LINCOLN WELDERS

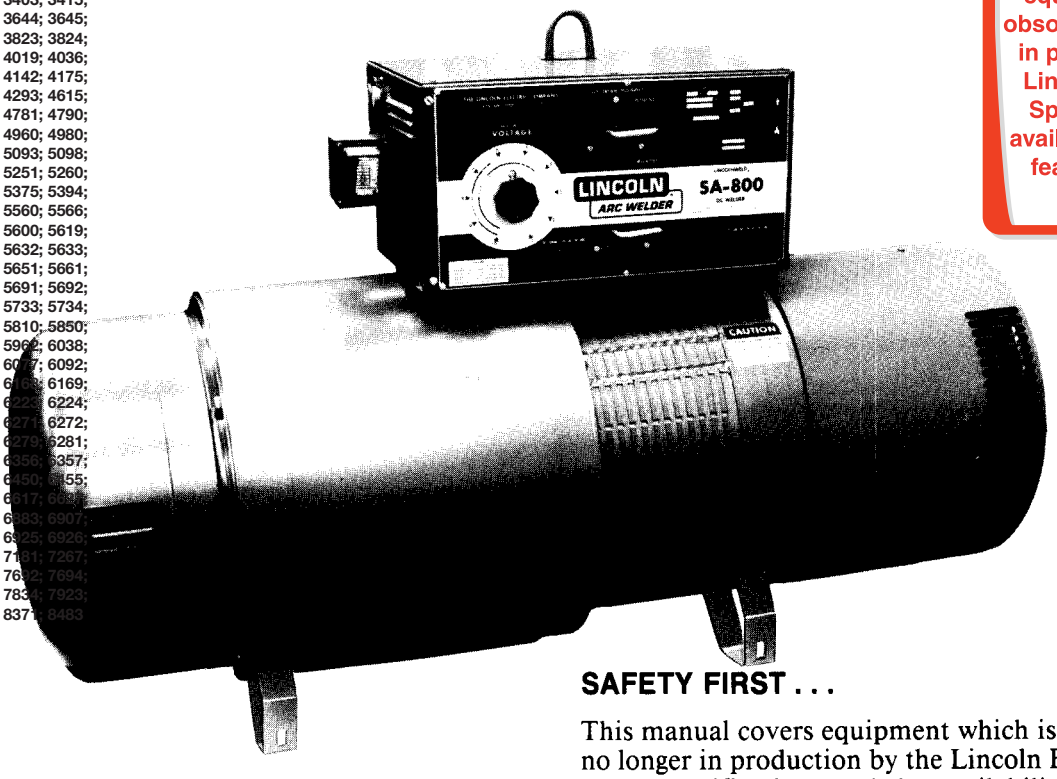
IM-205-B

OPERATING MANUAL

Lincolnweld®
SA-800
Automatic Arc Welding DC POWER SOURCE

Lincolnweld SA-800
October, 1991

3206; 3231; 3235; 3243; 3244; 3252; 3254; 3265; 3297; 3314; 3316; 3342; 3356; 3383; 3403; 3415; 3416; 3424; 3481; 3612; 3636; 3639; 3644; 3645; 3658; 3663; 3684; 3695; 3810; 3821; 3823; 3824; 3854; 3865; 3986; 4013; 4014; 4015; 4019; 4036; 4051; 4091; 4122; 4123; 4133; 4134; 4142; 4175; 4176; 4185; 4226; 4238; 4257; 4290; 4293; 4615; 4660; 4681; 4690; 4696; 4721; 4746; 4781; 4790; 4802; 4839; 4866; 4869; 4870; 4946; 4960; 4980; 5008; 5067; 5068; 5087; 5090; 5092; 5093; 5098; 5109; 5112; 5133; 5162; 5197; 5238; 5251; 5260; 5285; 5289; 5329; 5361; 5370; 5374; 5375; 5394; 5407; 5409; 5448; 5457; 5553; 5555; 5560; 5566; 5572; 5579; 5584; 5587; 5592; 5593; 5600; 5619; 5621; 5622; 5628; 5629; 5630; 5631; 5632; 5633; 5634; 5635; 5641; 5645; 5646; 5650; 5651; 5661; 5662; 5663; 5672; 5673; 5674; 5690; 5691; 5692; 5697; 5702; 5705; 5707; 5719; 5732; 5733; 5734; 5747; 5769; 5770; 5772; 5785; 5786; 5810; 5850; 5898; 5910; 5928; 5947; 5951; 5961; 5962; 6038; 6045; 6046; 6047; 6048; 6059; 6076; 6077; 6092; 6101; 6126; 6129; 6142; 6143; 6154; 6163; 6169; 6170; 6173; 6175; 6185; 6199; 6200; 6223; 6224; 6232; 6264; 6265; 6266; 6269; 6270; 6271; 6272; 6273; 6274; 6275; 6276; 6277; 6278; 6279; 6281; 6315; 6318; 6334; 6335; 6344; 6349; 6356; 6357; 6359; 6373; 6379; 6380; 6439; 6444; 6450; 6455; 6480; 6502; 6522; 6523; 6533; 6551; 6617; 6618; 6766; 6767; 6805; 6837; 6857; 6882; 6883; 6907; 6909; 6920; 6921; 6922; 6923; 6924; 6925; 6926; 6961; 6962; 7061; 7077; 7146; 7160; 7161; 7267; 7310; 7593; 7626; 7666; 7677; 7685; 7692; 7694; 7751; 7754; 7781; 7793; 7810; 7825; 7834; 7923; 8058; 8096; 8246; 8345; 8346; 8356; 8371; 8483



This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.

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SAFETY FIRST . . .

This manual covers equipment which is obsolete and no longer in production by the Lincoln Electric Company. Specifications and the availability of optional features may have changed. Replacement parts for your machine are available through your local Lincoln Field Service Shop.

Please carefully read all of the updated safety precautions and warnings on the following pages. Thoughtful operation of this machine after reviewing these modern warnings will increase your overall safety and that of those around you.

LINCOLN ELECTRIC

THE LINCOLN ELECTRIC COMPANY
World's Leader in Welding and Cutting Products • Premier Manufacturer of Industrial Motors
Sales and Service through Subsidiaries and Distributors Worldwide
Cleveland, Ohio 44117-1199 U.S.A.

ARC WELDING SAFETY PRECAUTIONS

WARNING: PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH.

ELECTRIC SHOCK can kill.

1. a. The electrode and work (or ground) circuits are electrically "hot" when the welder is on. Do not touch these "hot" parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

   b. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically "hot".

   c. Insulate yourself from work and ground using dry insulation. When welding in damp locations, on metal framework such as floors, gratings or scaffolds, and when in positions such as sitting or lying, make certain the insulation is large enough to cover your full area of physical contact with work and ground.

   d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

   e. Ground the work or metal to be welded to a good electrical (earth) ground.

   f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

   g. Never dip the electrode in water for cooling.

   h. 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.

   i. When working above floor level, protect yourself from a fall should you get a shock.

   j. Also see Items 4c and 6.

ARC RAYS can burn.

2. 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. Headshield and filter lens should conform to ANSI Z87.1 standards.

   b. Use suitable clothing made from durable flame-resistant material 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.

FUMES AND GASES can be dangerous.

3. 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. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

   d. Read and understand the manufacturer's instructions for this equipment and the consumables to be used, including the material safety data sheet (MSDS) and follow your employer's safety practices.

   e. Also see item 7b.

WELDING SPARKS can cause fire or explosion.

4. a. Remove fire hazards from the welding 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. Have a fire extinguisher readily available.

   b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

   c. 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.

   d. 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 "Recommended Safe Practices for the Preparation for

Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1-80 from the American Welding Society (see address below).

e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

f. Sparks and spatter are thrown from the welding arc. Wear 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 with side shields when in a welding area.

g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away 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.

h. Also see item 7c.

CYLINDER may explode if damaged.

5. a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

c. Cylinders should be located:
- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

d. Never allow the electrode, electrode holder, or any other electrically "hot" parts to touch a cylinder.

e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

f. Valve protection caps should always be in place and handtight except when the cylinder is in use or connected for use.

g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 1235 Jefferson Davis Highway, Arlington, VA 22202.

FOR ELECTRICALLY powered equipment.

6. a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

b. Install equipment in accordance with the National Electrical Code, all local codes and the manufacturer's recommendations.

c. Ground the equipment in accordance with the National Electrical Code and the manufacturer's recommendations.

FOR ENGINE powered equipment.

7. a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

c. Do not add the fuel near an open flame, welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

d. Keep all equipment safety guards, covers and devices in position and in 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.

e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

g. 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.

h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

HAVE ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR WORK performed by qualified people.

For more 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, P.O. Box 351040, Miami, Florida 33135.

PROPER GROUNDING DURING INSTALLATION

The 1985 National Electrical Code does not require this machine to be grounded under normal operating circumstances.

Some State, local or other codes or unusual operating circumstances may require the machine frame to be grounded. It is recommended that you determine the extent to which such requirements may apply to your particular situation and follow them explicity.

In general, if the machine is to be grounded, it should be connected with a #8 or larger copper wire to a solid earth ground such as a metal pipe going into the ground for at least ten feet and having no insulated joints, or to the metal framework of a building which has been effectively grounded. The National Electrical Code lists a number of alternate means of grounding electrical equipment. (If an older portable welder does not have a grounding stud, connect the ground to an unpainted frame screw or bolt.)

INSTALLATION, CONNECTION, AND MAINTENANCE OF BATTERY

To prevent EXPLOSION when:

a) Installing a new battery — disconnect the negative cable from the old battery first and connect the negative cable to the new battery last.

b) Connecting a battery charger — remove the battery from the welder by disconnecting the negative cable first, then the positive cable and battery clamp. When reinstalling, connect the negative cable last.

c) Using a booster — connect the positive lead to the battery first then connect the negative lead to the copper strap on the engine foot.

To prevent ELECTRICAL DAMAGE when:

a) Installing a new battery.

b) Using a booster.

Use correct polarity — Negative Ground.

To prevent BATTERY DISCHARGE, if you have an ignition switch, turn it off when the engine is not running.

To prevent BATTERY BUCKLING, tighten nuts on battery clamp only until snug.

(S-17851)

OPERATION OF ENGINE WELDERS

WARNING: Operate internal combustion engines in open, well ventilated areas or vent engine exhaust fumes outdoors.

OPERATION OF ALL WELDERS

DO NOT TURN THE "CURRENT RANGE SELECTOR" WHILE WELDING because the current may arc between the contacts and damage the switch.

MAINTENANCE AND TROUBLESHOOTING WARNINGS

WARNING: Have qualified personnel do the maintenance and troubleshooting work. Turn the engine (or electrical power at the switchbox) off before working inside the machine. In some cases, it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

ATTENTION OWNERS OF ENGINE WELDERS

WARNING: Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running. If a problem cannot be corrected by following the instructions, take the machine to the nearest Lincoln Field Service Shop.

CAUTION WHEN INSPECTING THE COMMUTATOR AND BRUSHES

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.

NAMEPLATES

Whenever routine maintenance is performed on this machine — or at least yearly — inspect all nameplates and labels for legibility. Replace those which are no longer clear. Refer to the parts list for the replacement item number.

INSTALLATION

The SA-800 is a combination variable voltage/constant voltage power source. Variable voltage is often used for the submerged arc welding process. Constant voltage is required for Innershield® and other open arc welding. The SA-800 was available with three different control boxes. One (Type "-F") has a field reversing relay for automatic welding with LAF, LT-3 and LT-34 wire feeders. The second (Type "-O", obsolete) had an output contactor, for use with the LN-7, LN-8, LN-9, NA-3, LT-7 and LT-56. The third (Type "-OF") has both the contactor and relay and can be used with any of the above mentioned wire feeders.

INPUT CONNECTION

Install the welder in a dry location where there is free circulation of air. An area which minimizes the amount of smoke and dirt drawn into the generator ventilating slots reduces the chance of dirt accumulation that can block air passages and cause overheating.

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

Have a qualified electrician connect the welder to the input power in accordance with the National Electrical Code, all local codes, and the wiring diagram located inside the control box on the cover.

The welder frame must be grounded. A stud marked by the symbol ⏚ located inside the control box 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 frame screw or bolt.)

Recommended Input Wire, Ground Wire and Fuse Sizes Based on National Electrical Code For 60 Hertz, 3 Phase Welders at 800 Amps, 44 Volts, 80% Duty Cycle

Welder Size	Input Volts	Input Amps	Copper Wire Size Type 75° C in Conduit		Super Lag Fuse Size in Amps
			3 Input Wires	1 Ground Wire	
SA-800	230	156	0	4	250
	460	78	4	6	125
	575	62	6	8	100

OUTPUT CONNECTION

Information for making the connections to current wire feeders follows. For other combinations, check the appropriate wire feeder Operating Manual or write to the factory giving model names and code numbers for both the power source and wire feeder.

a. LN-4, LN-5, LN-6, LN-7, LN-8 or LN-9 semiautomatic and NA-2, NA-3 or NA-5 [All] automatic wire feeder and LT-7 and LT-56 tractors. (The LN-4, -5 and -6 and NA-2 models are obsolete.)

Use the SA-800 with a contactor ("-O" or "-OF"). Use either the K-200 or K-224 field control with the LN-8. Use the K-224 with the LN-9, NA-3 (All), NA-5, LT-7 and LT-56. See the appropriate wire feeder Operating Manual for connection instructions.

SA-750 (Last Manufactured 1965)

The SA-750 was built only with a control box equipped with a field reversing relay similar to the SA-800 types "-F" and "-OF". Machines built to code 5555 and codes later than 5580 were combination variable voltage and constant voltage power sources. Older machines produced only variable voltage output.

Follow the "Installation" and "Output Connection" instructions for SA-800 welders equipped with a field reversing relay (types "-F" and "-OF"). (Exception: when the instructions call for terminal #F4 on the SA-800, use #4 on the SA-750.)

If an SA-750 connecting diagram is not included in the operating manual for a specific wire feeder, write to the factory giving model names and code numbers for both the power source and wire feeder.

The "Operation" instructions for the SA-800 apply to combination variable voltage/constant voltage SA-750 power sources (equipped with a voltage range switch) built to code 5555 and codes later than 5580. However, the SA-750 nameplate calls the rheostat an 'Output Control' rather than an 'Open Circuit Voltage' control. Older SA-750 machines cannot be used as constant voltage power sources for Innershield welding.

"Duty Cycle" rating of the SA-750 is 750 amps at 40 volts, continuous duty.

The "Auxiliary Power" output of the SA-750 welders built to code 5555 and codes later than 5580 is the same as the SA-800 — 1150 volt-amperes, 115 volt AC and 1 KW, 125 volt DC. The older machines produce the DC auxiliary power and 350 volt-amperes of 115 volt AC power from a step-down transformer.

The "Circuit Protection" of SA-750 machines built to code 5555 and codes later than 5580 is identical to the SA-800. Older SA-750 machines have a 15 amp fuse (T-10728-8) in the exciter output circuit to protect the field reversing relay and the exciter. The fuse is located next to the reversing switch inside the control box.

Other "Maintenance", "Trouble Shooting" and parts lists throughout this manual apply to the SA-750 except as specified on individual parts lists.

b. LAF-3, LAF-5, LT-3 or LT-34 automatic wire feeders (obsolete)

Use the SA-800 with a field reversing relay ("-F" or "-OF"). See the appropriate wire feeder Operating Manual for connecting instructions.

c. Miscellaneous Applications

To use the SA-800 for air arc gouging, hand welding, tacking, resistance heating or other applications, connect the fields to the exciter by connecting a jumper between #2 and #24 on the terminal strip to complete the field circuit.

For SA-800 **with field reversing relay** — disconnect any wire feeder leads from the terminal strip and 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 11.5 volts.

For the SA-800 **with an output contactor** — disconnect any wire feeder leads from the terminal strip and install a jumper between #2 and #C4 on the terminal strip. This closes the contactor. To turn the power source output 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. This switch turns the contactor on and off.

d. Paralleling Instructions

These power sources **cannot** be paralleled when connected for constant voltage (Innershield) welding.

The SA-800 (with field relay, "-F") was available with a 35 volt exciter. The 35 volt exciter machines were used for paralleling with the standard 125 volt exciter machine. The 125 volt exciter machines are used for all other installations. (Because the 35 volt exciter machines were designed for paralleling with another machine, the control box did not have a contactor or field reversing relay). See bulletin E133 for added information.

OPERATION

CONTROLS

Start and Stop the machine with the pushbutton on the control box. Run the power source for 15 minutes before welding. Once it is warmed up, there will be little change in output current from the start to finish of the weld.

Electrode Polarity — Turn the switch on the power source control box to electrode Positive or electrode Negative as desired for the particular application.

Voltage Range — When set on low, the open circuit voltage of the power source can be varied between 4 and 42 volts. When set on high, the open circuit voltage of the power source can be varied between about 40 and 86 volts.

Output Controls — *The method of setting welding current and voltage controls varies depending upon the machines and processes being used. General instructions are given here. For more information, refer to the appropriate wire feeder Operating Manual.*

Submerged Arc Output Controls — When used as a variable voltage power source for submerged arc welding, best weld quality is normally obtained with the 'Open Circuit Voltage' rheostat at 9-10. 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 600 amperes, use the 375-700 ampere stud and not the 500-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 — When used as a constant voltage power source, connect the electrode cable to the 'Innershield' stud. Set the exact welding current at the wire feeder. The effect of the 'Open Circuit Voltage Control' varies with the wire feeder being used.

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

Except when connected to an ML-3, the SA-800 with a field reversing relay is wired so the open circuit voltage drops to 11.5 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, the electrode will rapidly get red hot when the electrode is in contact with the work.

DUTY CYCLE

The rating of the SA-800 is 800 amperes, 44 volts, 80% duty cycle. Duty cycle is based on a 10 minute period. Therefore, the SA-800 can be loaded to its full output rating for 8 out of every 10 minutes without overheating.

AUXILIARY POWER

The SA-800 provides 1150 volt-amperes of 115 volt, AC power from an isolated winding in the motor stator and 1 KW of 125 volt DC power from the exciter. This power is always shut off when the power source is shut off. See the connection diagram for instructions for connecting to this power.

MAINTENANCE AND TROUBLE SHOOTING

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

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.

CIRCUIT PROTECTION

A fuse located on the rear of the control box protects the exciter circuit. It is a 15 amp FNM (Slo-Blow) type fuse. There is also a fuse to protect the 115-volt AC circuit located on the rear of the control box. This is a 10 amp FNM (Slo-Blow) type fuse.

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. Restart 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 restart the motor. Serious damage will result if the start button is held in with these conditions present.

CONTACTOR MAINTENANCE

Where the S-45, S-67 or S-78 output contactor is operated frequently when tacking or making short welds, inspect it every three months:

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

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 an experienced maintenance man clean them with fine sandpaper or a commutator stone. Never use emery cloth or paper for this purpose.

Have an experienced maintenance man replace brushes when they wear within $\frac{1}{4}$" of the pigtail. A complete set of replacement brushes should be kept on hand. Lincoln brushes have a curved face to fit the commutator. 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.

BEARINGS

Your 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.

TROUBLE SHOOTING

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

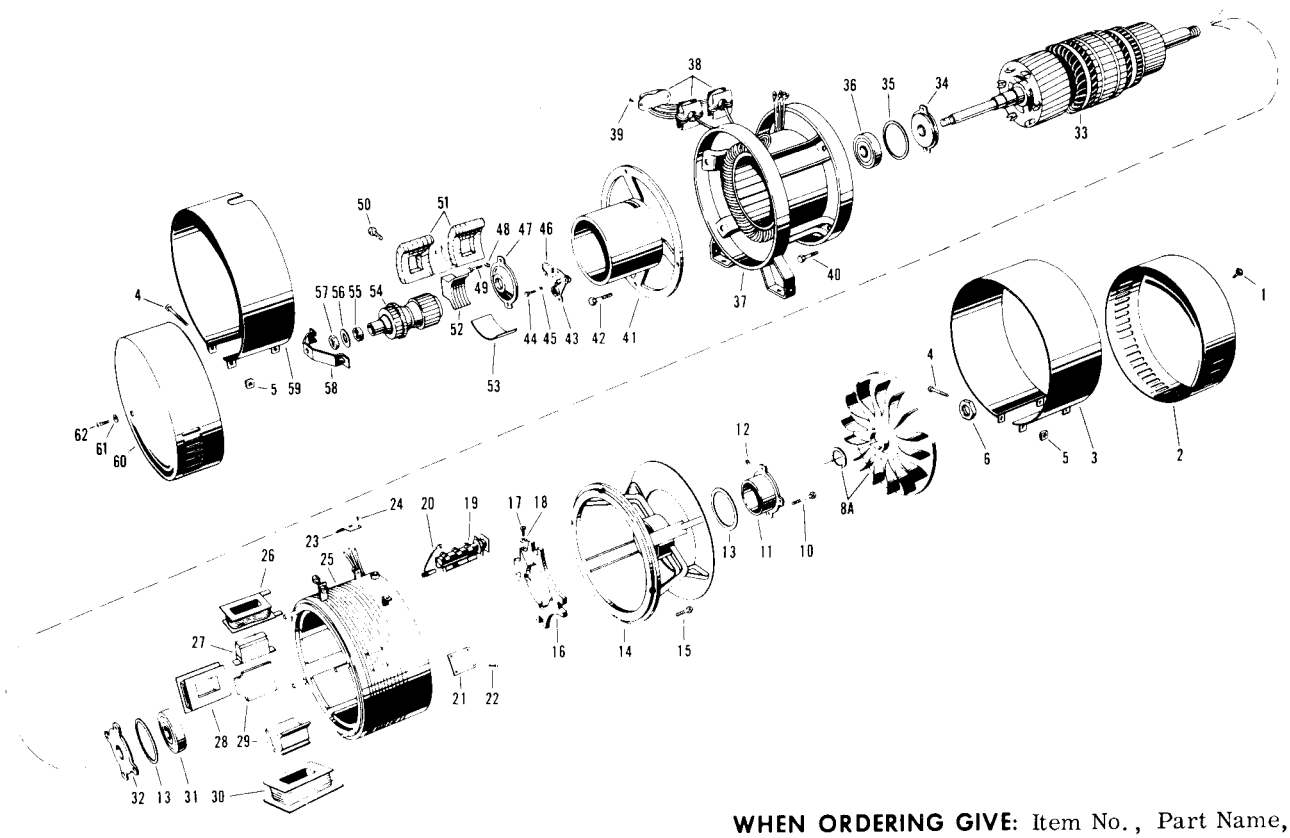
TROUBLE	CAUSE	WHAT TO DO
Machine fails to hold the "heat" constantly.	Rough or dirty commutator.	Commutator should be trued or cleaned.
	Brushes may be worn down to limit of adjustment.	Replace brushes.
	Brush springs may have lost adjustment or may be broken.	Replace brush springs.
	Field circuit may have variable resistance connection or intermittent open-circuit, due to loose connection or broken 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.	Use only genuine Lincoln parts.
	Field rheostat may be making poor contact and overheating.	Inspect rheostat and clean.
Welder starts but fails to generate current.	May be running in the wrong direction.	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 or lamp.
	Series field 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 resistance. Some machines give less outpt 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 with a source of DC current.*
		Replace the 15 amp, fuse located on the rear of the control box, (or on SA-750, next to the reversing switch.)
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 44 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 impaired.	Blow out and clean.
Machine fails to start.	Power circuit may be completely dead.	Look for open disconnect 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, turned off except when actually applying the flashing current. To flash the fields:

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

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

MOTOR GENERATOR

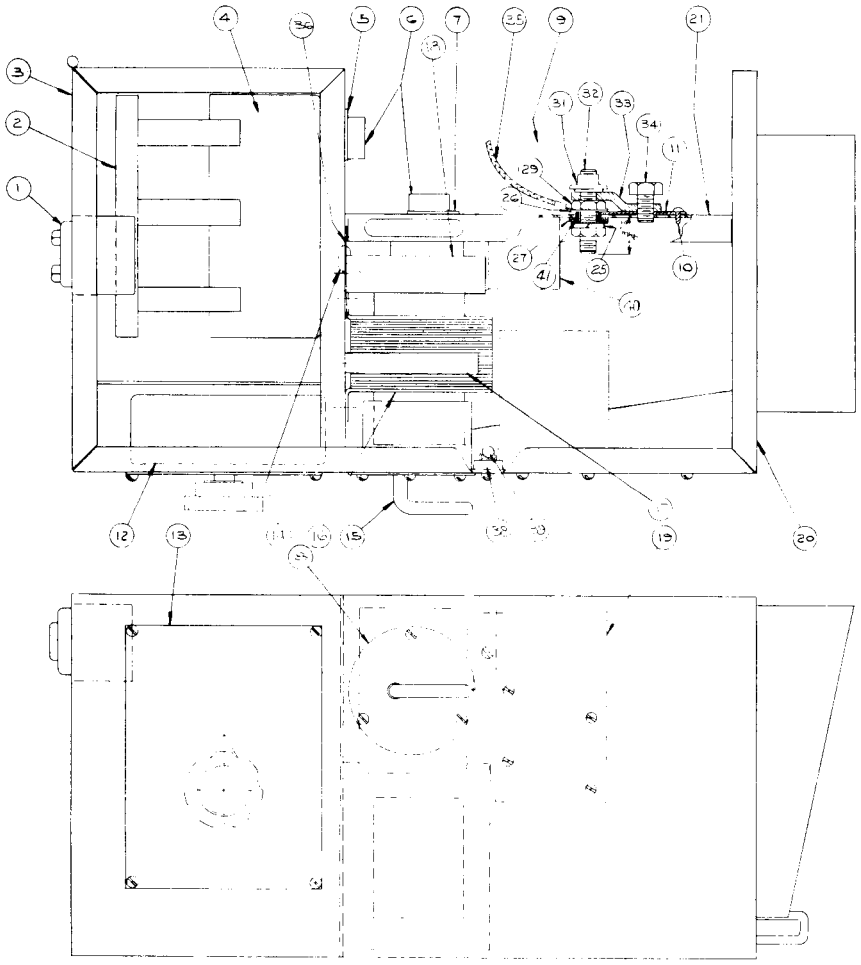


WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-28-C

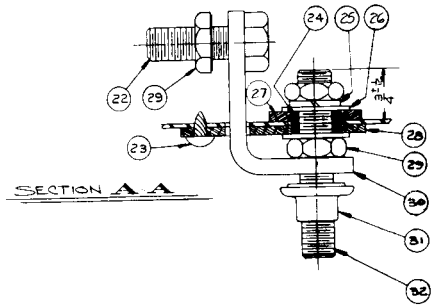
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Screw, Fan Guard	3
2	Fan Guard	1
3	Cover, End Bracket	1
4	Round Head Cap Screw	4
5	Square Nut	4
6	Hex Nut, Blower	1
8A	Blower	1
8A	Retaining Ring, Blower	1
10	Hex Head Cap Screw - Dust Cap	4
11	Dust Cap, Outer Commutator End	1
12	Pipe Plug	1
13	Gasket, Dust Cap	2
14	Bracket, DC End	1
15	Hex Head Cap Screw, DC Bracket to Frame	4
16	Rocker	1
17	Round Head Cap Screw	1
18	Lockwasher	1
19	Brusholder Assembly	4
	Brusholder Parts	See P-25-L
20	Brush, Generator	16
21	Rotation Plate	1
22	Drive Screw, Plate Mounting	2
23	Lead Block	1
24	Drive Screw, Lead Block	2
25	Generator Frame	1
26	Interpole and Coil Assembly, Item 27	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
	Armature Coil Spec	1
34	Dust Cap, Inner Motor End	1
35	Gasket, Dust Cap	2
36	Bearing	1
37	Wound Stator	1
	Stator Coil Spec	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 Brusholder	2
	Brusholder Parts	See P-25-M
44	Thread Cutting Screw, Brusholder 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 Coil Set	1
52	Exciter Pole Piece	2
53	Exciter Lead Shield	1
54	Exciter Armature Assembly	1
	Exciter Armature Spec	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
62	Self Tapping Screw	1

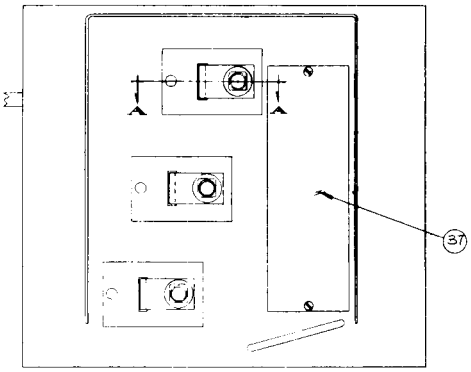
CONTROL BOX — SA-750



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

NOTE: Code 5555 and above code 5580 have added "Innershield" stud.





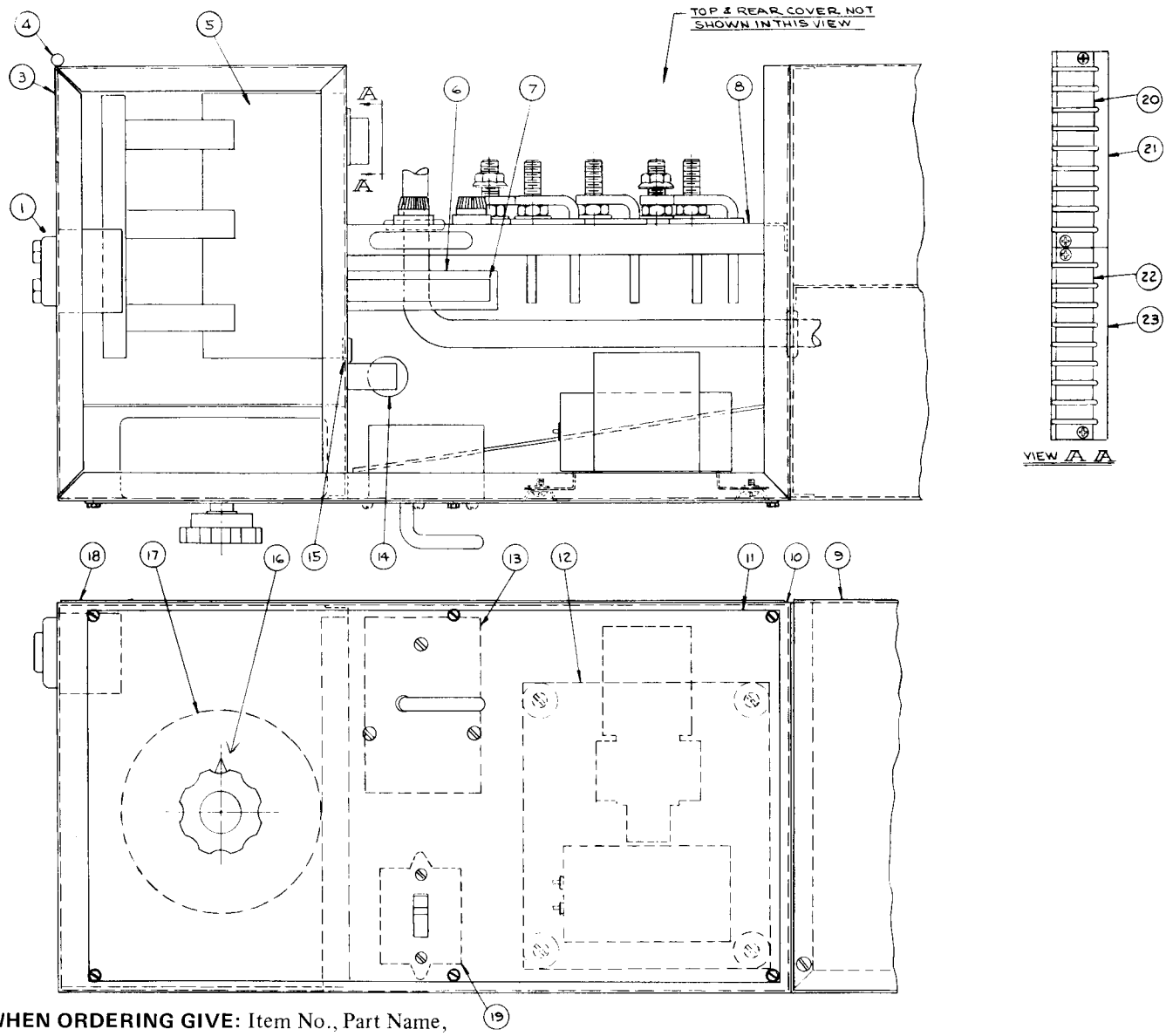
Parts List P-28-D

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Push Button	1
2	2-Volt Input Panel	1
3	End Cover	1
	Hinge Pin, End Cover Mounting	1
	Self Tapping Screw, End Cover Mounting	4
4	S-45 Starter	1
	S-45 Starter Parts See	P-28-E
5	Number Plate	1
6	Terminal Strip	2
7	Number Plate	1
8	Reversing Switch Plate	1
	Self Tapping Screw, Switch and Plate Mounting	3
	Cover Plate, Reversing Switch Hole Cover (35V)	1
9	"To Work" Marker	1
10	Drive Screw	1
11	Connecting Strap Insulation	1
12	Rheostat	1
	Rheostat Handle	1
13	Nameplate	1
	Self Tapping Screw, Nameplate Mounting	4
14	Grommet	1
15	Reversing Switch*	1
16	Transformer* (Not on Code 5555 and Above 5580)	1
17	Adjustable Resistor	1
18	Resistor Tube	1
19	Field Relay*	1
20	Case Assembly	1
21	Sub Panel	1
	Self Tapping Screw, Sub Panel Mounting	4
	Top Cover and Rear Door Assembly	1
	Self Tapping Screw, Top Cover Mounting	6

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
22	Hex Head Screw	3
23	Self Tapping Screw	3
24	Insulating Tube	3
25	Lockwasher	4
26	Flat Washer	8
27	Insulating Washer	4
28	Insulating Panel	3
29	Hex Jam Nut	11
30	Connection Strap	3
31	Flanged Nut	4
32	Stud	4
33	Connection Strap	1
34	Hex Head Screw	1
35	Lead	1
36	Insulation	3
37	Electrode Nameplate (Below Code 5580 Except 5555)	1
37	Electrode Stud Plates for Code 5555 and Above	
	5580 are as follows:	
	"Innershield" Marker	1
	"500 to Max." Marker	1
	"375 to 700" Marker	1
	"Min to 525" Marker	1
38	Fuse Block#	1
39	Fuse#	1
40	Condenser	1
41	Insulating Tube	1

* Not used on models with 35 volt exciter.
\# Two fuses and fuse holders are mounted on sub-panel on code 5555 and above 5580.

CONTROL BOX — SA-800



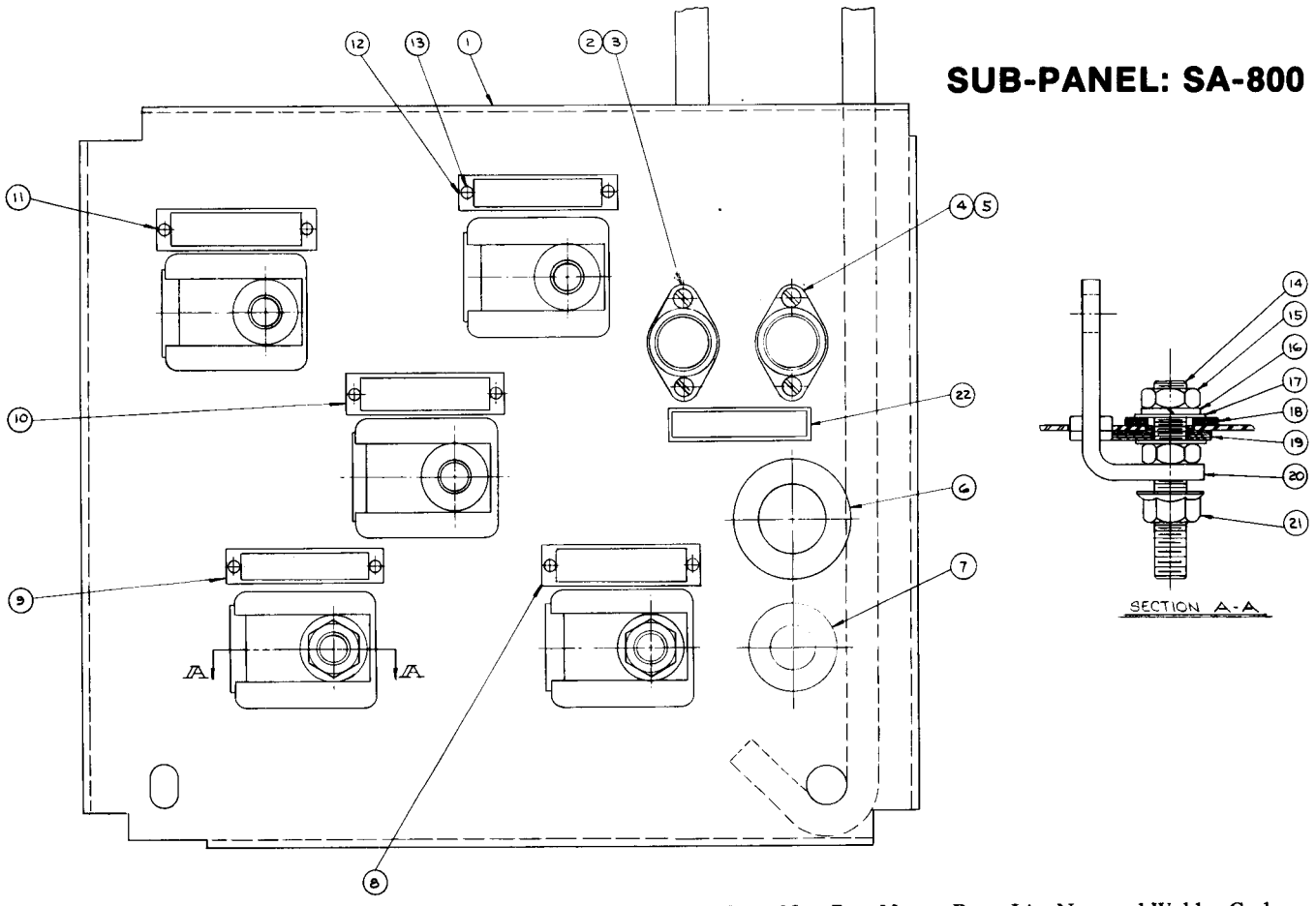
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-75-C

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Pushbutton	1
3	End Cover	1
4	Hinge Pin	1
5	S-45, S-67 or S-78 (Note 1)	1
	Starter Parts — See Page 10	
6	Discharge Resistor	1
7	Adjustable Resistor	1
8	Sub-Panel Assembly	1
	Sub-Panel Parts — See P-75-D	
9	Contactor Box *	1
	Contactor Box Parts — See P-75-D	
10	Case	1
11	Nameplate	1
12	Field Relay and Condenser Includes:*	1
12	Condenser Assembly (35V. Exciter) Includes:	1
	Condenser	1
	Condenser Strap	1
	Relay Panel Assembly	1
	Relay*	1
13	Polarity Switch	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
14	Resistor	1
15	Grommet	1
16	Rheostat Handle	1
17	Rheostat	1
18	Top and Rear Door	1
19	Voltage Control Switch*	1
20	Terminal Strip	1
21	Number Plate	1
22	Terminal Strip	1
23	Number Plate	1
	* Not used on models with 35 volt exciter.	
	Note 1: When ordering a complete starter, order the S-78 starter.	

SUB-PANEL: SA-800



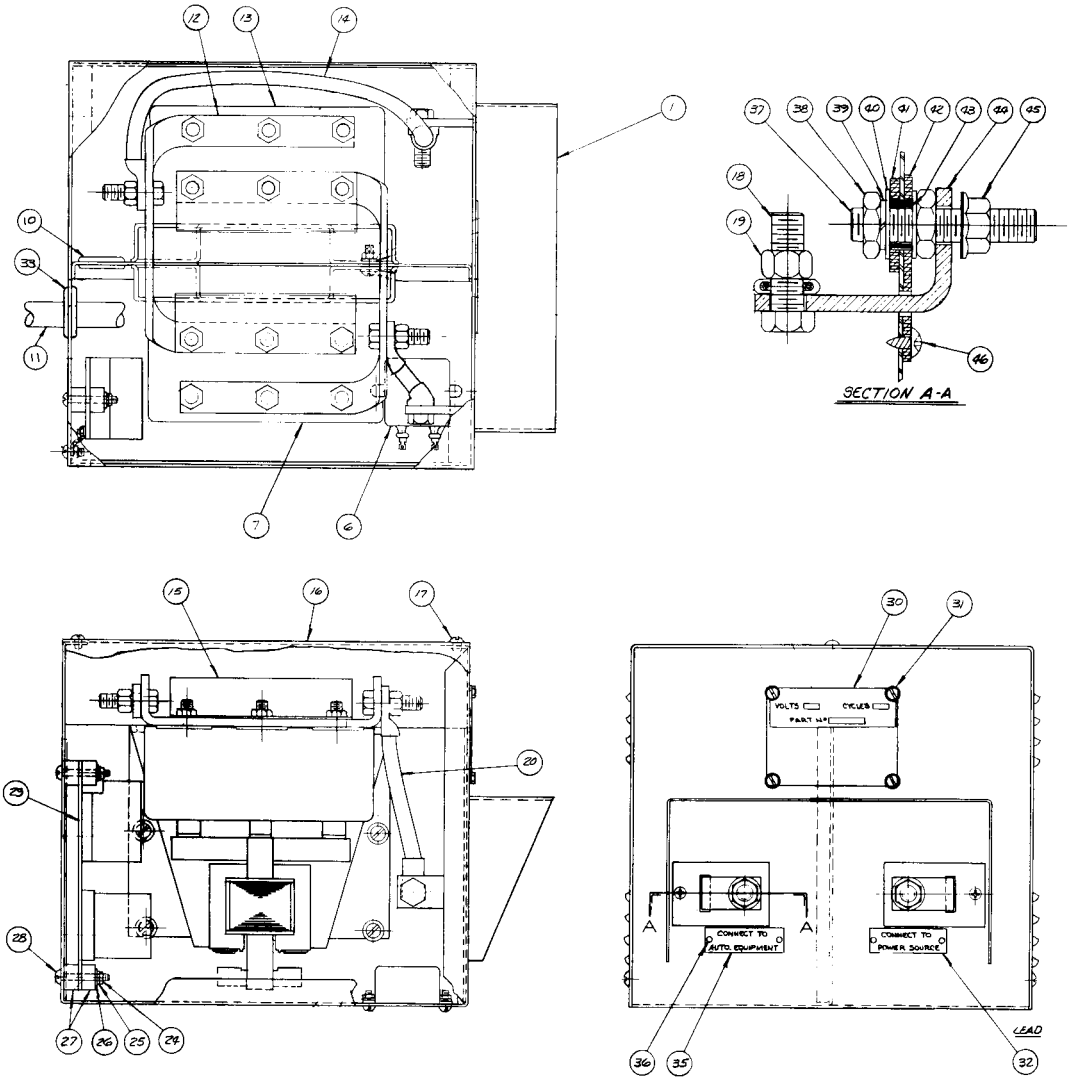
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-75-D

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Panel	1
2	Fuse	1
3	Fuse Holder	1
4	Fuse	1
5	Fuse Holder	1
6	Grommet	1
7	Grommet	1
8	'Min. to 525' Marker	1
9	'To Work' Marker	1
10	'375 to 700' Marker	1
11	'500 to Max.' Marker	1

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
12	'Innershield' Marker	1
13	Rivet	10
14	Stud	5
15	Hex Jam Nut	10
16	Lockwasher	5
17	Flatwasher	10
18	Insulating Washer	5
19	Insulator	5
20	Connection Strap	5
21	Flanged Nut	2
22	Fuse Decal	1

CONTACTOR BOX — SA-800 (Optional)



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

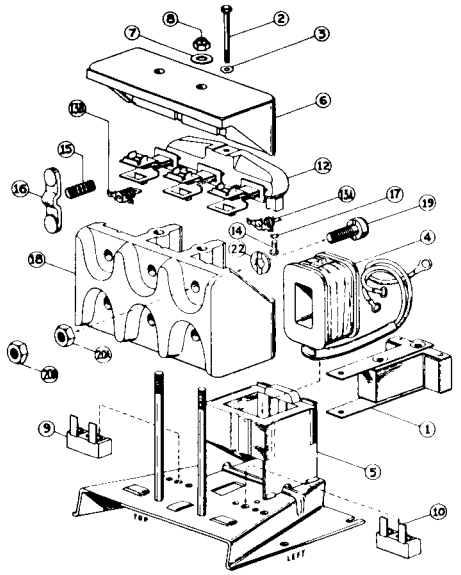
Parts List P-75-E

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Case	1
2	Hex Nut	4
3	Lockwasher	4
4	Flatwasher	4
5	Round Head Screw	4
6	Capacitor	1
7	S-45, S-67 or S-78 Contactor	1
	S-45, S-67 or S-78 Contactor Parts See Page	10
8	Hex Nut	1
9	Round Head Screw	1
10	Grommet	1
11	Cable	1
12	Contactor Jumper	2
13	S-45, S-67 or S-78 Contactor	1
	S-45, S-67 or S-78 Contactor Parts See Page	10
14	"Power Source" Cable	1
15	Heat Radiator	2
16	Contactor Box Cover	1
17	Self Tapping Screw	6
18	Hex Head Screw	4
19	Hex Nut	4
20	"Auto. Equipment" Cable	1
21	Round Head Screw	2

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
22	Flatwasher	2
23	Hex Nut	2
24	Hex Nut	2
25	Lockwasher	2
26	Flatwasher	2
27	Rubber Chassis Mounts	4
28	Round Head Screw	2
29	Relays and Mounting Panel	1
30	Nameplate	1
31	Self Tapping Screw	4
32	"Power Source" Marker	1
33	Grommet	1
35	"Auto. Equipment" Marker	1
36	Rivet	4
37	Stud	2
38	Hex Jam Nut	4
39	Lockwasher	2
40	Flatwasher	4
41	Insulating Washer	2
42	Insulating Panel	2
43	Insulating Tube	2
44	Connecting Strap	2
45	Flange Nut	2
46	Self Tapping Screw	2

S-45 & S-67 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

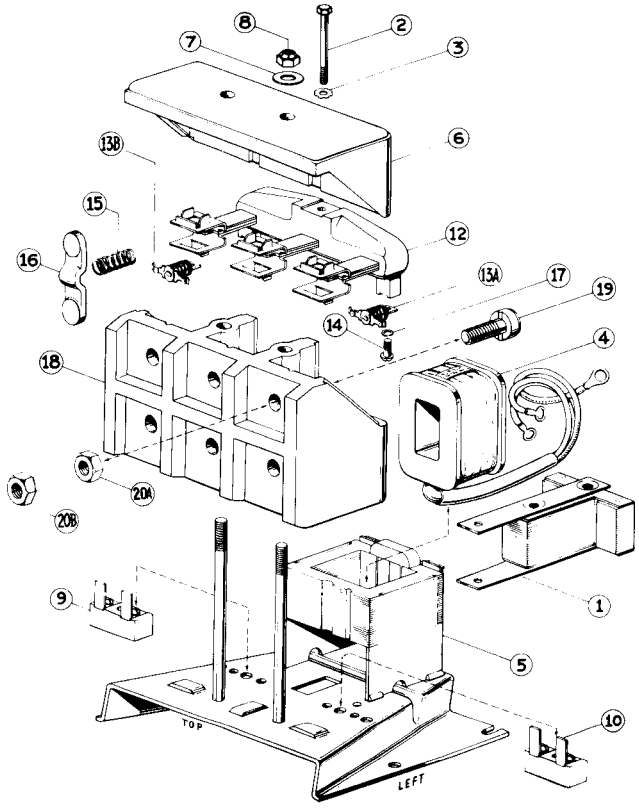


ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Complete Assembly Includes: (Less NVR Coil)	1
1	Moving Lamination Assembly	1
2	Screw - Lamination Mounting	1
3	Lockwasher	1
4	*	1
5	Lamination and Panel Assembly (Specify Input Hertz)	1
6	Contact Block Cover	1
7	Plain Washer	2
8	Hugnut	2
9	Stationary Interlock 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)

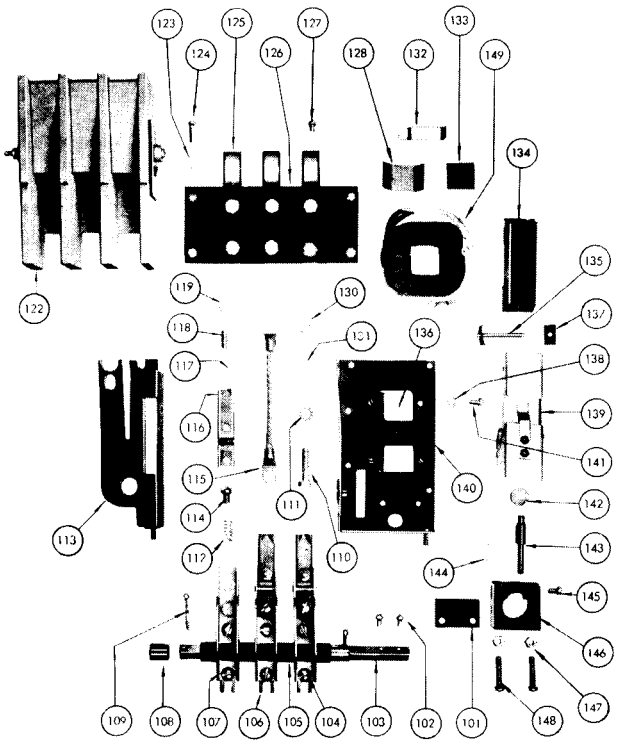


Parts List P-28-J.1

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

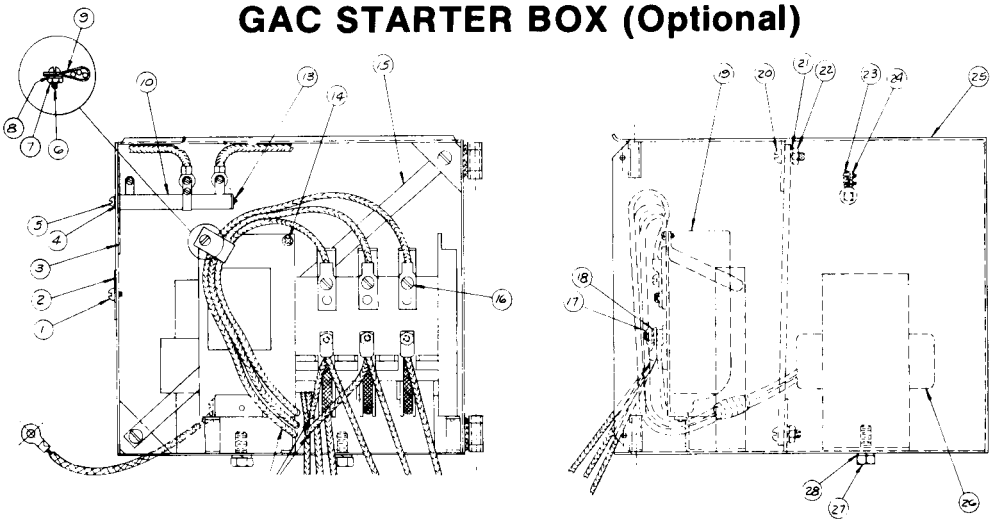
Used with GAC Starter Box



Parts List P-28-F

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

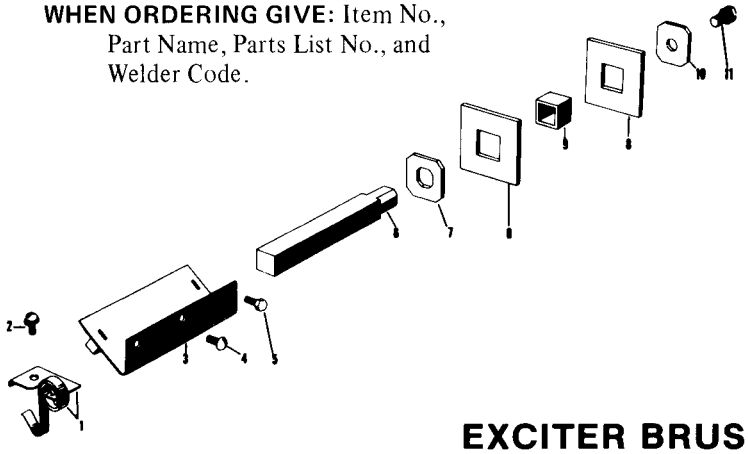


Parts List P-28-G

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

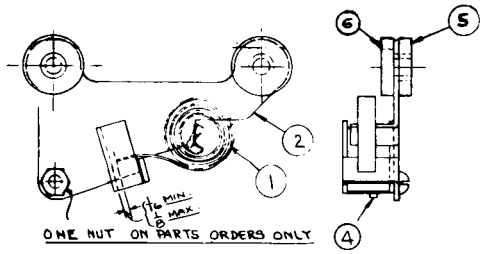
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.



Parts List P-25-L

ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Brushholder	1
1	Spring and Clip Assembly	4
2	Round Head Screw & Lockwasher	4
3	Plate and Retainer Assembly	1
4	Round Head Cap Screw	4
5	Hex Head Cap Screw	1
6	Stud	1
7	Clamping Washer	1
8	Insulating Washer	2
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 Brushholder Assembly Includes:	1
1	Spring	1
2	Brushholder	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 — complete part name and description, 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 own 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 in lieu of all 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.

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