LINCOLN WELDERS

IM-253-B

IM253
SAF-600
February, 1981

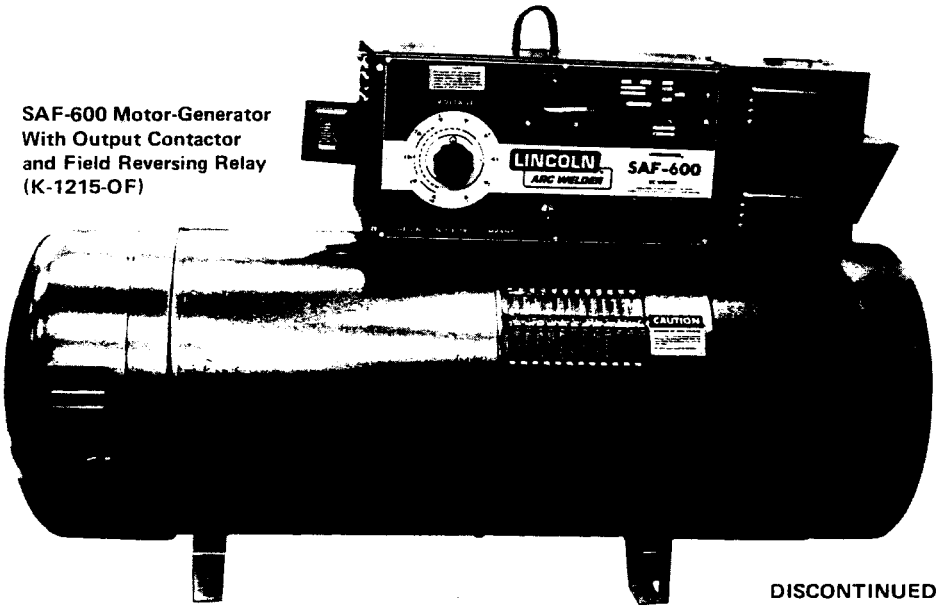
OPERATING MANUAL

5791; 5803; 5804; 5812; 5813; 5816; 5819; 5824; 5830; 5837; 5838; 5852; 5853; 5854; 5855; 5856; 5863; 5864; 5865; 5866; 5867; 5868; 5869; 5870; 5871; 5872; 5873; 5874; 5875; 5876; 5877; 5878; 5887; 5888; 5891; 5892; 5893; 5902; 5904; 5906; 5907; 5908; 5932; 5933; 5934; 5935; 5936; 5937; 5938; 5939; 5940; 5941; 5943; 5945; 5954; 5955; 5958; 5959; 5960; 5963; 5964; 5966; 5967; 5992; 5993; 5994; 5995; 5996; 5997; 5998; 5999; 6000; 6021; 6029; 6030; 6031; 6032; 6034; 6037; 6053; 6060; 6061; 6062; 6075; 6079; 6082; 6093; 6100; 6105; 6107; 6121; 6153; 6158; 6192; 6215; 6219; 6222; 6229; 6231; 6237; 6243; 6261; 6311; 6312; 6313; 6392; 6393; 6402; 6446; 6456; 6501; 6508; 6521; 6558; 6593; 6611; 6677; 6681; 6713; 6714; 6727; 6734; 6736; 6737; 6887; 6913; 6927; 6984; 6985; 6986; 6987; 6988; 6989; 6990; 7015; 7092; 7106; 7137; 7159; 7180; 7209; 7212; 7215; 7716; 7753; 7839; 7842; 7843; 7912; 8062; 8094; 8338; 8350; 8358; 8360; 8368; 8374; 8378; 8405; 8461

SAF-600

LINCOLNWELD® DC ARC WELDING POWER SOURCE

This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.



SAF-600 Motor-Generator With Output Contactor and Field Reversing Relay (K-1215-OF)

DISCONTINUED MODELS

SAF-600-Belted with optional contactor AC Auxiliary Power, and meters.

SAF-600 with output contactor (K-1215-O).

DAMAGE CLAIMS

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation . . . and thoughtful operation on your part. DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS OPERATING MANUAL AND THE ARC WELDING SAFETY PRECAUTIONS ON THE INSIDE FRONT COVER. And, most importantly, think before you act and be careful.

LINCOLN ELECTRIC

THE LINCOLN ELECTRIC COMPANY
World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Cleveland, Ohio 44117 U.S.A.

ARC WELDING SAFETY PRECAUTIONS

PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. READ AND UNDERSTAND BOTH THE SPECIFIC INFORMATION GIVEN IN THE OPERATING MANUAL FOR THE WELDER AND/OR OTHER EQUIPMENT TO BE USED AS WELL AS THE FOLLOWING GENERAL INFORMATION.

1. Have all installation, maintenance and repair work performed only by qualified people.

2. **ELECTRIC SHOCK can kill.**

Protect yourself from possible dangerous electrical shock:

a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Never permit contact between "hot" parts of the circuits and bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.
b. Always insulate yourself from the work and ground using dry insulation when welding in damp locations, on metal floors, gratings or scaffolds, and particularly when in positions (such as sitting or lying) where large areas of your body can be in contact with a conductive surface.
c. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition.
d. Never dip the electrode holder in water for cooling.
e. Never simultaneously touch electrically "hot" parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.
f. If using the welder as a power source for mechanized welding, the above precautions also apply for the automatic electrode, electrode reel, welding head, nozzle or semiautomatic welding gun.
g. When working above floor level, protect yourself from a fall should you get a shock. Never wrap the electrode cable around any part of your body.
h. Also see Item 7.

3. **FUMES AND GASES can be dangerous to your health.**

a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. When welding on galvanized, lead or cadmium plated steel and other metals which produce toxic fumes, even greater care must be taken.
b. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.
c. Also see Item 8b.

4. **ARC RAYS can injure eyes and burn skin.**

Arcburn may be more severe than sunburn. Therefore:

a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Filter lens should conform to ANSI Z87.1 standards.
b. Use suitable clothing to protect your skin and that of your helpers from the arc rays.
c. Protect other nearby personnel with suitable non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

5. **FIRE OR EXPLOSION can cause death or property damage.**

a. Remove fire hazards well away from the area. If this is not possible cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas.
b. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.
c. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned." For information purchase "Safe Practices for Welding and Cutting Containers That Have Held Combustibles", A6.0-65 from the American Welding Society, Miami, Florida 33125.
d. Vent hollow castings or containers before heating, cutting or welding. They may explode.
e. Also see Items 6c and 8c.

Additional Safety Precautions

6. **For Welding in General.**

a. Droplets of molten slag and metal are thrown or fall from the welding arc. Protect yourself with oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses when in a welding area. Use glasses with side shields when near slag chipping operations.
b. Keep all equipment safety guards, covers and devices in position and good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.
c. Be sure the work cable is connected to the work as close to the welding area as practical. Work cables connected to the building framework or other locations some distance from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

7. **For Electrically Powered Equipment.**

The high voltage and rotating parts associated with such units require observance of these additional precautions:

a. Disconnect and lock out all power sources before doing any work on the equipment.
b. Make the electrical installation in accordance with the National Electrical Code and all local codes.
c. Properly ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations. The work or metal to be welded must also be connected to a good electrical ground.

8. **For Engine Powered Equipment.**

The required fuel and rotating parts associated with such units require observance of these additional precautions:

a. Whenever possible, turn the engine off before troubleshooting and maintenance work.
b. Operate internal combustion engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.
c. Do not add the fuel near an open flame or when the engine is running. Stop the engine and, if possible, allow it to cool to prevent spilled fuel from igniting on contact with hot engine parts or electrical sparks. Do not spill fuel when filling tank.
d. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.
e. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

For moré detailed information it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting — ANSI Standard Z49.1" from the American Welding Society, Miami, Florida 33125.

INSTALLATION

DESCRIPTION

These machines are combination variable voltage/constant voltage power sources. Variable voltage is required for stick electrode welding and recommended for most submerged arc applications. Constant voltage is required for Innershield® and other open arc welding.

SAF-600 Motor Generator – Two different control boxes are available. "-F" has a field reversing relay for submerged arc full automatic welding using an obsolete LAF or LT-3 wire feeder. "-OF" has both the contactor (required for current Lincoln wire feeders) and the reversing relay. All can be used for stick electrode welding.

INPUT CONNECTION: Motor-Generator

Install the welder in a dry location where there is free circulation of air. Place the air intake end of the machine to minimize the amount of smoke and fumes from welding which are drawn into the welder.

Be sure the voltage, phase and frequency of the input power is as specified on the welder nameplate.

Dual input voltage machines with an input panel are shipped connected for the higher voltage. Machines without an input panel are shipped not connected. Connect for the available voltage as indicated on the wiring diagram inside the control box.

Have a qualified electrician connect 3 phase AC power to the input panel or starter as appropriate, in accordance with the National Electrical Code, all local codes and the wiring diagram glued to the inside of the door on the start button side of the control box.

The welder frame must be grounded. A stud marked with the symbol ⏚ located inside the machine is provided for this purpose. See the National Electrical Code for details on proper grounding methods. (If an old machine does not have a grounding stud, connect the grounding wire to an unpainted screw or bolt.)

Recommended Input Wire, Ground Wire and Fuse Sizes Based on National Electrical Code. For 60 Hertz, 3 Phase Welders at 675 amp, 60% Duty Cycle

Welder Size	Input Voltage	Input Ampere Rating	Copper Wire Size Type 75°C in Conduit		Fuse Size (Super Lag)
			3 Input Wires	1 Ground Wire	
SAF-600	230	160	1	4	250
	460	80	6	6	125

Start the welder and check the direction of rotation. Proper direction is shown by an arrow on the nameplate. The direction of rotation can be changed by interchanging any two of the 3-phase input leads.

OUTPUT CONNECTION

a. **With LN-4, LN-5, LN-6, LN-7, LN-8 or LN-9 Semiautomatic Squirt and NA-3, NA-5, LT-7 or LT-56 Automatic Wire Feeders**
Use a motor-generator model equipped with a contactor ("OF" or obsolete "O"). The obsolete belted model with the optional alternator and output contactor ("-AO") can also be used.

Instructions for connecting the power source to these welders are given in the appropriate Wire Feeder Instruction Manual.

b. **With Obsolete LAF-3, LAF-5, LT-3 or LT-34 Automatic Welders**
Use a motor-generator model equipped with a field reversing relay ("F" or "-0F").

Instructions for connecting the motor-generator to these welders are given in the appropriate Automatic Welder Instruction Manual.

The obsolete belted model (without AC/DC exciter) can be used with the LAF-5 only. Request connection instructions from the factory.

c. **Obsolete ML-2, ML-3 and MN-1 Squirt Welders and LAF-2 Automatic Welders**
These power sources can be connected to some of these obsolete wire feeders. Write to the factory for instructions. Give the model name and code number from the nameplate of the power source and wire feeder to be used.

d. **For Stick Electrode Welding and Miscellaneous Applications**
All of these power sources can be used for stick electrode welding, tacking, arc gouging, resistance heating or other applieations. When arc gouging, installation of the optional protection kit is recommended (machines with this kit can be identified by the letter "G" after the code number).

For motor-generators connect a jumper between #2 and #24 on the terminal strip to complete the field circuit. Also: For models with **field reversing relay** – connect a jumper between #2 and #F4 on the terminal strip. This puts the field reversing relay in the on position. To turn the power source output on and off from a remote location, put a switch in the jumper between #2 and #F4. The rating of the switch must be at least 2 amperes at 125 volts DC. When this switch is off, the open circuit voltage of the power source is about 12 volts.

For the models with an **output contactor** – install a jumper between #2 and #C4 on the terminal strip. This closes the contactor. Also install a jumper between #22 and #32 to open the full field relay contacts. To turn the output contactor on and off from a remote location, put a switch in the jumper between #2 and #C4. The rating of the switch must be at least 2 amperes at 125 volts DC.

e. **Other Wire Feeders**
These power sources can be used with wire feeders manufactured by other companies. The connection must be determined by the customer for the specific equipment being used.

Auxiliary power available for wire feeder operation is described under "Auxiliary Power" below. To operate the contactor (when installed), contacts on the wire feeder must close the #2 and #C4 circuit at the control box terminal strip.

f. **Motor-Generator Paralleling Instructions**
These power sources **cannot** be paralleled when they are connected for constant voltage welding.

Machines with a 125 volt exciter are used for all single power source installations. At one time a model with a 35 volt exciter for paralleling with a 125 volt exciter machine was available. Because the 35 volt exciter model was used only for paralleling when using the LAF-3, LT-3 or LT-34, the control box had no contactor, field reversing relay, or polarity switch.

Complete instructions for paralleling one machine with a 125 volt exciter and one with a 35 volt exciter are given in the LAF or LT Instruction Manuals. Paralleling two machines with 125 volt exciters requires some rewiring within the power source control box. Write to the factory for these instructions. Give the code numbers from the nameplate of the power sources being used.

SAF-600-B (Belted) (Obsolete)

These machines consist of the same generator and control box as the motor-generator models but are driven by a PTO, electric motor or an engine. Three models were available. One model (type "-AO") was equipped with the output contactor and AC/DC exciter needed to operate some Lincoln wire feeders. The other two models were used for heavy duty stick electrode welding and miscellaneous high current applications, such as arc gouging and resistance heating. Except as modified below, the appropriate operating and maintenance instructions in this manual apply to the belted welders.

A grounding stud marked with the symbol ⏚ is located on the welding generator support frame. As a safety factor connect this stud to a solid earth ground such as a metal pipe which goes into the ground or the metal framework of a building which is effectively grounded. For other alternatives, see the section on "Grounding Electrodes" in the National Electrical Code. The ground connector must be No. 8 or larger wire. If an older welder does not have a gounding stud, connect the ground wire to an unpainted frame screw or bolt.

INSTALLATION

Design the driving system to operate the generator at a steady 1800 RPM full load speed. Build a rigid mounting which maintains accurate alignment through the driving system and minimizes vibrations transmitted to the welder. Use a flexible type coupling when connecting the generator shaft directly to the power source shaft. For belt driven installations, prevent excessive bearing wear by using only enough belt tension to avoid slipping.

For stick electrode welding, the standard machines (without contactor) were shipped ready to weld. Machines with an output contactor (type "-AO") must have a jumper installed between #2 and #C4 on the terminal strip to close the contactor. Also install a jumper between #22 and #32 to open the full field relay contacts.

For connecting to wire feeders using a type "-AO" machine, see the appropriate section (a, c or e) under "Output Connections" on page 2.

AUXILIARY POWER

Standard machines (without the AC/DC exciter) produced 1000 watts of 120 volt DC power available from #1 and #2 on the terminal strip. Machines with the AC/DC exciter (types "-A" or "-AO") produced 1000 volt-amperes of 115 volt AC power available from #31 and the #32 on the terminal strip. Type "-AO" welders also produced 350 watts of 120 volt DC power available from #1 and #2 on a terminal strip.

OPERATION

DUTY CYCLE (Based on 10 minute period)

Model	Hertz	Amps	Volts	Duty Cycle
SAF-600 & SAF-600-B	60	600 675	55 55	80% 60%
SAF-600	50	600	55	60%

AUXILIARY POWER

All motor-generator models provide 1150 volt-amperes of 115 volt AC power from an isolated winding in the motor stator and 1KW of 120 volt DC power from the exciter.

The AC power is available from #31 and #32 on the terminal strip. The DC power is available from #1 and #2 on the terminal strip. This power is always shut off when the power source is shut off.

OUTPUT CONTROLS

Start and Stop the motor-generators with the push-button on the control box. Run the power source for 15 minutes before welding. Once it is warmed up, there will be little or no change in output current from the start to finish of the weld.

Electrode Polarity – Turn the switch on the control box to Electrode Positive or Electrode Negative as desired.

Voltage Range – When set on 'Low', the open circuit voltage of the power source can be varied between about 18 and 59 volts (or 4 to 42 volts for old machines below code 5980). When set on 'High', the open circuit voltage of the power source can be varied between about 40 and 86 volts.

Submerged Arc Output Controls – For submerged arc, best weld quality is normally obtained with the 'Open Circuit Voltage' rheostat set at 9-10 and the 'Voltage Range' switch set on 'High'. Connect the electrode cable to the sub-arc stud with the lowest current range which still permits welding at the desired current, i.e., if the welding current is to be 500 amperes, use the 300-575 ampere stud and not the 400-max. stud. Exact adjustment of the welding current is made at the automatic welder control box. If the higher current range stud is used, starting ability is slightly reduced and a higher short circuit current results when starting.

Innershield® Output Controls – For Innershield constant voltage welding, connect the electrode cable to the 'Innershield' stud and set the 'Voltage Range' switch as desired – usually 'Low'. The setting of the power source 'Open Circuit Voltage' Control depends upon the wire feeder. When using the NA-3, set it at 10. When using the NA-2, use it to set OCV for good arc starting. When using most other wire feeders use this rheostat as the major vol-

tage adjustment. Set the exact welding current and voltage with the wire feeder control. In cases where a slightly drooping output characteristic is desired when welding at low currents, connect the electrode cable to the '400 to Max' stud and set the 'Voltage Range' switch on 'Low'.

Output Controls for Stick Electrode Welding – Set the 'Voltage Range' switch on 'High'. Usually connect the electrode lead to the sub-arc or stick stud with the lowest current range that still provides the desired current. Then keep the 'Open Circuit Voltage' rheostat at the high side of the range.

Output Controls for Miscellaneous Applications – To adjust the current for arc gouging and other miscellaneous applications, connect the electrode cable to the sub-arc or stick stud for the current range desired. Turn the 'Open Circuit Voltage' rheostat to obtain the exact current desired.

Note: Except when connected to an ML-3, models with a field reversing relay are wired so the open circuit voltage drops to about 12 volts when idling. This voltage is necessary to operate the LAF-3, LAF-5, LT-3, LT-34 and the ML-2 controls. This voltage is set at the factory and further adjustments should not be necessary. However, it can be changed by adjusting the adjustable resistor in the control box. If adjusted too low, the LAF-3 automatic stop relay will fail to operate properly. If adjusted too high, small diameter electrodes will rapidly get red hot when the electrode is in contact with the work.

MAINTENANCE

WARNING: Have a qualified electrician do the maintenance and trouble shooting work. Turn the power off using the disconnect switch at the fuse box before working inside the machine.

CIRCUIT PROTECTION

A Slo-Blow type fuse to protect the exciter circuit is located on the rear of the control box. Also a Slo-Blow type fuse to protect the 115 volt AC circuit is located on the rear of the control box.

MOTOR PROTECTION

The AC motor is protected by a special device operated by both temperature and current. This device stops the machine if the windings reach the maximum safe operating temperature because of frequent overloads, high room temperature plus overload, or abnormally high or low input voltage. Protection is also assured against excessive currents resulting from single phase or unbalanced line conditions.

The thermostat automatically resets when the temperature reaches a safe operating level. Re-start the motor by pushing the start button.

Cooling of the motor can be speeded by holding in the start button and operating the machine idle. If the reason for the disconnection was single phase or unbalanced line conditions, correct the situation before attempting to re-start the motor. Serious damage will result if the start button is held in with these conditions present.

COMMUTATOR AND BRUSHES

The generator and exciter brushes are properly adjusted when the welder is shipped. They require no particular attention. DO NOT SHIFT THE BRUSHES or adjust the rocker setting.

Periodically inspect the commutators and brushes by removing the commutator covers. DO NOT remove or replace these covers while the machine is running.

Commutators require little attention. However, if they are black or appear uneven, have them cleaned by an experienced maintenance man using fine sandpaper or a commutator stone. Never use emery cloth or paper for this purpose.

Replace brushes when they wear within 1/4" of the pigtail. A complete set of replacement brushes should be kept on hand. Lincoln brushes have a curved face to fit the commutator. Have an experience maintenance man seat these brushes by lightly stoning the commutator as the armature rotates at full speed until contact is made across the full face of the brushes. After stoning, blow out the dust with low pressure air.

WARNING: Uncovered rotating equipment can be dangerous. Use care so your hands, hair, clothing or tools do not catch in the rotating parts. Protect yourself from particles that may be thrown out by the rotating armature when stoning the commutator.

Arcing or excessive exciter brush wear indicates a possible misaligned shaft. Have an authorized Field Service Shop check and realign the exciter shaft.

BEARINGS

This welder is equipped with double-shield ball bearings having sufficient grease to last indefinitely under normal conditions. Where the welder is used constantly or in excessively dirty locations, it may be necessary to add one ounce of grease per year.

When greasing the bearings, keep all dirt out of the area. Wipe the fittings completely clean and use clean grease and equipment. More failures are caused by dirt introduced while greasing than from insufficient grease.

MAINTENANCE INSTRUCTIONS

General Instructions

1. Blow out the welder and controls with an air hose at least once every two months. In particularly dirty locations this cleaning may be necessary once every week. Use low pressure air to avoid driving dirt into the insulation.
2. The starter should be inspected every six months. Any accumulated dust should be blown out of the starter.
3. Keep electrode and work connections tight.

CONTACTOR MAINTENANCE

Where the output contactor is operated frequently when tacking or making short welds, inspect it every three months:

1. Be sure the mating surfaces of alloy contacts are not worn and all make contact at approximately the same time.
2. Make sure the springs and holders are not broken or out of adjustment. Approximate spring compression after making contact is 1/8". Less than 1/16" compression indicates worn contacts that should be replaced.
3. Make sure the moving contact or other moving parts are not binding.
4. Check interlock contacts and springs. Be sure mounting screws are tight.

TROUBLE SHOOTING

WARNING: Have a qualified electrician do the maintenance and trouble shooting work. Turn the power off using the disconnect switch at the fuse box before working inside the machine.

TROUBLE	CAUSES	WHAT TO DO
Machine fails to hold the "heat" constantly.	Rough or dirty commutator.	Commutator should be trued, or cleaned.
	Smoke or fumes from welding or other processes drawn into air intake may cause a film to form on the commutator.	Locate air intake end so fumes will not be drawn through the machine. Clean the commutator.
	Brushes may be worn down to limit of adjustment or life.	Replace or readjust brushes.
	Brush springs may have lost adjustment or may be broken.	Replace brush springs.
	Field circuit may have variable resistance connection or intermittent open-circuit, due to loose connection or boken wire.	Check field current with ammeter to discover varying current. This applies to both the main generator and exciter.
	Electrode lead or work lead connections may be poor.	Tighten all connections.
	Wrong grade of brushes may have been installed on generator.	Check with manufacturer's recommendations.
	Field rheostat may be making poor contact and overheating.	Inspect rheostat and clean.
Welder starts but fails to generate current.	May be running the wrong way.	Check direction of rotation with direction arrow. On three-phase motors, direction of rotation may be changed by interchanging any two input leads.
	Generator or exciter brushes may be loose or missing.	Be sure that all brushes bear on the commutator and have proper spring tension.
	Exciter may not be generating.	Check exciter output voltage with voltmeter.
	Series field and armature circuit may be open-circuited.	Check circuit with ringer or voltmeter.
	Field circuit of generator or exciter may be open.	Check for open circuits in rheostat, field leads, field coils and resistors. All machines give less output when fields are open.
	Polarity reversing switch may be in the neutral position.	Put handle in positive or negative position.
	Exciter may have lost excitation.	Flash the exciter fields.*
	Exciter fuse may have blown.	Replace the 15 amp fuse located in the control box next to the reversing switch (Item 52 on P-77-E).
Motor trips off the line.	Power circuit may be single phased.	Check for one blown fuse or dead line.
	Thermostat may have tripped.	Check for overload condition.
	Welding electrode or work leads may be too long or too small in cross-section.	Check terminal voltage while machine is loaded; it should not exceed 55 volts when operating at rated current.
	Combination of overload and high room temperature may have caused thermostat to trip.	When room temperature is over 100°F., reduce work load slightly. Be sure there is no interference with normal ventilation of the machine.
	Motor input voltage too low (or high) under load. Unbalanced input voltage.	Motor supply voltages should not fall below 90% of normal voltage. Have power company check transformer and line capacity. The supply leads may be too long or too small.
	Ventilation may be imparied.	Blow out and clean.
Machine fails to start.	Power circuit may be completely dead.	Look for open disconnected switch, fuses removed from clips or blown fuses.
	Power circuit may be single phased.	Look for one blown fuse or one dead line.
	Power-line voltage may not be suitable for motor, or may be extremely low; may be accompanied by chattering of the motor starter.	Check voltage with voltmeter, particularly at the moment of attempted starting.
	Machine may be jammed.	See that armature turns over easily by hand, and look for foreign material in air gaps.
	Motor starter may be single-phased.	Check to see that all contacts on starter make contact simultaneously when closed.
	Overload protecting device may be tripped or contacts open-circuited.	If machine has had time to cool after tripping due to overload, or is cold and starter fails to close – check for circuit through push button, NVR coil and thermostats to find the open-circuited part. See wiring diagram for normally closed and open contacts on the push button.

*Flashing the exciter fields consists of passing current through the fields using an external source of 6 to 125 volts of DC power from a storage battery or DC generator. If using a DC generator, keep the generator turned off except when actually applying the flashing current. To flash the fields of Lincoln welders:

1. Turn the welder off, close the Electrode Polarity switch and raise one exciter brush off the commutator.
2. Attach the positive lead from the DC source to the right hand brushholder.
3. Carefully holding an insulated section of the negative lead from the DC source, touch its lug or clamp to the left hand brushholder for 5 seconds. Pull it away quickly to minimize arcing.

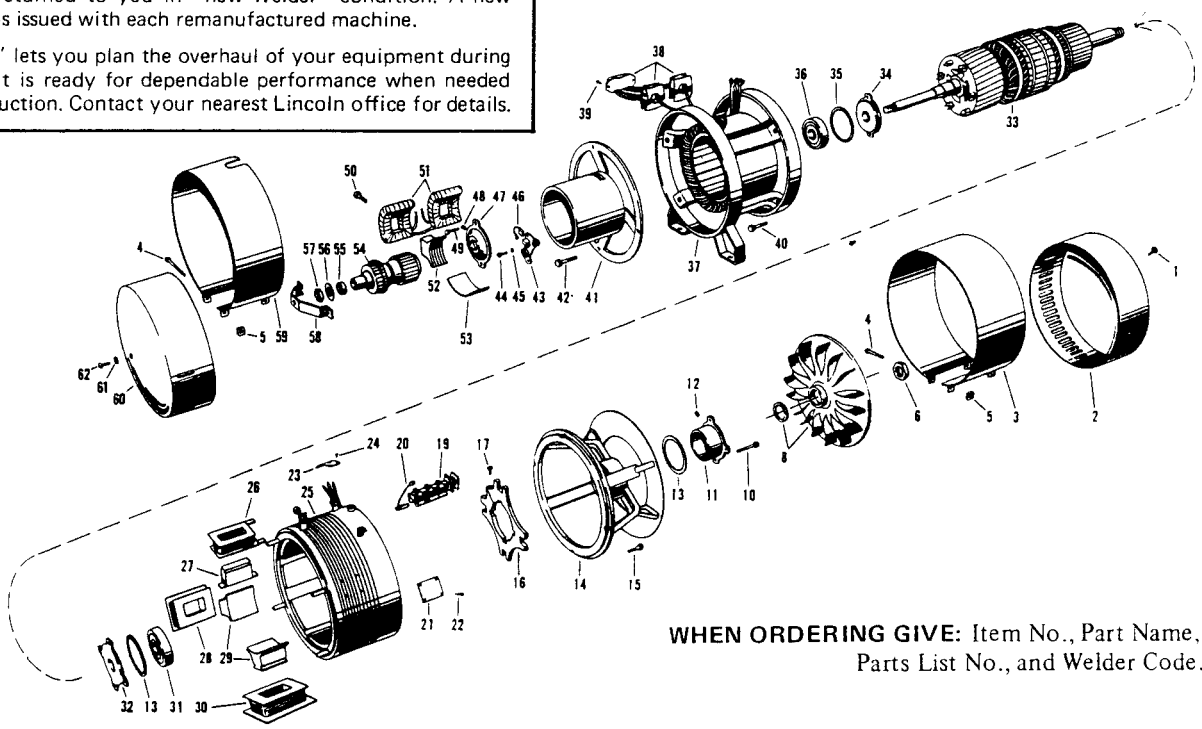
Remove the leads from the brushholder, replace the brush on the commutator, start the welder and the generator voltage should build up.

REMANUFACTURING

After your welder has provided many years of service, it can be returned to the factory for a remanufacturing service called Linconditioning™. It will be completely disassembled and all electrical and mechanical parts will be refurbished or replaced as needed. The machine will be returned to you in "new Welder" condition. A new welder guarantee is issued with each remanufactured machine.

"Linconditioning" lets you plan the overhaul of your equipment during slack periods so it is ready for dependable performance when needed for full scale production. Contact your nearest Lincoln office for details.

MOTOR GENERATOR



WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

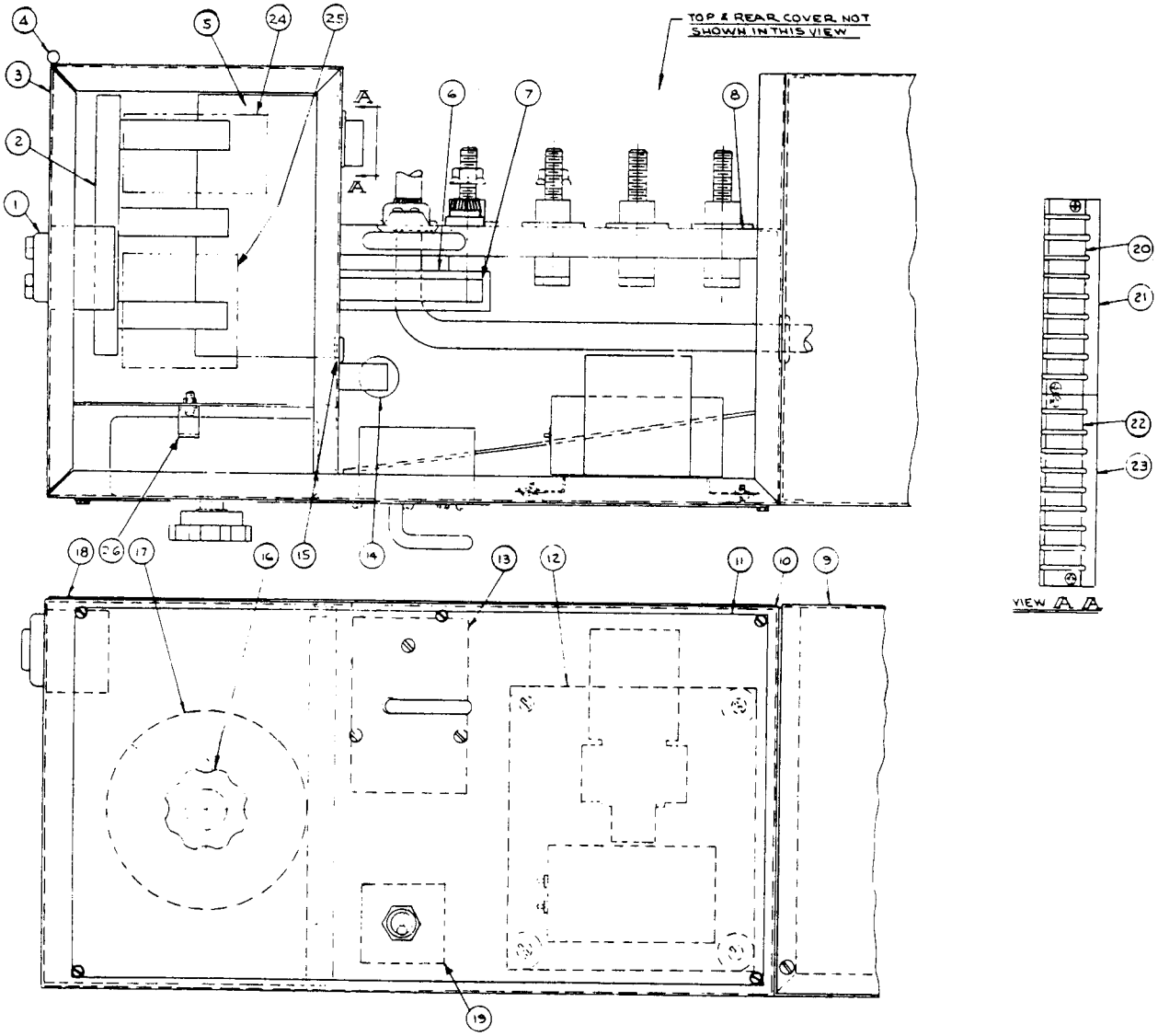
Parts List P-77-C

See P-36-D in IM-229-A for SAF-600-B Belted Generator parts.

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Screw - Fan Guard	3
2	Fan Guard	1
3	Cover - End Bracket	1
4	Round Head Cap Screw	4
5	Square Nut	4
6	Hex Nut - Blower	1
8	Blower	1
	Retaining Ring - Blower	1
10	Hex Head Cap Screw - Dust Cap	4
11	Dust Cap - Outer Commutator End	1
12	Pipe Plug	1
13	Gasket - Dust Cap	2
14	Bracket - DC End	1
15	Hex Head Cap Screw - DC Bracket to Frame	4
	Rocker and Brushholder Assembly, Includes:	1
	Support Ring (Below Code 5860 Only)	1
16	Rocker	1
17	Locking Screw	1
19	Brushholder Assembly	4
	Brushholder Parts See P-25-L	
20	Brush - Generator	12
21	Nameplate	1
22	Drive Screw - Plate Mounting	2
23	Lead Block	1
24	Drive Screw - Lead Block	2
25	Generator Frame	1
	Interpole and Coil Assembly, (Set of 4) Includes	1
26	Interpole Coil (Set of 4)	1
27	Pole Piece	4
28	Shunt Coil	2
29	Main Pole Piece	4
30	Series Coil	2
31	Bearing	1
32	Dust Cap - Inner Commutator End	1
33	Armature Assembly	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
34	Dust Cap - Inner Motor End	1
35	Gasket - Dust Cap	2
36	Bearing	1
37	Wound Stator	1
	Stator Coil	1
38	Thermostat Assembly	1
39	Screw - Thermostat Mounting	2
40	Hex Head Cap Screw - AC Frame to DC Frame	4
41	Bracket - AC End	1
42	Hex Head Cap Screw - AC Bracket to Frame	4
43	Exciter Brushholder	2
	Brushholder Parts See P-25-M	
44	Thread Cutting Screw - Brushholder Mounting	4
45	Plain Washer	4
46	Brush - Exciter	2
47	Dust Cap - Outer Motor End	1
48	Pipe Plug	1
49	Hex Head Cap Screw - Dust Cap Mounting	2
50	Hex Head Cap Screw - Pole Piece Mounting	4
51	Exciter Field Coil	2
52	Exciter Pole Piece	2
53	Exciter Lead Shield	1
54	Exciter Armature	1
55	Spacer Collar	1
56	Washer - Exciter Nut	1
57	Nut - Exciter	1
58	Bracket - Exciter Cover	1
59	Cover - Motor Frame	1
60	Cover - Exciter End	1
61	Washer	1
62	Self Tapping Screw	1

CONTROL BOX

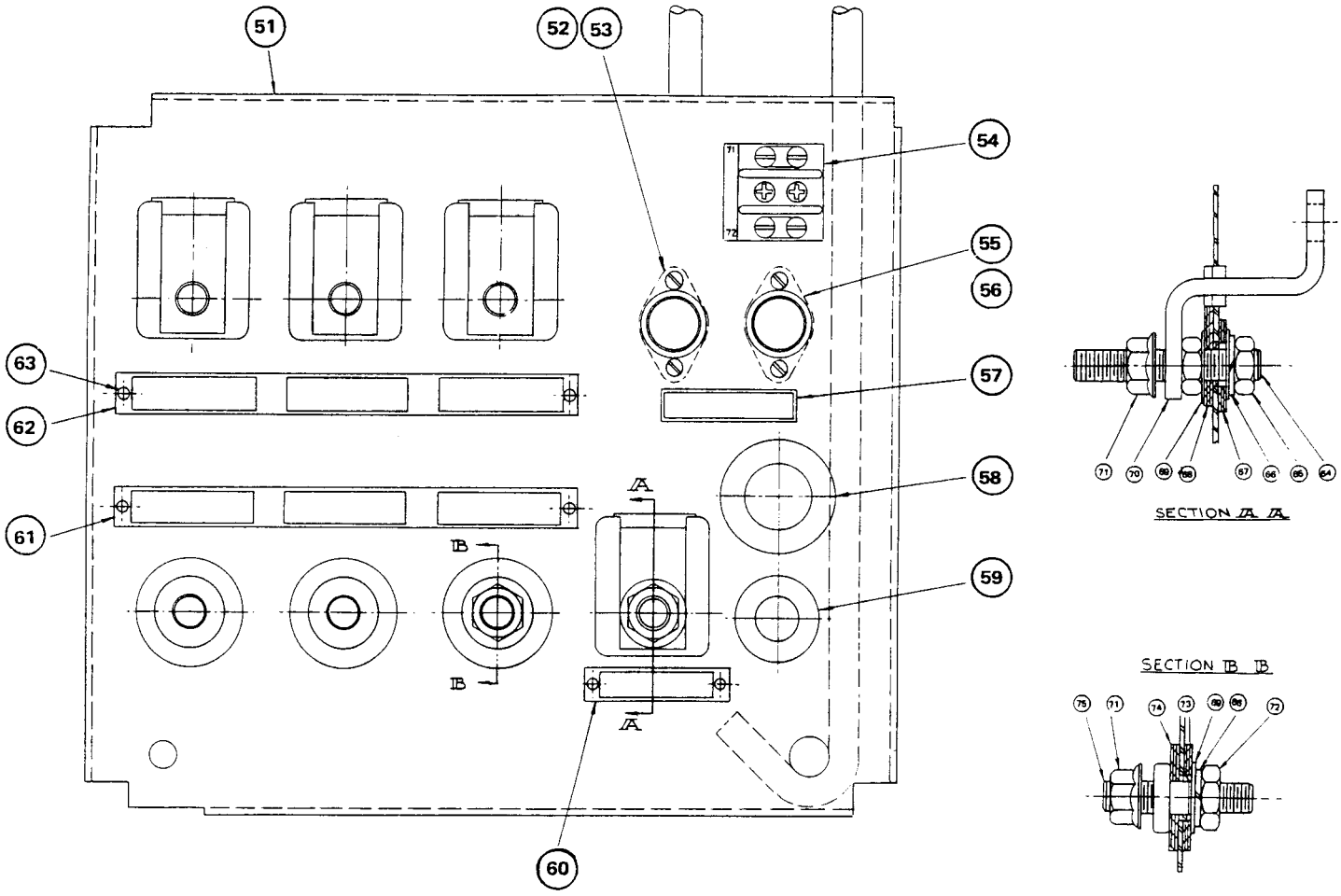


WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-77-D.1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Push Button	1
2	Input Panel	1
3	End Cover	1
4	Hinge Pin	1
5	S-45 Starter (2 Required for 550 or 575 Volt)	
	(Less NVR Coil)*	1
	S-45 Starter Parts See P-28-E	
5	S-67 Starter (2 Required for 550 or 575 Volt)	
	(Less NVR Coil)*	1
	S-67 Starter Parts See P-28-H	
5	S-78 Starter (2 Required for 550 or 575 Volt)	
	(Less NVR Coil)*	1
	S-78 Starter Parts See P-28-J	
6	Discharge Resistor	1
7	Adjustable Resistor	1
8	Sub-Panel Assembly See P-77-E	
9	Contactor Kit ("O" Option) See P-77-F	
10	Case	1
11	Nameplate	1
12	Field Relay & Condenser Assembly ("F", 125V)	1
12	Includes:	
	Condenser Assembly ("F", 35V) Includes:	1
	Condenser	1
	Condenser Strap	1
	Mounting Panel	1
	Relay	1
13	Polarity Switch, 125 Volt Exciter Only	1
14	Resistor	1
15	Grommet	1
16	Rheostat Handle	1
17	Rheostat	1
18	Top and Rear Door	1
19	Voltage Range Switch	1
20	Terminal Strip	1
21	Number Plate	1
22	Terminal Strip	1
23	Number Plate	1
24	Mag-Amp Rectifier (FDAC Belted Only)	1
25	Choke Coil Assembly (FDAC Belted Only)	1
26	Lead Clip	1
	GAC Starter (Optional Not Shown) (Less NVR Coil)	1
	GAC Starter Parts See P-28-G	
	Adjustable Resistor - Used on Codes 6713 & 6714 Only	
*	When Ordering New Starter, Order S-78 Starter L-6200-1A	

SUB-PANEL



Note: Machines below code 6300 and codes 6329, 6393, 6402, require 7 stud assemblies illustrated by Section AA and O stud assemblies illustrated by Section BB.

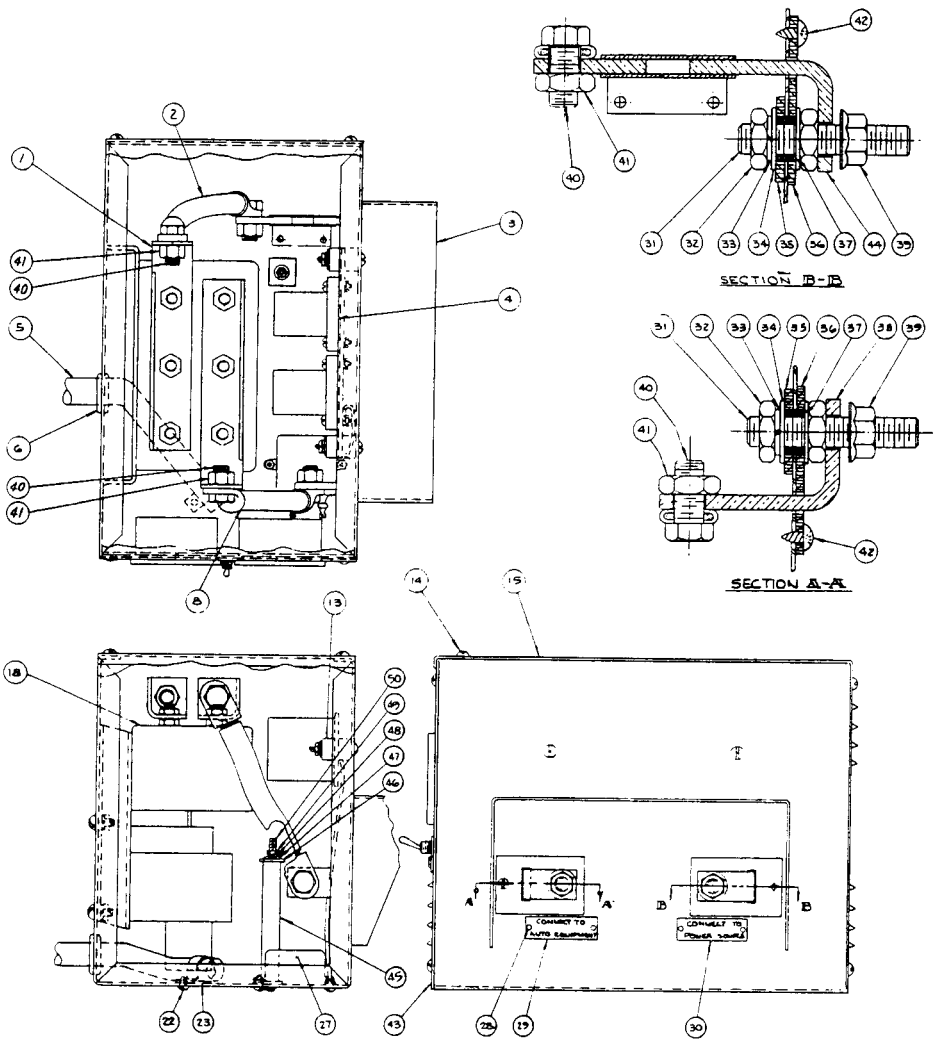
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-77-E

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Sub Panel Assembly, Includes:	1
51	Panel	1
52	Fuse (Exciter Circuit)	1
53	Fuse Holder	1
54	Terminal Strip	1
54	Number Plate	1
54	Self Tapping Screw	2
55	Fuse (AC Circuit)	1
56	Fuse Holder	1
57	Fuse Nameplate	1
58	Grommet	1
59	Grommet	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
60	"TO WORK" Marker	1
61	Marker, "Min to 140, 130 to 225, 210 to 330"	1
62	Marker, "300 to 575, 450 to Max, Innershield"	1
63	Rivet	6
64	Stud (Below Code 6300, See Note 1)	4
65	Hex Jam Nut	7
66	Lockwasher	7
67	Insulating Washer	4
68	Insulator	4
69	Flatwasher	10
70	Connection Strap	4
71	Flange Nut	2
72	Brass Nut	3
73	Insulating Washer	3
74	Insulator	3
75	Stud (Below Code 6300, See Note 1)	3

CONTACTOR BOX



WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

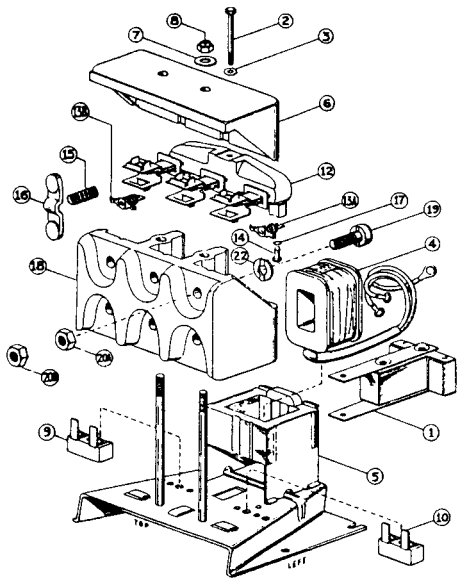
Parts List P-77-F.1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Contactor Jumper	2
2	"Power Source" Lead	1
3	Case	1
4	Relay Assembly, Includes:	1
	Pilot Relay	1
	Full Field Relay	1
	Mounting Panel	1
6	Grommet	1
8	"Automatic Equipment" Lead	1
13	Rubber Chassis Mountings	4
14	Self-Tapping Screw	10
15	Wrap Around	1
18	S-45 Contactor (Less NVR Coil)*	1
	S-45 Contactor Parts See P-28-E	
18	S-67 Contactor (Less NVR Coil)*	1
	S-67 Contactor Parts See P-28-H	
18	S-78 Contactor (Less NVR Coil)*	1
	S-78 Contactor Parts See P-28-J	
22	Self Tapping Screw	1
22	Clamp Mounting Screw	1
23	Cable Clamp	1
27	Capacitor	1
28	Rivet	4
29	"Automatic Equipment" Marker	1
30	"Power Source" Marker	1
31	Stud	2
32	Hex Jam Nut	4
33	Lockwasher	2
34	Flatwasher	4

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
35	Insulating Washer	2
36	Insulating Panel	2
37	Insulating Tube	2
38	Connecting Strap	2
39	Flange Nut	2
40	Hex Head Screw	4
41	Hex Jam Nut	4
42	Self Tapping Screw	2
43	Meter Panel Assembly (Optional), Includes:	1
	Ammeter	1
	Voltmeter	1
	Toggle Switch	1
	Nameplate	1
	Self Tapping Screw, Nameplate Mounting	2
	Panel	1
44	Meter Shunt	1
45	Resistor	1
46	Insulating Washer	2
47	Flatwasher	1
48	Lockwasher	1
49	Hex Nut	1
50	Bolt	1

* When ordering new Starter, Order S-78 Starter L-6200-4A. For L-2630-S-1 or L-4300-4A & L-6200-6A for L-4300-6A.

S45 AND S67 STARTER & CONTACTOR



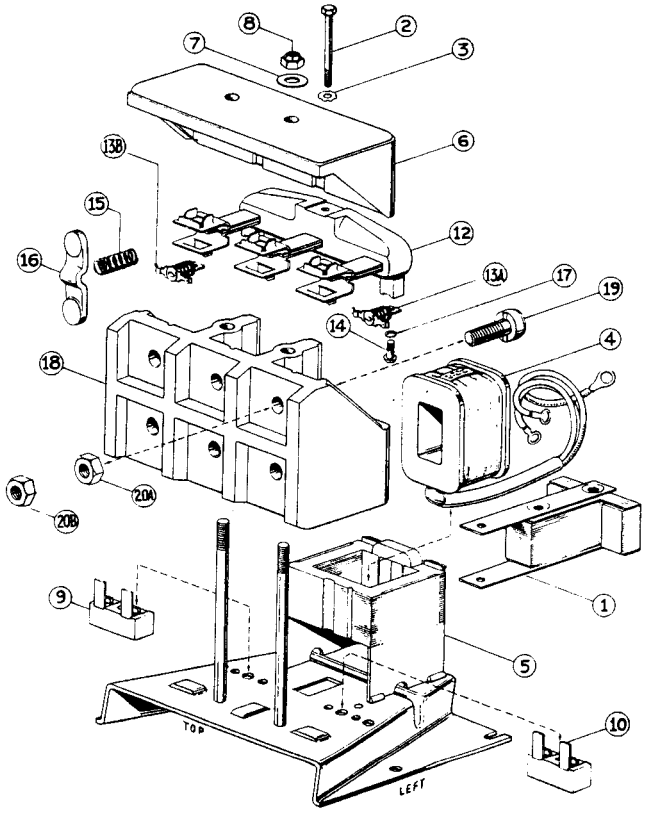
Below Code 6300†: Used S-45 Type – Parts List P-28-E
Above Code 6300: Used S-67 Type – Parts List P-28-H
†Plus Codes 6392, 6393 and 6402

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Complete Assembly Includes: (Less NVR Coil)	1
1	Moving Lamination Assembly	1
2	Screw - Lamination Mounting	1
3	Lockwasher	1
4	*	1
5	Lamination and Panel Assembly (Specify Input Hertz)	1
6	Contact Block Cover	1
7	Plain Washer	2
8	Hugnut	2
9	Stationary Interlock Contact Assembly	1
10	Stationary Interlock Contact Assembly	1
	Screw-Lead Connections	4
11	Screw-Interlock Block Mounting	2
	Contactor Assembly	1
12	Moving Contactor	1
13A	Moving Interlock Contact Assembly	1
13B	Moving Interlock Contact Assembly	1
14	Round Head Screw	1
15	Spring - Main Contact	3
16	Moving Contact	3
17	Lockwasher	1
	Main Contact Block Assembly	1
18	Main Contact Block	1
19	Main Stationary Contact	6
20A	Hex Jam Nut - Brass	As Needed
20B	Hex Jam Nut - Brass	As Needed
22	Spacer Washer	4
*	NVR Coil	

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

S-78 STARTER & CONTACTOR

(Above Code 8300)

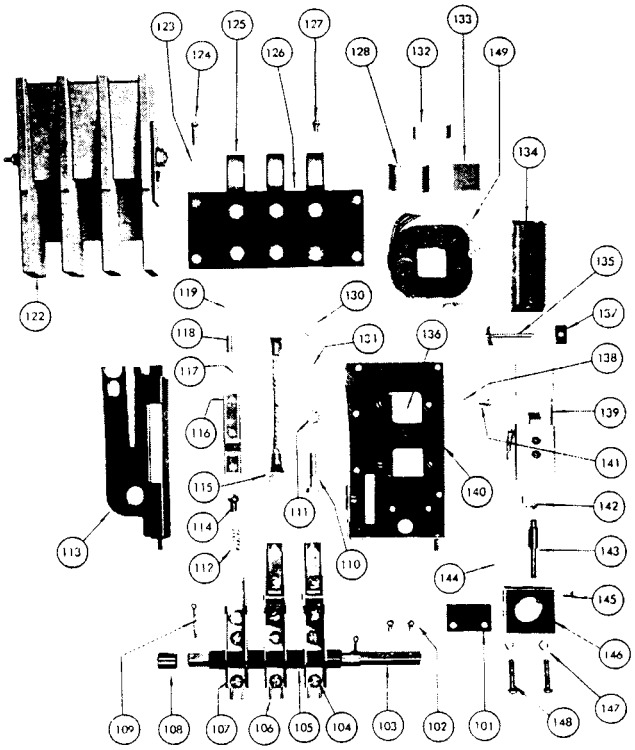


Parts List P-28-J.1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	S-78 Starter Assembly, Includes: (Less NVR Coil)	1
1	Moving Lamination Assembly	1
2	Screw-Lamination Mounting	1
3	Lockwasher	1
4	NVR Coil (Not Included in L-6200 Assembly)	1
5	Lamination and Panel Assembly(Specify Input Hertz)	1
	Plastic Insert	1
6	Contact Block Cover	1
7	Plain Washer	2
8	Hug Nut	2
9	Stationary Interlock Contact Assembly	1
10	Stationary Interlock Contact Assembly	1
	Moving Contactor Assembly, Includes:	1
12	Moving Contactor Block	1
13A	Moving Interlock Contact Assembly	1
13B	Moving Interlock Contact Assembly	1
14	Round Head Screw	As Req'd.
15	Spring-Main Contact	As Req'd.
16	Moving Contact	As Req'd.
17	Lockwasher	As Req'd.
	Main Contact Block Assembly, Includes:	1
18	Main Contact Block	1
19	Main Stationary Contact	As Req'd.
20A	Hex Jam Nut - Brass	As Req'd.
20B	Hex Jam Nut - Brass	As Req'd.

GXL STARTER

Used with GAC Starter Box

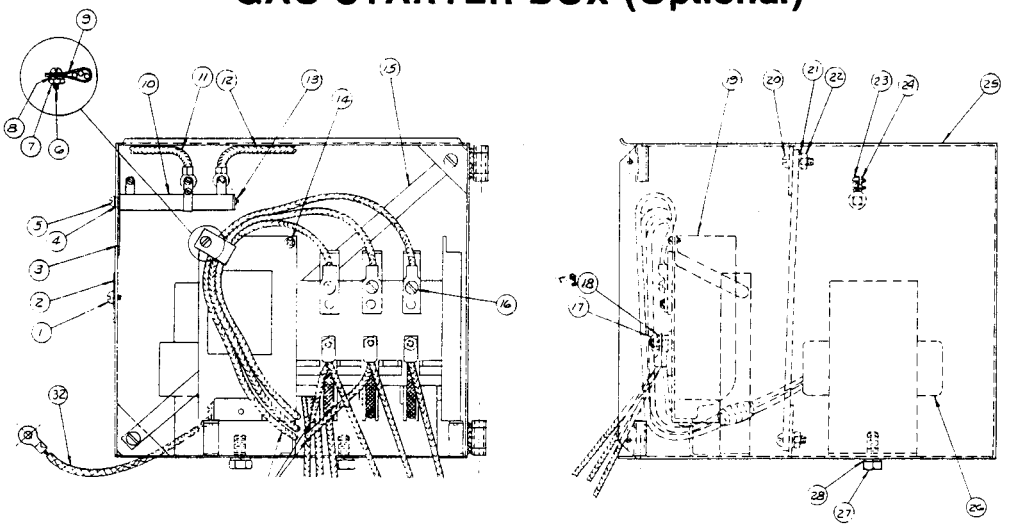


ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	GXL Starter, Includes: (Less NVR Coil)	1
101	Interlock Insulation	1
	Interlock Support Plate	1
102	Sems Round Head Screw	2
	Shakeproof Lockwasher	2
103	Square Shaft	1

Parts List P-28-F

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
104	Sems Round Head Screw	6
105	Shaft Insulation	1
106	Contact Arm Clamp	3
107	Contact Arm	3
108	Bearing, Red Brass	2
109	Cotter Pin	2
110	Hex Head Cap Screw - Contact Mounting (Lower)	3
110	Hex Head Cap Screw - Contact Mounting (Upper)	3
111	Shakeproof Washer	6
112	Contact Spring	3
113	Side Panel, Left Side	1
114	Sems Round Head Screw	3
115	Lead With Lugs	3
116	Moving Contact	3
117	Rivet, Contact Assembly	3
118	Headless Slotted Set Screw	3
119	Hex Nut	3
122	Barrier	1
123	Hex Nut, Side Panel Mounting	4
124	Sems Round Head Cap Screw - Contact Block Mounting(Lower)	2
124	Sems Round Head Cap Screw - Contact Block Mounting(Upper)	2
	Shakeproof Washer	4
	Contact Block Assembly, Includes:	1
125	Stationary Contact	3
126	Contact Block	1
127	Sems Round Head Screw - Lead Connection	2
128	NVR Coil Clamp Insulation	1
129	Copper Lead	2
130	Hex Nut	4
131	Square Nut	3
132	Clamp, NVR Coil	1
133	Fiber Retainer, NVR Coil	1
134	Moving Lamination Note 1	1
135	NVR Arm Pin	1
136	Stationary Lamination	1
137	Tinnerman Nut	2
138	Hex Nut	4
	Shakeproof Washer	4
139	Movable NVR Crossing Arm	1
140	Side Panel - Right Hand	1
141	Sems Round Head Screw, Lamination Mounting	4
	Interlock Assembly, Includes:	1 or 2
142	Plain Washer	1
143	Plunger	1
144	Coil Spring	1
145	Sems Phillips Head Screw	2
146	Interlock Block	1
146	NVR Arm Stop - Without Interlock	1
147	Hex Nut	2
148	Sems Round Head Screw - Interlock Mounting	2
148	Sems Round Head Screw - Arm Stop Mounting	2
	Lug	3
	Round Head Screw - Lug Mounting	3
149	NVR Coil (Specify Input Voltage)	1
	Note 1: To obtain proper moving lamination (Item 134) specify input line cycles.	

GAC STARTER BOX (Optional)

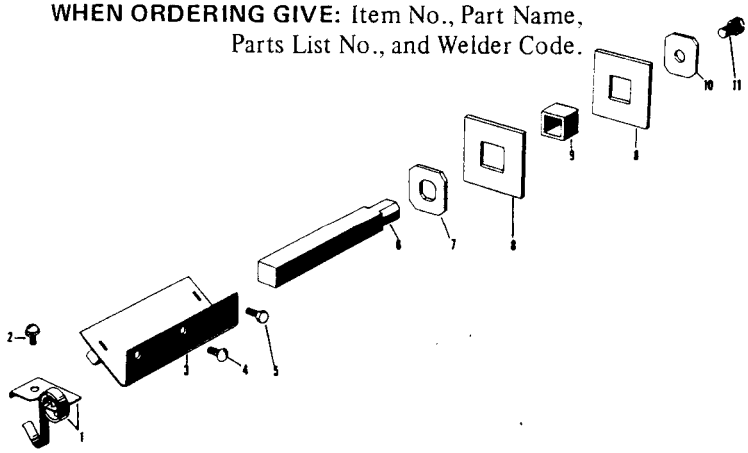


Parts List P-28-G

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	GAC Starter	1
1	Self Tapping Screw	2
2	Nameplate	1
3	Insulation	1
4	Lockwasher	1
5	Round Head Screw	1
6	Round Head Screw	1
7	Hex Nut	1
8	Lockwasher	1
9	Lead Clip	1
10	Resistor	1
13	Square Nut	1
14	Self Tapping Screw	1
15	Cross Brace	1
16	Round Head Screw	3
17	Hex Nut	3
18	Lockwasher	3
19	XL Starter	1
	XL Starter Parts	See P-28-F
20	Round Head Screw	2
21	Lockwasher	2
22	Hex Nut	2
23	Round Head Screw	2
24	Hex Nut	4
25	Case	1
26	Reactance Coil With Lamination	1
27	Hex Head Screw	2
28	Lockwasher	2

GENERATOR BRUSH HOLDER

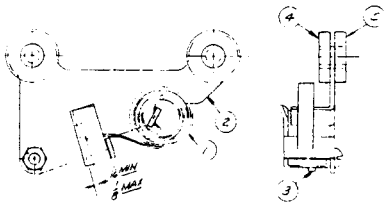
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.



Parts List P-25-L

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Brusholder Assembly Includes:	4
1	Spring and Clip Assembly	4
2	Round Head Cap Screw	4
3	Plate and Retainer Assembly	1
4	Round Head Cap Screw	3
5	Hex Head Cap Screw	1
6	Stud	1
7	Clamping Washer	1
8	Insulating Washer	1
9	Insulating Tube	1
10	Clamping Washer	1
11	Hex Head Cap Screw, Sems Kantlink	1

EXCITER BRUSH HOLDER



Parts List P-25-M

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Exciter Brusholder Assembly Includes:	2
1	Spring	1
2	Brusholder	1
4	Hex Nut	1
5	Insulating Washer	2
6	Bushing	2

HOW TO ORDER REPLACEMENT PARTS

Order parts only from Lincoln offices or from the Authorized Field Service Shops listed in the "Service Directory". Give the following information:

(a) From the nameplate — machine model, code and serial numbers.
(b) From this manual — part name, item number, quantity required and the number of the list used to get this information.

Any items indented in the "Parts Name" column are included in the assembly under which they are listed. The indented items may be ordered separately. If the entire assembly is needed, do ***not*** order the indented parts.

GUARANTEE

The Lincoln Electric Company, the Seller, warrants all new equipment except engines and accessories thereof against defects in workmanship and material for a period of one year from date of shipment, provided the equipment has been properly cared for, and operated under normal conditions. Engines and engine accessories are warranted free from defects for a period of ninety days from the date of shipment.

If the Buyer gives the Seller written notice of any defects in equipment or electrode or flux within any period of warranty and the Seller's inspection confirms the existence of such defects, then the Seller shall correct the defect or defects at its option, either by repair or replacement F.O.B. its factory or other place as designated by the Seller. The remedy provided Buyer herein for breach of Seller's warranty shall be exclusive.

No expense, liability or responsibility will be assumed by the Seller for repairs made outside of the Seller's factory without written authority from the Seller.

The Seller shall not be liable for any consequential damages in case of any failure to meet the conditions of any warranty. The liability of the Seller arising out of the supplying of said equipment or electrode or its use by the Buyer, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the equipment or replacing defective electrode in accordance with the above guarantee. Upon the expiration of any period of warranty, all such liability shall terminate.

The foregoing guarantees and remedies are exclusive and except as above set forth. There are no guarantees or warranties with respect to engines, accessories, equipment, electrodes, or flux, either express or arising by operation of law or trade usage or otherwise implied, including without limitation the warranty of merchantability, all such warranties being waived by the Buyer.

WARRANTY SUPERSEDED
SEE IMWS 1

LINCOLN ELECTRIC

THE LINCOLN ELECTRIC COMPANY

World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors

Cleveland, Ohio 44117 U.S.A.

Branch Offices, Field Service Shops and Distributing Agencies in All Principal Cities
LINCOLN ELECTRIC CO., (Australia) Pty., Ltd., Sydney 2211, Australia
LINCOLN ELECTRIC CO., of Canada, Ltd., Toronto M4G 2B9, Canada
LINCOLN ELECTRIC CO., (Europe) S.A., Rouen 76120, France

Export Representatives
ARMCO INTERNATIONAL — DIV. OF ARMCO STEEL CORP., Middletown, Ohio, U.S.A.

Printed Feb. '81 4M

1-80

Litho in U.S.A.