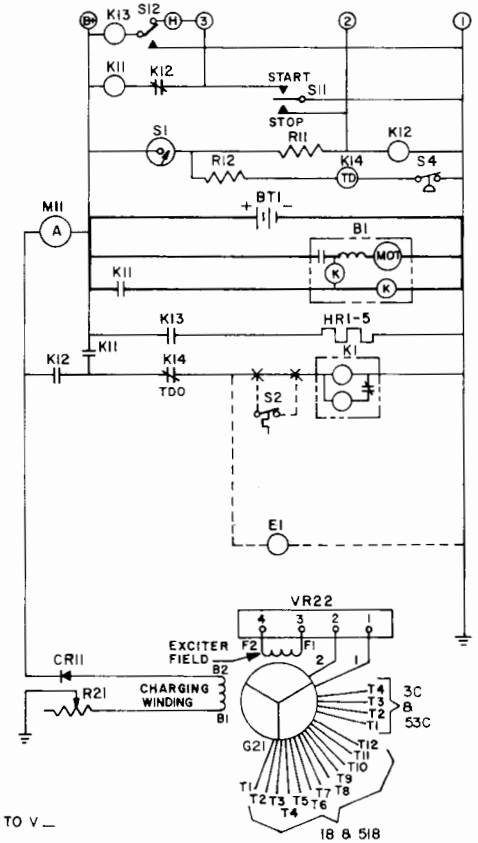
A separate battery charge winding is placed in the generator stator and has a voltage produced in it dependent upon the field strength of the main generator. The charging current is controlled by resistor R21. This charging circuit is essentially a 5 ampere circuit. Battery charging current is supplied through diode CR11 to the ammeter and to the battery back to ground and to the charging winding. This charges the battery and prepares it for supplying power for the next start. The charge winding also supplies power to maintain the fuel solenoid K1, energized.

612-4792

WIRING DIAGRAM

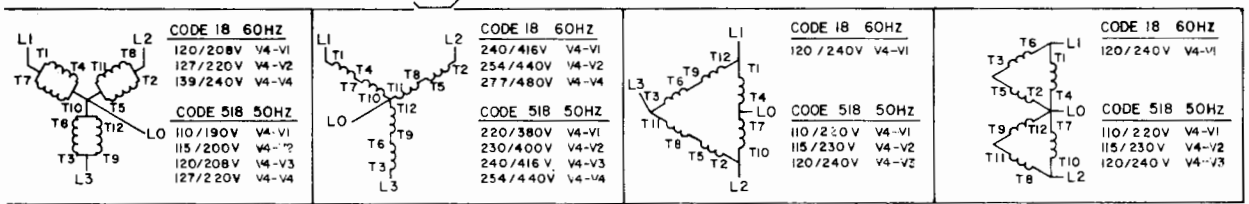


SCHEMATIC DIAGRAM



NOTES

1. CONNECT LEAD W10 FROM V4 TO V— PER VOLTAGE CHART BELOW.
2. CONNECT X1 TO 5 FOR CODE 53C & 518(50HZ)
   CONNECT X1 TO 6 FOR CODE 3C & 18(60HZ)
3. UNLESS OTHERWISE NOTED, ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION.



CODE 18 60HZ		
120/208V	V4-V1	
127/220V	V4-V2	
139/240V	V4-V4	
CODE 518 50HZ		
110/190V	V4-V1	
115/200V	V4-V2	
120/208V	V4-V3	
127/220V	V4-V4	

CODE 18 60HZ	
240/416V	V4-V1
254/440V	V4-V2
277/480V	V4-V4
CODE 518 50HZ	
220/380V	V4-V1
230/400V	V4-V2
240/416V	V4-V3
254/440V	V4-V4

CODE 18 60HZ	
120/240V	V4-V1
CODE 518 50HZ	
110/220V	V4-V1
115/230V	V4-V2
120/240V	V4-V3

CODE 18 60HZ	
120/240V	V4-V1
CODE 518 50HZ	
110/220V	V4-V1
115/230V	V4-V2
120/240V	V4-V3

CODE 18 60HZ	
120V	V4-V1
CODE 518 50HZ	
110V	V4-V1
115V	V4-V2
120V	V4-V3

CODE 3C & 53C

CODE 3C,60Hz 240V V4-V1 1PH 2W
CODE 53C,50Hz 220V V4-V1 230V V4-V2 240V V4-V3 1PH,2W

CODE 3C,60Hz 120V V4-V1 1PH 2W
CODE 53C,50Hz 110V V4-V1 115V V4-V2 120V V4-V3 1PH,2W

CODE 3C,60Hz 120/240V V4-V1 1PH 3W
CODE 53C,50Hz 110/220V V4-V1 115/230V V4-V2 120/240V V4-V3 1PH,3W

MODEL	VR22 4 CYL.	VR23 4 CYL	VR22 MARINE	VR23 MARINE	VR22 2 CYL	VR23 2 CYL.
3CR & 53CR	-01	-03	-05	-07	-09	-11
18R & 518R	-02	-04	-06	-08	-10	-12

(B) (C) MARINE

C ADDED -09 THRU -12 — 5-17-74

* WHEN USED DIESEL

MODEL NO
4.5 & 9.0KW-53CR/96AA
4.5 & 9.0KW-518R/96AA
6.0 & 12.0KW-3CR/96AA
6.0 & 12.0KW-18R/96AA
6.0,10.0 & 12.0KW-53CR/1AA
6.0,10.0 & 12.0KW-518R/1AA
7.5,12.0 & 15.0KW-3CR/1AA
7.5,12.0 & 15.0KW-18R/1AA

1 & 3 PH, 50 & 60HZ

ENG PARTS LIST (REF)

REF. DES.	PART NO.	QTY.	DESCRIPTION
B1		1	STARTER & SOLENOID
BT1		1	BATTERY 12V
* E1		1	FUEL PUMP
HR1		1	HEATER-MANIFOLD
HR2,3		2	HEATER-GLOW PLUG (2 CYL)
HR2-5		4	HEATER-GLOW PLUG (4 CYL)
K1	307-0628	1	SOLENOID-FUEL
S1		1	SWITCH-CENTRIFUGAL
* S2		1	SWITCH-HIGH TEMP
S4		1	SWITCH-LOW OIL PRESS

AC PARTS LIST

G21		1	GENERATOR
R21	304-0709	1	RESISTOR ASSY
VR22	305-0532	1	REGULATOR ASSY-VOLTAGE (W/O V ADJ) -01,-02,-05,-06,-09,-10
VR23	305-0533	1	REGULATOR ASSY-VOLTAGE (W/V ADJ) -03,-04,-07,-08,-11,-12
W9	338-0744	1	WIRING HARNESS (F1-F2)

CONTROL BOX PARTS LIST

CR11	305-0496	1	RECTIFIER & LEAD ASSY
K11	307-0845	1	RELAY-START SOLENOID
K12	307-0623	1	RELAY-START DISC & FUEL SOLENOID
K13	307-1046	1	RELAY-MANIFOLD HEATER
K14	320-0104	1	RELAY-EMERGENCY (LOP)
M11	302-0446	1	AMMETER-CHARGE 5-0-5
R11,S11	308-0307	1	SWITCH & RESISTOR ASSY
R12	304-0697	1	RESISTOR & LEAD ASSEMBLY
S12	308-0304	1	SWITCH & LEAD ASSY
TB11	332-0604	1	TERMINAL BLOCK
	332-0616	1	MARKER STRIP
TB12	332-0706	1	TERMINAL BLOCK
	332-0739	1	MARKER STRIP
W1	336-1466	1	LEAD ASSY
W2	336-2289	2	LEAD ASSY
W3	336-1470	1	LEAD ASSY
W4	336-1465	2	LEAD ASSY
W5	336-0179	1	LEAD ASSY
W6	332-0602	1	JUMPER
W7	336-1470	1	LEAD ASSY
W8	336-1045	2	LEAD ASSY
	301-1961	1	PANEL-CONTROL BOX
	301-1962	1	CONTROL BOX
	301-3714	1	COVER-REGULATOR
	301-3683	1	SADDLE-CONTROL BOX
	301-3682	1	OUTPUT BOX -01,-02,-03,-04
	301-0856	1	COVER -01,-02,-03,-04
	301-2467	1	OUTPUT BOX -05 THRU -12
	301-2466	1	COVER -05 THRU -12
	508-0183	1	GROMMET
	402-0070	4	RUBBER MOUNTS
	337-0036	1	GROUND STRAP
	98-1683	1	SILKSCREEN(ADD LOW OIL & RESET)
	98-2606	1	SILKSCREEN(3CR,53CR)-01 THRU -11
	98-2607	1	SILKSCREEN(18R,518R)-02 THRU -12

STANDARD DIESEL CONTROL 612-4792

Low Oil Pressure Cut-Out (LOPKO)

The low oil pressure cutout circuit is from the battery side of the ammeter through the centrifugal disconnect switch S1 to resistor R12, through the heater of the emergency time delay relay K14 and through the low oil pressure switch S4 to ground. Resistor R12 sets the timing interval of emergency relay K14. Should there be a loss of oil pressure or an excessive drop in level, switch S4 will close and the emergency time delay relay K14 will operate in approximately 15 seconds. When time delay relay K14 operates due to low oil pressure, its normally closed contacts open and break the circuit to the fuel solenoid K1. The fuel solenoid de-energizes and its plunger drops down on the control arm of the fuel injection pump causing the fuel to spill and shuts down the engine.

Unit Stopping

To stop the engine it is necessary to ground terminal #2 through the load transfer control or to place start-stop switch S11 in the stop position. Grounding terminal #2 or placing start-stop switch S11 in the stop position causes a ground to be placed on the supply side of the start-disconnect and fuel solenoid relay K12. Relay K12 de-energizes, its contacts open and break the circuit to the fuel solenoid K1 causing engine shutdown. Resistor R11 is placed in the circuit so a short circuit or direct ground is not placed on the battery charging circuit.

Fast Troubleshooting

If the ammeter does not indicate a charge, it usually means the generator has not built up voltage. This generator does not have an automatic field flash circuit; and consequently, it is necessary to make a field voltage measurement. This can be done across terminals 3 and 4 at the end bell of the generator or at terminal 7 or 8 of the voltage regulator assembly. Terminal 8 is positive and terminal 7 is negative. Should no voltage be measured at these points, refer to the "YD" Generator Service Manual (900-0184).

The water-cooled units have a high water temperature cutoff switch S2 in series with the fuel solenoid K1. This switch can be checked by placing a jumper across the terminals of the switch and closing the start switch S11 to see if the solenoid energizes.

If there has been a low oil pressure cutout condition, the red button on the emergency relay K14 will be sticking out. One minute of "cool down" is required before resetting (pushing in the button) the relay to place it back in operation. A shorter time may result in the solder pot not fusing correctly and permitting the button to be pushed out by the spring when the unit vibrates.

Should the centrifugal switch S1 fail to close or make contact, the start-disconnect and fuel solenoid relay K12 will de-energize as soon as the start switch S11 is released and then the unit will shut down. This causes a cycling condition on the generator set. The centrifugal switch S1 can be checked by removing the cover and holding the contacts closed manually after the unit has started. Set the centrifugal disconnect switch gap at approximately .025 inches for proper wipe and contact pressure. Should the centrifugal switch S1 fail to open on shutdown, it will cause a battery discharge and burn out of the emergency time delay relay (K14).

OPERATING SEQUENCE FOR "MARINE" DIESEL CONTROL #612-2334

Starting Circuit

The common practice for Onan controls is to ground the center of the switch portion of all start-stop switches. The operation of the control is accomplished through grounding certain components.

Moving the handle of the manifold heater switch S11 to the heat position energizes the manifold solenoid K12, which then supplies battery power through the main contact of relay K12 to the glow plugs and the manifold heater. This switch should be held in this position for 30 seconds normally or if weather conditions are such that extreme cold is encountered, then for either one minute or two minutes.

After a sufficient pre-heat time has been allowed, placing the start-stop switch S12 in the start position causes a current flow from the B+ terminal of start solenoid K11 to the coil, to the start-disconnect and fuel solenoid relay K13. Then from this point through the normally closed contacts of that K13 relay, to the start side of the start-stop switch S12 to terminal one on the terminal connection block to ground. This energizes the start solenoid K11 and supplies battery power to the solenoid shift on the cranking motor and then to the starter, cranking the engine.

Battery voltage is picked up at the ammeter and this causes a current flow to the coil of the start relay K14 through the coil to the normally closed contacts on the K13 relay to the start switch S12 and to ground. This causes the start relay K14 to energize. From the battery a current flows through the ammeter, through it to the start relay K14 contacts, which are now closed, through the contacts on the emergency relay K15. (This is a low oil pressure relay and its heater is energized when the unit starts and if the low oil pressure switch fails to open.) Through these contacts to the terminal 4 on the terminal block, to the high temperature cut-out switch S2, to the fuel solenoid K1. This energizes the fuel solenoid K1 and allows the governor to position the metering sleeve in the fuel injection pump to full fuel. With the manifold heater switch S11 released and the start switch S12 still closed, the starter solenoid K11 and the manifold heater solenoid K12 remain energized. Battery power is supplied to the glow plugs and manifold heater and to the cranking motor.

Start-Disconnect Circuit

The cranking motor continues to crank the engine until it starts and accelerates. 900 RPM is the speed at which the centrifugal switch S1 has been set to operate. The centrifugal switch S1 is driven by a gear from the camshaft gear. As centrifugal force is high enough the weights fly out allowing the cam to drop in and the centrifugal disconnect closes. When the centrifugal switch S1 closes, battery power is supplied through this switch to the 15 ohm, 10 watt resistor R12, to the coil of the start disconnect and fuel solenoid relay K13 and to ground. This energizes K13 relay causing the normally closed contacts to open and break the start solenoid K11 circuit. This also de-energizes the coil on the start relay K14. The contact in the start relay K14 opens just after the contacts in the start-disconnect and fuel solenoid relay K13 close. This supplies power to the fuel solenoid K1 and keeps it energized so that it does not release and cause the injection pump control metering sleeve to go to minimum fuel and stop the engine.

The engine governor maintains the engine speed at rated value for that particular unit. In this case it is 1800 RPM.

Battery Charging Circuit

When the engine has come up to speed the residual magnetism in the rotor poles produce a small voltage in the battery winding of the generator. A consequent voltage build up is produced. When voltage has built up to normal then the battery charge winding in the stator has a voltage produced in it which is directed through the charge rectifier CR11 to the charge ammeter to the battery terminal on the manifold heater solenoid K12 and to the battery, recharging it. The charge resistor R1, is adjustable for the most satisfactory charge rate. It is factory set at approximately 5 amperes. The charge rectifier CR11 replaces the reverse current relay used in earlier models. It is a battery charge diode and this unit has only the one step of battery charging.

Low Oil Pressure Cut Off (LOPKO)

The one ohm, 10 watt resistor R11 is to limit the current through the heater on the emergency relay K15. This heater gets current only after the generator has come up to a certain speed and centrifugal switch S1 has closed. Should low oil pressure remain for 15 seconds, the heater HR1 will allow the ratchet to release and contacts will open breaking the circuit to the fuel solenoid K1 causing a shut down.

Unit Stopping

Placing the start-stop switch S12 in the stop position, shorts out the power supply to the start-disconnect and fuel solenoid relay K13 and breaks the circuit to the fuel solenoid K1. The K1 solenoid shaft applies force to the injection pump control arm causing positioning of the metering sleeve to "No fuel" position. The engine stops due to lack of fuel to the injectors. Fuel removal is the only means provided for stopping the Onan diesel.

Fast Troubleshooting

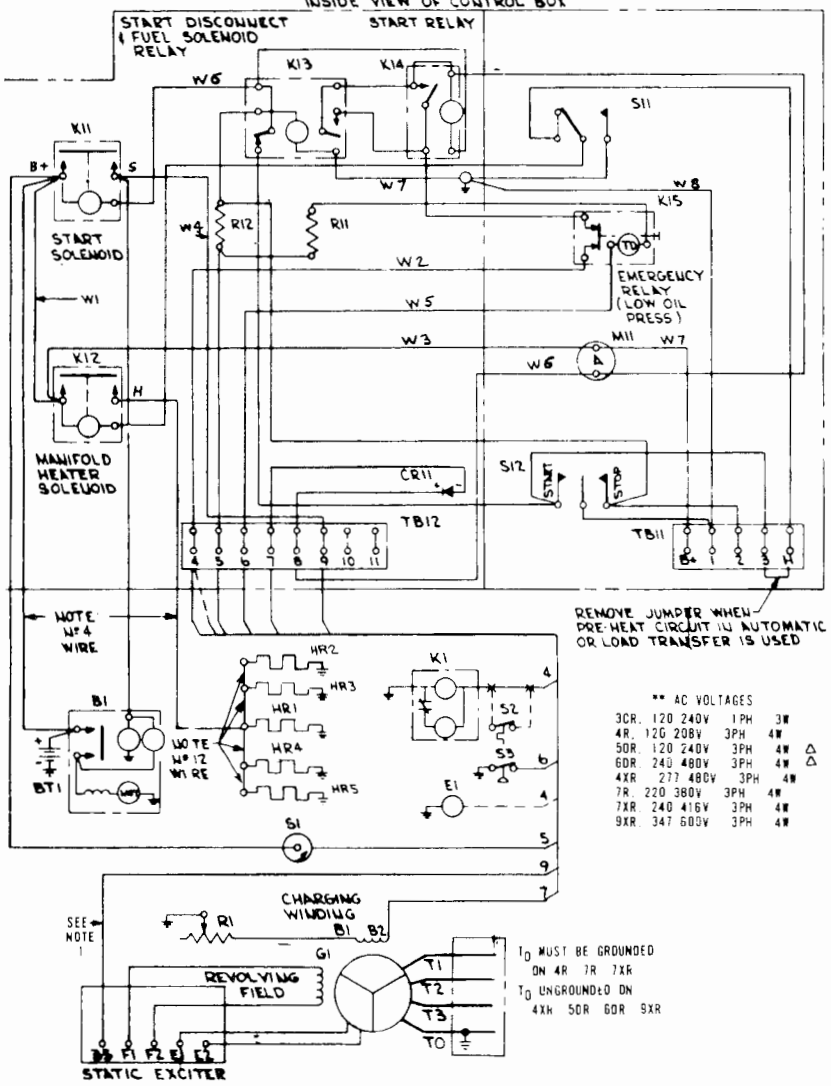
The ammeter indicating "0" usually means the generator has not built up voltage. This generator has an automatic field flash circuit which receives power from the "F" terminal of the start solenoid K11. When K11 start solenoid is energized, power is applied to the static exciter and to the revolving field for faster voltage build up. The 12-volt battery used does not cause damage to the exciter nor to the revolving field due to the high cranking current causing a substantial voltage drop across the battery and reducing this voltage to approximately 8-volts.

Should the centrifugal switch S1 fail to close or make contact, the start-disconnect and fuel solenoid relay K13 will not energize and as soon as the S12 start switch is released the unit will shut down. This can be readily checked by taking the cover off the S12 switch and holding contacts closed manually. It also can be checked by taking the cover off the control box and holding the start-disconnect and fuel solenoid relay K13 armature closed by hand. Should centrifugal switch S1 fail to open on shut down, it will cause a battery discharge and also cause the operation of the emergency relay K15.

612C2334

WIRING DIAGRAM

INSIDE VIEW OF CONTROL BOX



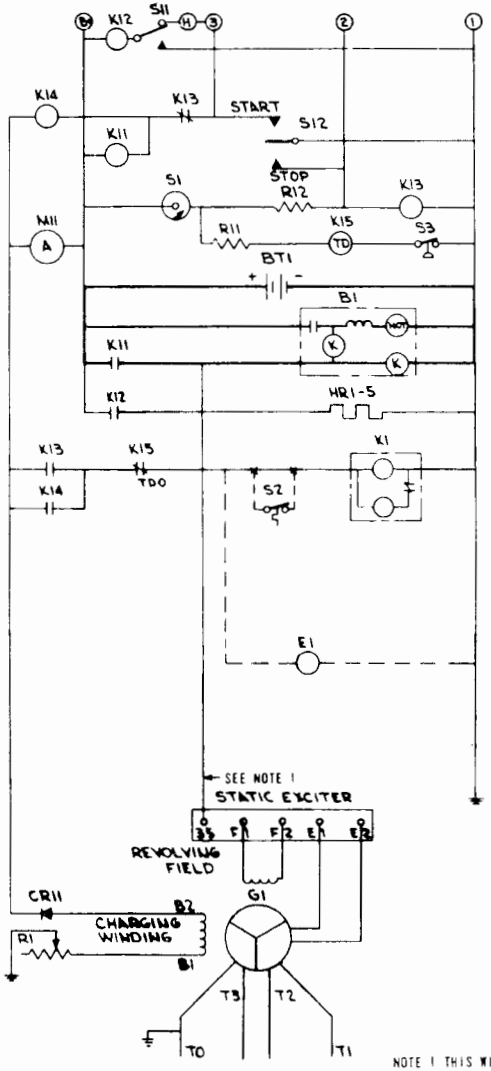
** AC VOLTAGES

3CR. 120 240V	1PH	3W	
4R. 120 208V	3PH	4W	
5DR. 120 240V	3PH	4W	△
6DR 240 480V	3PH	4W	△
4XR 277 480V	3PH	4W	
7R. 220 380V	3PH	4W	
7XR 240 416V	3PH	4W	
9XR. 347 600V	3PH	4W	

T_0 MUST BE GROUNDED ON 4R 7R 7XR

T_0 UNGROUNDED ON 4XR 5DR 6DR 9XR

SCHEMATIC

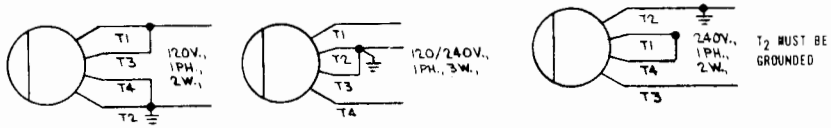


NOTE 1 THIS WIRE USED FOR 3CR 4R 7R 7XR ONLY

ENG-GEN PARTS LIST (REF)		
REF DES	QTY	DESCRIPTION
B1	1	STARTER & SOLENOID
C11	1	BATTERY 12V
E1	1	FUEL PUMP
G1	1	GENERATOR & STATIC EXCITER ASSY
HR1	1	HEATER-MANIFOLD
HR2-5	4	HEATER-GLOW PLUG
K1	1	SOLENOID-FUEL
R1	1	RESISTOR-CHARGE ASSY
S1	1	SWITCH-CENTRIFUGAL
S2	1	SWITCH-HIGH TEMP
S3	1	SWITCH-LOW OIL PRESS
CONTROL BOX PARTS LIST		
	1	RECTIFIER & LEAD ASSY
CR11	1	DIODE-RECTIFIER
	1	BRACKET-RECTIFIER MTG
K11	1	RELAY-START SOLENOID
K12	1	RELAY-MANIFOLD HEATER
K13	1	RELAY-START/DISC & FUEL
	1	RELAY & LEAD ASSY
K14	1	RELAY-START IGN
K15	1	RELAY-EMERGENCY (LOP)
M11	1	AMMETER-CHARGE 5-0-5
R11	1	RESISTOR-1 OHM, 10 W
	1	SWITCH & LEAD ASSY
S11	1	SWITCH-TOGGLE
	1	SWITCH & RESISTOR ASSY
S12	1	SWITCH-START/STOP
R12	1	RESISTOR 15 OHM, 10 W
TB11	1	TERMINAL BLOCK
	1	MARKER STRIP
TB12	1	TERMINAL BLOCK
	1	MARKER STRIP
W1	1	JUMPER
W2	1	LEAD ASSY 8"
W3	1	LEAD ASSY 13-1/2"
W4	1	LEAD ASSY 7"
W5	1	LEAD ASSY 8"
W6	2	LEAD ASSY 9"
W7	2	LEAD ASSY 12"
W8	1	LEAD ASSY 12"
	1	PANEL-CONTROL BOX
	1	CONTROL BOX
	1	COVER-CONTROL BOX
	1	BRACKET-CONT BOX MTG
	1	BRACKET-OUTPUT BOX
	1	GROMMET
	4	MOUNTS
	1	STRAP-GROUND
	1	COVER-OUTPUT BOX
	1	OUTPUT BOX
	1	GROMMET (OUTPUT BOX)
	1	SILKSCREEN (ADD LOW OIL & RESET)
	1	SILKSCREEN (3CR ONLY)

*WHEN USED

SINGLE PHASE AC LOAD CONNECTIONS (3CR)



NOTE 2 UNLESS OTHERWISE NOTED ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION

STANDARD MARINE DIESEL CONTROL

612-2334

CONTROL—OPERATING SEQUENCE FOR "DJA" AND "MDJA" UNITS #610-0328

Starting Circuit

Place the preheat switch in the "preheat" position. Battery current will flow through the coil of K2, through the preheat switch back to ground and to the battery. K2 energizing will complete the circuit to the manifold heater and the glow plug. After a sufficient preheat time place the start switch (S1) in the "start" position, battery current will flow through coil K1, through the start switch (S1) to ground and to the battery. When K1 energizes, its large contacts will close connecting the cranking windings of the generator to the battery. The generator acting as a DC cranking motor will cause the engine to turn. At this point the decompression mechanism maintains the exhaust valve in the open position preventing compression buildup. When the generator has cranked the engine long enough and to a high enough RPM, the low oil pressure switch S5 closes. When it closes, battery current will flow through the large contacts of K1, through the charging resistor through resistor R3 to the coil of relay K4, through the low oil pressure switch (S5) to ground. K4 relay energizes and its contacts close. This is the decompression solenoid relay. When its contacts close, a circuit is provided from the battery, through the ammeter, through the K4 contacts, through the high temperature cutout switch, to the decompression solenoid, to ground to the battery. The decompression solenoid (K5) energizes and its plunger pulls back and allows the decompression mechanism mounted on the head and in the valve cover to operate removing the pressure from the exhaust valve rocker allowing the exhaust valve to close. When the exhaust valve closes, compression takes place and with fuel injected the charge is fired and the engine starts and accelerates to govern speed.

When the engine has reached approximately 900 RPM, releasing the start switch (S1), breaks the starting circuit. If the unit is controlled by an automatic demand control, then the control will break the starting circuit when the generator's voltage has reached a value high enough to close the line relay. The decompression solenoid has a resistor in series with the pickup coil to maintain it energized after starting so both pickup coil and holding coil are energized to aid in maintaining compression on the unit.

Battery Charging

With the engine running at 1860 RPM, the generator should be producing both AC output voltage and excitation and battery charging voltage. The battery charging circuit is completed from the S1 terminal to the start solenoid S1 terminal to resistor R2 (adjustable) to the current coil of the reverse current relay (K3) through the contacts of K3 to the ammeter and to the battery. R2 is adjustable to provide a means of altering the battery charging rate.

When the unit is stopped, a reversal of current through the current coil of K3 relay causes an opposing effect on the magnetic fields and the armature drops out breaking the charging circuit. This prevents the battery from discharging back through the generator on shutdown.

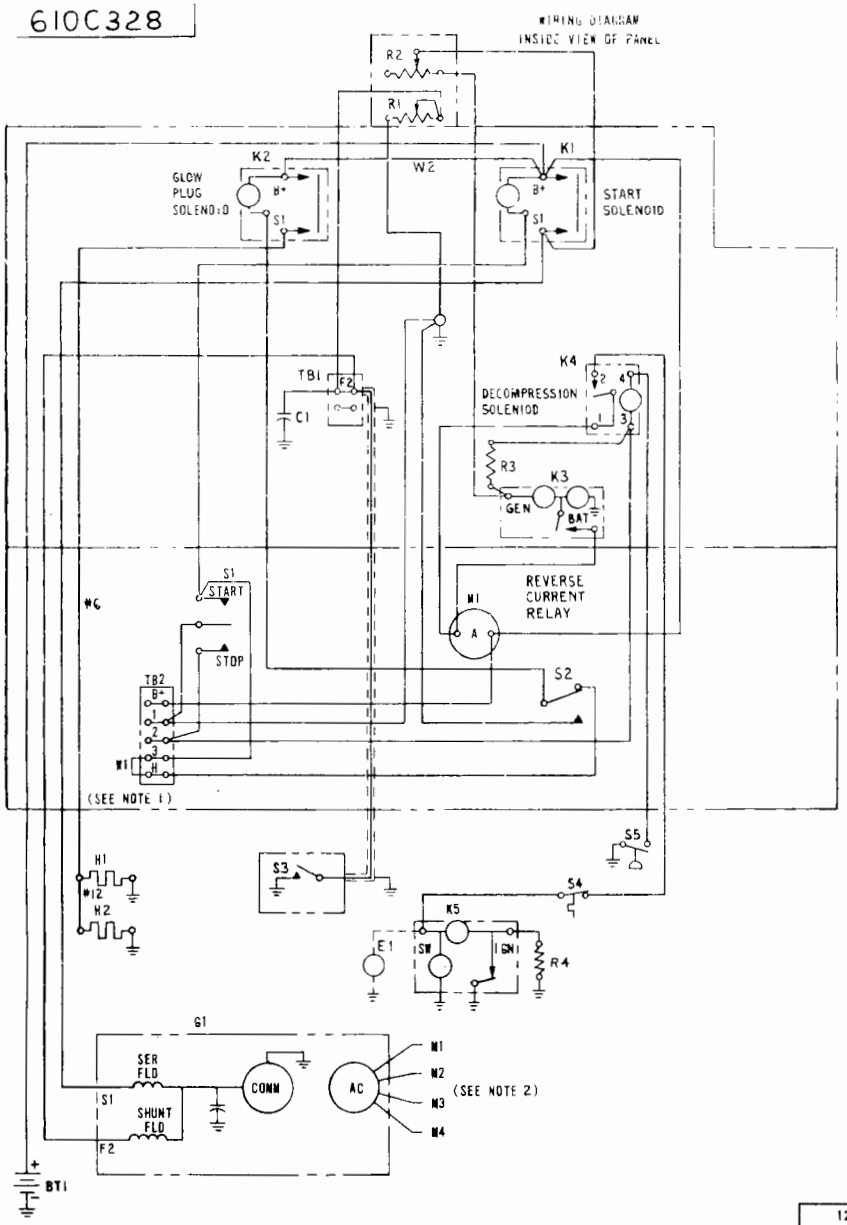
Stop Circuit

To stop the unit place the switch S1 in the stop position. This places a ground on the supply side of K4 decompression solenoid relay causing it to de-energize. When it de-energizes, its contacts open breaking the circuit to the decompression solenoid allowing the plunger to be pushed in against the decompression mechanism causing it to swing over and hold the exhaust valve open. With no compression the engine stops. Resistor R3 is in the circuit to prevent a dead ground on the charging circuit.

Flicker Circuit

The single cylinder 1800 RPM unit employs a flicker circuit to eliminate the flare or flickering of lights on the power stroke. A switch (S3) opens to insert resistor R1 in the shunt field circuit toward the end of the compression stroke so field power is reduced on the power stroke to compensate for the increase in RPM. After the power stroke, the switch (S3) closes bypassing resistor R1 and allowing the field to build back up to normal and eliminating a drop in voltage.

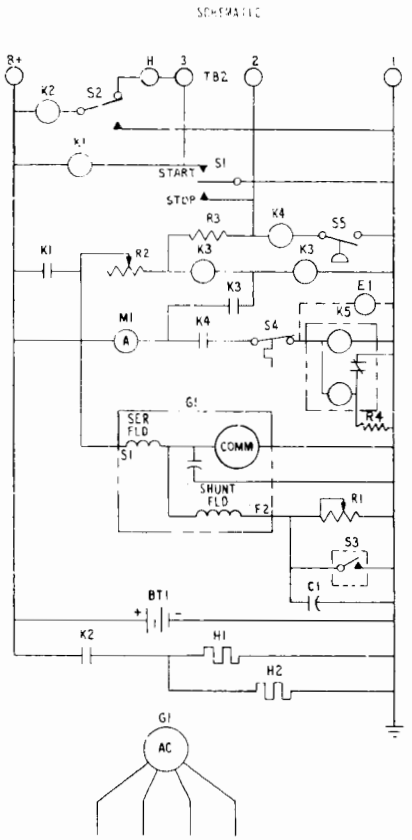
610C328



NOTES:

1. REMOVE JUMPER (W1), WHEN PREHEAT CIRCUIT IN AUTOMATIC OR LINE TRANSFER IS USED.
2. ALL AC LEADS HAVE .1 MFD CAPACITORS TO GROUND IN GENERATOR
3. UNLESS OTHERWISE NOTED, ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION.

SCHEMATIC



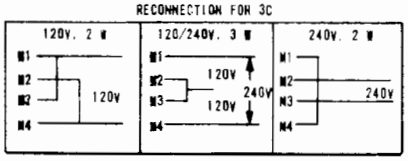
AC SLIP RINGS

VOLTAGE CODE

M1	M2*			
M4	M3	M2*	M1	--1-2
M3	M2	M1	M0*	--3C
M3	M2	M1		--4,7 & 8
M0*	M1	M2	M3	--4X
				--5

COMM END ← → BEARING END

RECONNECTION FOR 3C



PARTS LIST

REF DES	PART NO	QTY	DESCRIPTION
C1	312A187	1	CAPACITOR ASSY, 1MFD
K1	307B1046	1	RELAY - START SOLENOID
K2	307B1046	1	RELAY - GLOW PLUG SOLENOID
K3	307B180	1	RELAY - REVERSE CURRENT
K4	307B4	1	RELAY - DECOMPRESSION SOLENOID
M1	302A446	1	AMMETER - CHARGE 5-0-5
R1	304A694	1	RESISTOR ASSY
R2	304A175(REF)	1	RESISTOR - FLICKER, 10 .50 W
	304A695	1	RESISTOR & LEAD ASSY
	304A506(REF)	1	RESISTOR, 80 150 W
R3	304A691	1	RESISTOR & LEAD ASSY
	304A32 (REF)	1	RESISTOR, 15Ω, 10W
S1	308A303	1	SWITCH & LEAD ASSY.
	308P154(REF)	1	SWITCH - START STOP
S2	308-304	1	SWITCH - GLOW PLUG ASSY
TB1	332A609	1	BLOCK - TERMINAL
TB2	332A604	1	BLOCK - TERMINAL
	332A616	1	STRIP - MARKER
W1	332A592	1	JUMPER (SEE NOTE 1)
W2	332A602	1	JUMPER
	301C1963	1	COVER-CONTROL BOX
	301D2008	1	CONTROL BOX
	301C2009	1	PANEL - CONTROL BOX
	301C2424	1	BRACKET - MTG
	301A2425	1	BRACKET - CONT BOX MTG (L.H.)
	301A2426	1	BRACKET - CONTROL BOX MTG (R.H.)
	301B2012	1	COVER-RESISTOR
	98A1876	1	SILKSCREEN - RECONNECTION
	402-70	4	RUBBER MOUNTS
	337-36	1	STRAP-BOND

PARTS LIST ENG GEN (REF) 610C328

BT1		1	BATTERY, 12V
* E1		1	FUEL PUMP
G1		1	GENERATOR
H1		1	HEATER - MANIFOLD
H2		1	GLOW PLUG
K5	307C1098	1	SOLENOID-DECOMPRESSION
R4	304A3	1	RESISTOR-5Ω,50 W
S3		1	POINTS - FLICKER
S4		1	SWITCH - HIGH AIR TEMP
S5		1	SWITCH - OIL PRESS

*WHEN USED

DJA AND MDJA
610-0328

Troubleshooting

Should the preheat solenoid (K2) or start solenoid (K1) fail to close when the switches are manipulated, a jumper can be used from the small terminal on the solenoid to ground to check to be sure the solenoid coil is operational. This also checks the preheat switch (S2) and the start-stop switch (S1). If high voltages are encountered, it is an indication that switch S3 has not opened and requires adjusting. If no output voltage is produced, check resistor R1 and switch S3. If the unit does not start but cranks, check to be sure the decompression solenoid (K4) is energizing. The high temperature cutout switch S4 may be faulty and have the circuit open. Oil pressure switch S5 may not be closing due to low oil pressure or a faulty switch which will prevent K4 (decompression solenoid relay) from energizing. If a chattering of the K1 or K2 relays develops, check the battery connections at the battery or the generator for corrosion and also the battery for condition.

OPERATING SEQUENCE FOR DIESEL GENERATING SET CONTROL #611-1082

Starting Circuit

The common practice for placing "Onan" Class "A" controls into operating condition is by grounding certain components. The switch is used to place this ground on the affected components.

Moving the handle of the manifold heater switch S12 to the preheat position causes a current flow from B+, through the coil of manifold heater solenoid K13 to ground and back to battery negative terminal. This causes manifold heater relay K13 to energize and closes its contacts to supply power to the manifold intake heater and glow plugs. If the preheat circuit is controlled by a load transfer control, this relay is energized by the grounding of terminal "H." The length of preheat can be selected through the use of a relay or through manually holding heater switch S12 on.

After the preheat period has passed, the load transfer control will cause terminal 3 to be grounded energizing the starting circuit. The starting circuit can also be energized by placing start-stop switch S11 in the start position. This allows battery current to flow from the B+ through start solenoid relay coil K11, through the closed contacts of the start-disconnect and fuel solenoid relay K12, through the start switch S11, to the center terminal to ground and to the battery causing start solenoid K11 to energize. K11 start solenoid energizes and causes its main contacts to close, connecting the battery through the cranking motor. At the same time the main contacts of K11 are closed, an auxiliary circuit is also completed from start solenoid K11 through the contacts of the emergency time delay relay K14, to the fuel solenoid K1, and to the battery. The fuel solenoid K1 is a two coil unit with a pickup coil and a holding coil. This relay energizes to take pressure off the control arm of the fuel injection pump and allows the metering sleeve to be positioned so fuel is supplied to the injectors so the engine can fire, start and run.

When the engine has started and accelerated to approximately 900 RPM, the centrifugal disconnect switch S1 closes. When switch S1 closes, battery current flows through its contacts, through resistor R11, through the coil of the start-disconnect and fuel solenoid relay K12 to the battery. This causes the K12 relay to energize and breaks the circuit to the start solenoid relay K11 causing the start solenoid K11 to de-energize and remove the cranking motor from the battery. At the same time, another set of K12 contacts close supplying power from the charging circuit or the battery through the normally closed contacts of emergency relay K14 to the fuel solenoid K1. This keeps relay K1 (fuel solenoid) energized and allows the governor to control the fuel injection pump.

The engine governor will maintain engine speed at approximately 1860 RPM (62 cycles) or a fairly constant speed with load added.

Voltage Buildup

One pole face on the exciter field assembly has a permanent magnet embedded in it. This is installed at the time the lamination stack is assembled. This permanent magnet aids in the voltage build-up in the exciter. The residual magnetism of the pole pieces plus the permanent magnet in the one pole, causes a higher residual voltage to be produced. This produces, in the three phase exciter rotor, a voltage which is rectified by a network of three positive and three negative diodes to the generator rotor for field excitation. The voltage produced in the stator is supplied to the voltage regulator which controls the turn on point of the SCR's and in turn controlling field current. When the generator's voltage reaches the control point, the voltage regulator maintains field current to hold essentially constant output voltage.

Battery Charging Circuit

A separate battery charge winding is placed in the generator stator and has a voltage produced in it dependent upon the field strength of the main generator. The charging current is controlled by resistor R21. This charging circuit is essentially a 5 ampere circuit. Battery charging current is supplied through diode CR11 to the ammeter and to the battery back to ground and to the charging winding. This charges the battery and prepares it for supplying power for the next start. The charge winding also supplies power to maintain the fuel solenoid K1, energized.

Low Oil Pressure Cut-Out (LOPKO)

The low oil pressure cutout circuit is from the battery side of the ammeter through the centrifugal disconnect switch S1 to resistor R12, through the heater of the emergency time delay relay K14 and through the low oil pressure switch S4 to ground. Resistor R12 sets the timing interval of emergency relay K14. Should there be a loss of oil pressure or an excessive drop in level, switch S4 will close and the emergency time delay relay K14 will operate in approximately 15 seconds. When time delay relay K14 operates due to low oil pressure, its normally closed contacts open and break the circuit to the fuel solenoid K1. The fuel solenoid de-energizes and its plunger drops down on the control arm of the fuel injection pump causing the fuel to spill and shuts down the engine.

Unit Stopping

To stop the engine it is necessary to ground terminal #2 through the load transfer control or to place start-stop switch S11 in the stop position. Grounding terminal #2 or placing start-stop switch S11 in the stop position causes a ground to be placed on the supply side of the start-disconnect and fuel solenoid relay K12. Relay K12 de-energizes, its contacts open and break the circuit to the fuel solenoid K1 causing engine shutdown. Resistor R11 is placed in the circuit so a short circuit or dead ground is not placed on the battery charging circuit.

Fast Troubleshooting

If the ammeter does not indicate a charge, it usually means the generator has not built up voltage. This generator does not have an automatic field flash circuit; and consequently, it is necessary to make a field voltage measurement. This can be done across terminals 3 and 4 at the end bell of the generator or at terminal 7 or 8 of the voltage regulator assembly. Terminal 8 is positive and terminal 7 is negative. Should no voltage be measured at these points, refer to the "YD" Generator Service Manual (900-0184).

The water-cooled units have a high water temperature cutoff switch S2 in series with the fuel solenoid K1. This switch can be checked by placing a jumper across the terminals of the switch and closing the start switch S11 to see if the solenoid energizes.

If there has been a low oil pressure cutout condition, the red button on the emergency relay K14 will be sticking out. One minute of "cool down" is required before resetting (pushing in the button) the relay to place it back in operation. A shorter time may result in the solder pot not fusing correctly and permitting the button to be pushed out by the spring when the unit vibrates.

Should the centrifugal switch S1 fail to close or make contact, the start-disconnect and fuel solenoid relay K12 will de-energize as soon as the start switch S11 is released and then the unit will shut down. This causes a cycling condition on the generator set. The centrifugal switch S1 can be checked by removing the cover and holding the contacts closed manually after the unit has started. Set the centrifugal disconnect switch gap at approximately .025 inches for proper wipe and contact pressure. Should the centrifugal switch S1 fail to open on shutdown, it will cause a battery discharge and burn out of the emergency time delay relay K14.

Emergency Shutoffs

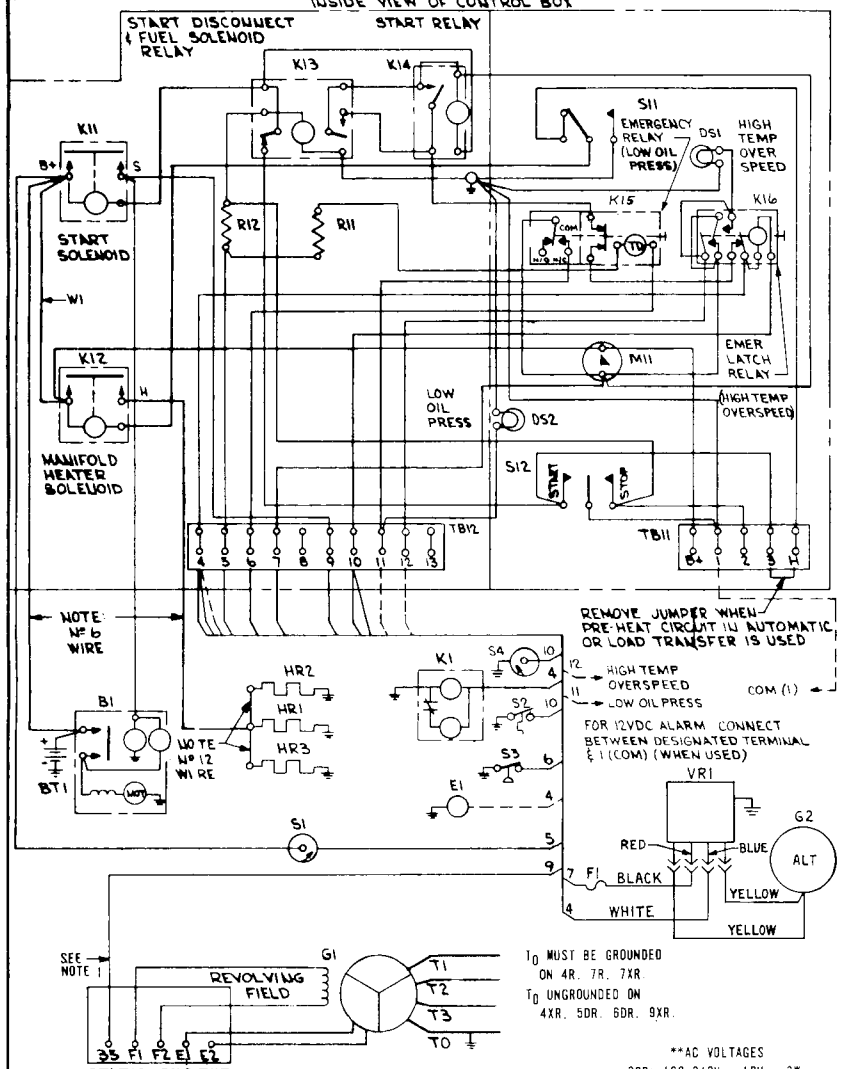
The control also has provision for connecting an alarm circuit to indicate low oil pressure and high temperature and overspeed. Should an overspeed or high temperature condition present itself, relay K16 will energize. This is a latching relay which has to be reset after one of the mentioned conditions has occurred. When relay K16 energizes its contacts open, breaking the circuit to the fuel solenoid (K1) shutting the engine down. When the fault condition has been corrected, the K16 relay must be reset by pushing the button which protrudes from the control.

Should a low oil pressure condition exist, the switch S3 closes and after approximately 15 seconds K15 operates and breaks the circuit to the fuel solenoid causing engine shutdown. This device has an added unit to it whereby a circuit is made to activate a low oil pressure alarm. The high temperature-overspeed will also complete an alarm circuit to activate an alarm to indicate a fault.

611C1082

WIRING DIAGRAM

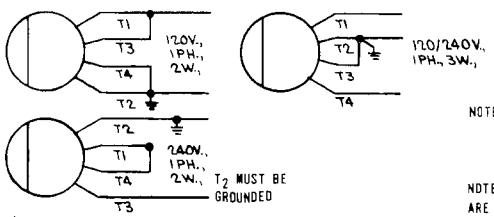
INSIDE VIEW OF CONTROL BOX



T_0 MUST BE GROUNDED ON 4R, 7R, 7XR

T_0 UNGROUNDED ON 4XR, 5DR, 6DR, 9XR.

SINGLE PHASE AC LOAD CONNECTIONS (3CR)



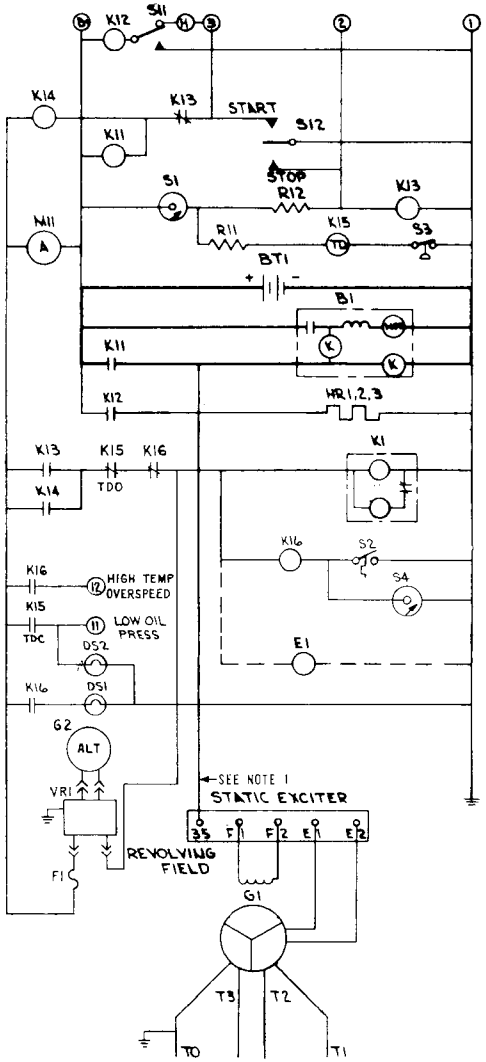
**AC VOLTAGES

3CR; 120 240V., 1PH., 3W
4R; 120 208V., 3PH., 4W
5DR; 120 240V., 3PH., 4W △
6DR; 240 480V., 3PH., 4W △
4XR; 277 480V., 3PH., 4W
7R, 220 380V, 3PH., 4W
7XR; 240/416V., 3PH., 4W
9XR; 347/600V., 3PH., 4W

NOTE:1 THIS WIRE USED FOR 3CR, 4R, 7R, 7XR ONLY

NOTE:2 UNLESS OTHERWISE NOTED ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION.

SCHEMATIC



	GEN PARTS LIST (REF)	
REF. DES.	QTY.	DESCRIPTION
B1	1	STARTER & SOLENOID
BT1	1	BATTERY 12V
E1	1	FUEL PUMP
F1	1	FUSE - 30A
G1	1	GENERATOR & STATIC EXCITER ASSY
G2	1	ALTERNATOR - FLYWHEEL
HR1	1	HEATER - MANIFOLD
HR2, 3	2	HEATER - GLOW PLUG
K1	1	SOLENOID - FUEL
S1	1	SWITCH - CENTRIFUGAL
S2	1	SWITCH - HIGH TEMP
S3	1	SWITCH - LOW OIL PRESS
S4	1	SWITCH - OVERSPEED
VR1	1	VOLTAGE REGULATOR
DS1	1	LAMP - HIGH TEMP & OVERSPEED
DS2	1	LAMP - LOW OIL PRESS
	2	HOLDER - LAMP
K11	1	RELAY - START SOLENOID
K12	1	RELAY - MANIFOLD HEATER
K13	1	RELAY - START DISC & FUEL SOLENOID
K14	1	RELAY - START
K15	1	RELAY - EMERGENCY (LOP)
K16	1	RELAY - EMERGENCY LATCH(HIGH TEMP & OVERSPEED)
M11	1	AMMETER - CHARGE 20-0-20
R11	1	RESISTOR - 1-OHM, 10W
R12	1	RESISTOR - 15-OHM, 10W
		611C1082
S11	1	SWITCH - MANIFOLD HEATER
S12	1	SWITCH - START STOP
TB11	1	TERMINAL BLOCK
	1	MARKER STRIP
TB12	1	TERMINAL BLOCK
	1	MARKER STRIP
W1	1	JUMPER
	1	PANEL - CONTROL BOX
	1	CONTROL BOX
	1	COVER - CONTROL BOX
	1	MTG BRACKET - CONTROL BOX
	1	GROMMET
	4	RUBBER MOUNTS
	1	GROUND STRAP
	1	TINNERMAN CLIP
	1	SILKSCREEN
	1	SILKSCREEN (3CR ONLY)

KW	DASH NO
3CR	-01
ALL OTHERS	-02

DIESEL CONTROL
611-1082

CONTROL—OPERATING SEQUENCE FOR UTILITY CONTROL #610-0340

Starting Circuit

Placing the start switch (S1) in the start position places a ground on terminal three. This permits battery current to flow from plus side of the battery to the coil of the start solenoid (K3) through the start switch (S1) to ground back to the battery. When K3 energizes its large contacts close connecting the battery to the cranking windings of the generator. The generator then acts as a DC motor to turn the engine. At the same time, current is supplied to the cranking windings of the generator; a circuit is established from "A" positive to K4 fuel solenoid and through resistor R1 to K2 stop relay to ground and to the battery. The fuel solenoid energizes to permit fuel flow to the carburetor and K2 energizes and closes its contacts to supply ignition power. The ignition circuit now is from B+ through the circuit breaker, (CB1) through the ammeter (M1) to the closed contacts of K2 to the primary of the ignition coil, to the breaker points to ground and back to the battery. With the engine turning, fuel supplied and ignition the engine fires, starts, and accelerates to governed speed. At the same time, power is supplied to the heater of the choke, E1.

Running (Ignition) Circuit

When the engine has started and accelerated to governed speed, releasing the start switch (S1) breaks the circuit to the start solenoid (K3) and it de-energizes. Its large contacts open to disconnect the generator from battery charging. The charging circuit is established from A1 through the blocking diode CR1 to the closed contacts of K1 through the ammeter and circuit breaker CB1 to the battery. At this point, a heavy charging current is supplied to bring the battery up to charge quickly. Should a load be on the vehicle battery, the generator supplies the high current required for communications equipment or any other DC powered devices.

Charge Disconnect Circuit

If the vehicle is equipped with a generator, then a connection wire is required to the truck's generator from terminal B. With the truck engine running, and the generator producing power supplied to charge disconnect relay, K1, this relay energizing causes its contacts to open and disconnect the DC output from the generating set from the battery. This eliminates the possibility of the truck generator or the generating set becoming a load to the other. This connection is not required if the vehicle is equipped with an alternator.

Stop Circuit

Placing the switch S1 in stop position places a ground on the supply side of the stop relay (K2) cutting off power from the relay causing its contacts to open, breaking the ignition circuit. Should switch S2 (Electric start-hand crank) be in the hand-crank position, the stop relay is ineffective in breaking the ignition circuit and the unit will continue to run as long as fuel is supplied. This switch is for the purpose of supplying ignition power in the event of a low battery which will not supply cranking power. It should be placed in the electric start position after the generating set has been started manually.

Options

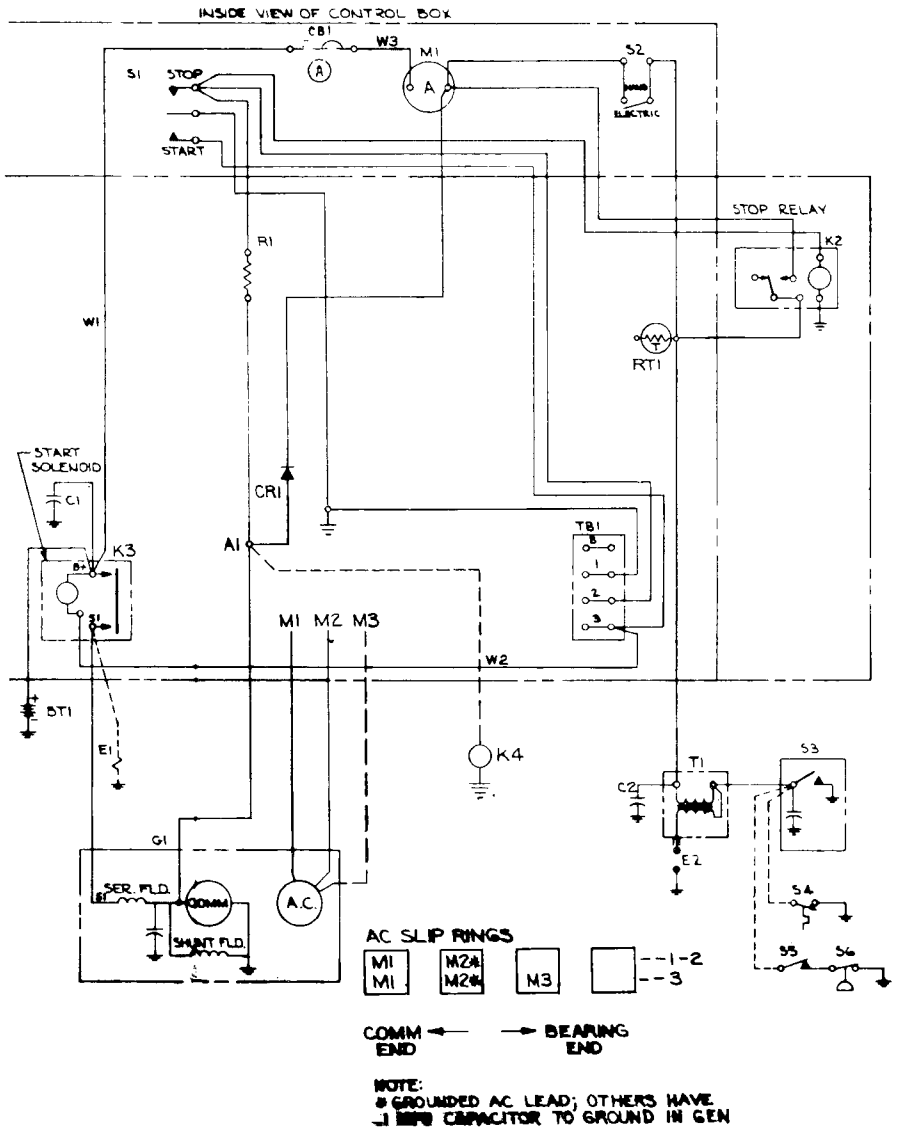
An optional high air temperature switch can be installed to cut off the ignition in the event of a high temperature condition. A low oil pressure cut out switch can also be installed which will cut off ignition in the event oil pressure is lost. A momentary contact switch (S5) is installed in series with the low oil pressure switch to make possible starting through hand crank.

Governor Adjusting

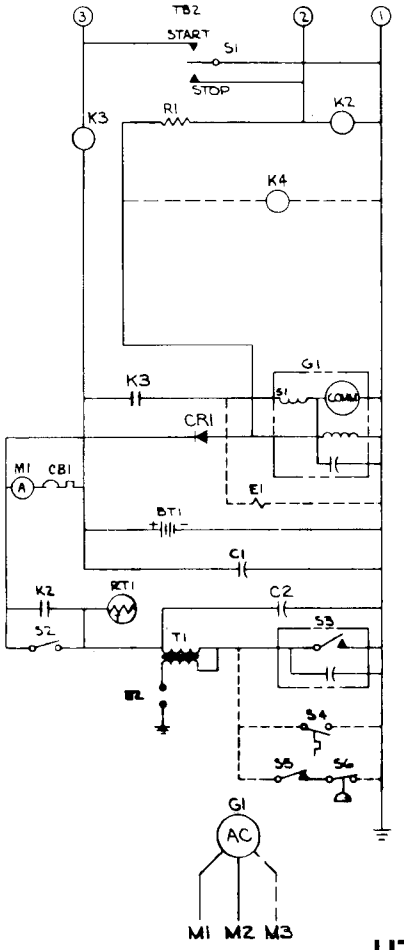
The governor on this series is set to battery charging voltage rather than frequency. The generating set should be run for approximately a half hour to bring it to operating temperature. Connect an AC load and alternately remove and connect to adjust governor sensitivity if this becomes necessary. Then remove the AC load and stop the generating set. Disconnect the generator lead A1 at the diode in the set control. Connect a DC voltmeter across lead A1 and ground and adjust the governor to produce 15 volts DC. When the governor has been adjusted, shut the set down and reconnect the A1 lead to the diode.

610C340

WIRING DIAGRAM



SCHEMATIC DIAGRAM



PARTS LIST

REF. DES	QTY	DESCRIPTION
C1	1	CAPACITOR ASSY 1 OMFD
CB1	1	CIRCUIT BREAKER
CR1	1	DIODE & HEAT SINK ASSY
	4	INSULATOR
K2	1	RELAY & LEAD ASSY - STOP
	1	RELAY - STOP
K3	1	RELAY - START SOLENOID
M1	1	AMMETER - DC 45-0-45A
	1	SWITCH ASSY - RMT START
S1	1	SWITCH - STOP START
R1	1	RESISTOR 30 Ω 5W
	1	SWITCH & RESISTOR ASSY
S2	1	SWITCH - HAND ELEC START
RT1	1	RESISTOR 1 72 Ω 25W
TB1	1	TERMINAL BLOCK
	1	MARKER STRIP
W1	1	LEAD ASSY
W2	1	LEAD ASSY
W3	1	STRAP GROUND
	1	CONTROL BOX & PANEL ASSY
	1	MTG BRACKET
	1	COVER
	1	ENDPLATE
	1	SILK SCREEN
	1	SILK SCREEN

PARTS LIST (ENG-GEN) 610C340

BT1	1	BATTERY 12 VOLT
C2	1	CAPACITOR 9 1 MFD
E1	1	ELECTRIC CHOKE
E2	1	SPARK PLUGS
G1	1	GENERATOR
K4	1	FUEL SOLENOID
S3	1	BREAKER & CAP ASSY
S4	1	SWITCH - HIGH AIR TEMP.
S5	1	SWITCH
S6	1	SWITCH - LOW OIL PRESS
T1	1	IGNITION COIL - (DNAN)

* WHEN USED

UTILITY SET CONTROL
610-0340

CONTROL—OPERATING SEQUENCE FOR ELECTRIC START "CCK" WELDER #606-0138

Starting Circuit

Place the ignition switch in the "on" position. This removes the ground from the magneto allowing it to supply ignition power. Push the large start switch. This connects the battery to the cranking windings of the generator. When this circuit is energized, the generator acts as a direct current motor to start the engine. When the engine has started and accelerated to govern speed, release the switch which breaks the cranking circuit.

Stopping Circuit

To stop the unit, move the governor control arm to the low speed or AC power position. Move the ignition switch to the off position which places a ground on the magneto and prevents sparking of the plugs stopping the engine.

AC Load Circuit

With the unit running in the 1800 RPM position, the microswitch operated by the governor control is closed. This bypasses a 5.5 ohm shunt field current control resistor. This allows the shunt field to energize to higher value; thus, the generator produces 120 volts AC for the operation of various types of electrically powered hand tools or trouble lights. This circuit would be from M1 to the microswitch through it to the duplex receptacle and back to M2 of the generator. The other contact of the microswitch causes a bypass of the current limit resistor and rheostat to provide full field excitation for the generator.

Battery Charging

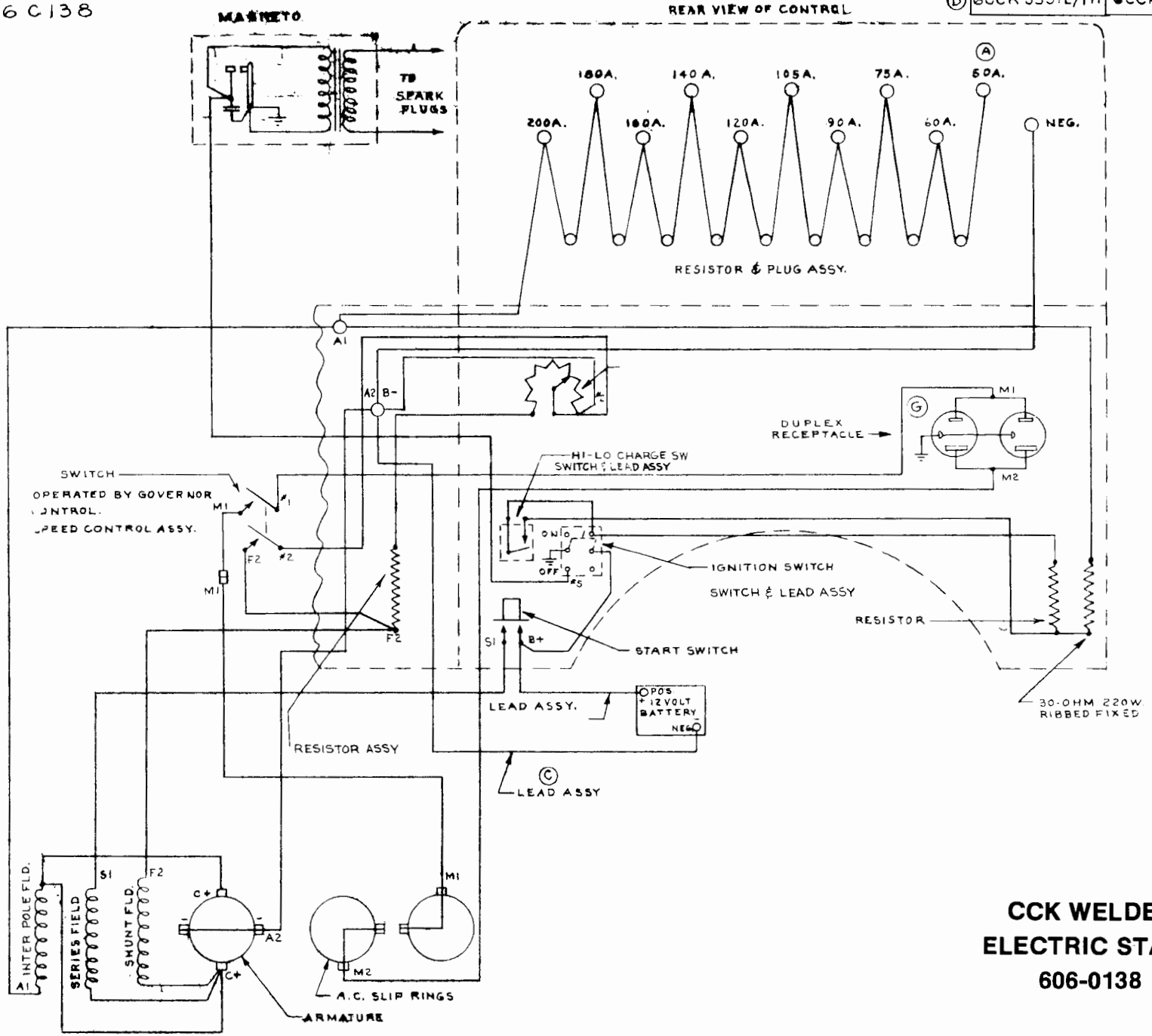
A battery charging circuit is picked from the A1 terminal in the welder control. A wire leads to two paralleled resistors. This provides a 2 amp charge rate when the charging switch is placed in the high charge position. It provides 1-1/4 amps charge when the switch is in the low charge position. With the switch in the high charge position, one charging resistor (15 ohm, 75 watt) is removed from the circuit. In the low charge position the resistor is inserted in series with the other charging resistor lowering the charging rate. The welder jack receptacles have various sizes and value resistance elements connected between each. By moving the welding cable to consecutive jack receptacles, the total resistance is lowered making possible higher welding current. Then the rheostat is adjusted to refine this current value for the particular welding application.

Welding Mode

When the governor arm is moved to the weld position, the microswitch opens. This disconnects the AC circuit to the receptacles and also introduces the current limiting resistor and rheostat into the shunt field circuit. This reduces excitation to compensate for the increase in RPM for welding and makes possible a fine current control between current jacks of the welder. Should a slightly higher or lower welding current be required from that available at the particular jack, manipulating the rheostat will adjust field current; thus, will refine welding voltages from the generator.

Some welders have the identical control but have a fuse to each of the AC power receptacles to prevent damage should excessive load or short circuit conditions develop.

606 C138



CCK WELDER
ELECTRIC START
606-0138

CONTROL—OPERATING SEQUENCE FOR "CCK" WELDER CONTROL #602-0205

Starting Circuit

Place the governor control in the AC power position. Place the choke in a position appropriate for the ambient temperature and engine temperature. Pull the engine over compression to prime it somewhat and then with a good steady pull start the engine. When the engine accelerates to governed RPM, manipulate the manual choke to obtain smooth engine performance. With the engine running in the AC power position, the microswitch is closed. This connects the AC output to the duplex receptacle. The output voltage should be 120 volts at 60 cycles. The switch also established the bypass circuit for the exciter field resistor and rheostat to obtain the required AC output voltage.

Welding Position

With the governor arm placed in the weld position, the engine accelerates to the governed welding speed. The microswitch is opened disconnecting the AC receptacles from the generator. This eliminates the possibility of high voltage being applied to electrically powered tools. It also removes the bypass from the exciter resistor and rheostat. A resistor being inserted in the exciter field reduces excitation to prohibit excessively high welding voltages and the rheostat makes possible refining the current between the receptacle jacks. Should a particular receptacle jack not supply the correct welding current, manipulate the rheostat to adjust the current from the jack in use.

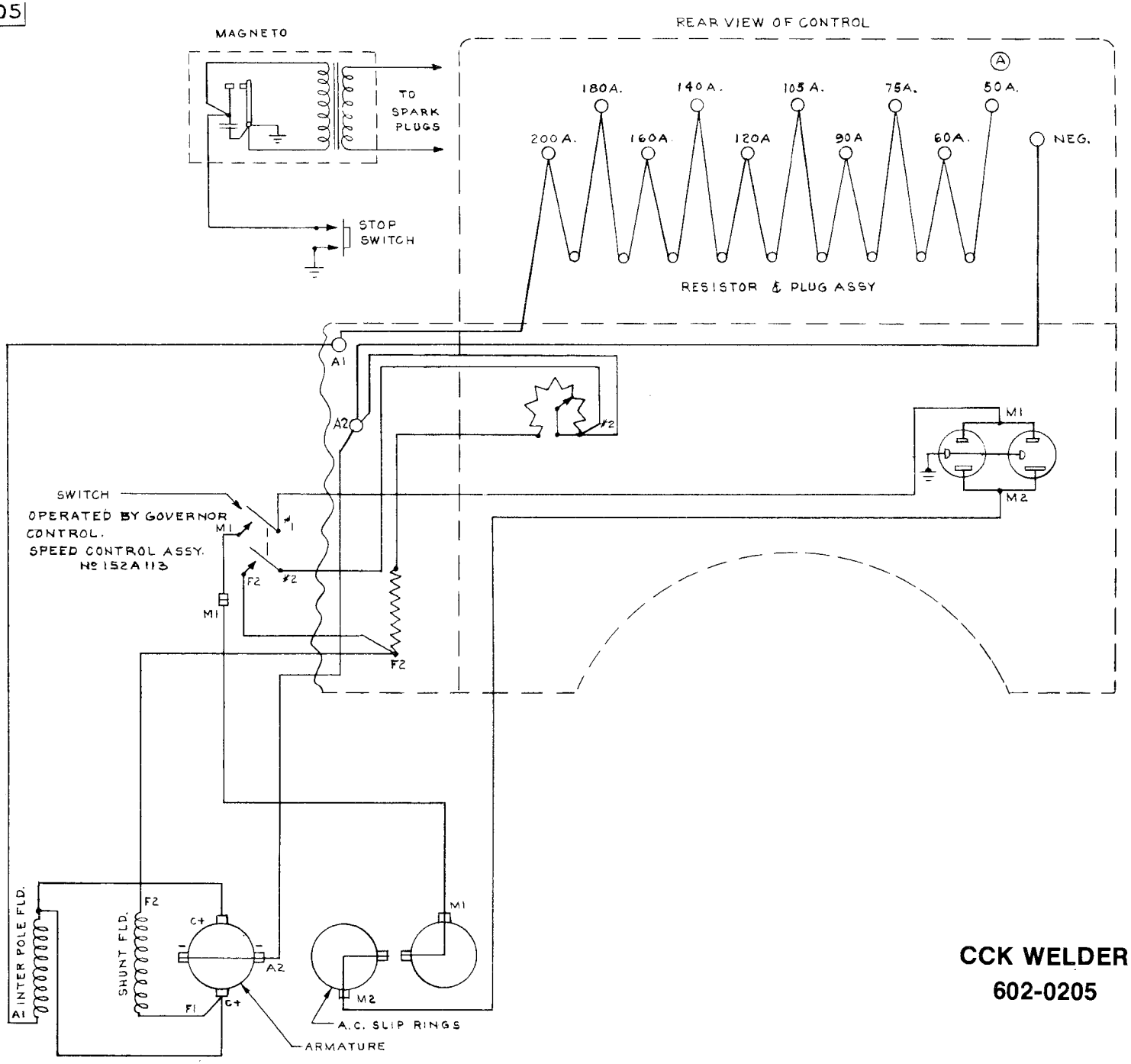
Stopping

To stop the unit press the stop switch which places a ground on the magneto cutting off ignition and stopping the engine.

Troubleshooting

Periodically inspect the resistance elements to be certain they are still fastened tightly and no screws or jack receptacles have become corroded or loose. Inspect sheet metal and the various resistors to be sure they are tight and functioning. Should no AC output be available in the AC power position, examine the microswitch for a loose or burned connection or opens. Periodically examine the DC and AC brushes for wear, adequate pressure and good brush shunts.

602C205



CCK WELDER
602-0205

CONTROL—OPERATING SEQUENCE FOR "5 BF" WELDER #605-0115

Starting Circuit

Connect the welding cables to the power terminals on the panel before starting the unit. Be sure to open the fuel shut-off valve and adjust the choke to the ambient temperature conditions. Place ignition switch in the on position. Placing the ignition switch (S2) in the on position provides a current path from the battery through the switch S2 to the primary of ignition coil (T1) to the ignition breaker points to ground. Pushing the start switch (S3) connects the B+ side of the battery through the switch to the cranking motor (B1) causing it to energize and turn the engine. When the engine starts, it accelerates to governed speed of just over 3600 RPM.

Voltage Build-Up

With ignition switch S2 closed, a circuit is provided from the B+ side of the battery through the build-up board A1 to the revolving field of the welder to ground and back to the battery. Terminal board A1 consists of a diode and resistor. The diode prevents reversal of current when the welder has built up and the resistor reduces the battery load during starting. This build-up board A1 is for the purpose of assuring voltage build-up at start. With battery power supplied to the revolving field coil a voltage is produced in excitation windings (T5, T6, T7) and applied to the revolving field through brushes and slip rings and then to ground and back to the excitation windings. The ground end of the excitation windings has a blocking diode to provide DC current to the revolving field. With this excitation circuit, coil T5 and T6 provide voltage to the field on one half cycle and winding T6 and T7 provide voltage on the other half cycle. This provides full wave DC to the revolving field from an AC source. With the generator running at governed RPM, a nominal 25 volts AC is supplied to the reactor (L1).

Operation

The AC output from the load winding is supplied to the reactor through a permanently connected lead and through a movable arm contact. Current selection is made by moving the switch handle (S1) to the current tap for the particular welding rod size selected. The current selection may be made at any time the unit is running provided no load is applied to the welding terminals. Moving the selector from the low current to the higher current position removes windings from the reactor, reducing the voltage drop across that portion of the reactor and increasing the welding voltage and current. AC power may be taken from the machine from the AC receptacles at any time provided the unit is not overloaded.

Ignition Circuit

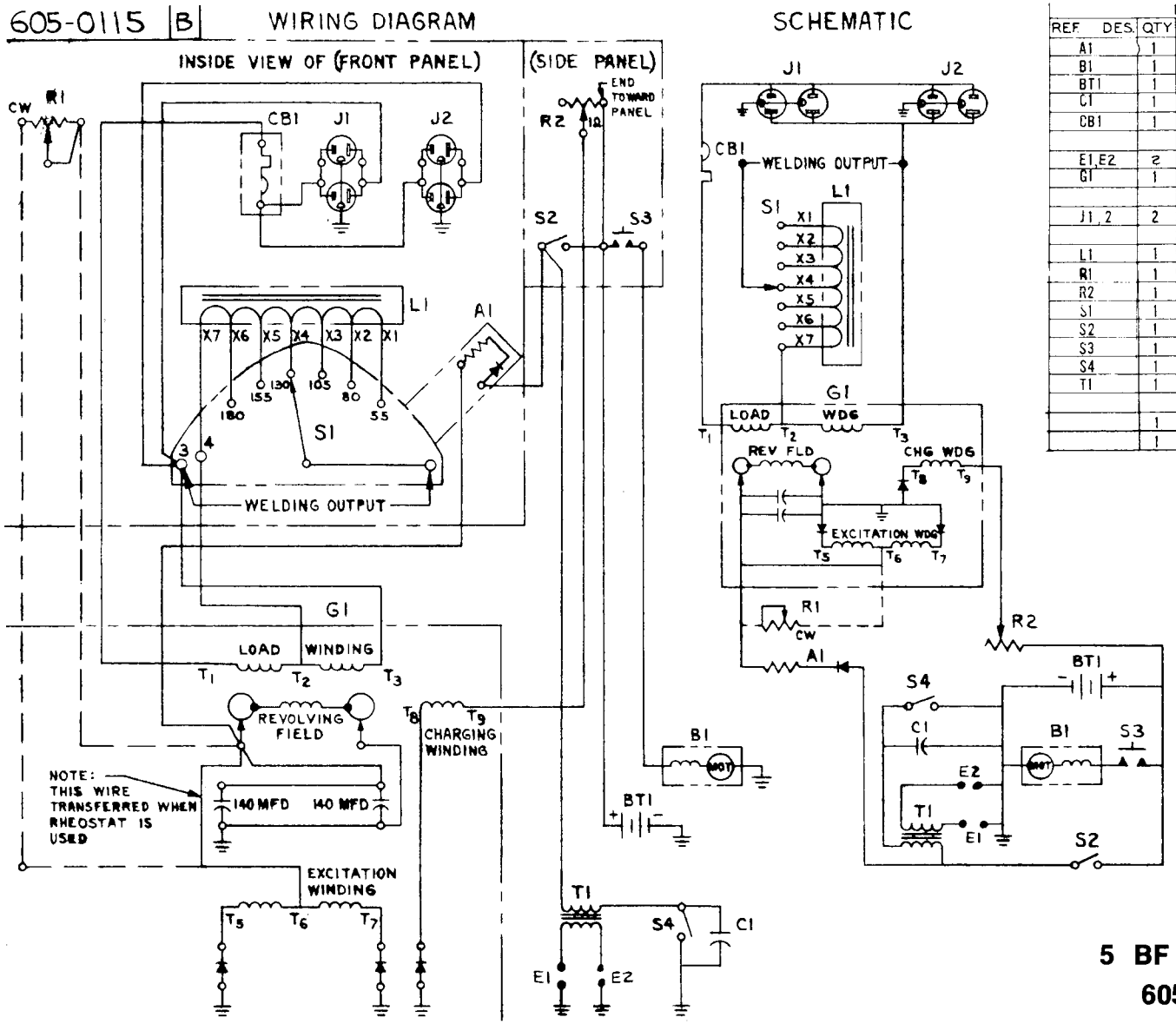
The ignition for this unit is a battery ignition. With the ignition switch (S2) closed the circuit is provided from the B+ side of the battery through the prime rate of the ignition coil through the ignition breaker points to ground and to the battery. With the start switch S3 closed, the cranking motor receives power from the battery and cranks the engine. The engine starts and accelerates to governed RPM. To stop the unit, open the ignition switch S2 to break the primary circuit and prevent the plug from firing. This also breaks the build-up circuit to the generator.

Stop Circuit

To stop the unit, place the ignition switch (S2) in the stop position which places a ground on the charge coil of the alternator preventing the capacitor from charging and cutting off ignition. The switch also interrupts the circuit to the revolving field so the battery does not discharge during shutdown.

Troubleshooting

Should ignition switch S2 fail to make contact the build-up circuit will not be energized and there is a possibility of the unit not producing output voltage. Should the capacitor fail, ignition voltage will not be produced and the plug won't fire. If the SCR shorts out, the capacitor will be bypassed and there will be no ignition power to fire the plugs. If the magnet loses its charge, the flywheel alternator will not work for charging the capacitor nor for triggering the SCR.



PARTS LIST		
REF. DES.	QTY	DESCRIPTION
A1	1	CIRCUIT BOARD ASSY (BUILD-UP)
B1	1	STARTER
BT1	1	BATTERY, 12 V
C1	1	CAPACITOR-IGN, .3 MFD, 300VDC
CB1	1	CIRCUIT BREAKER-THRM, 40 AMP
E1,E2	2	SPARK PLUG
G1	1	ALTERNATOR ASSY
J1, 2	2	RECEPTACLE-DUPLEX
L1	1	REACTOR
R1	1	RHEOSTAT
R2	1	RESISTOR, 1.5Ω, 50 W (ADJ TO 1Ω)
S1	1	SWITCH-ROTARY TAP
S2	1	SWITCH-IGN
S3	1	SWITCH-START
S4	1	POINTS-IGN
T1	1	COIL-IGN
	1	CONTROL-GEN ASSY
	1	CONTROL-GEN ASSY

5 BF WELDER
605-0115

Battery Charging Circuit

A separate battery charging winding is placed in the stator of the generator. This charge winding receives its excitation from the revolving field and is a half wave rectifier system. A blocking diode is placed in line with the charge winding in the generator to provide the DC pulse through adjustable charge resistor R1 to the battery. Should the blocking diode short out, it will place a ground on the B+ side of the battery causing it to discharge. Should the wiper on the adjustable resistor R1 be improperly placed or burn, it can produce an open circuit and prevent battery charging.

Loss of Welding Power

Should a loss of welding power occur, remove the control box cover screws and lift off the cover. Check the rotary switch wiper blades and contact points to be certain they are not badly burned. Should these contacts be burned, they will have to be replaced. If the switch appears satisfactory, then a point to point check will have to be made with a continuity indicator to determine the cause of failure. Also check the blocking diodes in the end bell of the generator as a shorted diode can cut off excitation power. Shorted power capacitors across the revolving field can cause a loss of excitation and a subsequent loss of output voltage. Loss of auxiliary power can be caused by tripped circuit breakers due to overloads. Press the reset buttons to be sure the circuit breakers are set.

CONTROL—OPERATING SEQUENCE FOR "5.0 TJ" WELDER #605-0120

Starting Circuit

Connect the welding cables to the power terminals on the panel before starting the unit. Be sure to open the fuel shut-off valve and adjust the choke to the ambient temperature conditions. Place ignition switch in the on position. Placing the ignition switch (S2) in the on position provides a current path from the battery through the switch S2 to the primary of ignition coil (P1) to the ignition breaker points to ground. Pushing the start switch (S3) connects the B+ side of the battery through the switch to the cranking motor (B1) causing it to energize and turn the engine. When the engine starts, it accelerates to governed speed of just over 3600 RPM.

Voltage Build-Up Circuit

With ignition switch S2 closed, a circuit is provided from the B+ side of the battery through the build-up board A1 to the revolving field of the welder to ground and back to battery. Terminal board A1 consists of a diode and resistor. The diode prevents reversal of current when the welder has built up and the resistor to reduce the battery load during starting. This build-up board A1 is for the purpose of assuring voltage build-up at start. With battery power supplied to the revolving field coil a voltage is produced in excitation windings (T5, T6, T7) and applied to the revolving field through brushes and slip rings and then to ground and back to the excitation windings. The ground end of the excitation windings has a blocking diode to provide DC current to the revolving field. With this excitation circuit, coil T5 and T6 provide voltage to the field on one half cycle and winding T6 and T7 provide voltage on the other half cycle. This provides full wave DC to the revolving field from an AC source. With the generator running at governed RPM, a nominal 25 volts AC is supplied to the reactor (L1).

Operation

The AC output from the load winding is supplied to the reactor through a permanently connected lead and through a movable arm contact. Current selection is made by moving the switch handle (S1) to the current tap for the particular welding rod size selected. The current selection may be made at any time the unit is running provided no load is applied to the welding terminals. Moving the selector from the low current to the higher current position removes windings from the reactor, reducing the voltage drop across that portion of the reactor and increasing the welding voltage and current. AC power may be taken from the machine from the AC receptacles at any time provided the unit is not overloaded.

Ignition Circuit

The engine is equipped with a capacitor discharge ignition system. The stator mounted on the front of the engine has a capacitor charge coil and an ignition pulse coil. When the unit is operated, a capacitor is charged from the charging coil and the magnets passing across the pulse coil will trigger an SCR which permits the capacitor to discharge through the primary of the ignition coil. This produces a high voltage pulse applied to the spark plug causing it to fire and ignite the fuel charge. When the pulse has dissipated the SCR turns off and the charge coil recharges the capacitor and prepares it for the next discharge cycle.

Stop Circuit

To stop the unit, place the ignition switch (S2) in the stop position which opens the ignition circuit. The switch also interrupts the circuit to the revolving field so the battery does not discharge during shutdown.

Troubleshooting

Should ignition switch S2 fail to make contact the build-up circuit will not be energized and there is a possibility of the unit not producing output voltage. No ignition voltage will be supplied to the coil and the plugs won't fire.

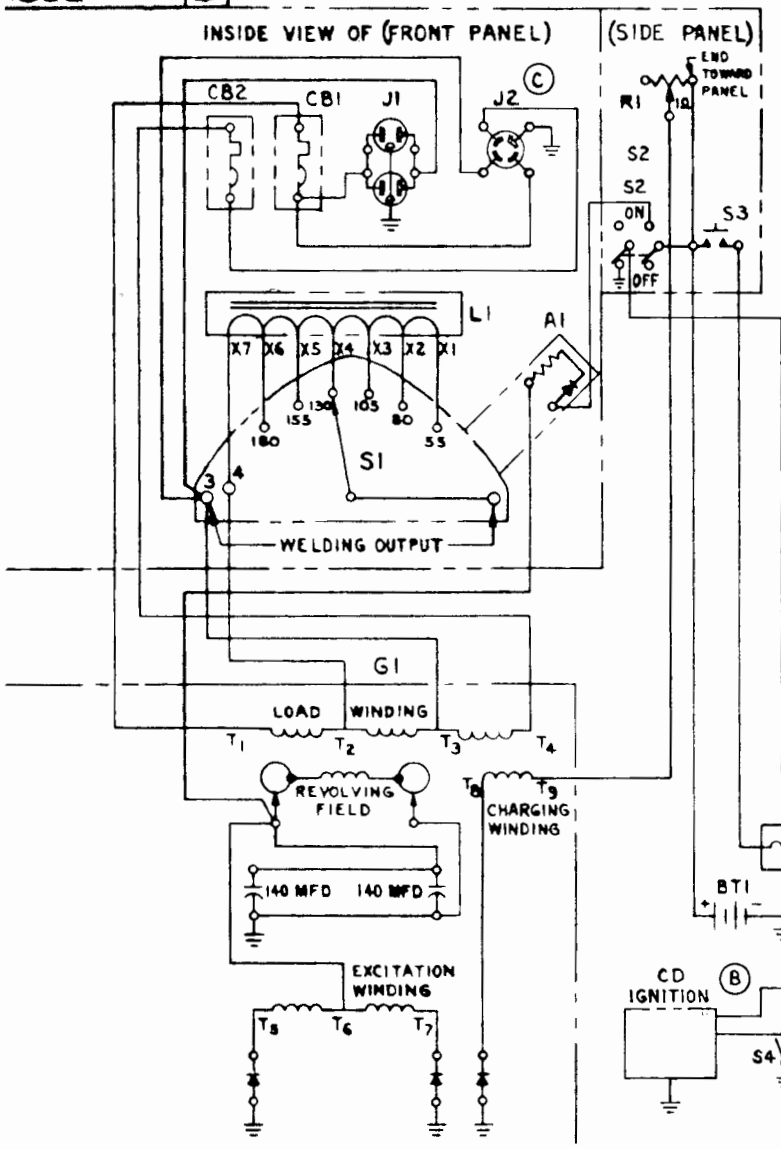
Battery Charging Circuit

A separate battery charging winding is placed in the stator of the generator. This charge winding receives its excitation from the revolving field and is a half wave rectifier system. A blocking diode is placed in line with the charge winding in the generator to provide the DC pulse through adjustable charge resistor R1 to the battery. Should the blocking diode short out, it will place a ground on the B+ side of the battery causing it to discharge. Should the wiper on the adjustable resistor R1 be improperly placed or burn, it can produce an open circuit and prevent battery charging.

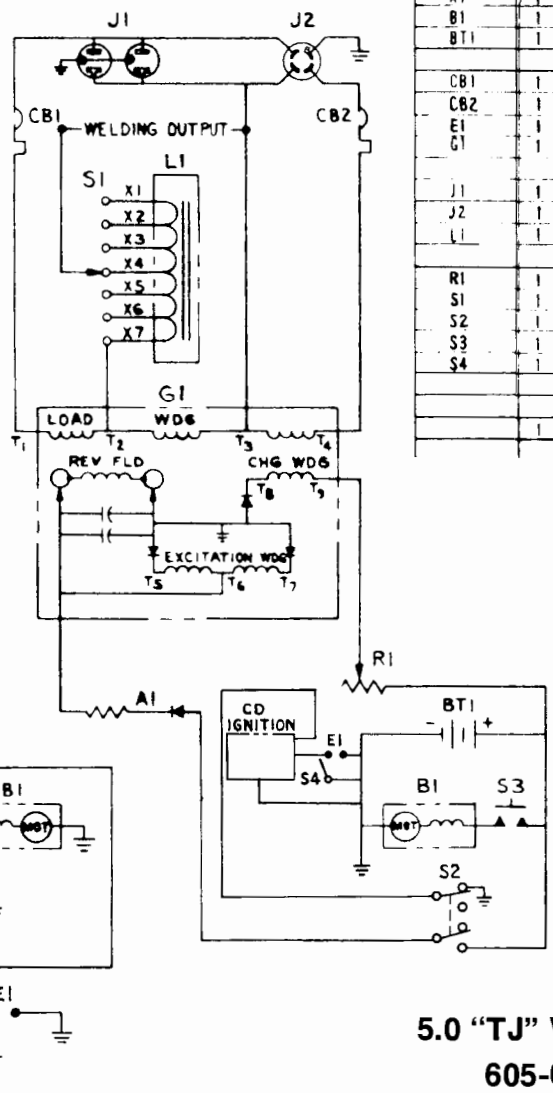
Loss of Welding Power

Should a loss of welding power occur, remove the control box cover screws and lift off the cover. Check the rotary switch wiper blades and contact points to be certain they are not badly burned. Should these contacts be burned, they will have to be replaced. If the switch appears satisfactory, then a point to point check will have to be made with a continuity indicator to determine the cause of failure. Also check the blocking diodes in the end bell of the generator as a shorted diode can cut off excitation power. Shorted power capacitors across the revolving field can cause a loss of excitation and a subsequent loss of output voltage. Loss of auxiliary power can be caused by tripped circuit breakers due to overloads. Press the reset buttons to be sure the circuit breakers are set.

605-0120 B WIRING DIAGRAM



SCHEMATIC



PARTS LIST

REF DES	QTY	DESCRIPTION
A1	1	CIRCUIT BOARD ASSY (BUILD-UP)
B1	1	STARTER
BT1	1	BATTERY 12 V
CB1	1	CIRCUIT BREAKER-THRM, 40 AMP
CB2	1	CIRCUIT BREAKER-THRM, 25 AMP
E1	1	SPARK PLUG
G1	1	ALTERNATOR ASSY
J1	1	RECEPTACLE-DUPLEX
J2	1	RECEPTACLE-TWISTLOCK
L1	1	REACTOR
R1	1	RESISTOR, 1.5Ω, 50 W (ADJ TO 1Ω)
S1	1	SWITCH-ROTARY TAP
S2	1	SWITCH-IGN
S3	1	SWITCH-START
S4	1	SWITCH-STOP
	1	CONTROL-WELDER

5.0 "TJ" WELDER
605-0120

CONTROL—OPERATING SEQUENCE FOR "7 CCK" WELDER #606-0156

Starting

Place the ignition switch (S2) in the on position. This removes the ground from the breaker points and allows the magneto to fire the plugs. Place the choke in a position appropriate for the ambient temperature. Pressing the large start switch (S3) on the front of the control connects the battery to the cranking windings of the generator. The generator acts as a DC cranking motor for the engine; if all proper preparation procedures have been followed, the engine should start and will accelerate to approximately 3700 RPM. This will produce approximately 120 volts AC output from the receptacles located on the cover of the control. Plug J2 connects the AC output of the armature to the receptacles on the control. It also connects the controlled shunt winding to its controlled circuit and connects the rheostat circuit of the voltage control.

Operation

The welder has a voltage control unit (A2) mounted on the lower left of the welder control. A switch is located at the top of this control to select the welding mode, either constant current or constant potential. It also has a rheostat for adjusting the welding voltage. A current control rheostat is mounted on the welder control for operation in the constant current position. There are two large studs mounted on the lower right of the control for the connection of the cables to be used for a constant voltage mode.

A plug J1 connects the voltage control unit to the welder control. This supplies AC power to transformer A2T, the plunger connects the selector switch to the voltage or current control mode, the voltage control rheostat to the welder control for shunt field current control and the battery charging bridge diode to the starting battery.

Constant Potential

When using the constant potential mode, be sure to connect the cord from the wire drive unit to the appropriate receptacle on the rear of the voltage control unit. This supplies 120 volts, 60 hertz power to operate relay A2K. When this relay is energized, its normally opened contacts close connecting the CR2 bridge to the transformer winding A2T. It also breaks the circuit to the current control rheostat on the control panel. In this position the A2R rheostat becomes operative and is used to adjust the current through the shunt field of the generator to obtain voltage control of 15-36 volts. Welder currents are controlled or regulated by the wire feed up to welder rating of 225 amps. There will be approximately 1 to 1-1/2 volts drop per 100 amperes welding current. This is normal. The A2R rheostat is used as a means of refining the welding voltage to obtain better arc control.

Constant Current

Placing switch A2S in the current mode disconnects the voltage control from the controlled excitation winding of the generator. Relay A2K drops out when the plug is removed from the voltage control to the wire drive unit. Its contacts revert to the original position and connect the R2 current control rheostat back into the controlled shunt field circuit. Plugging the welder cables into the current receptacle jacks on the front of the control selects the current value for the particular welding rod used. Should a refinement of the current be required, manipulate the rheostat to increase or decrease slightly the current from that particular receptacle. This rheostat causes an increase or decrease in the controlled shunt field current to increase or decrease the output voltage which, in turn, controls the current.

R4 resistor was placed in the circuit as a means of limiting controlled shunt field current to prevent the possibility of excessively high voltages.

Battery Charging Circuit

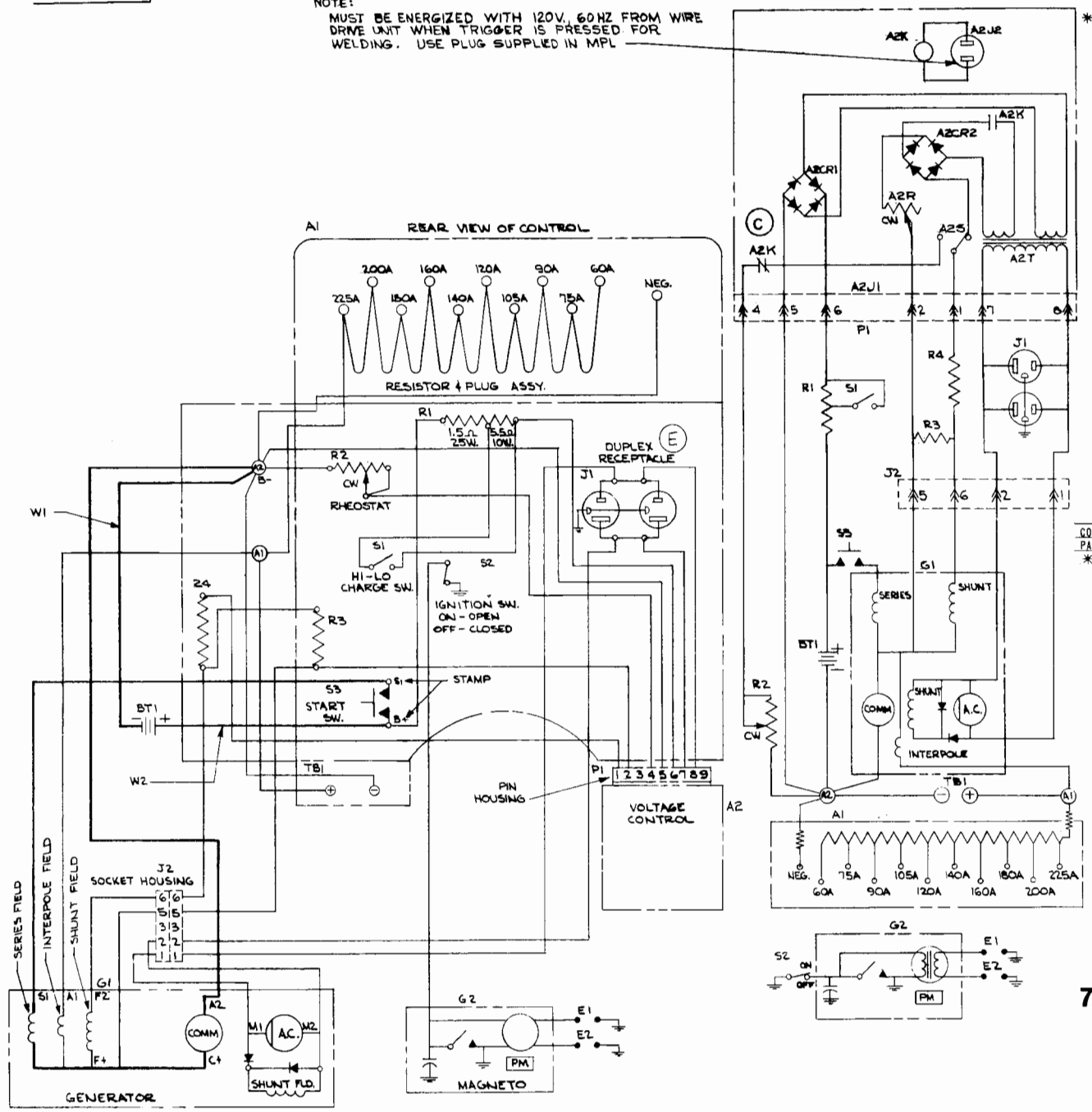
Battery charging is supplied to a secondary winding on transformer A2T. This secondary output is supplied to diode bridge CR1 and converted to direct current. The DC flows from CR1 to resistor R1 (charge resistor) to battery positive and back to the diode bridge. Switch S1 is the high charge switch and, when closed, shunts out part of resistor R1 to increase battery charging current. High charge is approximately 3 amperes and low charge approximately 3/4 amp.

Stop Circuit

To stop the unit, place the ignition switch (S2) in the off position. This places a ground on the ignition point side of the magneto and cuts off ignition power to the spark plugs stopping the engine.

606C156

NOTE:
MUST BE ENERGIZED WITH 120V., 60HZ FROM WIRE DRIVE UNIT WHEN TRIGGER IS PRESSED FOR WELDING. USE PLUG SUPPLIED IN MPL



PARTS LIST		
REF DES	QTY	DESCRIPTION
A1	1	RESISTOR & PLUG ASSY
* A2	1	VOLTAGE CONTROL
BT1	1	BATTERY
E1, E2	2	SPARK PLUG
G1	1	GENERATOR
G2	1	MAGNETO
J1	1	DUPLEX RECEPTACLE
J2	1	CONNECTOR, SOCKET HOUSING
	4	SOCKETS
P1	1	CONNECTOR, PIN HOUSING
	7	PINS
R1	1	RESISTOR 7 OHM, 35W
R2	1	RHEOSTAT 3.5 OHMS 100W
	1	KNOB
R3	1	RESISTOR 50 OHM, 25W
R4	1	CORRIB RESISTOR 5.5 OHMS, 160W
S1	1	HI-LO CHARGE SWITCH
S2	1	IGNITION SWITCH
S3	1	START SWITCH
TB1	1	TERMINAL BOARD
W1	1	WIRE-LEAD ASSEMBLY
W2	1	WIRE-LEAD ASSEMBLY
	1	CONTROL BOX
	2	STUD
	1	CONTROL BOX REFLECTOR PLATE
	1	CONTROL BOX VENT PLATE
	1	RESISTOR MTG BRKT.
	1	PANEL CONTROL
	1	TERMINAL BOARD MTG. BRKT.
	1	TERMINAL BOARD MTG BRKT.
	2	GROMMETS

CONSISTS OF THE FOLLOWING COMPONENTS PART NO'S. FOR REFERENCE ONLY

* A2	1	RECTIFIER - BRIDGE
	1	RECTIFIER - BRIDGE
A2CR1	1	SOCKET HSG CONNECTOR
A2CR2	1	BASE - RECEPTACLE
A2J1	1	RELAY
A2J2	1	RHEOSTAT
A2K	1	SWITCH - TOGGLE
A2R	1	TRANSFORMER
A2S		
A2T		

7 CCK WELDER
606-0156

AC Power

AC power can be taken from the welder at any time it is in operation. The receptacles are continuously connected to the AC coils of the armature through plug J2. The generator is a rectifier excited unit receiving its main excitation power from the AC coil through two diodes. Should one of these diodes fail, AC power will be lost along with DC power and a check is necessary to determine which has failed and then replacing it.

Ignition

Ignition system is a magneto ignition employing a stationary coil and revolving magnet in the blower wheel. Breaker points operate to fire the spark plugs at the appropriate timed point. Badly fouled spark plugs can produce erratic engine operation and low power.

CONTROL—OPERATING SEQUENCE FOR LTEU 30-3/12703E TRANSFER CONTROL #619-2704

On this load transfer, it will be assumed the generating set is shut down and normal commercial power is available. With commercial power supplied, there will be 240 volts available between lines A and B and 120 volts available between line A and ground and line B and ground. All AC relays will be 240 volt operated devices.

With normal power on the line, a current flow from line A through the coil of relay K6 (start-stop) and through the coil of relay K3 (instant transfer to line) through the TB2 jumper between terminals 14 and 15, through the S1 (test transfer) switch to line B. Both the relays energize causing their contacts to change position from that when de-energized. With K3 energized, its contacts close completing the circuit from line A through coil of relay K1 (closing coil of the line side of the transfer switch) through the normally closed interlock contacts of K2 (generator side of the transfer switch) through the closed contacts of K3 to line B. This energizes K1 and closes the line side of the transfer switch.

When K6 (start-stop) relay energizes, it causes a set of contacts to close completing this circuit from terminal 2 through the normally closed contacts of the set exerciser clock through the selector switch (in automatic mode) to ground. Grounding terminal 2 causes the generator set to shut off, if running, or prevents its starting. The normally closed contacts of K6 open to break this circuit to terminal 3 and remove the ground on terminal 3. This prevents the generating set from starting.

When K1 closes the line side of the transfer switch, the interlocks open to break the circuit to the K2 coil of the generator side of the transfer switch. This prevents the generator side from attempting to close while normal power is on the system.

Should a power outage occur, relay K6 and K3 will de-energize. This will cause K6 contacts to switch positions. One set will open breaking the ground circuit to terminal 2 and the other set will close completing the ground circuit for terminal 3 through the selector switch automatic position to ground. Grounding terminal 3 causes the generator set control to complete the starting circuit and the engine should crank and start. At the same time that terminal 3 is grounded, current is also passed through the K5 (cranking limiter) from B+. Should the unit fail to start in 45 seconds, this limiter operates and opens its contacts breaking the ground on terminal 3. This causes the starting circuit to be broken and disengages the cranking motor on the generating set. A one minute time period is required before resetting the cranking limiter. This allows the solder to solidify in the solder pot.

When the generating set has started and its voltage has come up to a pre-selected value, the K4 relay (start disconnect) energizes. When it energizes, its normally closed contacts open breaking the ground on terminal 3, breaking the circuit through the coil of K1 (line contactor) and also a set of contacts close completing the circuit to the closing coil of K2 (generator contactor) allowing it to close. The generator is now connected to the load.

While the generator is supplying power to the load, M3 (total time meter) is energized from the generator output to record the length of time the generator set operates to supply power to the load.

When normal power is restored, relay K6 and K3 energize. Their contacts reverse position thereby breaking the circuit to the coil of K2 causing it to de-energize and open. Also, the interlock contact of K2 closes as does the contact of K3 completing the circuit through K1 coil, energizing it and allowing its contacts to close. This connects the load to the commercial power supply. When K6 energizes, it completes the circuit from terminal 2 through the automatic position of the selector switch to ground causing terminal 2 to be grounded. This shuts down the engine of the generator set.

A set exerciser clock (M2) is employed to assure exercising of the generator set at a preselected time on a preselected day. When the exerciser clock operates, it causes a set of contacts to open and remove the ground from terminal 2 and a set of contacts close completing the circuit from terminal 3 to ground. Grounding terminal 3 energizes the starting circuit on the generator set; if all conditions are right, the engine will start and operate. It will run for a predetermined period of time at which time the exerciser clock's contacts reverse position and place the ground on terminal 2 which causes the engine to shut down.

The selector switch has four positions. In the stop position, a ground is maintained on terminal 2 preventing the engine from starting. This is the position at which it is placed when servicing of the generator set is being provided. In the automatic position, should a power failure occur, the generator set will be started. In the check position, the generator set will start when the switch is placed at that position. The hand crank position is inoperative. At one time it was provided to make necessary starting of the generator set at the set itself.

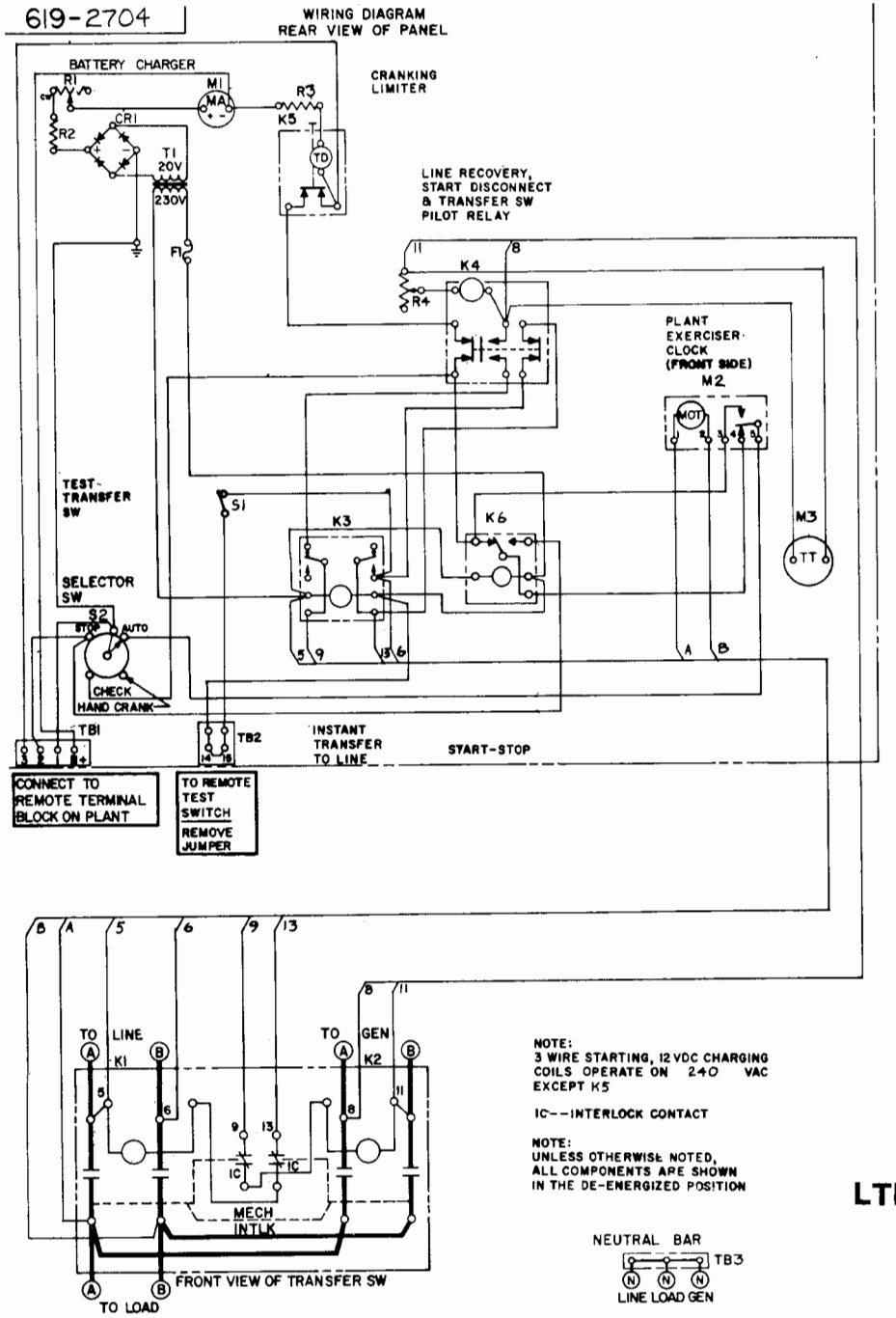
A battery trickle charging circuit is also provided in the control. This does not recharge the batteries but maintains them at charge once they have reached a preselected charge level. The trickle charging rate is adjusted through the manipulation of a rheostat on the transfer panel. It is usually set to give a trickle charging rate approximately half of the full scale deflection of the milliammeter. Should the batteries fail to maintain their charge, the trickle charging rate must be increased.

The S1 (test transfer switch) is for the purpose of simulating a power outage. When this switch is placed in the off or open position, it breaks the circuit to relays K6 and K3. These are the sensing relays and when de-energized will operate the control the same as an actual power outage would. Closing the switch is the same as restoring normal power and the K6 and K3 relays will re-energize and restore the load to the line side. This is a good check to be certain the line contactors are operating as designed.

The main contactors are both mechanically and electrically interlocked. This means a mechanical device prevents both contactors closing at the same time. The electrical interlocks prevent the contactor coils from electrically energizing at the same time.

Before placing the load transfer into operation, it is suggested that the generator set be started by itself to be sure it is operating at the correct frequency and voltage. Then the generator set should be started by the manipulation of the selector switch in the transfer panel. The transfer panel should be checked to be sure there are no stray pieces of wire, insulation or other foreign material which could prevent the operation of the contactors. Then the generator set should be started through the manipulation of the test transfer switch. Then a power outage can be simulated by opening the main line disconnect. When all these checks have been completed, then the exerciser clock should be set for a desired length of operation and then manually operated to check the starting and stopping of the generator set. Then the exerciser clock should be set to the appropriate day and time through the use of the day pointer and hour pointer.

Gently close the cover on the load transfer being sure the door is securely fastened and make a visual check of both transfer and generator set to be sure all is in order. Make a last minute check on oil level in the engine to be sure an adequate supply is in the case.

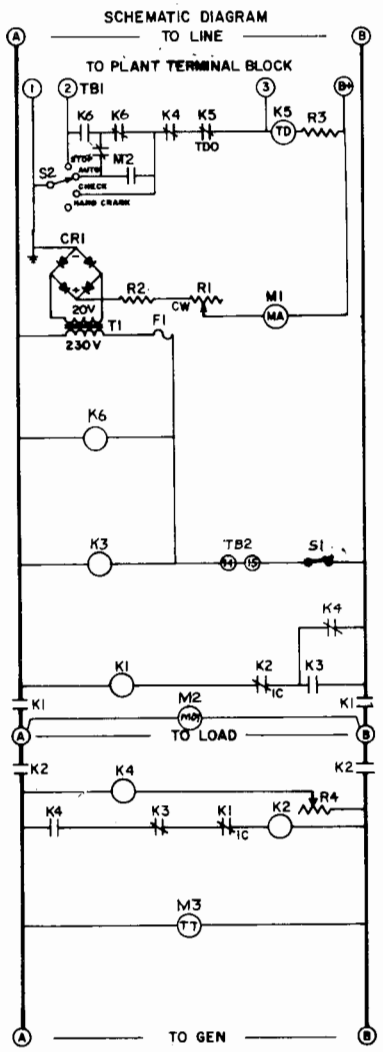


NOTE:
3 WIRE STARTING, 12 VDC CHARGING COILS OPERATE ON 240 VAC EXCEPT K5

IC--INTERLOCK CONTACT

NOTE:
UNLESS OTHERWISE NOTED, ALL COMPONENTS ARE SHOWN IN THE DE-ENERGIZED POSITION

NEUTRAL BAR
TB3
LINE LOAD GEN



REF DES	ALT	QTY	DESCRIPTION
XLK2	C	1	TRANSFER SWITCH
K3	B	1	RELAY-INSTANT TRANSFER TO LINE
K4	C	1	RELAY-START DISCONNECT
K5	B	1	RELAY-CRANKING LIMITER
	A	1	NAMEPLATE
K6	B	1	RELAY-START STOP
M2	B	1	CLOCK-PLANT EXERCISER
M3	P	1	METER-RUNNING TIME, 240V
	A	1	PLATE-METER MTG
R3	A	1	RESISTOR, 3 OHM, 10W
R4	A	1	RESISTOR, 750 OHM, 25W
S1	P	1	SWITCH-TEST TRANSFER
	A	1	NAMEPLATE
S2	A	1	SWITCH-SELECTOR
	-		KNOB
	A	1	NAMEPLATE
TB1	A	1	TERMINAL BLOCK
	A	1	MARKER STRIP
TB2	A	1	TERMINAL BLOCK
	A	1	MARKER STRIP
TB3	B	1	NEUTRAL BAR ASSY
			STD CHARGER
CR1	A	1	RECTIFIER
F1	-	1	FUSE-1 AMP
	P	1	HOLDER-FUSE
	A	1	NAMEPLATE
M1	P	1	MILLIAMMETER, 0-300
R1	P	1	RHEOSTAT-CHARGE, 150 OHM
	-	1	KNOB
	A	1	NAMEPLATE
R2	A	1	RESISTOR, 15 OHM, 5 W
T1	B	1	TRANSFORMER-CHARGE
	D	1	CONTROL BOX
	D'	1	PANEL
	B	1	DOOR
	A	2	HOLDER-WIRE
	A	1	NAMEPLATE-ONAN
	-	2	CLIP-NAMEPLATE
	A	1	NAMEPLATE-CONTROL
	P	1	DOORLOCK (REF)
	-	1	LATCH (REF)
	A	3	PLATE-COVER

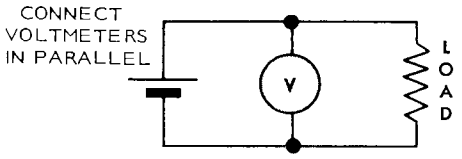
LTEU 30-3/12703E TRANSFER CONTROL 619-2704

TEST EQUIPMENT

The service technician that has a thorough knowledge of electrical fundamentals and a working knowledge of the use of test equipment finds his job much easier.

Test meters and load banks are essential aids in diagnosing troubles in electrical circuits and controls.

The following selected tools are specifically recommended for use in troubleshooting controls and associated electrical equipment.

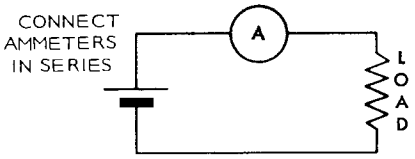


VOLTMETER USAGE

Ammeters

Having a very low resistance, connecting the ammeter in series does not introduce any appreciable added resistance to the circuit that would alter the true current flow.

CAUTION **The ammeter has a very low resistance so it must be connected in series in the circuit, never across the voltage source. If connected across the voltage source, such as a battery, the meter may be instantly damaged.**

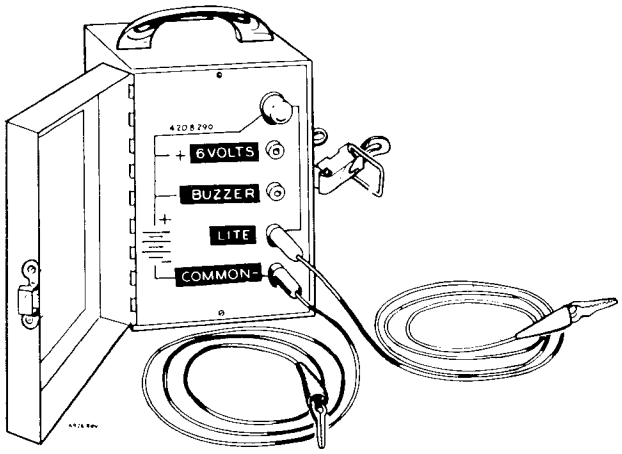


AMMETER USAGE

Voltmeters are connected ACROSS (in parallel with) the voltage to be measured. Since the voltmeter has a high resistance, adding this component to the circuit will change the total circuit current very little, and the voltage reading obtained indicates the true voltage present without the meter in the circuit.

Continuity Tester

The six-volt lite/buzzer test set available from Onan is a safe and practical continuity tester for checking rectifiers, resistors, coils, and ignition circuits. It can also be used when checking for opens, shorts, and grounds.

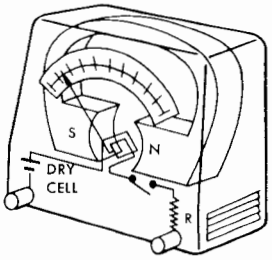


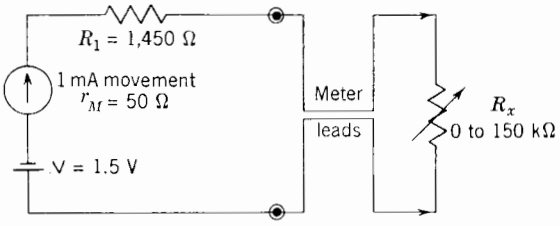
CONTINUITY TESTER

Ohmmeters

An ohmmeter of the moving coil type contains a resistor and dry cell battery connected internally to the moving coil. When the ohmmeter is connected to a resistor, the current flow through the moving coil is directly related to the value of the resistor, and the scale is calibrated accordingly to indicate the resistor value in ohms.

CAUTION **Ohmmeters should never be connected to an external source of voltage, as the meter movement may be damaged.**



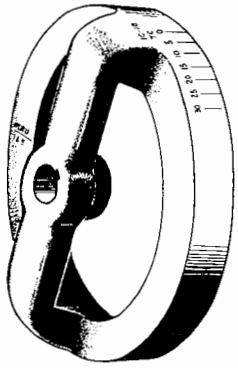


OHMMETER

Magneto Adjusting Gauge

With timing marks to simplify ignition timing. Assures proper pole shoe air gap on flywheel magnetos.

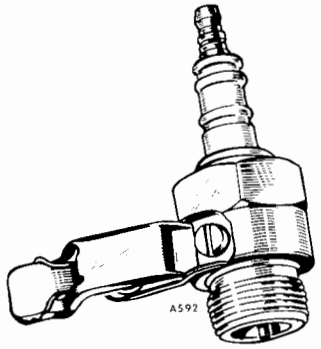
PART NO.	SERIES
420-0096	AH, AJ, AK, MAJ
420-0249	CCK, NB, NH, NHA, NHB, NHC



Test Spark Plug

Simulates normal compression firing. Ground to engine and connect hi-tension lead.

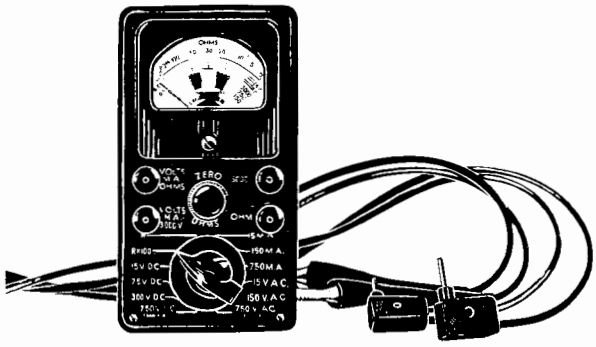
PART NO.	SERIES
420-0255	ALL



AC-DC Multimeter

Check AC-DC volts, ohms, DC milliamperes, complete with test leads and instructions. SCALE: AC-volts, 0-15, 150, 750, 3000. DC volts, 0-15, 75, 300, 750, 3000, DC-Milliamps, 0-15, 150, 750, ohms 0-30, 3000, 300,000.

PART NO.
302-0195



ACCESSORY AND SAFETY FEATURES

All "Onan" units are built with safety being of utmost importance in the design, operation and servicing of all Onan units regardless of size. Many units feature low oil pressure cut off switches, high water or high air temperature cut off switches, thermostats, overspeed shut down, guards or scrolls over all moving pulleys, belts, fans, air inlets and outlets, etc.

These protective covers, etc., should never be removed or by-passed during normal operation.

For certain types of service, some covers or guards must be removed for access to certain components. In most cases, extra warning or caution stickers will appear if and when covers are removed. Take whatever extra precautions are suggested if these are suggested upon removing any protective covers.

Observe all "Warning" and "Caution" decals wherever posted throughout the operator and/or service manual.

Keep appropriate fire extinguishers nearby and never sacrifice or risk human lives to save a piece of equipment.

Most "Onan" manuals of all types have a safety section or page in the beginning of the manual. Read these over before proceeding with any further operation or service.

End of Session

When the electric generating set is correctly serviced and maintained, it provides many hours of safe and efficient operation. Service and maintenance includes proper adjustment and testing procedures and repairing or replacing any necessary parts.

NOTES

NOTES

SERVICE SCHOOL

IN SESSION

"ONAN" FACTORY SERVICE TRAINING SCHOOLS

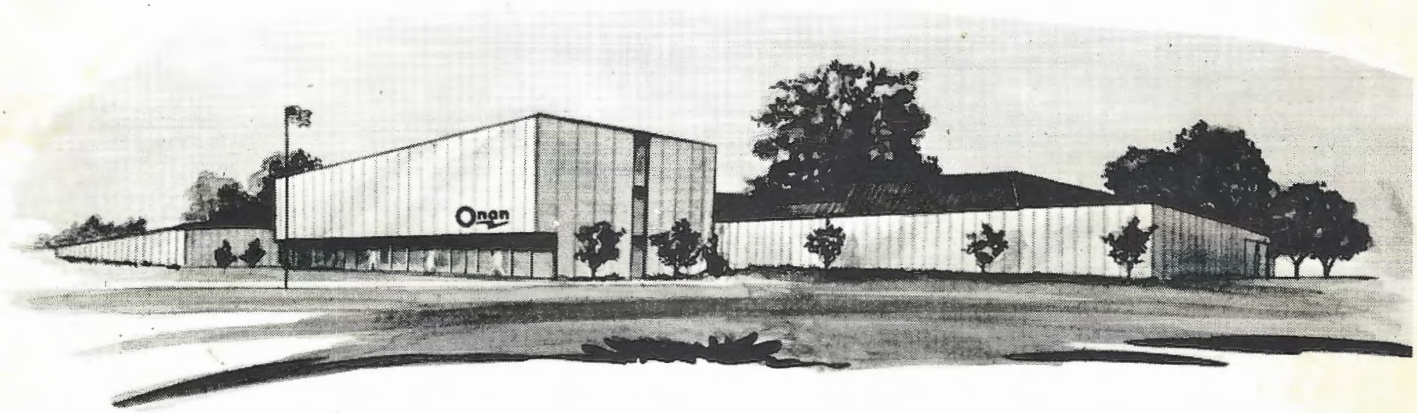
After familiarizing yourself with the contents of this training manual we would like to remind you that there are two "Electrical Seminars" which you may wish to attend.

These one week sessions concentrate on newer type generators and controls including Load Transfer controls and Automatic Transfer switches, solid state controls, wiring diagrams and troubleshooting.

The only prerequisite for attendance is that the student MUST have previously attended a Class A, Dealer, RV or Marine Service School.

For further information, agenda, schedule and enrollment, contact the Service Training Co-ordinator at the Onan Factory in Minneapolis. The telephone number is area code 612/574-5000.

PRICE $2.00 each



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932-0406

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