LINCOLN WELDERS

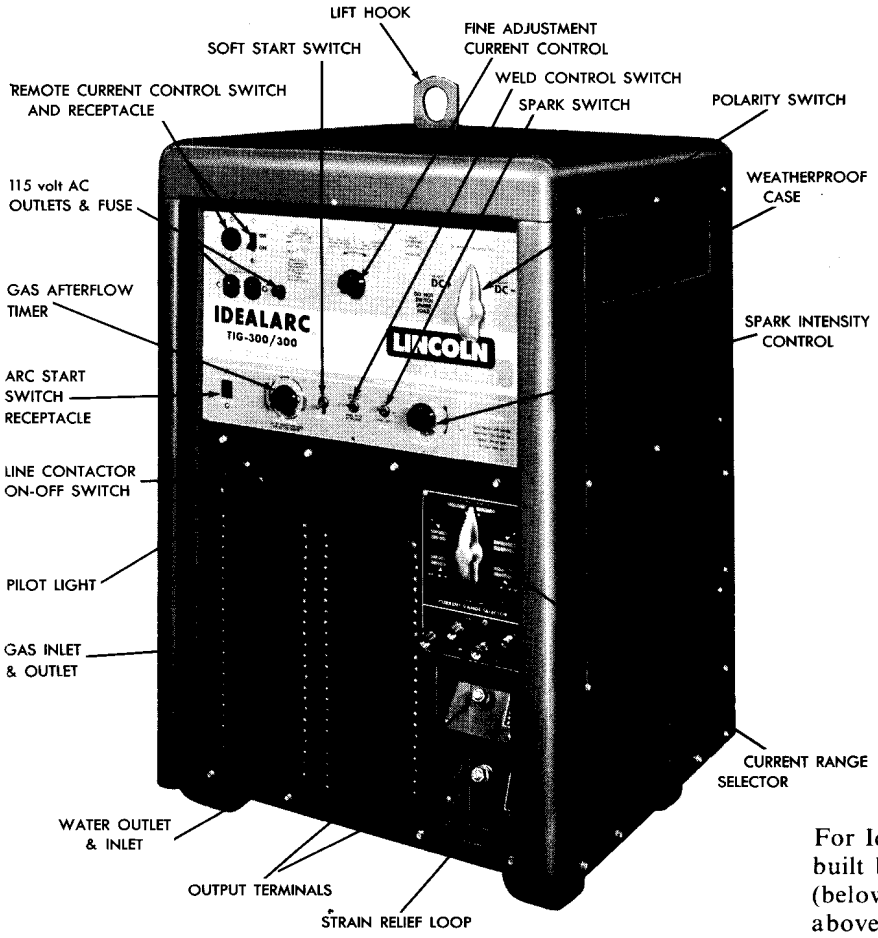
OPERATING MANUAL

IM-243-A

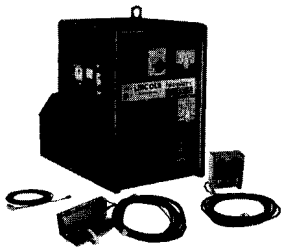
Idealarc TIG
March, 1981
4350; 4352; 4353; 4354; 4355; 4356; 4362; 4368; 4369; 4370; 4371; 4372; 4373; 4374; 4377; 4384; 4385; 4386; 4389; 4390; 4391; 4392; 4395; 4398; 4399; 5165; 5166; 5171; 5172; 5174; 5176; 5177; 5178; 5179; 5180; 5191; 5192; 5211; 5269; 5271; 5308; 5315; 5316; 5317; 5318; 5319; 5320; 5321; 5322; 5323; 5373; 5435; 5479; 5547; 5713; 5984; 6039; 6083; 6178; 6186; 6187; 6189; 6198; 6203; 6220; 6338; 6702; 6723; 6958

IDEALARC® TIG

300 AMPERE
AC and Combination AC/DC Welders
for conventional electrode and inert gas welding



This manual covers equipment which is obsolete and no longer in production by The Lincoln Electric Co. Specifications and availability of optional features may have changed.



For Idealarc TIG models built before October 1961 (below code 4345 — illustrated above) see IM-228.

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 WITH 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 requires 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 requires 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 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, Miami, Florida 33125.

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.

INSTALLATION

Have a qualified electrician connect the input leads to AC power of the voltage and frequency specified on the nameplate. Use a single phase line or one phase of a two or three phase line.

- If you machine is not equipped with a line contactor and a start-stop pushbutton (straight AC's only), install a suitable switch in the input power lines. Fuse the input circuit with the recommended super lag fuses. Choose an input wire size according to local requirements or use the table below. Use copper wire only.

As a safety factor ground the machine frame. A grounding stud marked with the symbol ⏚ is located inside the machine. Connect this stud to a solid earth ground. Choose the wire size according to local requirements or use the size recommended in the table below.

RECOMMENDED INPUT WIRE SIZES
60 Hertz, Single Phase
Based On the 1968 National Electrical Code

Welder	Volts Input	Amps Input		Copper Wire Size — Type 75°C in Conduit — 2 Input Wires, 1 Ground Wire				Super-Lag Fuse Size In Amps	
		With Cond.	Without Cond.	With Cond.	Without Cond.	With Cond.	Without Cond.	With Cond.	Without Cond.
300 & 300/300	230	102	114	4	3	6	6	150	150
	460	51	57	8	8	8	8	70	80
	575	41	46	8	8	10	8	60	70

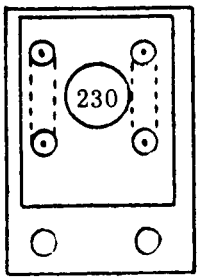
When welding with AC and the tungsten inert gas process, a circulating DC current appears in the welder secondary circuit. This circulating DC saturates the transformer iron, raising the input current of the welder. Thus, when TIG welding with AC near maximum output the
- input current may be up to 30% higher than on the welder nameplate. The welder transformer is designed to withstand this current but larger input lines and fuses than given in above table should be installed.

DUAL VOLTAGE INPUT MODELS

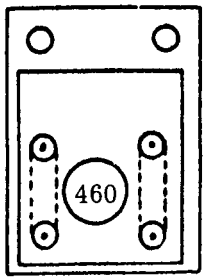
For dual voltage input models not equipped with a line contactor (Accessory L), connect the power lines to H_1 and H_2 for operation on 230 volts. Connect to leads H_1 and H_3 for operation on the higher voltage. Tape the lead not used.

Idealarcs equipped with a dual voltage input panel are shipped connected for the higher input voltage. To change this connection, proceed as follows:

WARNING: Be sure the main power is turned off.



If your input voltage is 230 volts, the contact panel should look like this.



If your input voltage is 460 volts, the contact panel should look like this.

1. Remove the input side panel of the welder case.
2. Remove the insulated jumper plate by taking off the 4 nuts.
3. The jumper plate has two positions, an upper and a lower. Each position is for a different voltage.
4. Place jumper plate in position with your input voltage appearing in the opening in this plate. Tighten all 4 nuts.

RECOMMENDED CABLE SIZES

With the input power off, connect the output cables to the proper studs on the output panel. The cables should be led through the strain relief loop below the studs to prevent damage to the studs if the cables are pulled excessively. Cable size may be selected according to the following table.

COPPER CABLE SIZES FOR COMBINED LENGTHS OF ELECTRODE AND WORK CABLE FOR WELDING WITH REGULAR COATED ELECTRODES

Machine Size	Lengths up to 50 ft.	50 to 100 ft.	100 to 150 ft.	150 to 200 ft.	200 to 250 ft.
300	1/0	1/0	1/0	2/0	3/0

NOTE: Do not leave a stick electrode welding cable connected when doing TIG welding.

CURRENT RANGE SELECTOR

Start the welder. A pilot light on the front panel indicates when the output studs are energized. The 'Current Range Selector' Control is a five step rough selector having overlapping current ranges. For the smoothest arc, set this switch to the lowest usable range, then adjust the heat with the 'Fine Adjustment Current Control'.

FINE ADJUSTMENT CURRENT CONTROL

The 'Fine Adjustment Current Control' rheostat raises and lowers the output current within the range set on the

'Current Range Selector'. This permits the operator to dial the exact current desired. Unless an Amptrol™ is being used the remote current control switch must be 'Off'.

POLARITY SWITCH (On AC/DC Models)

Turn the arc polarity switch located in the upper right corner to AC, DC negative, or DC positive as required for the particular application. **CAUTION:** DO NOT CHANGE THE POLARITY SWITCH WHILE WELDING. Doing this will cause the current to arc across the contacts seriously damaging the switch.

DUTY CYCLE

This welder is rated for 60% duty cycle. Duty Cycle is based on a ten minute period. Therefore, this welder can be operated at the nameplate rated output for 6 minutes out of every 10 minute period.

AUXILIARY POWER

115 volts AC current is available from the receptacle on the front of the welder. This receptacle is fused for 15 amperes. If it should blow, replace with 15 ampere, 125 volt (ABC 15) fuse available locally.

OVERLOAD PROTECTION

All AC/DC Idealarcs and all straight AC's equipped with a line contactor have a built-in protective thermostat operated by both temperature and current. This device stops the machine if the transformer or rectifier reaches the maximum safe operating temperature because of frequent overload or high room temperature plus overload. The thermostat automatically resets when the temperature reaches a safe operating level.

The thermostat is mounted on the transformer coil. In AC/DC Idealarcs, another thermostat is mounted on the rectifier.

CONDENSERS (Accessory C)

When the power factor correction condensers fail, it is not always apparent from the appearance of the condensers. To check the condensers, operate the welder at rated input voltage drawing rated output current. The input current should correspond to the nameplate amperes. If the input current is 10% or 20% higher, at least one condenser has failed. (**NOTE:** If TIG welding with AC, the input current is higher than on the nameplate. See "Installation" page 2.)

LINE CONTACTOR (Accessory L)

The line contactor is standard on all combination AC/DC models. It is an accessory on AC models only. The overload protective thermostat and start-stop pushbutton is included with the line contactor assembly.

HIGH FREQUENCY UNIT (Accessory H)

General

The high frequency unit is a complete factory installed package incorporating a high frequency spark generator, gas and water controls and the controls required for inert gas welding.

Connection

Connect the welding torch to the 'Electrode' stud of the welder. Insert the plug of the separate arc start switch into the 'Arc Start Switch Receptacle'. Tape the arc start switch to the torch in a position where it can be conveniently pressed by your thumb when holding the torch in position for welding. (If using an Amptrol see page 6.)

Connect the necessary gas and water hoses to the fittings. Any torch conforming to IAA standards can be connected to the Idealarc TIG. The fittings have the following threads:

Gas inlet: $\frac{5}{16}$" — 18 right hand female.
Gas to Electrode: $\frac{5}{16}$" — 18 right hand female.
Water inlet: $\frac{1}{4}$" pipe right hand male.
Water to Electrode: $\frac{5}{8}$" — 18 left hand female.

When using a water cooled electrode cable the drain water from the torch must flow out the hose which contains the electrode cable. At least three feet of insulating hose must be used in the drain line between the point where the electrode cable enters the line and a solid earth ground.

The gas tank should be equipped with a pressure regulator and flow-meter. Gas flow setting depends upon the procedures used.

A strainer should be installed in the water line between the supply and the welder. The return water should be allowed to flow freely into a trank or drain. DO NOT operate a water cooled torch unless water is flowing.

Operation

Weld control switch turns the entire high frequency unit on and off. To weld with high frequency or with gas and water flowing turn this switch to 'Inert Gas Welding'. To use the machine to weld with coated electrodes, turn the switch to 'Other Types of Welding'. Do not leave the stick electrode welding cable connected when doing TIG welding.

'Spark' switch controls the type of high frequency operation. This switch has no effect on the output contactor or the gas and water valves. With the 'Spark' switch 'On', the high frequency operates continuously while welding. With the 'Spark' switch 'Off' the high frequency is off at all times. With the 'Spark' switch on 'Start Only', the high frequency operates to start the arc but turns off auto-

matically when the arc is established.

'Soft Start' switch reduces the current surge when striking the arc. Once the arc is established, it has no effect. Experience indicates the 'Soft Start' is most effective on the three highest AC ranges. It should be switched off when welding with DC or the two lowest AC ranges.

'Gas Afterflow' timer determines the length of time the gas and water flow after the arc is stopped. The dial is calibrated according to tungsten size. Time is normally set according to the tungsten size being used.

'Spark Intensity' rheostat is used to increase or reduce the intensity of the spark. Set it as required for good arc characteristics. Keeping it low helps minimize radiation.

Sequence of Operation:

1. Turn the welder on.
2. Set the 'Gas Afterflow'.
3. Set the 'Spark Intensity'.
4. Set the 'Soft Start' switch as appropriate:

Type of Welding	Polarity	'Soft Start'
Stainless Steel welding	DC	Off
Aluminum Welding — Two lowest Current ranges	AC	Off
Aluminum Welding — Three high Current ranges	AC	On
Other Metals	As Req'd.	As Req'd.

5. Set the 'Spark' switch as appropriate:

	'Spark'
TIG — No high frequency	Off
TIG — High frequency Starting	Start Only
TIG — With high frequency	On

6. Turn the weld control switch to 'Inert Gas Welding'. Momentarily press the arc start switch. This opens the gas and water valves purging the lines of air. These valves shut off after a time determined by the setting on the 'Gas Afterflow' timer. The welder is now ready to weld.
7. Set the gas tank flowmeter according to the procedure being used.
8. Press the arc start switch taped to the torch. This opens the gas and water valves and closes the output contactor. Start the arc.
9. Hold the arc start switch down and complete the weld. Release the arc start switch to stop the arc. When the time set on the 'Gas Afterflow' elapses, the gas and water valves close. To restart the arc press the arc start switch and restrike the arc. If using an 'Amptrol' see the instructions on page 6.

Recommended Tungsten Size

Electrode Diameter (inches)	Current-Amperes		Approx. Argon Gas Flow C.F.H. at 20 PSI	
	Pure Tungsten	Thor. Tungsten	Aluminum	Stainless Steel
.010	0 — 8	0 — 8	3 — 8	3 — 8
.015	5 — 12	5 — 12	5 — 10	5 — 10
.020	8 — 20	8 — 20	5 — 10	5 — 10
.040	20 — 50	20 — 50	5 — 10	5 — 10
1/16	40 — 120	50 — 150	13 — 17	9 — 13
3/32	100 — 160	140 — 250	15 — 19	11 — 15
1/8	150 — 210	220 — 350	19 — 23	11 — 15
5/32	190 — 270	300 — 450	21 — 25	13 — 17
3/16	250 — 350	400 — 550	23 — 27	18 — 22
1/4	300 — 490	500 — 800	28 — 32	23 — 27

Grounding the High Frequency Unit

The maximum rated output of a high frequency unit is limited by regulations of the Federal Communications Commission. The following recommendations will help to minimize the amount of radiation:

1. Keep the 'Spark Intensity' low.
2. Keep the electrode and work leads as short as possible.
3. Keep the electrode and work leads on the floor as close together as possible.
4. Keep the covers on the unit.
5. Keep the spark gaps set at .008" to .010". The opening in the high frequency control panel provides access to the spark gaps.
6. The case must be grounded. The ground lead should be less than eight feet in length. A water pipe within eight feet of the welder going directly into the soil, makes a good ground. Otherwise a direct earth ground should be installed. Grounding to the building frame or a long pipe system can make radiating aerials of these members.
7. Be sure there is a good electrical contact between the welder case and input lead conduit.

Installation of Special Torch Safety Switch

Devices to prevent burned out torches resulting from improper water flow are available from other manufacturers. To install these devices the Idealarc TIG can be revised so the water flow is not controlled by the 'Gas Afterflow' timer. Rather the water flows continuously as long as the machine is turned on and the weld control switch is set for 'Inert Gas Welding'. To change this wiring proceed as follows:

1. Disconnect machine from supply lines. Remove case top and input side panel.

2a. (Above code 5160 only) Unsolder lead (tagged W) from water solenoid at timer relay contacts. Resolder to other side of timer relay contacts at same point as lead 49.

2b. (Below code 5160 only) Unsolder lead (tagged W) from water solenoid at timer switch N.C. contact. Resolder to timer switch common contact.

3. Solder a 40" lead to the unused terminal of the weld switch. Pass this lead around the choke on the left hand side, down through the small hole in the baffle next to lead 27.
4. Disconnect lead 27 from X_5 at transformer. Connect one lead from water flow switch in its place.
5. Connect new lead from weld switch, lead 27 and other water flow switch lead together.
6. Check all connections and clearance.
7. Replace top and side panel. Machine is now ready for use.

AMPTROL™ (Optional)

General

The 'Amptrol' is a remote current control. It is available in either hand or foot operated models. **NOTE:** The Amptrol designed for the machines built prior to Oct. 1961 (Below code 4345) is not interchangeable with these later models.

Connection

Insert the three prong plug from the Amptrol into the 'Remote Current Control' receptacle on the welder. Turn the switch next to this receptacle 'On'. Operation of the Amptrol will now vary the welding current.

Insert the two prong plug from the Amptrol into the 'Arc Start Switch Receptacle' on the welder. Remove the separate arc start switch from the torch.

Current Control Range

The range over which the Amptrol will vary the welding current depends upon the settings of the welder current controls. If the 'Fine Adjustment Current Control' is set on maximum, the amptrol can vary the current over the entire range for the particular 'Current Range Selector' setting. If the 'Fine Adjustment Current Control' is set on less than maximum, the Amptrol can vary the current from the maximum set by the 'Fine Adjustment Current Control' to the minimum of the range set on the 'Current Range Selector'.

Operation — Current Control

Set the 'Fine Adjustment Current Control' for the maximum current desired. Depress the foot Amptrol fully to get maximum current. Raising the foot reduces the current.

Tape the hand Amptrol to the torch in position so the actuator can be extended conveniently by the operator's thumb. Maximum current is obtained with the actuator fully extended.

Operation — Arc Start Switch

The arc start switch incorporated as part of the Amptrol replaces the arc start switch taped to the gun. It operates in the same manner as described above. It is pressed when the foot Amptrol is depressed slightly or when the hand Amptrol thumb actuator is extended.

ARC POLARIZER (Optional)

General

This attachment improves arc characteristics on two types of aluminum AC TIG welding applications: feather-edge butt welds where it is desired to obtain a smooth well-shaped bead on the back of the joint, such as the root pass in a pipe joint weld; and low current applications which require exceptional cleaning, such as thin edge or corner welds using less than 40 amps. It is not used for DC TIG welding or any stick electrode welding.

Installation

The Arc Polarizer consists of three parallel six volt automotive batteries mounted in a case. If the batteries are the "dry" type, fill with the electrolyte per instructions enclosed with the batteries.

Connection instructions are given on the Arc Polarizer nameplate. Be certain that the lead from the work is connected to the 'Polarizer In' stud only for the conditions specified on the nameplate.

Charging the Batteries

Once the Arc Polarizer is in operation, charging comes from two sources. First: when the Arc Polarizer is in the welding circuit, that is, when the cable to the work is connected to the 'Polarizer In' stud, the batteries are charged by the welding current. Second: batteries can also be charged by the trickle charger included in the Arc Polarizer.

If the Arc Polarizer is used for several hours a day at currents over 150 amps, the batteries will be kept fully charged. In these cases leave the 'Battery Charger' switch 'Off' to avoid overcharging the batteries.

If the Arc Polarizer is used at lower currents or for only a few hours per day, turn the 'Battery Charger' switch 'On' for several hours per day. Do not overcharge the batteries. If water must be added frequently, the batteries are being overcharged.

To bring partially discharged batteries up to welding charge (specific gravity 1.150), turn the 'Battery Charger' switch 'On'. If all three batteries are low, the 10 amp fuse (AGC-10) in the Arc Polarizer may blow. When the specific gravity for all three batteries is over 1.150, the machine can be used for welding. The batteries will then quickly come to full charge.

If a battery is completely discharged, remove it and have it charged at a battery shop. **CAUTION:** WELDING WITH A DISCHARGED BATTERY RESULTS IN

CHARGING AT AN EXCESSIVE RATE CAUSING SERIOUS HEAT DAMAGE TO THE BATTERY.

AUTOMATIC ARC FADE CONTROL (Optional)

General

This attachment automatically fades-out the current when the operator releases the arc start switch. It cannot be used when the Amptrol is connected to the welder.

Connection

For code 4365, and all machines below code 4345, the welder must be rewired before the Arc Fade Control can be used. Instructions are shipped with the Automatic Arc Fade Control.

Insert the three prong plug from the Arc Fade into the 'Remote Current Control' receptacle on the welder. Turn the switch next to the receptacle 'On'.
Insert the two prong plug from the Arc Fade into the 'Arc Start Switch Receptacle' on the welder. Insert the two prong plug from the arc start switch into the 'Arc Start Switch Receptacle' on the Arc Fade.

Operation

Strike the arc and make the weld using the arc start switch taped to the torch as described on page five. A soft start is automatically obtained when the Arc Fade Control is used.

When the arc start button is released, the current will start to fade. The rate at which the current fades is dependent upon the setting of two controls — the 'Current Fade-Out' rheostat on the Arc Fade Control and the 'Fine Adjustment Current Control' on the Idealarc TIG. When the 'Current Fade-Out' is set on 'Slow', the current will decay more slowly than when it is set on 'Fast'.

The 'High Frequency Cutoff Level' rheostat on the Arc Fade Control adjusts the time the output contactor will stay in after the arc start button is released. When this rheostat is set on 'High', the time is short. When it is set on 'Low', the time is long. When set for a short time, the current may not get down to the minimum for the current range set on the Idealarc TIG. Normally, when set for a long time, the current will reduce to the minimum current for the range setting and remain there until the contactor opens. The time for cutoff is never less than one second nor longer than 60 seconds.

MAINTENANCE INSTRUCTIONS

1. The fan motor has sealed ball bearings which require no service.
2. In dusty locations, dirt may clog the air channels causing the welder to run hot. Under these conditions, blow out the welder at regular intervals.
3. Inspect the spark gaps monthly to maintain the .010 setting. The door in the high frequency panel provides access to the spark gaps.
4. If the electrode is oxidized and the arc is hard to start, adjust the Afterflow Timer for a longer flow of gas after the arc is broken.
5. If the machine is not operating properly, refer to the Trouble Shooting Chart.

WARNING: USE EXTREME CAUTION WHEN WORKING WITH THE SECONDARY CIRCUIT OF THE HIGH FREQUENCY UNIT TRANSFORMER. THE OUTPUT VOLTAGE OF THIS TRANSFORMER IS DANGEROUSLY HIGH. TURN THE MACHINE OFF WHEN WORKING ON THIS PART OF THE CIRCUIT.

TROUBLE SHOOTING

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

TROUBLE	CAUSES	WHAT TO DO
Starter Chatters.	Check Low Line Volts.	Check with Power Company.
	Faulty Starter.	Repair or Replace.
Welder will not start. (Starter not operating.)	Supply line fuse blown.	Replace. (Look for reason for blown fuse first.)
	Power circuit dead.	Check voltage.
	Broken power lead.	Repair.
	Wrong voltage.	Check input voltage against nameplate.
	Thermostat tripped. (Welder Overheated.)	Make sure that fan is operating and that there are no obstructions to free flow of air. Operate at normal current and duty cycle.
	Starter switch jammed.	Remove obstruction.
	NVR coil open.	Replace.
Welder will not weld. (Starter operating.)	Electrode or work lead loose or broken.	Tighten and repair connections.
	Open transformer circuit.	Send to repair shop to have coils replaced.
	Polarity switches not centered on arrows. (AC-DC only.)	Center polarity switch on arrow.
Welder welds but soon stops welding. (Thermostat tripped.)	Proper ventilation hindered.	Make sure all case openings are free for proper circulation of air.
	Either AC or DC unit loaded beyond rating.	Operate at normal current and duty cycle consistent with both AC and DC rating.
	Fan inoperative.	Check leads and motor bearings. Fan can be tested on 115 volt line; with welder on, voltage across fan should be 115 volts.
Variable or sluggish welding arc.	Poor work or electrode connection or poor connection in control circuit.	Check and clean all connections.
	Current too low.	Check recommended currents for rod type and size.
	Low line voltage.	Check with Power Company.
	Welding leads too small.	Use 1/0 cable. If combined length of electrode and work cable is over 150 feet, use 2/0 or larger cables.
Polarity switch won't turn.	Arced by turning under load.	Replace Polarity Switch.
High Frequency weak or not present.	Spark switch in "Off" Position.	Throw Spark switch to ON.
	Weld control switch in Other Types of Welding position.	Turn the weld control switch to Inert Gas Welding position.
	Open or poor contact in H.F. Input Circuit.	Check connection and leads.
	H.F. being internally grounded in machine.	Check electrode circuit in machine for H.F. grounds. Check machine by-pass condenser and condenser leads.
	Torch connections wrong.	See page 4.
Welder welds only on minimum — no control.	Open Control Circuit Lead.	Repair.
	Amptrol Remote Current Control Switch in wrong position.	Throw Switch to OFF.
	Open mag-amp control circuit lead or coil.	Repair.
Machine welds only on maximum — no control.	Shorted AC mag-amp coil (one or both).	Repair or replace.
	Short or misconnection in mag-amp control circuit keeping control on at all times.	Repair.
Welder welds from some point above minimum to maximum, using control-welder will not reach minimum.	Bias circuit on mag-amp open.	Repair.
	Bias circuit resistor open, shorted or changed value.	Replace.

TROUBLE SHOOTING (Continued)

TROUBLE	CAUSES	WHAT TO DO
Gas & Water valves apparently not turning on or off at proper time.	Timing off.	Adjust 'Gas Afterflow' timer.
	No gas.	Check bottle for gas pressure.
	No water.	Check water line for pressure.
	Faulty Interlock on S-45 S-67 Contactor.	Check Interlock Circuit.
	Faulty Electronic Timer.	Replace.
	Timer relay inoperative.	Check timer relay.
Amptrol Control does not control output.	Remote Current Control Switch in wrong position.	Throw switch to ON.
	Plug on Amptrol attachment not securely in Remote Current Control receptacle.	Secure plug.
	Poor Contact or open lead in Amptrol itself.	Check connections and leads in control.
	Open lead or connection to Remote Current Control receptacle or switch.	Repair.
Intermittent high frequency.	Spark gaps out of adjustment.	Set gaps to .010", resurface or replace spark gaps.
Machine welds at some point above min. at 1 on 'Fine Adjustment Current Control' and drops to min. as rheostat is increased to 8 or 9. Current shoots up to about ¼ of max. on 10.	Bias resistor shorted.	Replace.
Machine welds at min. from 1 to about 6 to 8 on the 'Fine Adjustment Current Control' and then rapidly climbs to ½ to ⅔ max. at 10 control position.	One of the mag-amp leads to the self-saturating diodes open.	Repair.
	One of the AC mag-amp coils is open.	Replace.
	One of the self-saturating diodes is shorted.	Replace Control Rectifier.
Machine welds at min. for all 'Fine Adjustment Current Control' positions up to 8 or 9 and goes up to about ⅓ max. at 10.	Gain adjustment resistor shorted.	Reset or replace.
	Both self-saturating diodes shorted.	Replace control rectifier.
Welder control is backwards starting at about ⅔ max. at 1 and dropping off to min. at 5 or 6 'Fine Adjustment Current Control' position. Remains at min. until 10 is reached where it increases slightly.	Mag-amp coil leads to self-saturating diodes are interchanged.	Interchange leads.

INDEX OF PARTS LISTS

ACCESSORIES

Several accessories are available for addition to the basic TIG welder. Each accessory is designated by a single letter as listed below. To see which accessories were factory installed in your welder, check the code number stamped on the nameplate. Each letter after the four digit code number indicates one of the following accessories. Always give the full welder code number when ordering parts.

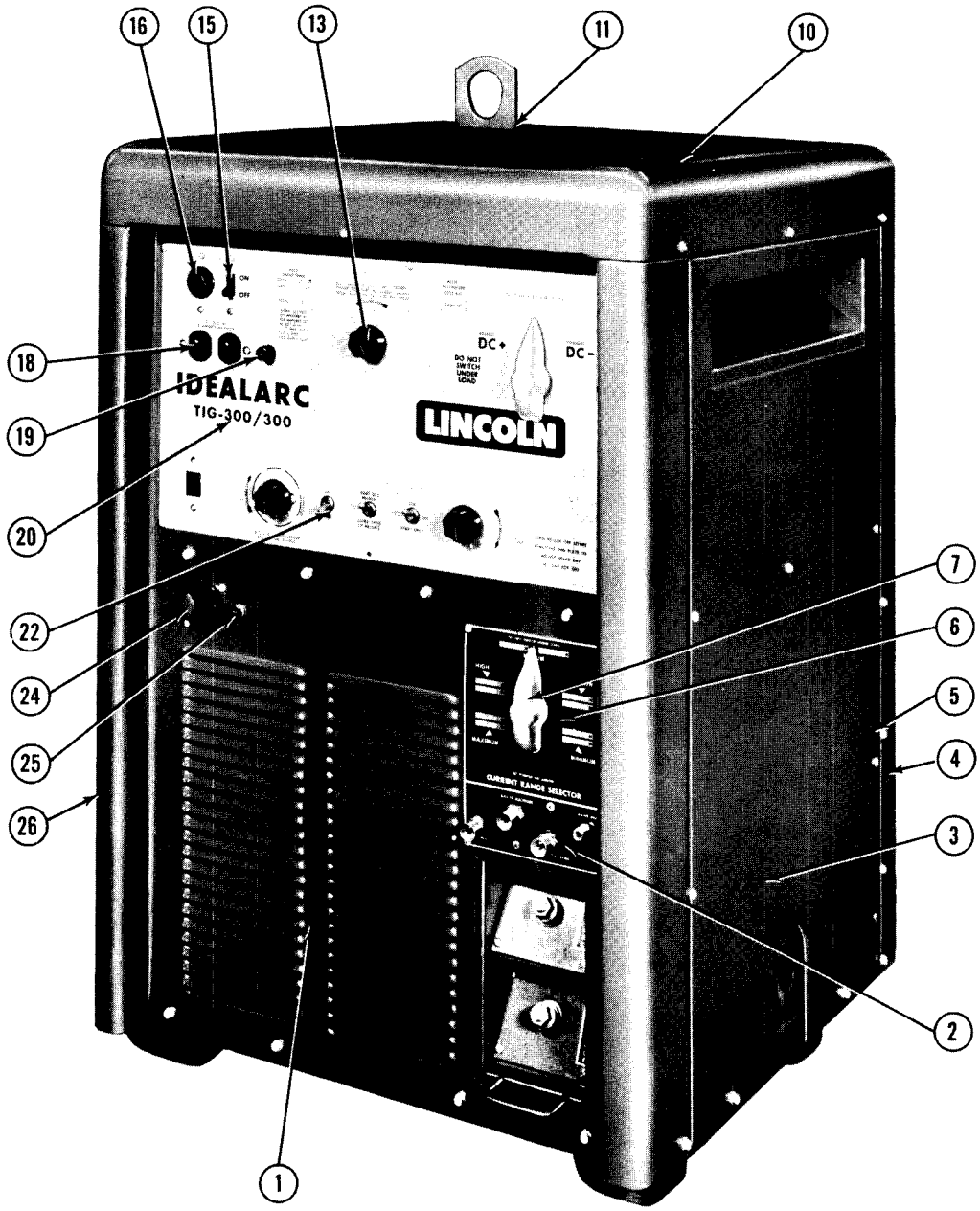
Letter	Name	Parts List No.	Page
C	Condensers	See P-66-E	13
H	High Frequency Unit	See P-66-H	17
	S-45 or S-67 Contactor (part of H)	See P-28-E	18
L	Line Contactor (Standard on AC/DC's, optional on straight AC's)	See P-66-G	19
	GXL Starter (part of Accessory L)	See P-28-F	19
P	115 Volt Push-Button	—	—
—	Foot Amptrol (K-746)	See P-66-J	21
—	Hand Amptrol (K-745)	See P-66-K	21
—	Automatic Arc Fade Control	Request Drawing	
—	Arc Polarizer (K-751)	Request Drawing	

SEE THE BACK COVER FOR INSTRUCTIONS ON HOW TO ORDER PARTS

WIRING DIAGRAMS

The diagrams for each machine are glued to the inside of the right side panel. If the diagram is illegible, write to the Service Department at the factory for a replacement. Give the diagram number or machine code number.

CASE EXTERIOR AND GENERAL ASSEMBLY

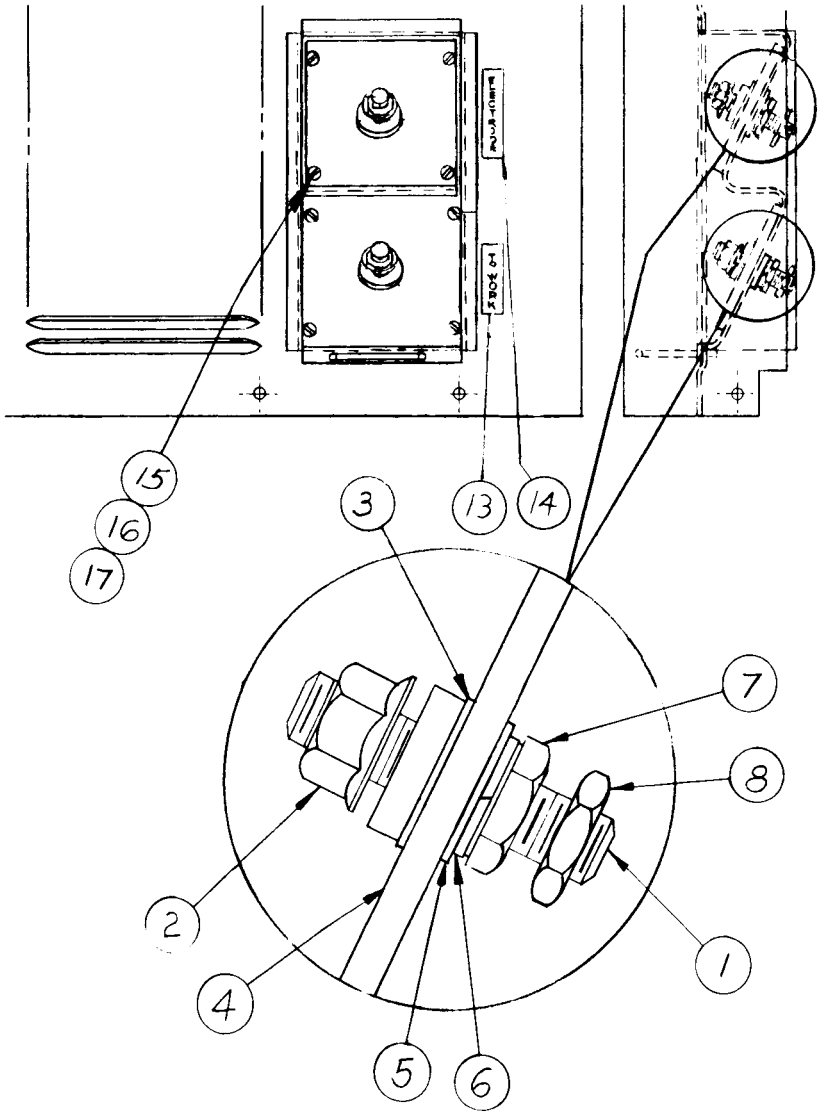


WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-66-C		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
1	Case Front Panel	1
	Speed Nut	4
	Spacer, Top to Front Panel	1
2	Water and Gas Valves See	P-66-H
3	Right Side Panel	1
4	Case Rear Panel, Includes:	1
	Speed Nut	9
5	Self Tapping Screw, Fastens Side, Front, and Back Panels	17
6	Current Range and Valves Nameplate, Specify AC or AC/DC	1
	Self Tapping Screw, Nameplate to Panel	4
7	Current Range Selector Handle, Includes:	1
	Set Screw	1
	Current Range Selector Switch See	P-66-F
10	Case Top	1
11	Cover Seal	1

Parts List P-66-C		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
13	Fine Adjustment Current Control Rheostat, Includes:	1
	Knob	1
15	Remote Current Control Switch	1
16	Remote Current Control Receptacle	1
	Sems Screw, Switch and Receptacle to Case	4
18	Duplex Receptacle	1
19	Fuse	1
	Fuse Holder	1
20	Nameplate, Specify AC or AC/DC	1
	Self Tapping Screw, Nameplate Mounting	8
22	High Frequency Parts See	P-66-H
24	Push Button and Starter Parts See	P-66-G
25	Pilot Light	1
26	Left Side Panel	1

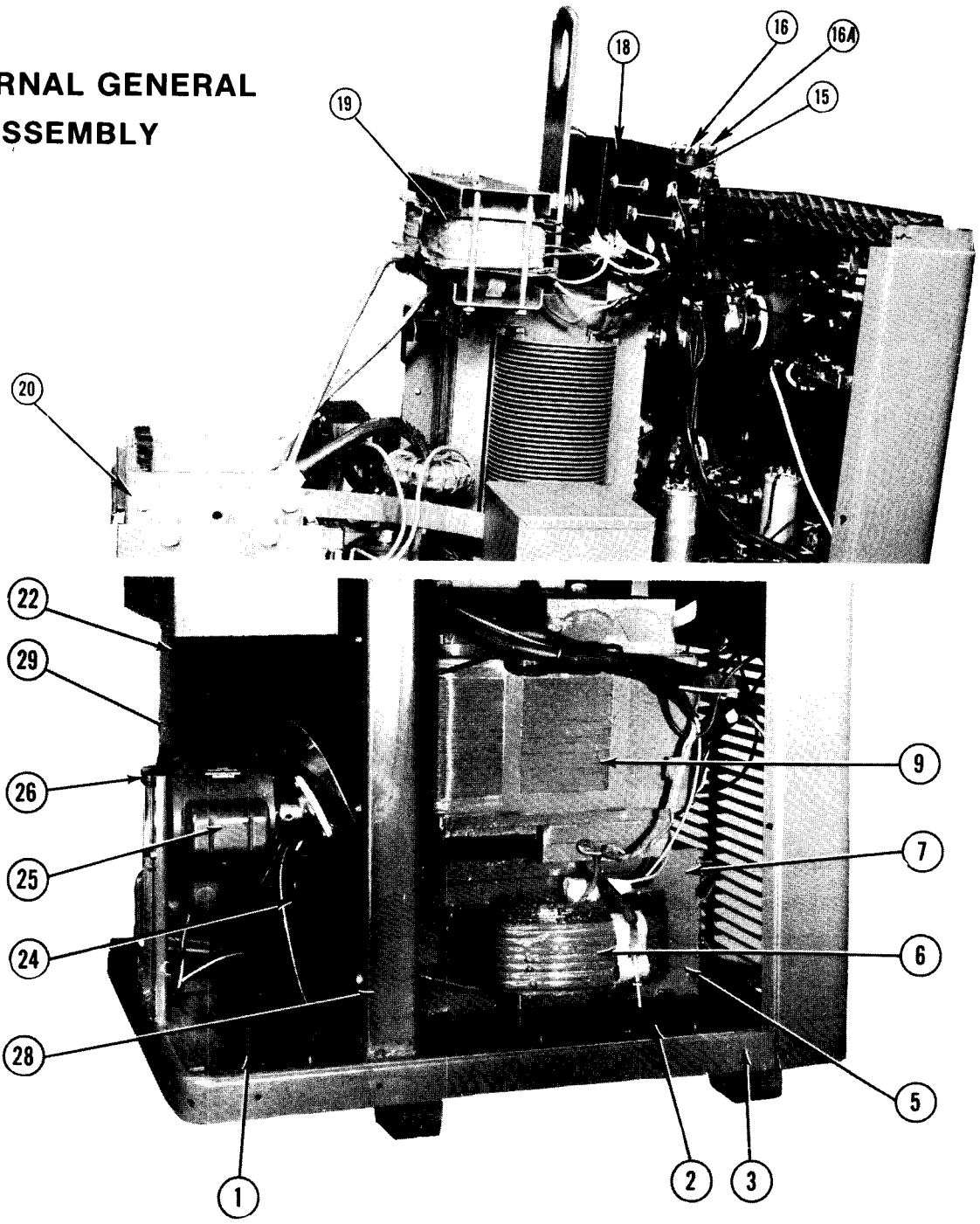
OUTPUT STUDS



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

	Parts List P-66-D	
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
1	Stud	2
2	Hex Weld-Nut	2
3	Plain Washer	2
4	Insulation Plate	2
5	Plain Washer	2
6	Lockwasher	2
7	Hex Nut, Brass	2
8	Hex Nut	2
13	"To Work" Marker	1
14	"Electrode" Marker	1
15	Round Head Screw	8
16	Plain Washer	8
17	Hex Nut	8

INTERNAL GENERAL ASSEMBLY

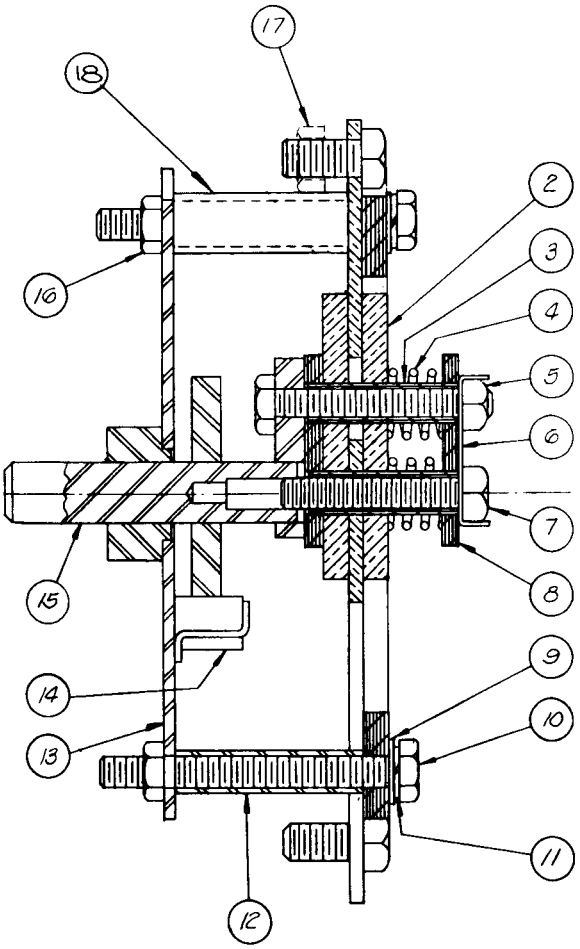


WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-66-E		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
1	Small Base Baffle	1
2	Large Base Baffle	1
3	Base	1
5	Transformer Lower Lamination	1
6	Transformer Coil	1
7	Transformer Upper Lamination	1
	Hex Head Screw, Clamps Transformer Halves	4
9	Reactor Coil and Lamination Assembly, Includes:	1
	AC Reactor Coil, Edge Wound	1
	AC Reactor Coil, Ribbon Wound	1
	DC Reactor Coil	2
15	Bias Rectifier	1
16	Bias Resistor	1
16A	Gain Adjustment Resistor	1

Parts List P-66-E		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	Terminal Strip	1
	Bracket, Mounts Rectifier Resistor and Terminal Strip	1
18	Control Rectifier	1
19	Mag-Amp Coil and Core Assembly	1
20	DC Unit Parts See P-62-G	
22	Panel, Without Condensers	1
22	Condenser and Panel Kit, Includes:	1
	Condenser	1
24	Fan Blade	1
25	Fan Motor	1
26	Fan Bracket Support	1
28	Vertical Baffle	1
29	Stabilizing Condenser, Not Illustrated	1

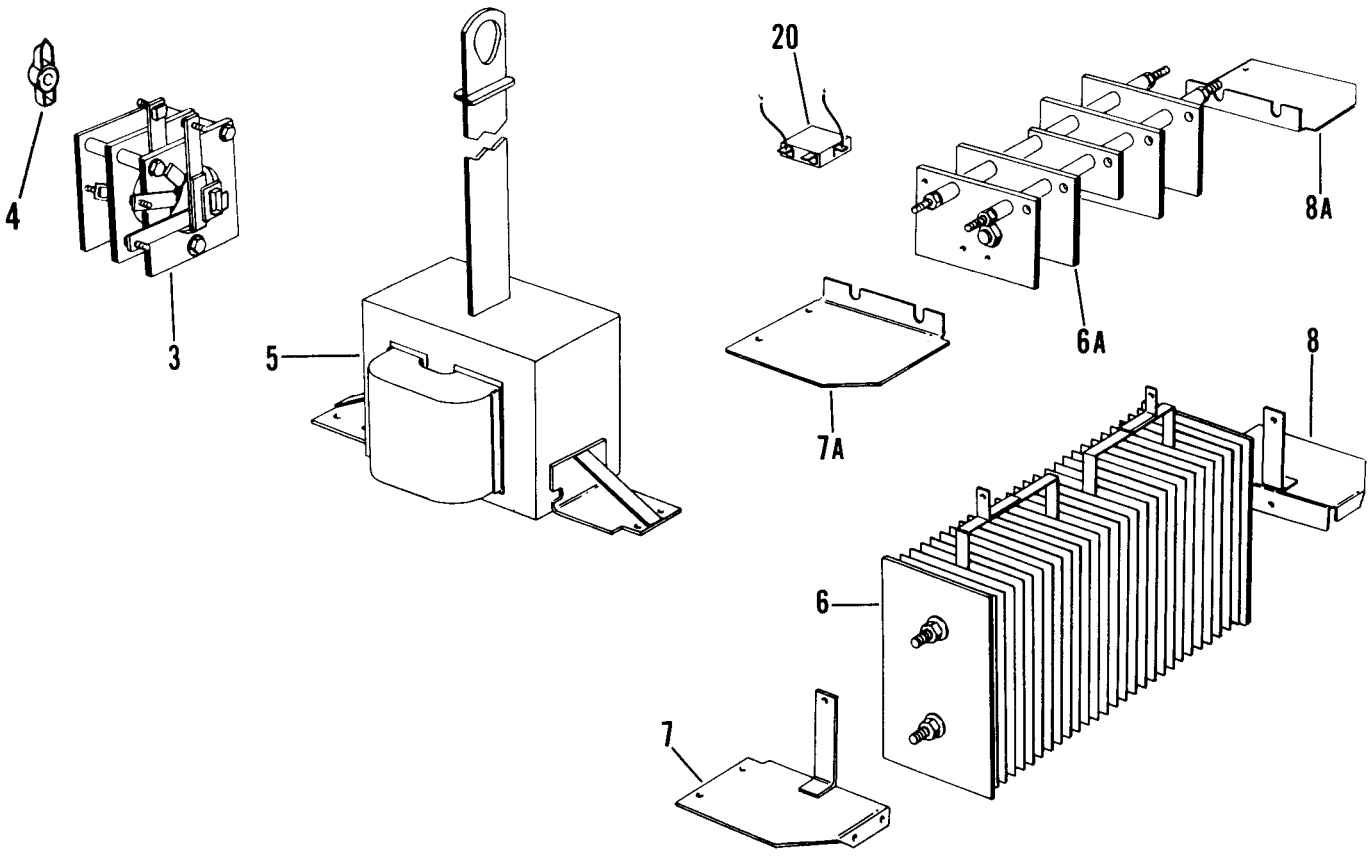
CURRENT RANGE SELECTOR



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

	PARTS LIST P-66-F	
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	Current Range Selector Switch, Includes: (5 Ranges)	1
1	Switch Plate Assembly	1
2	Moving Contact	2
3	Insulating Tube	2
4	Spring	2
5	Hex Nut	1
6	Locking Clip	1
7	Hex Head Bolt	1
8	Insulation	2
9	Flat Washer	3 Min.
10	Hex Head Bolt	3
11	Lockwasher	3
12	Spacer	3
13	Bracket Assembly	1
14	Cam Spring	1
15	Rotor Arm Assembly	1
16	Hex Nut	3
17	Hex Nut	6
18	Insulating Tube	1

DC UNIT — AC/DC MODELS



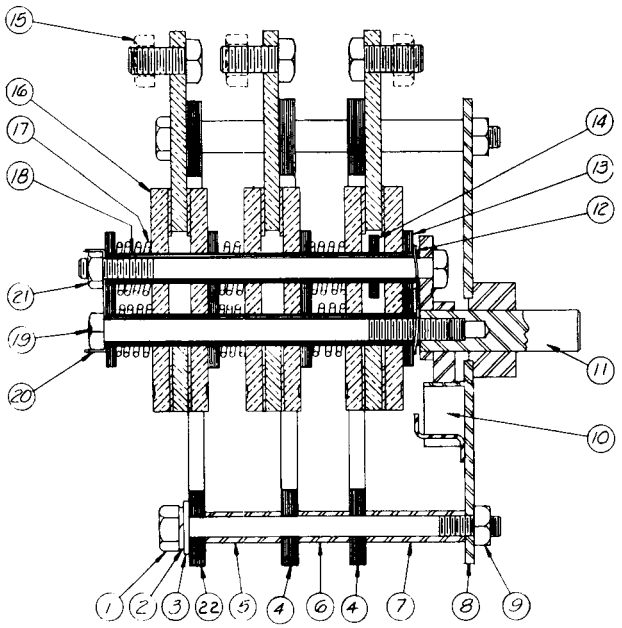
WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-62-G (Selinium Rect.) Parts List P-66-L (Silicon Rect.)		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
3	Arc Polarity Switch (3 Gang) With Selenium Rectifier	1
	Switch Parts	See P-62-H
3	Arc Polarity Switch (2 Gang) With Silicon Rectifier	1
	Switch Parts	See P-61-H
4	Polarity Switch Handle	1
5	Choke	1
6	Selenium Rectifier, Below Code 5310	
7	Rectifier Support Bracket, Right Hand	1
8	Rectifier Support Bracket, Left Hand	1
6A	Silicon Rectifier, Above Code 5310	1
7A	Rectifier Support Bracket, Right Hand	1
8A	Rectifier Support Bracket, Left Hand	1
20	Capacitor	1
	Spacer, Capacitor Mounting	2
	Self Tapping Screw, Capacitor Mounting	2
	Thermostat Assembly	1

ARC POLARITY SWITCH — 3 GANG

With Selenium Rectifier

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

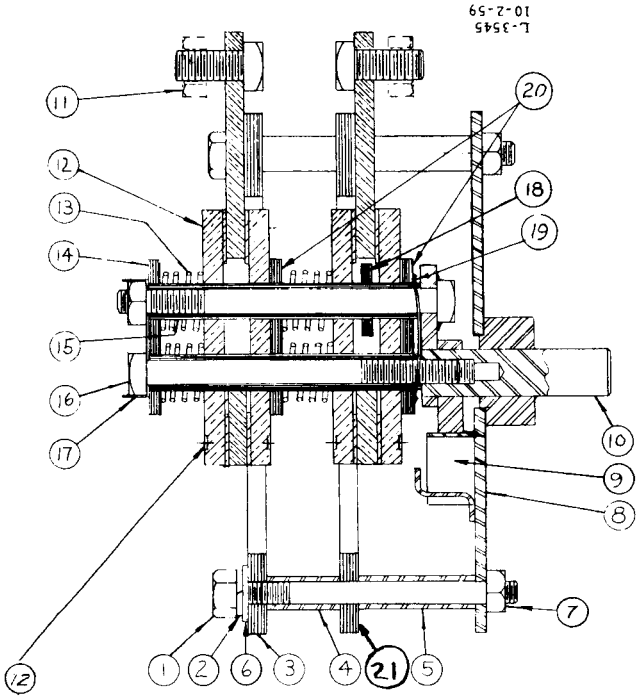


Parts List P-62-H		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Arc Polarity Switch Assembly, Includes:	1
1	Hex Head Bolt	3
2	Lockwasher	3
3	Flat Washer	3
4	Contact Panel	2
5	Spacer	3
6	Spacer	3
7	Spacer	3
8	Mounting Bracket	1
9	Hex Nut	3
10	Switch Spring	1
11	Rotor Arm	1
12	Spring	1
13	Insulating Washer	4
14	Insulating Washer	1
15	Hex Nut	12
16	Moving Contact	6
17	Spring	6
18	Insulating Tube	2
19	Hex Head Bolt	1
20	Locking Clip	1
21	Hex Nut	1
22	Contact Panel	1

ARC POLARITY SWITCH — 2 GANG

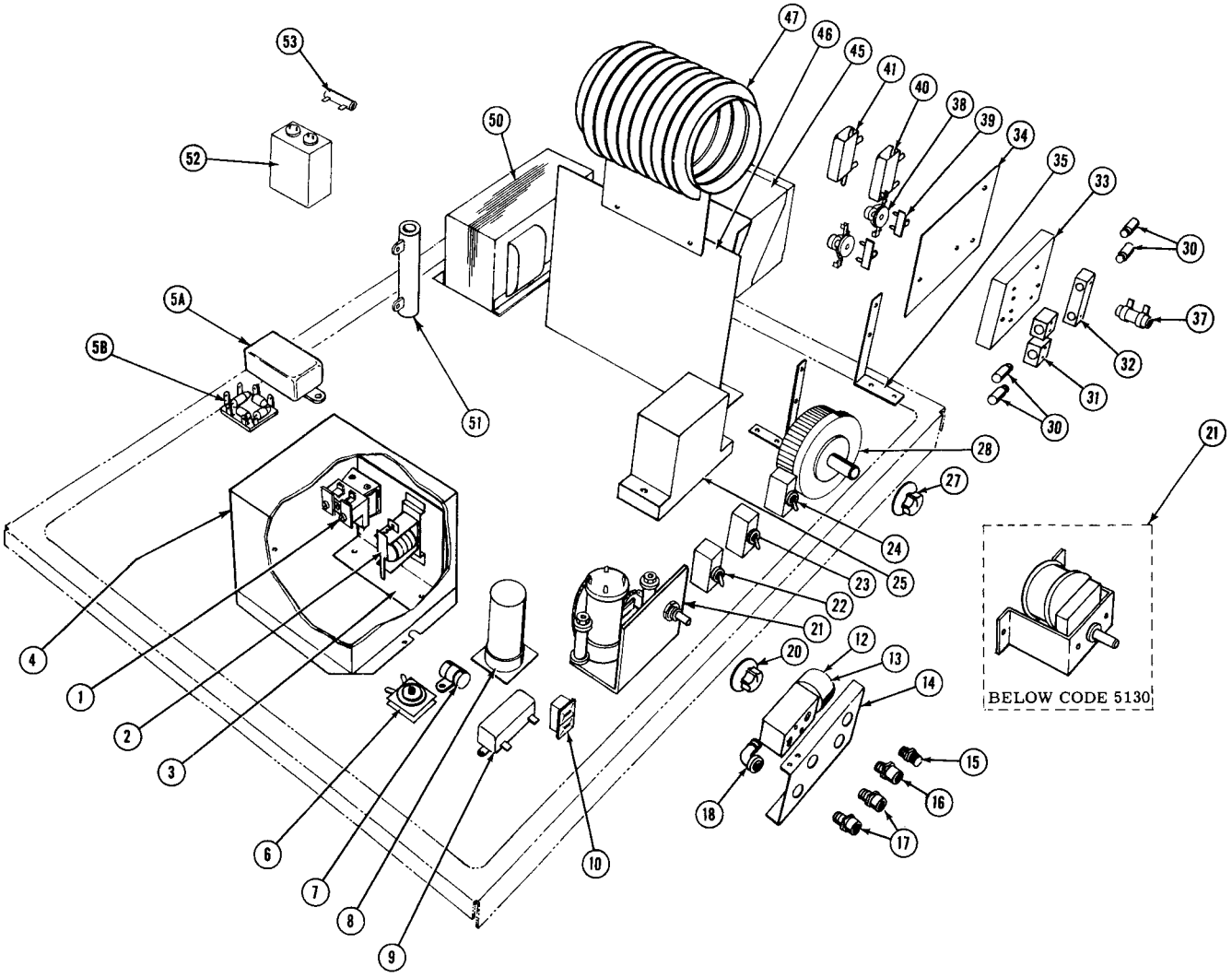
With Silicon Rectifier

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



Parts List P-61-H		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Arc Polarity Switch Assembly, Includes:	1
1	Hex Head Bolt	3
2	Lockwasher	3
3	Contact Panel Assembly	2
4	Spacer	3
5	Spacer	3
6	Plain Washer	3
7	Hex Nut	4
8	Mounting Bracket Assembly	1
9	Spring	1
10	Shaft Assembly	1
11	Hex Nut	8
12	Moving Contact	4
13	Spring	4
14	Insulating Washer	1
15	Insulating Tube	2
16	Square Head Bolt	1
17	Locking Clip	1
18	Insulating Washer - 300 Amp Only	1
19	Spring	1
20	Rotor Insulation	2
21	Contact Panel Assembly	1

H — HIGH FREQUENCY UNIT

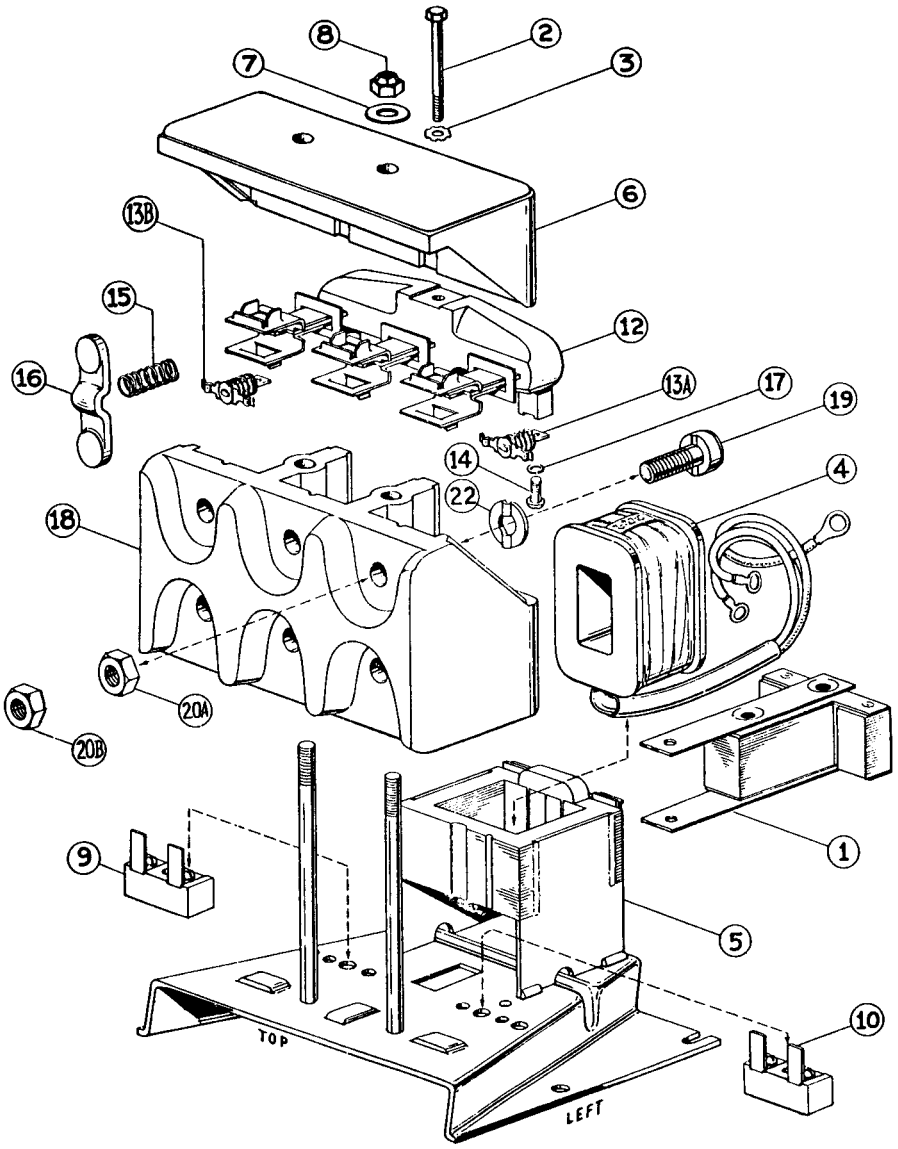


WHEN ORDERING: GIVE: Item No., Part Name, Parts List No., and Welder Code.

Parts List P-66-H		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
1	Pilot Relay	1
2	Timer Delay Relay	1
3	Relay Mounting Panel	1
4	Relay Cover Box	1
5A	Condenser (AC Machines Only)	1
5B	Pilot Relay Rectifier (AC Machines Only)	1
6	Rectifier	1
7	Filter Condenser	1
8	Condenser	1
9	Condenser	1
10	"Arc Start Switch" Receptacle	1
12	Water Solenoid Valve	1
13	Gas Solenoid Valve	1
14	Solenoid Mounting Bracket	1
15	Hex Nipple, Water Inlet	1
16	Female Connector, Water Outlet	1
17	Female Connector, Gas Inlet and Outlet	2
18	Street Ell	2
20	Knob	1
21	Timer (Below Code 5130)	1
21	Electronic Timer (Above Code 5130)	1
22	"Soft Start" Switch	1
23	Weld Control Switch	1

Parts List P-66-H		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
24	"Spark" Switch	1
25	Condenser	1
27	Knob	1
28	"Spark" Intensity Rheostat	1
	Spark Gap Assembly, Includes Items 30 thru 33	1
30	Electrode	4
31	Spark Gap Support	2
32	Spark Gap Support	1
33	Ceramic Base	1
34	Spark Gap Mounting Panel	1
35	Mounting Panel Bracket	2
37	Resistor (Codes 4380 to 5310 Used on AC/DC)	1
38	Radio Frequency Choke	2
39	Terminal Strip	2
40	Bypass Condenser (Codes 4380 to 5310 Used on AC/DC)	1
41	Bypass Condenser	1
45	High Frequency Unit S-45 or S-67 Contactor See	P-28-E
46	Contactor Mounting Panel	1
47	Air Core Transformer	1
50	Transformer	1
51	Resistor	1
	Resistor and Condenser Assembly Includes:	1
52&53	Condenser & Resistor Assembly	1

S-45 OR S-67 OUTPUT CONTACTOR



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

1. Be sure the mating surfaces of silver 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.

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

Parts List P-28-E		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	S-45 or S-67 Starter 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 Cycles)	1
	Plastic Guide	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
11	Contactor Assembly, Includes:	1

Parts List P-28-E		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	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	1
15	Spring - Main Contact	3
16	Moving Contact	3
17	Lockwasher	1
	Main Contact Block Assembly, Includes:	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	6
*	NVR Coil (Specify Input Voltage)	

L — LINE CONTACTOR

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

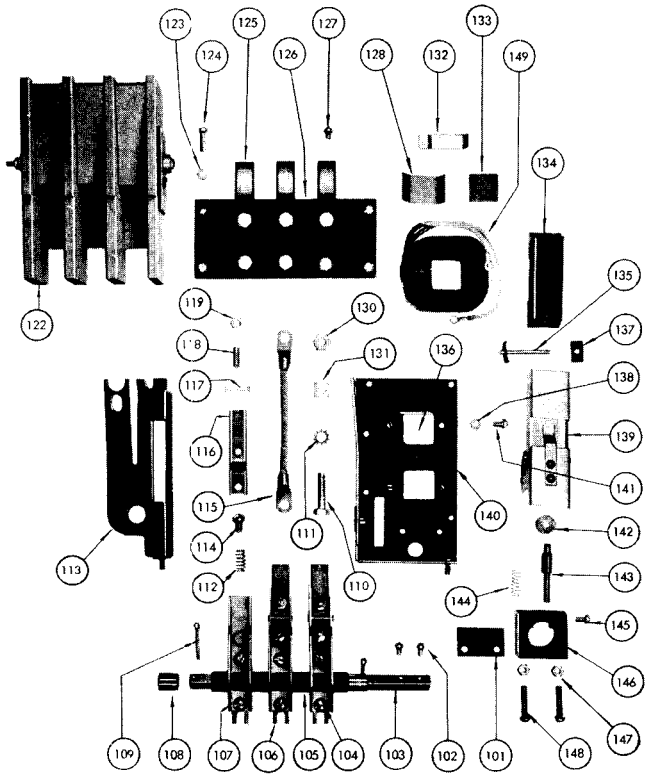
Parts List P-66-G		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	GXL Starter Less NVR Coil	1
	Starter Parts See P-28-F	
	Two Volt Input Panel, Stationary, Specify Voltages	1
	Two Volt Input Panel, Movable	1

Parts List P-66-G		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
	Starter Mounting Panel	1
	AC Thermostat Assembly, Includes	1
	Push Button	1
	Klixon Thermostat	1

GXL STARTER

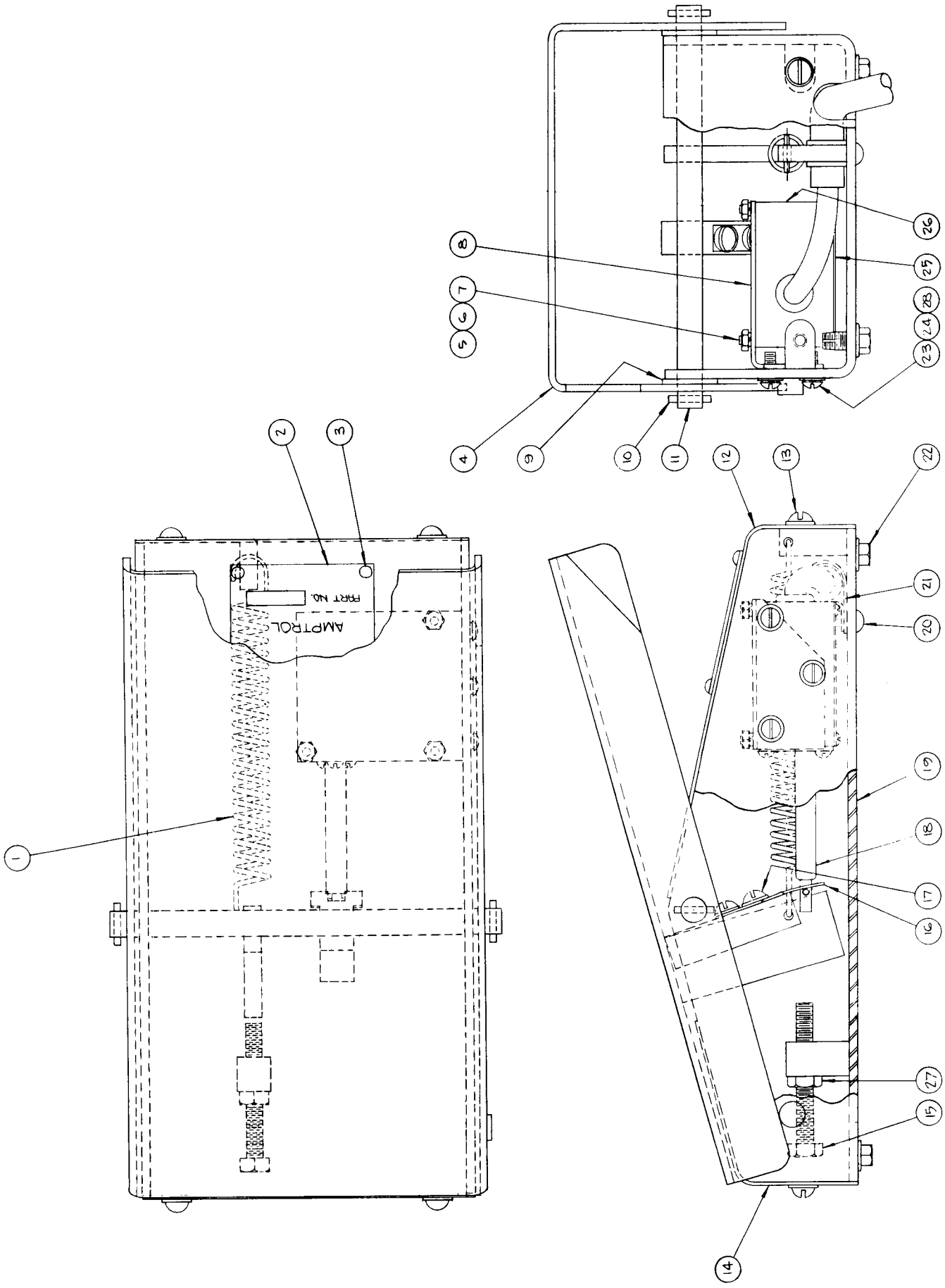
Parts List P-28-F

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



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	Sems Round Head Screw	2
103	Square Shaft	1
104	Sems Round Head Screw	6
105	Shaft Insulation	1
106	Contact Arm Clamp	2
107	Contact Arm	2
108	Bearing, Nylon	2
109	Cotter Pin	2
110	Hex Head Cap Screw - Contact Mounting (Lower)	3

Parts List P-28-F		
ITEM	PART NAME AND DESCRIPTION	NO. REQ'D.
110	Hex Head Cap Screw - Contact Mounting (Upper)	3
111	Shakeproof Washer	6
112	Contact Spring	2
113	Side Panel, Left Side	1
114	Sems Round Head Screw	3
115	Lead With Lugs	2
116	Moving Contact	2
117	Rivet, Contact Assembly	2
118	Headless Slotted Set Screw	2
119	Hex Nut	2
122	Barrier	1
123	Hex Nut, Contact Block Mounting	4
124	Sems Round Head Cap Screw - Contact Block Mounting	4
	Shakeproof Washer	4
	Contact Block Assembly, Includes	1
125	Stationary Contact	2
126	Contact Block	1
127	Sems Round Head Screw - Lead Connection	2
128	NVR Coil Clamp Insulation	1
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
142	Plain Washer	1
143	Plunger	1
144	Coil Spring	1
145	Sems Phillips Head Screw	2
146	Interlock Block	1
147	Hex Nut	2
148	Sems Round Head Screw - Interlock 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.	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FOOT AMPTROL; K-746

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and part numbers stamped on the Amptrol name plate.

Parts List P-66-J		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	Foot Amptrol, Includes:	1
1	Tension Spring	1
2	Nameplate	1
3	Drive Screw	4
4	Foot Plate	1
5	Round Head Screw	4
6	Lockwasher	4
7	Hex Nut	4
8	Bracket	1
9	Washer	2
10	Roll Pin	2
11	Pivot Pin	1
12	Cover	1
13	Sems Screw	4
14	Cover	1
15	Hex Head Screw	1
16	Actuator Spring	1
17	Sems Screw	2
18	Actuator Arm Assembly	1
19	Base	1
20	Self Tapping Screw	1
21	Lead Clamp	1
22	Thread Cutting Screw	4
23	Round Head Screw	3
24	Lockwasher	3
25	Cover Plate	1
26	Control Unit, Includes	1
	Rheostat	1
	Micro Switch	1
	Cable	1
27	Hex Nut	1
28	Plain Washer	3

HAND AMPTROL; K-745

WHEN ORDERING GIVE: Item No., Part Name, Parts List No., and part numbers stamped on the Amptrol name plate.

Parts List P-66-K		
ITEM	**PART NAME AND DESCRIPTION**	**NO. REQ'D.**
	Hand Amptrol, Includes:	1
	Actuator Arm Assembly	1
	Nameplate	1
	Control Unit, Includes:	1
	Rheostat	1
	Micro Switch	1
	Cable	1
	Bottom Cover Plate	1

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 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 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 of trade usage or otherwise implied, including without limitation the warranty of merchantability, all such warranties being waived by the Buyer.

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