LINCOLN® WELDERS

IM-299

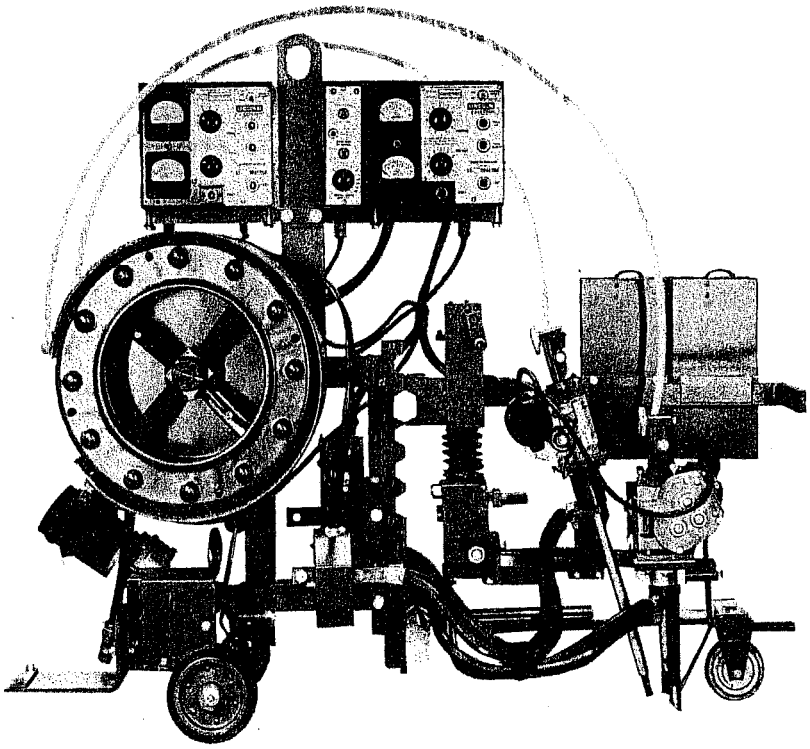
IM299
LT-56 Tractor
7943
January, 1989

OPERATING MANUAL

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

LT-56

TANDEM ARC TRACTOR
FOR SUBMERGED ARC WELDING



SHIPPING DAMAGE CLAIMS

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

SAFETY DEPENDS ON YOU

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

LINCOLN® ELECTRIC

THE LINCOLN ELECTRIC COMPANY
World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Sales and Service 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.

INDEX

GENERAL DESCRIPTION AND FEATURES

The LT-56 tractor is a tandem arc unit for DC-AC submerged arc operation.

Main features of the LT-56 are as follows:

1. Solid state DC and AC controls similar to LT-7. Easy adjustment of both current and voltage at tractor with no remote control boxes at the power source. Input power — 115 volts AC, 50 or 60 hertz.
2. Very versatile rugged steel frame construction.
3. Height, 45.5 inches; width, 17.5 inches; length, 54.0 inches or 59.5 inches (with front arm extended); weight, 390 pounds with empty reels and empty flux hoppers.
4. Wire size capability — 3/32 through 3/16 (both wire feeders).
5. 1500 amp rating (both DC and AC).
6. Travel — heavy duty drive with a calibrated dial for speeds of 6 to 100 inches per mintue. Clutch (operated from either side) allows easy positioning of the tractor.
7. Vertical adjustment — 4.00 inches of continuous travel as an integral part of tractor. Fixed major height adjustments provided for longer electrical stickouts.
8. Horizontal adjustment — 2.00 inches of continuous travel as an integral part of the tractor. Fixed major horizontal adjustments so electrodes can weld between or outside the line made by either rear wheel.
9. Flux capacity — 30 pounds with manually controlled discharge rate from two separate LT-7 type hoppers.
10. Joint versatility
    a. **Butt Welds** — in line or on either side of the tractor.
        1. prepared deep groove
        2. tight butts
        3. open joint - unprepared butts
    b. **Horizontal Fillets or Laps** — Both right and left with electrode to joint angles between 40° and 50°.
    c. **Flat Fillets** — Unit may be positioned for either the 30° and 45° flat fillet with minimum flange height of 5.5 and minimum web height of 18.75.
11. Troubleshooting lights on the P.C. boards allow unit to be quickly repaired and returned to service.
12. P.C. boards used in both the AC and DC controls are the same as used in the LT-7.
13. Many parts are common with the NA-3 or 4 or LT-7.
14. All the positioning adjustments on the tractor are so designed that they can be locked tight. This eliminates any movement of these adjustments when the tractor is moved about the shop.

LT-56 EQUIPMENT REQUIREMENTS FOR TANDEM WELDING

1. LT-56 Tractor	K286 — (3/32 thru 3/16 wire)
2. Control and Power Input Cables	K215 — (30′, 50′, 75′ and 100′) 2 required
3. Ground Cable	See 6403 of Price Book
4. Optional Features	
Butt Seam Guide Kit	K230 — Allows guiding from a prepared "V" or a slightly open seam.
Horizontal Fillet Lap Kit	K288 — Attachments required for making left or right horizontal fillets or laps.
Flat Fillet Kit	K287 — Attachment required for making flat fillets.
5. Power Requirements	
DC	Suitable Power Sources DC 1500 and DC 1000
AC	AC 1200
6. Motor Generator Remote Control	K224 — (Required to have current control at wire feeder when using SAF-600 or SA-800.)
7. Welding Materials	See 6322, 6323, 6327, & 6331 in Price Book.

DESCRIPTION AND OPERATION OF MAIN COMPONENTS

The LT-56 is made up of Integral assemblies.

I. A. DC Wire Feeder (Lead Arc)
B. DC Control

II. A. AC Wire Feeder (Trail Arc)
B. AC Control

III. Travel
A. Travel Control
B. Travel Carriage

IV. Wire Feeder Mountings and Adjusters
A. Vertical Adjustment
B. Horizontal Adjustment
C. Main Head Pivot
D. Wire Feeder Mountings

V. Main Frame, Control Box and Wire Reel Mounting

VI. Flux Hoppers

I. A. The DC wire feeder is similar to the LT-7 and consists of the following:

1. DC shunt motor.
2. 90:1 gear box using helical-spur gears, non-fluid lubrication, and needle-ball bearing construction for high efficiency and long life.
3. Wire straightener for solid wire.
4. Hardened-knurled drive rolls — driving teeth on both sides so that they can be turned to double life.
5. Ball bearing type idle roll — fixed setting for all wire diameters.
6. Accurately aligned ingoing and outgoing guide tube for quick loading of new electrode.
7. K231 type nozzle (minus the concentric flux cone).

B. The DC control box assembly is similar to the LT-7 and consists of:

1. Power Switch — turns power on to all controls and resets the grounding lead protector.
2. Built in "ground lead protective circuit".
3. Inch up and inch down buttons — with a fixed inching speed of "cold" electrode.
4. Start and stop buttons — to initiate and terminate welding.
5. Weld voltage and current control rheostats.
6. Weld voltage and current meters. Note: Leads on the rear of the meters must be reversed with a change in arc polarity.
7. Constant Current (CC) and Constant Voltage (CV) selector switch (located inside the control box on the upper center of the front P.C. board). Switch should be in the CC position when the equipment is used with a constant current power source.

   A constant voltage nameplate (L5283-1) is mounted under the constant current nameplate on the DC control box. If the tractor is to be used on constant voltage type operation the mode selector switch should be placed into the CV position and the constant voltage nameplate then should be mounted on top of the constant current nameplate which is on the control box.
8. Circuit breaker — for the overload protection of the equipment.
9. One-half amp Slo-blow (replaceable) field fuse (inside of control box at lower right side of the back P.C. board).
10. Two-tenths amp fuse for short circuit protection (inside of control box at the top center of the back P.C. board).
11. Arc — can be started either "hot" or "cold".
12. Linc Fill starting built in.
13. 115 Volt AC receptacle on the bottom rear of the control box (up to a 120 watt capacity) for use of extension lights.
14. Travel relay — for starting and stopping the travel unit.

II. A. AC wire feeder (trail arc) same as DC wire feeder except the nozzle requires an extension.

B. AC Control — same as the DC control box, except:

1. No travel relay — or tie in with travel control circuit.
2. Weld voltage and current meters are AC.

III. Travel

A. Travel Control Box is similar to that used on the LT-7. It consists of:

1. Solid state circuitry packaged in its own control box and is physically and electri-

cally attached to the DC wire feed control box.

2. Travel Mode Switch

   a. Automatic position — travel starts and stops with the arc start and stop buttons.

   b. Off — no travel.

   c. Manual position — travel on (clutch in).

3. Travel direction switch — forward and reverse travel.

4. Travel speed control — calibrated in inches per minute on dial (6 to 100" min).

5. Circuit breaker — for overload protection of circuit.

6. One-half amp Slo-blow field fuse (inside travel control box on the P.C. board).

B. Travel Carriage

1. The unit is propelled by two six inch diameter canvas-tired wheels. Both wheels are driven by a common axle.

2. The travel gear box is an NA-3 type with a special adapter gear box between the motor and gear box proper. The assembly is a helical-spur-bevel type unit driven by a DC shunt motor. Lubrication is of a non-fluid type. Gear box ratio is 640/1. Total ratio from motor shaft to axle shaft is 1344/1.

3. Travel carriage has a built in clutch which can be operated from either side of the tractor. When the gears are engaged the travel unit drives the tractor; when the gears are disengaged the tractor can be moved forward or backward manually.

4. The front support wheel is attached to a telescoping arm which is clamped to the lower cross arm. The arm can be mounted so that it is either on the left or right of the center mast depending upon the mode of operation. The front wheel yoke is mounted to a spring loaded cam shaft, so that it will return to its original position after releasing the turning force. The front wheel can be adjusted so that the tractor will travel in a straight line or "toe" either left or right.

IV. Wire Feeder Mountings and Adjusters

A. Vertical Adjustment

The vertical lift is a standard feature and is capable of a total continuously adjustable movement of four inches. In conjunction with this there are five different fixed mounting positions on the main mast so that major vertical movements can be made. The wire feeders can be mounted so that any of the Linc Fill procedures can be used (electrical stickouts up to 5").

B. Horizontal Adjustment

A continuous horizontal adjuster (K96) is a standard feature and is capable of a total horizontal movement of two inches. In addition, the vertical lift adjuster clamps on an upper cross arm which allows the heads to be positioned anywhere between a line formed by the two rear wheels to 3.5 inches outside the wheels on either side of the tractor.

C. Main Head Pivot

The telescoping arm housing which supports both wire feeders is fastened to the main pivot housing. At this pivot point the housing can be positioned to one of three positions. The center position is the vertical fixed position. The other two positions are the floating positions, which allow the welding heads to pivot between angles of 40° to 50° on either side of the tractor. When the heads are in one of the floating positions they are spring loaded so that the horizontal fillet or lap guide rollers are forced downward against the horizontal plate.

D. Wire Feeder Mountings

1. DC wire feeder (front head) — is mounted on a telescoping arm, so that electrode spacing from 5/8 to 5" is attainable. Since the arm is not keyed, the two welding heads can be set to the angle differential desired and then locked into position. The DC wire feeder is mounted in a vertical position and can be raised and lowered independent of the other vertical head lift adjustments. This feature is necessary so that the proper electrical stickout can be maintained when the trail head push angles are changed.

2. AC wire feeder — is mounted to the telescoping arm housing. The mounting is of the pivot type so that push angle positions from 5° to 20° can be made.

V. Main Frame Assembly

The main frame is a rugged steel tube fabrication which is fastened to the travel carriage base. The frame can be mounted in a vertical, a 30°, or a 45° position. The frame also provides three positions for mounting the lower cross arm to which the front wheel is attached. The lower

cross bar position should be in the corresponding position of the main mast so that all three wheels are in the same plane.

There are five clamping slots cut into the front of the main mast. These slots are used for mounting the upper cross arm and provide the major vertical position changes of the wire feeder mountings and adjusters.

From the top of the main frame is welded the tractor lift bar with a hole at the top to take a crane hook. The control boxes are mounted on this lift bar and can face either to the left or to the right. Each box is clamp-mounted to the control box support bar. The desired direction in which the control box faces can be accomplished by loosening the set of clamps on the bottom of the control box. The unit can be slid off the end of the bar and then rotated 180° and slid back onto the bar and reclamped.

The wire reel mountings are also mounted on the main frame. Insulated wire reel housings are provided for wire containment and protection. Nylon wire guides for each electrode from the reel to the heads are provided to protect the wire from accidental grounding.

VI. Flux Hoppers

The unit has two flux hoppers, each having a 15 pound capacity and individual flux control valves. They are attached to a bracket which is clamped on the upper cross arm and can be mounted either to the right or left of the heads. Both hoppers feed flux into a "Y" connection and thereby discharge through one opening at the arc.

INSTALLATION

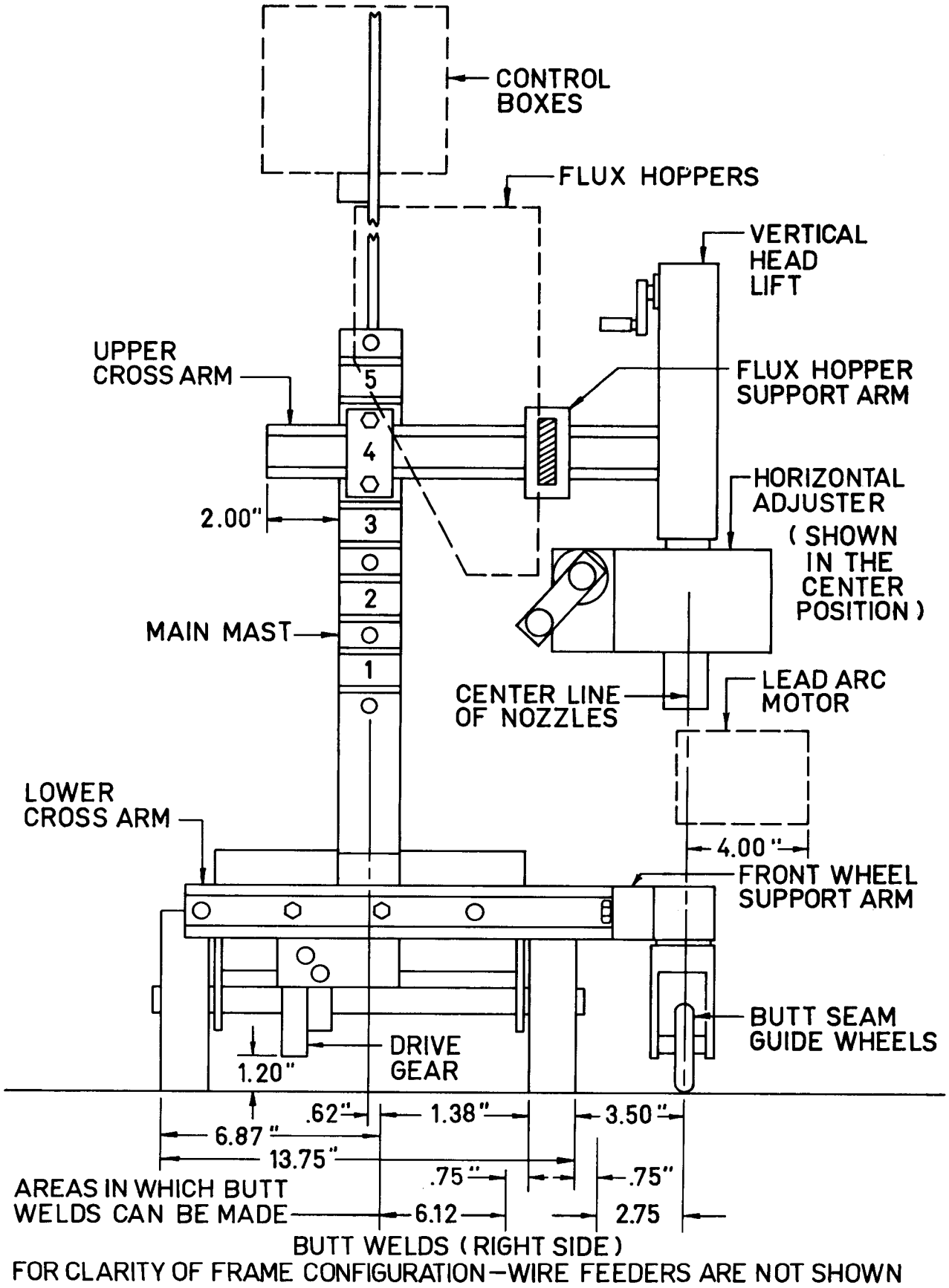
I. SET UP FOR DIFFERENT TYPES OF WELDS

Determine the type of weld to be made and arrange the tractor per the following instructions. Throughout these instructions, when right or left is used it is when facing the front of the tractor.

A. Butt Welds

Follow instructions in either section 1 or 2 and then section 3.

1. Tractor configuration for butt welds on **right side** (see Figure 2 for left side butts) of tractor. See Figure 1 and proceed as follows.
   a. Raise the front wheel support arm of tractor and place a wooden block or blocks (approximately 3⅝ height required) directly under the main mast, so the front wheel will be up off the surface.
   b. Using the two middle mounting holes, mount the lower cross arm so that the long end extends toward the right side of the tractor.
   c. Clamp the front wheel support arm on the right side of the lower cross arm.
   d. Front wheel assembly may be mounted on the right or left side of the front wheel supporting arm as required. Install the butt weld guide wheels if they are to be used.
   e. The wooden block or blocks can now be removed.
   f. Remove the flux hopper arm assembly from the upper cross arm. Remove the vertical lift and head assembly from the upper cross arm.
   g. Place the upper cross arm into the fourth slot from the bottom and let it extend to the left of the mast by 2.00″. Tighten the locking clamp.
   h. Clamp the vertical head lift assembly on the right side of the upper cross bar.
   i. Place the flux hopper support arm, (with the bent portion toward the left) between the vertical lift assembly and the main mast. Tighten the locking clamp. Mount the flux hoppers to the left side of this arm and forward, approximately an inch and a half from the bent arm. When making butt welds inside the right wheel it may be necessary to remove the hopper support arm from the right side of the cross arm and shift it to the left side of cross arm.



FOR CLARITY OF FRAME CONFIGURATION—WIRE FEEDERS ARE NOT SHOWN

FIGURE 1

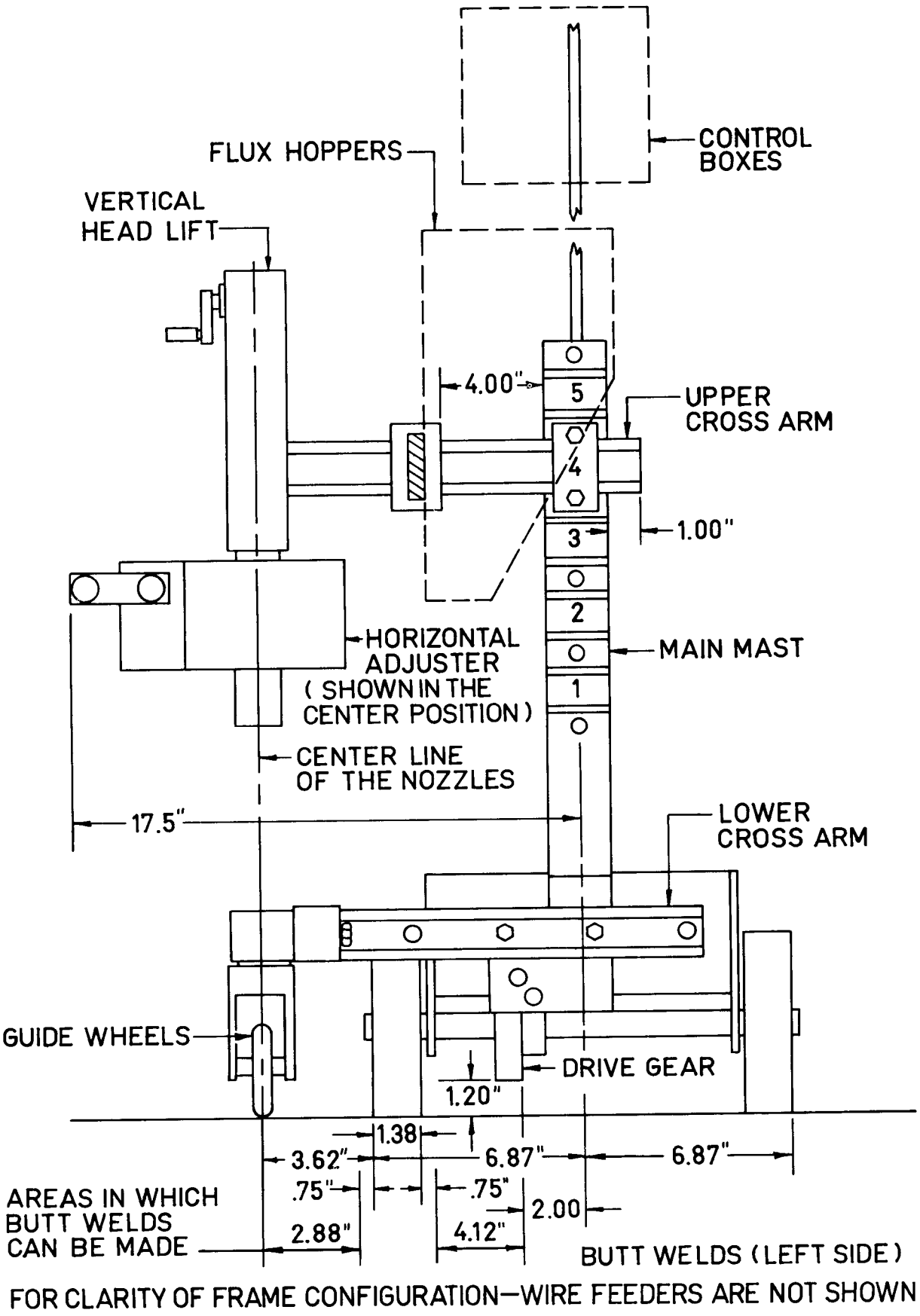

FLUX HOPPERS
CONTROL BOXES
VERTICAL HEAD LIFT
4.00"
5
UPPER CROSS ARM
4
1.00"
3
2
MAIN MAST
1
HORIZONTAL ADJUSTER
(SHOWN IN THE CENTER POSITION)
CENTER LINE OF THE NOZZLES
17.5"
LOWER CROSS ARM
GUIDE WHEELS
DRIVE GEAR
1.20"
1.38
3.62"
6.87"
6.87"
.75"
.75"
2.00
AREAS IN WHICH BUTT WELDS CAN BE MADE
2.88"
4.12"
BUTT WELDS (LEFT SIDE)
FOR CLARITY OF FRAME CONFIGURATION—WIRE FEEDERS ARE NOT SHOWN

FIGURE 2

2. Tractor configuration for butt welds on **left side** of tractor.

   See Figure 2 and proceed as follows.

   a. Raise the front wheel support arm of the tractor and place a wooden block or blocks (approximately 3⅝" height required) directly under the main mast, so the front wheel will be up off the surface.

   b. Using the two middle mounting holes, mount the lower cross arm so that the long end of the bar extends toward the left side of the tractor.

   c. Clamp the front wheel support arm on the left side of the lower cross arm.

   d. The front wheel assembly may be mounted to the left or right side of the front wheel supporting arm as required. Install the butt weld guide wheels if they are to be used.

   e. The wooden block or blocks can now be removed.

   f. Remove the flux hopper arm assembly from the upper cross arm. Remove the vertical lift and head assembly from the upper cross arm.

   g. Place the upper cross arm into the fourth slot from the bottom and let it extend to the right of the mast by 1.00 inch.

   h. Clamp the vertical head lift assembly on the left side of the upper cross bar.

   i. Place the flux hopper support arm, (with the bent portion toward the right) between the vertical lift assembly and the main mast. Tighten the locking clamp. Mount the flux hoppers to the right side of this arm and forward on the arm, approximately an inch and a half from the bent arm.

3. General Information

   a. With the tractor set in these configurations the maximum electrical stickout is 2.25 inches (AC head set at a 5° push angle). If longer ESO are desired then the upper cross arm should be positioned into the top notch in the main mast.

   b. Do not make butt welds which are in line with either rear wheel. The life of the rear wheel is increased if the welds are made far enough outside or inside to prevent the tire from becoming too hot.

   c. The tractor in Figures 1 and 2 is shown with the K230 seam butt weld guiding rolls in place of the standard front wheel. The tractor is self-guiding when these wheels are being used.

   d. When using the standard front wheel, the tractor as it is shipped from the factory, has the front wheel guidance set so that the tractor will follow a straight line. If this position has been moved for other modes of operation it will be necessary to reset the front wheel position. Follow the instructions on the nameplate which is on the front wheel assembly, for the resetting of the front wheel tracking. When properly set, the tractor should travel with only an occasional correction by the operator. This is easily done since the front wheel is spring loaded and will snap back into straight line travel after corrections are made. The position of the standard wheel with respect to the seam to be welded will be different than the seam guiding wheels, since the wheel must be riding on a flat surface. The wheel position can be either to the right or left of the weld.

   e. The tractor is shipped with the cable support bracket located on the left side of the tractor as shown in Sketch A. When using tractor for butt welds made between the left wheel and center line of tractor, locate the cable support bracket on right side of the tractor as shown in Sketch B. Two ⅜" × 1¼" bolts, two ⅜" nuts and two ⅜" lockwashers must be supplied by the user to make this change. This will give greater clearance between the weld and the input cable assembly.

      When mounted in either the left or right position, the long side of the L-shaped bracket can be positioned close to the plate or turned over so it is spaced away. See Sketch C.

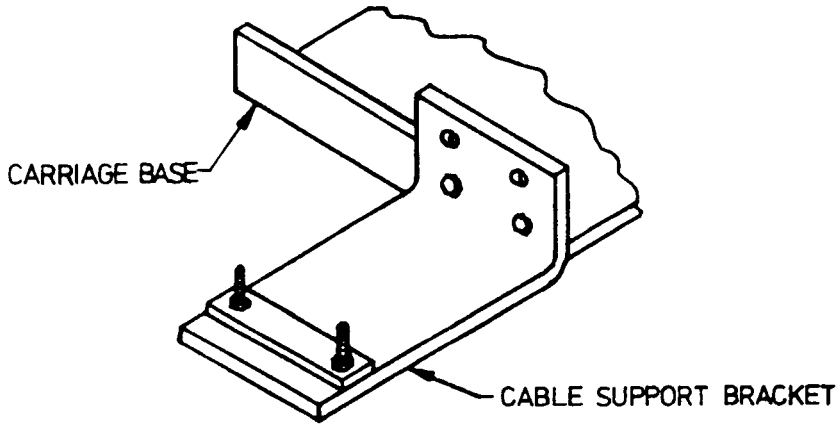
B. Horizontal Fillets or Lap Welds

Follow instructions in section 1 or 2 and then 3. For lap welds also see section 4.

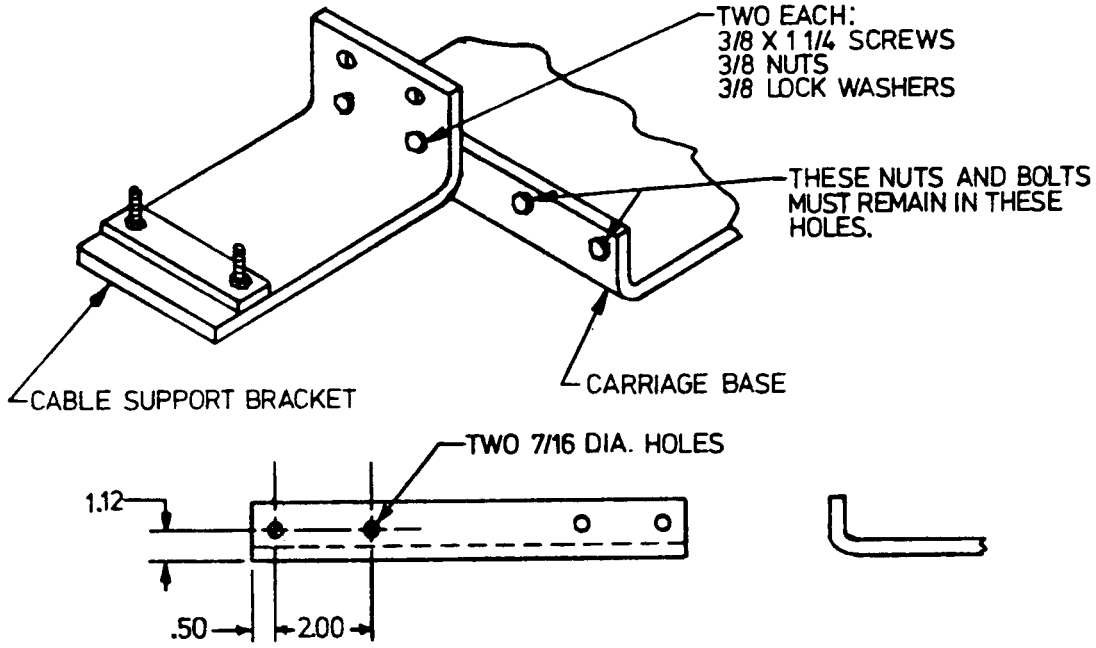
1. Tractor frame configuration for right side horizontal fillets (see section 2 for left side fillets). See Figure 3 and proceed as follows.

   a. Raise the front wheel support arm of the tractor and place a wooden block

SKETCH A

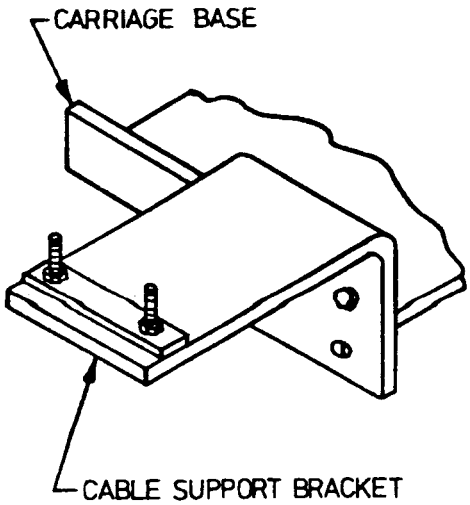


SKETCH B



IF THE TWO HOLES ARE NOT IN THE LEFT SIDE OF THE CARRIAGE BASE, DRILL TWO 7/16 DIA HOLES AS SHOWN.

SKETCH C



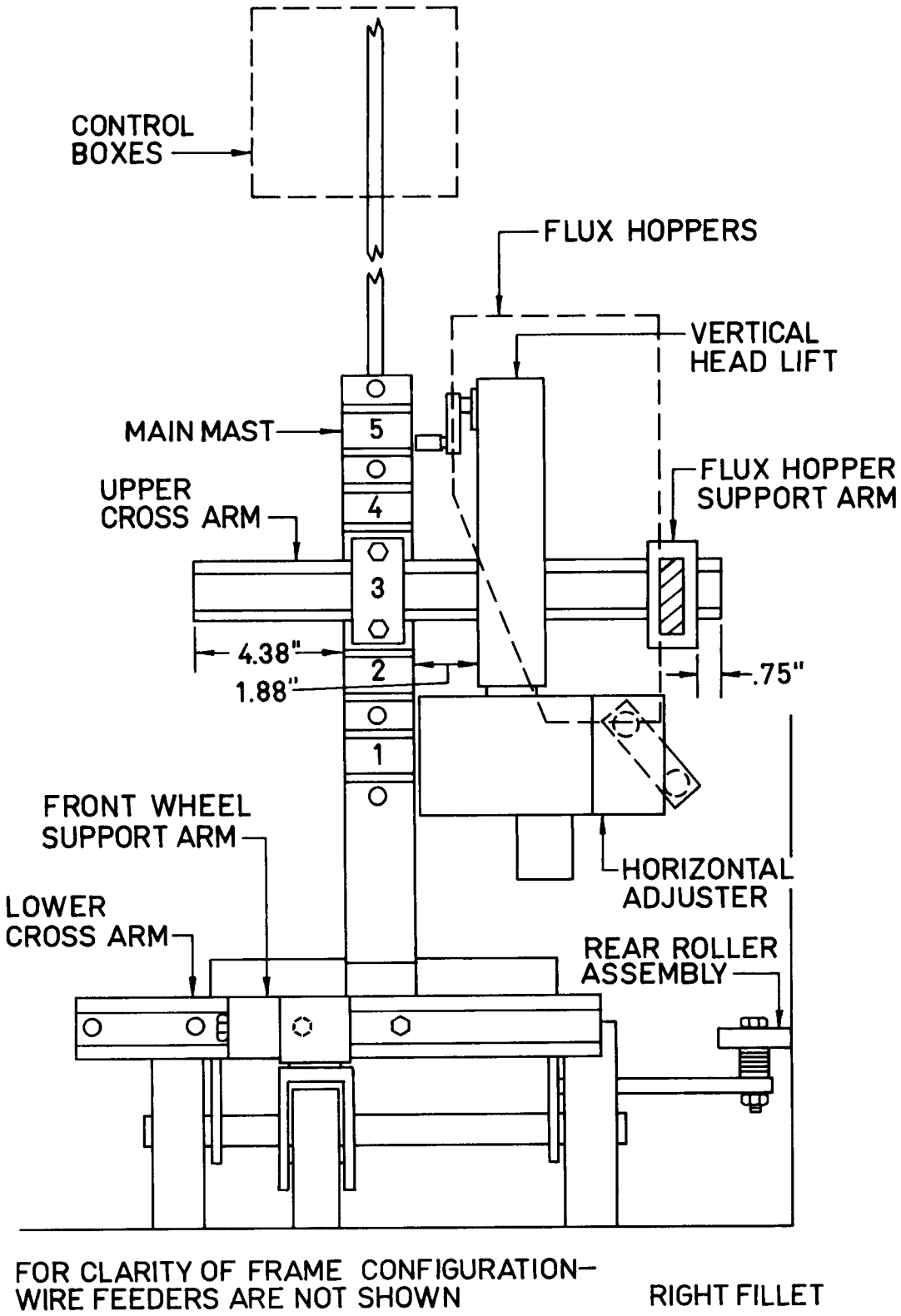

CONTROL BOXES
FLUX HOPPERS
VERTICAL HEAD LIFT
MAIN MAST
5
4
3
2
1
UPPER CROSS ARM
FLUX HOPPER SUPPORT ARM
4.38"
1.88"
.75"
FRONT WHEEL SUPPORT ARM
HORIZONTAL ADJUSTER
LOWER CROSS ARM
REAR ROLLER ASSEMBLY
FOR CLARITY OF FRAME CONFIGURATION— WIRE FEEDERS ARE NOT SHOWN
RIGHT FILLET

FIGURE 3

or blocks (approximately 3.62″ in height) directly under the main mast, so the front wheel will be up off the surface.

b. Mount the lower cross arm to the main mast using the two holes nearest to the center of the cross bar. (See Figure 3).

c. Mount the front wheel support arm onto the left side of the lower cross arm, slide it as far to the right as possible and then clamp it securely.

d. Mount the front wheel housing and wheel assembly to the right side of the wheel support arm.

e. Remove the blocks from under the center mast.

f. Remove the flux hopper arm assembly from the upper cross arm. Remove the vertical lift and head assembly from the upper cross arm. Detach the head assembly from the head pivot shaft.

g. Mount the upper cross arm into the third slot up from the bottom in the main mast, allowing one end to stick out 4 3/8 inches to the left of the mast. Clamp the bar securely to the mast.

h. Mount the vertical head lift and wire feed assembly onto the right side of the upper cross bar at a position 1 7/8 inches away from the main mast. Clamp the assembly securely to the cross arm. Mount the head assembly onto the pivot shaft. Set the heads into the 45° position.

i. Mount the flux hopper support arm (with bent arm pointing left) onto the upper cross arm at a distance of 3/4 of an inch from the right end. Clamp the assembly to the cross bar securely.

j. Mount the flux hoppers as shown. They should be forward on the bar (within 1 1/2 inches of the bent end).

k. Loosen the large draw bolt nut on the horizontal adjuster and the draw bolt nut on the mounting block below the horizontal adjuster. Rotate the entire housing so that the hand crank is on the back right-hand side of the horizontal adjuster. Make sure the adjuster is parallel with the cross bars, and the head support arm is perpendicular to the cross bar. Tighten both of the draw bolt nuts securely.

l. Position the control boxes so that they face left.

2. Tractor frame configuration for left side horizontal fillets (See Figure 4) and proceed as follows.

a. Raise the front wheel support arm of the tractor and place a wooden block or blocks (approximately 3.62″ in height) directly under the main mast, so the front wheel will be up off the surface.

b. Mount the lower cross arm to the main mast using the two holes nearest to the center of the cross bar.

c. Mount the front wheel support arm onto the right side of the lower cross arm at a distance of 1 3/4 inches to the right of the main mast. Tighten the clamp securely.

d. Mount the front wheel housing and wheel assembly to the left side of the wheel support arm.

e. Remove the blocks from under the center mast.

f. Remove the flux hopper arm assembly from the upper cross arm. Remove the vertical lift and head assembly from the upper cross arm. Detach the head assembly from the head pivot shaft.

g. Mount the upper cross arm into the third slot up from the bottom in the main mast, allowing one end to stick out 4.38 inches to the right of the mast. Clamp the bar securely to the mast.

h. Mount the vertical head lift and the horizontal adjuster assembly onto the upper cross arm at a position 1 7/8 inches to the left of the mast. Clamp the assembly securely to the cross arm. Mount the head assembly onto the head pivot shaft. Set heads into the 45° position.

i. Mount the flux hopper support arm (with the bent arm pointing right) onto the upper cross arm at a distance of 3/4 of an inch from the left end. Clamp the assembly securely.

j. Mount the flux hoppers as shown. They should be forward on the bar (within 1 1/2″ of the bent end).

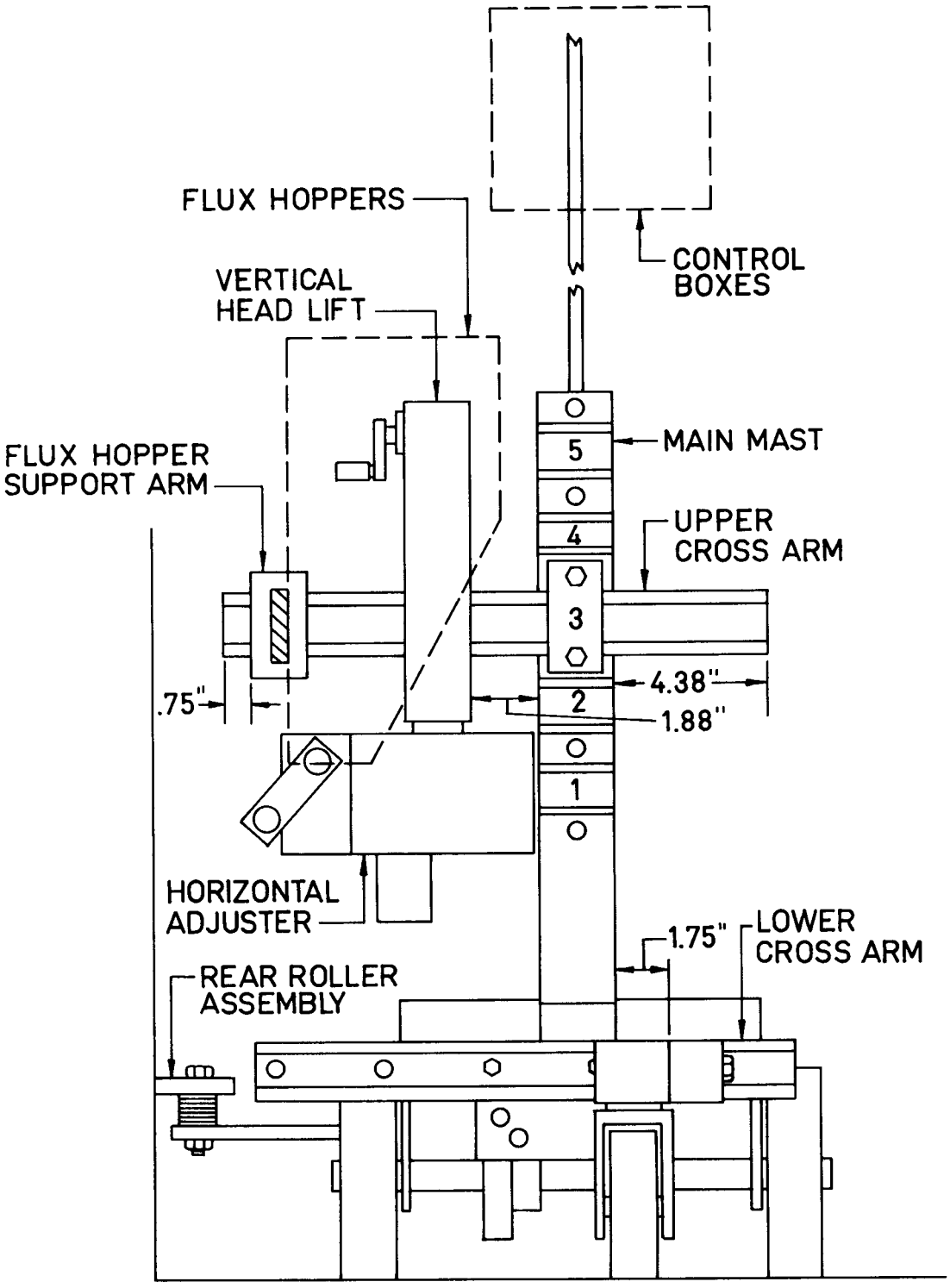
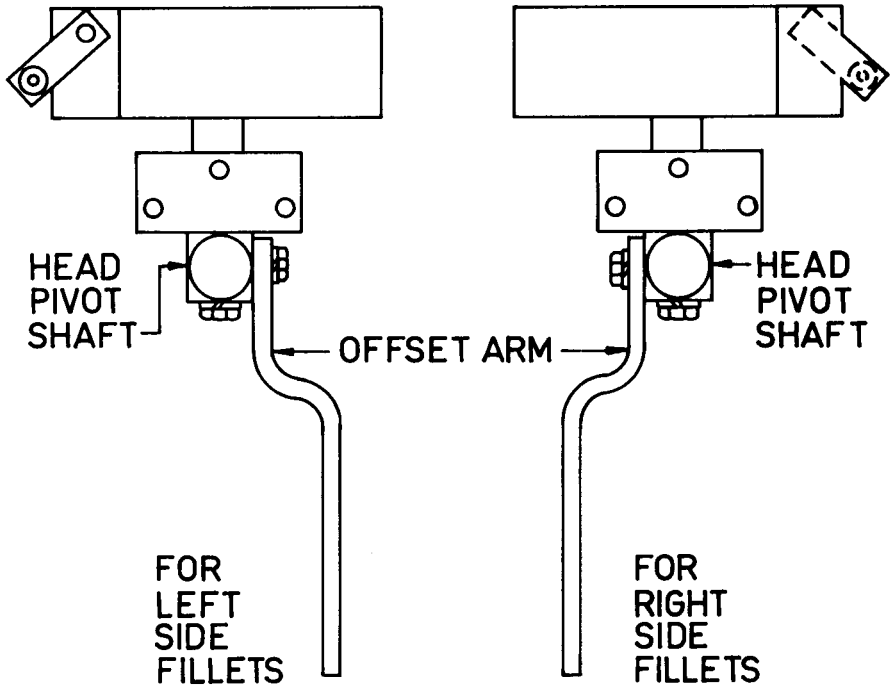

FLUX HOPPERS
CONTROL BOXES
VERTICAL HEAD LIFT
FLUX HOPPER SUPPORT ARM
MAIN MAST
5
4
UPPER CROSS ARM
3
4.38"
.75"
2
1.88"
1
HORIZONTAL ADJUSTER
1.75"
LOWER CROSS ARM
REAR ROLLER ASSEMBLY
FOR CLARITY OF FRAME CONFIGURATION— WIRE FEEDERS ARE NOT SHOWN
LEFT FILLET

FIGURE 4



SKETCH D

k. The position of the horizontal adjuster should be as shown with the hand crank to the left and to the front side of the unit. If this is not the case, loosen the large draw bolt nut on the horizontal adjuster and the draw bolt nut on the mounting block below the horizontal adjuster. Rotate the adjuster 180° to the correct position. Make sure the adjuster is parallel with the cross bars, and the head support arm is perpendicular to the cross bar. Tighten both the draw bolt nuts securely.

l. Position the control boxes so that they face to the right.

3. K288 Horizontal Fillet and Lap Welding Kit (Installation).

The kit consists of the following items:

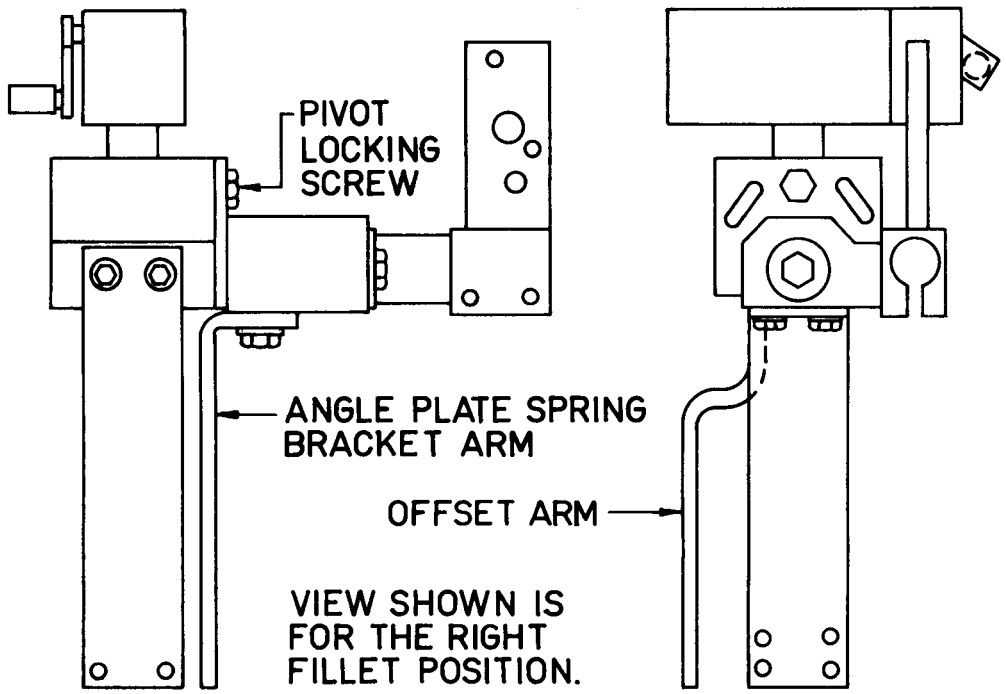
- Fillet wheel yoke for 90° horizontal fillet welds
- Lap wheel yoke assembly for the lap welding
- A telescoping arm which fastens to the lead arc head and supports either of the above yoke assemblies
- A set of brackets and a spring
- A rear roller guide assembly
- A set of flux hoses

After setting the tractor into the frame configuration required per section 1 or 2, install the kit components as follows.

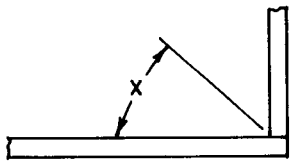
a. Install the offset arm spring bracket arm to the head pivot shaft bar per sketch using the two 1/4-20 × .75 hex head screws and lockwashers. (See Sketch D.)

b. Mount the angle plate spring bracket arm to the bottom of the head pivot housing using the two 1/4-20 × .50 long hex head screws and lockwashers. (See Sketch E.)

c. Remove the pivot locking screw, swing the head assembly so that the nozzles are pointing towards the fillet to be welded. Determine what electrode angle (X) the procedure dictates. (See Sketch F.) Engage one end of the spring into the hole at the bottom end of the offset arm. Engage the other end of the spring into the lower hole of the angle plate arm for elec-



SKETCH E



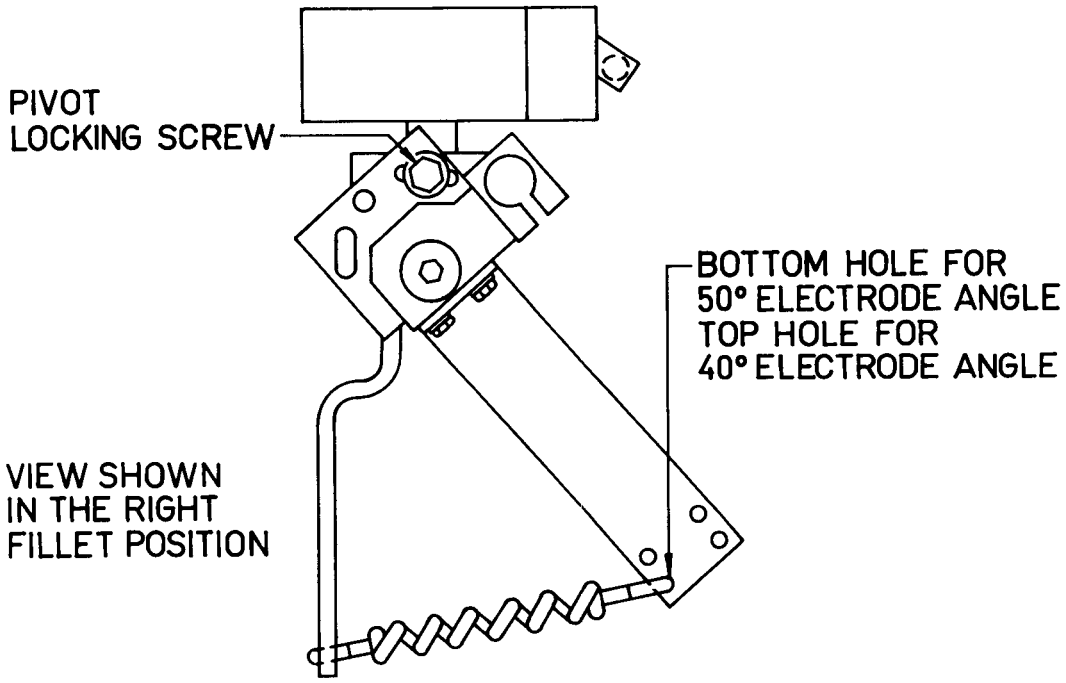
SKETCH F

trode angle of 50°. For electrode angle of 40° place the end of spring into the upper hole (see Sketch G.) Continue to swing the head assembly until the spring is under tension. Insert the pivot locking screw removed previously into the slot. Set the head position to the correct angle per the procedure and then temporarily tighten the pivot locking screw.

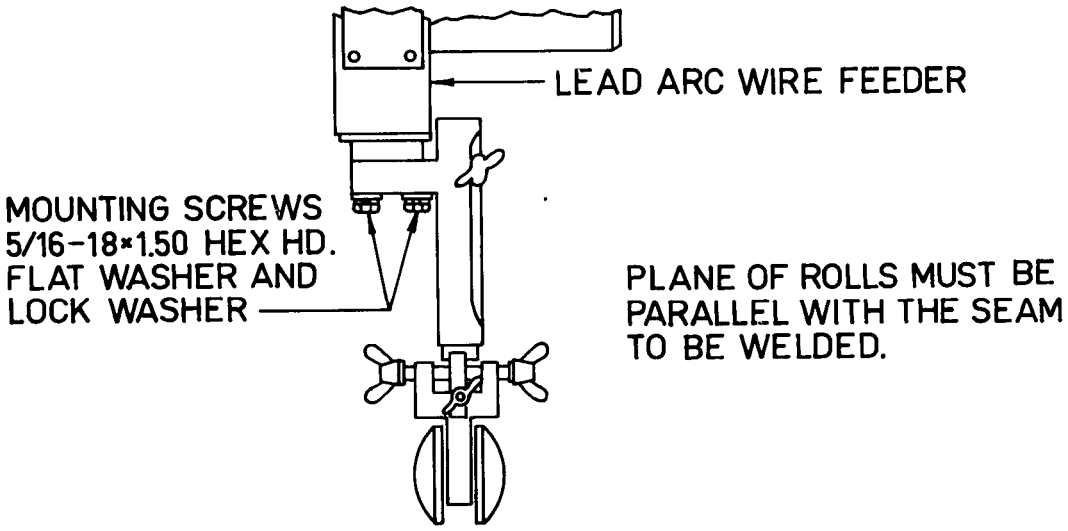
d. Mount the fillet guide wheel telescoping arm to the bottom of the lead arc head (with the hardware supplied). The wing screws should be loosened and the arm made as short as possible. Correct length will be set later. (See Sketch H.)

e. Install the rear roller guide assembly to the bottom of the travel drive carriage frame. It should extend to right from the frame for right side fillets, and from the left side of the frame for left fillets. The mounting holes are just slightly behind the large driving wheels. The arm should be mounted so the guide roller is on the top side. (See Sketch I.)

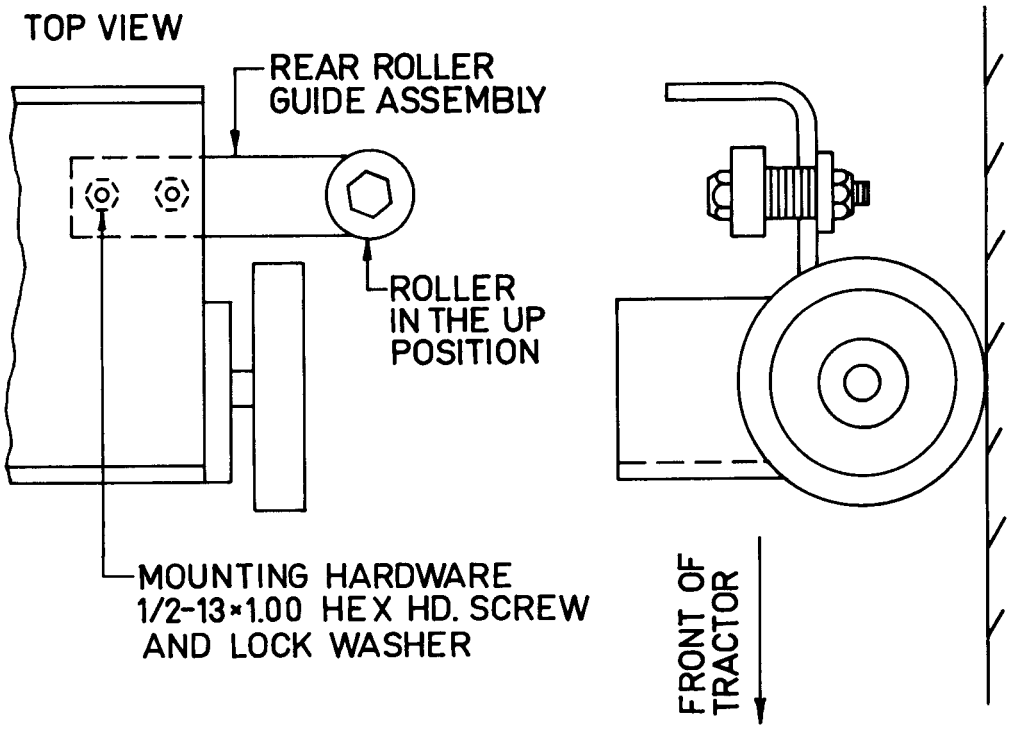
f. Loosen the two screws in the lead arc clamping block which lock the back and forth movement of the lead arc head and move the head assembly forward several inches. Temporarily retighten one of the screws. Loosen the two hex head screws which mount the



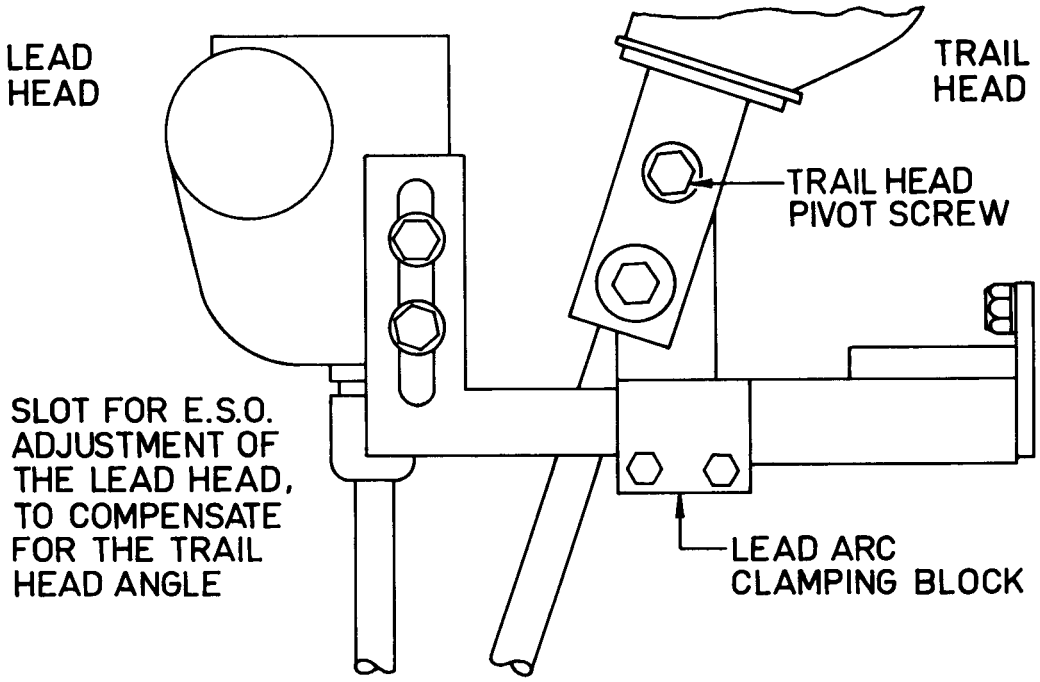
SKETCH G



SKETCH H



SKETCH I



SKETCH J

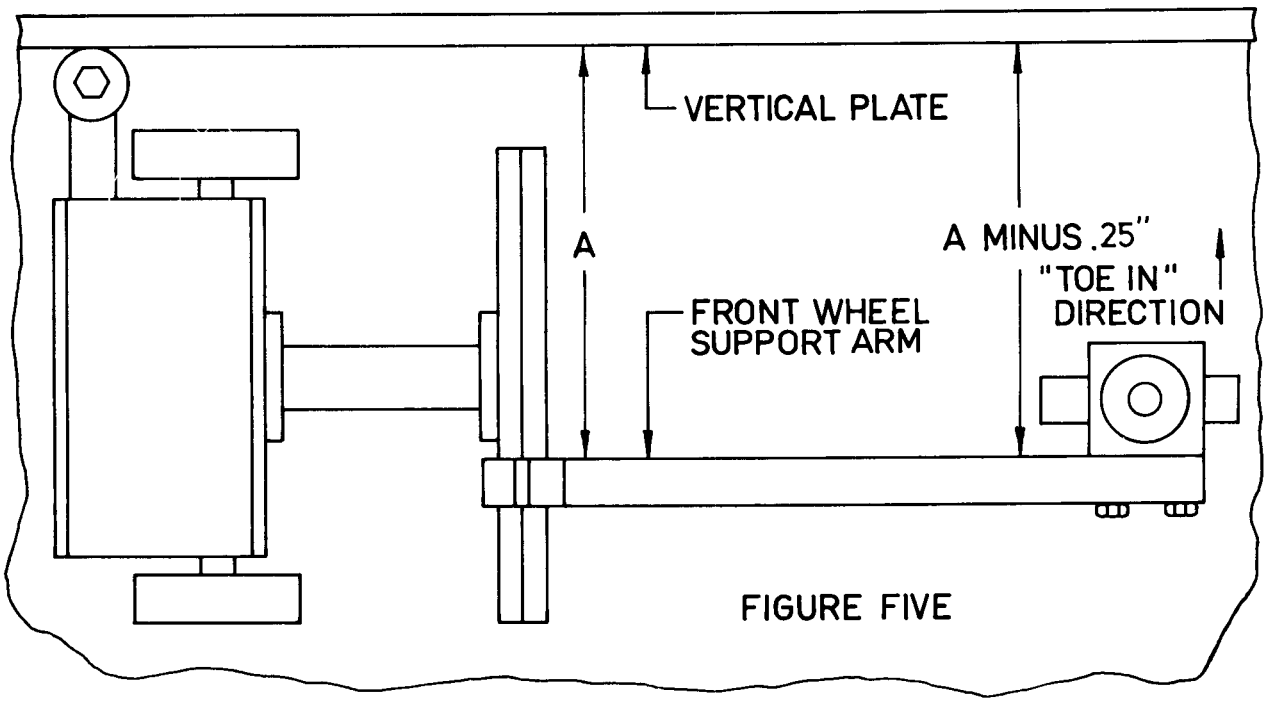


FIGURE 5

trail arc head; this will allow the head to pivot on the top screw. Tilt the head to the proper push angle as specified in the procedures and retighten the two locking screws. (See Sketch J.)

g. Set the tractor into the welding position with the rear guide roller up against the vertical member to be welded (see Figure 5).

   Toe the entire frame into the vertical plate approximately ½°-1°. To do this, set the rear roller against the plate. Measure the distance to the front wheel support arm at the two positions shown. Shift the front until the measurement at the front end is .25 of an inch less than that at the rear position. Front wheel should be adjusted so that it also toes into the vertical plate slightly.

h. Loosen the large hex draw bolt locking nut which is **below** the horizontal adjuster, swing the head mounting boom so that it is parallel to the vertical member to be welded. Retighten the locking nut. (This is to compensate for the above ½°-1° setting of the tractor frame.)

i. Adjust the vertical head lift and the horizontal adjuster until the end of the contact tip is so located with respect to the seam to give the correct electrical stickout on the trail arc head.

j. Adjust the lead arc head for proper electrical stickout, electrode spacing, and electrode alignment. Lock the position securely.

k. Loosen the thumb screw which is on the telescoping arm of the fillet guide roll attachment; this will allow the rollers to come down and rest in the corner to be welded. Tighten the thumb screw when the wheels are down in position.

l. Loosen the head pivot locking screw; this will allow the head mounting arm to be free to pivot, and with the spring tension applied to this arm the fillet guide wheel will be pushed down against the plate. It is important that this action is functioning properly for accurate following of the seam.

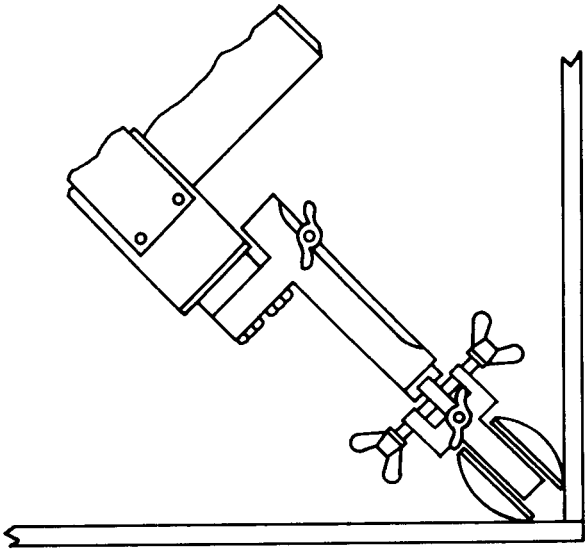
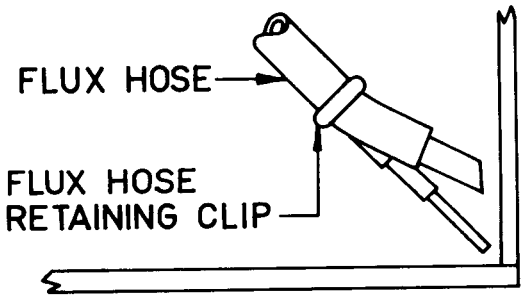
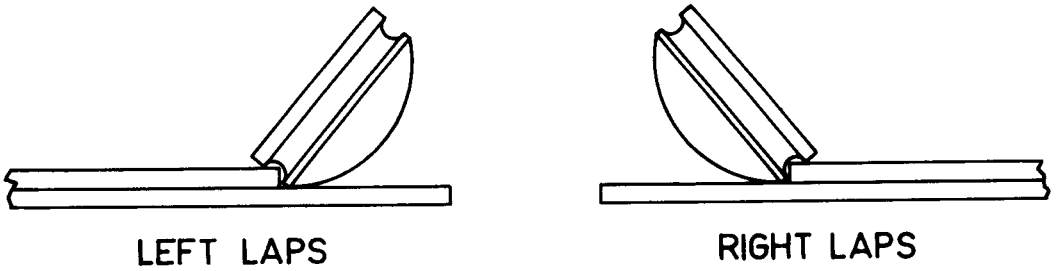


FIGURE 6



SKETCH K



SKETCH L

m. The thumb screws on either side of the pivot are adjustments to accurately position the electrode with respect to the seam. When making this adjustment, one of the screws has to be loosened and the other one tightened. After the electrode has been positioned, lock both screws. (See Figure 6.)

n. Set the flux hose retaining clip on the front nozzle in such a manner to allow the flux to be discharged ahead of the lead arc and up against the vertical member. (See Sketch K.)

4. Lap Welds (K288 Kit)

The tractor configurations and head adjustments are the same as for the fillet welds. There are only two minor changes to be made.

a. The fillet wheel yoke must be changed to the lap wheel yoke. Remove the fillet wheel yoke by removing the pivot screw. Slide the assembly out of the slot. Put the lap wheel yoke into the slot and replace the pivot screw. The correct position of the grooved roller is shown in Sketch L.

b. Since there is no vertical member for the rear roller guide wheel to ride against, the position of the O.D. of this roller should be directly above the lap weld. It is important that the tractor frame and front wheel angle is set approximately 2° so that it will always crowd the unit toward the joint, thus insuring good pressure on the guide wheels at all times.

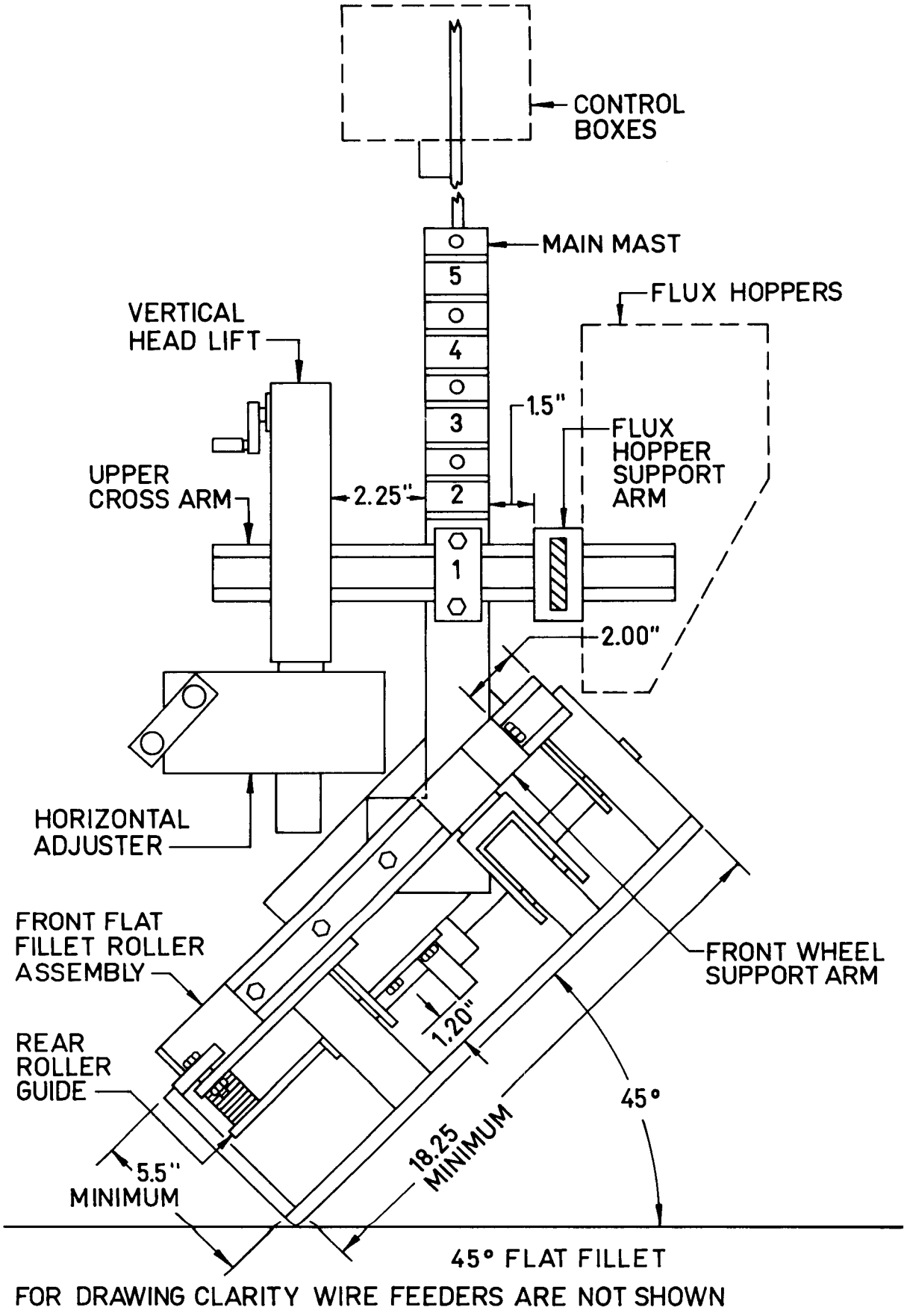

CONTROL BOXES
MAIN MAST
5
4
3
2
1
FLUX HOPPERS
VERTICAL HEAD LIFT
1.5"
FLUX HOPPER SUPPORT ARM
UPPER CROSS ARM
2.25"
2.00"
HORIZONTAL ADJUSTER
FRONT FLAT FILLET ROLLER ASSEMBLY
FRONT WHEEL SUPPORT ARM
1.20"
REAR ROLLER GUIDE
45°
18.25 MINIMUM
5.5" MINIMUM
45° FLAT FILLET
FOR DRAWING CLARITY WIRE FEEDERS ARE NOT SHOWN

FIGURE 7

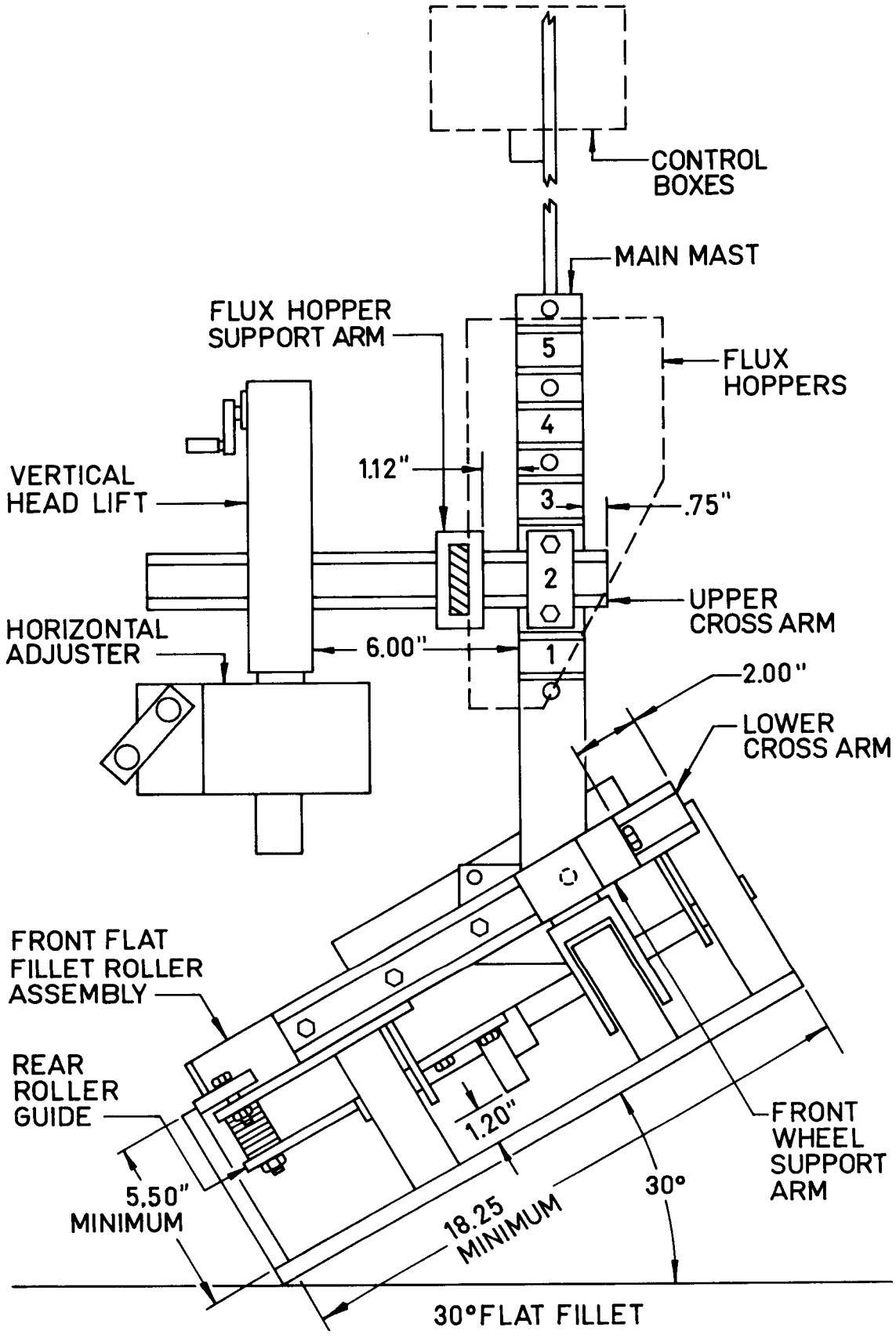
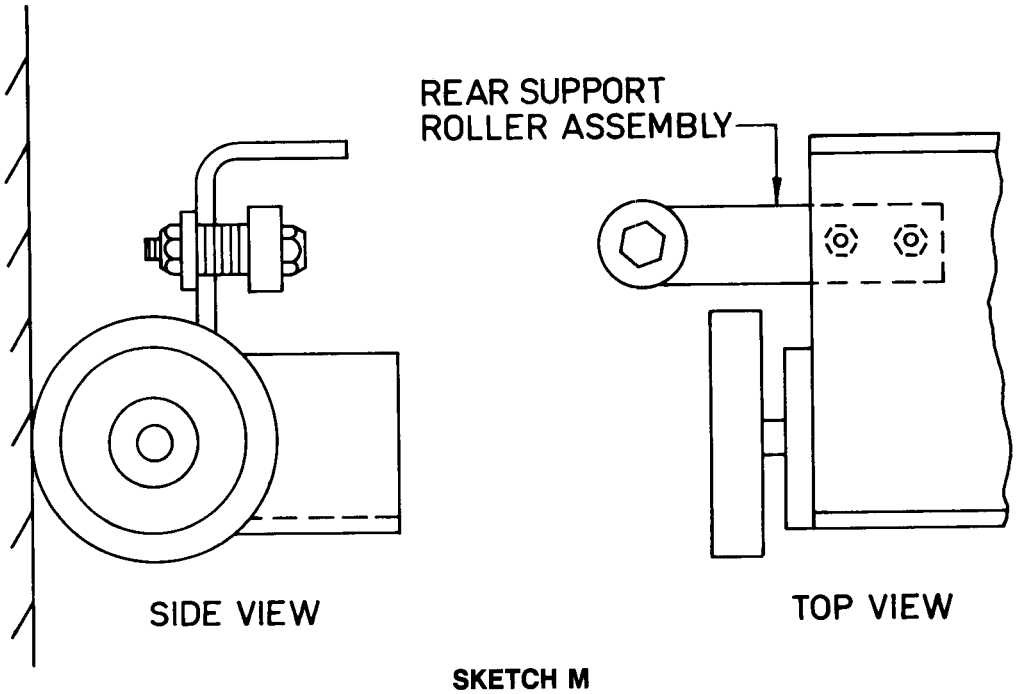

CONTROL BOXES
MAIN MAST
FLUX HOPPER SUPPORT ARM
FLUX HOPPERS
5
4
3
2
1
VERTICAL HEAD LIFT
1.12"
.75"
UPPER CROSS ARM
HORIZONTAL ADJUSTER
6.00"
2.00"
LOWER CROSS ARM
FRONT FLAT FILLET ROLLER ASSEMBLY
REAR ROLLER GUIDE
1.20"
FRONT WHEEL SUPPORT ARM
5.50" MINIMUM
18.25 MINIMUM
30°
30°FLAT FILLET
FOR DRAWING CLARITY WIRE FEEDERS ARE NOT SHOWN

FIGURE 8



SKETCH M

C. Flat Fillets (K287 Kit)

Tractor configuration for 30° and 45° flat fillets. See Figure 7 for 45° and proceed as follows.

The tractor setup as shown in Figures 7 and 8 is not a self standing unit on a flat surface and therefore it must be placed into a "parking platform" or into the weld structure that is going to be welded.

When converting the tractor into either the 30° or the 45° flat position it is advisable to have an overhead hoist or jib crane above the unit.

1. Remove the flux hopper arm assembly from the upper cross bar.
2. Remove wire reels from the tractor.
3. Unplug the wire feed motors from their respective control boxes. Disconnect the electrode leads at each of the nozzle flags.
4. As a unit, remove the vertical head lift, the cross seam adjuster and the two wire feeders. Loosen the clamp which fastens the vertical head lift to the upper cross arm and then slide the entire assembly off the end of the cross bar.
5. With the aid of the hoist, lift the tractor by its lift bale.

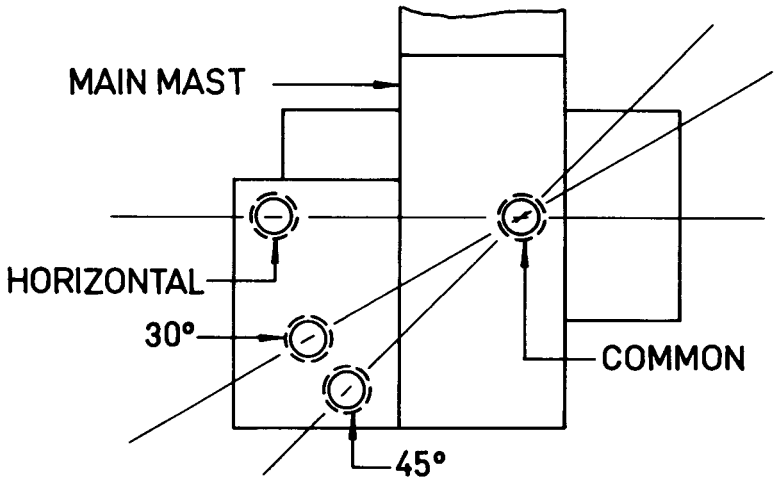
a. Remove the front wheel mounting arm from the lower cross bar. The front wheel can remain attached to the arm.

b. Install the rear support roller assembly (part of the flat fillet kit) to the bottom of the travel unit frame with the two ½ x 13 x 1.00 hex head screws and lockwasher. The roller should be on the top side of the arm as shown in Sketch M.

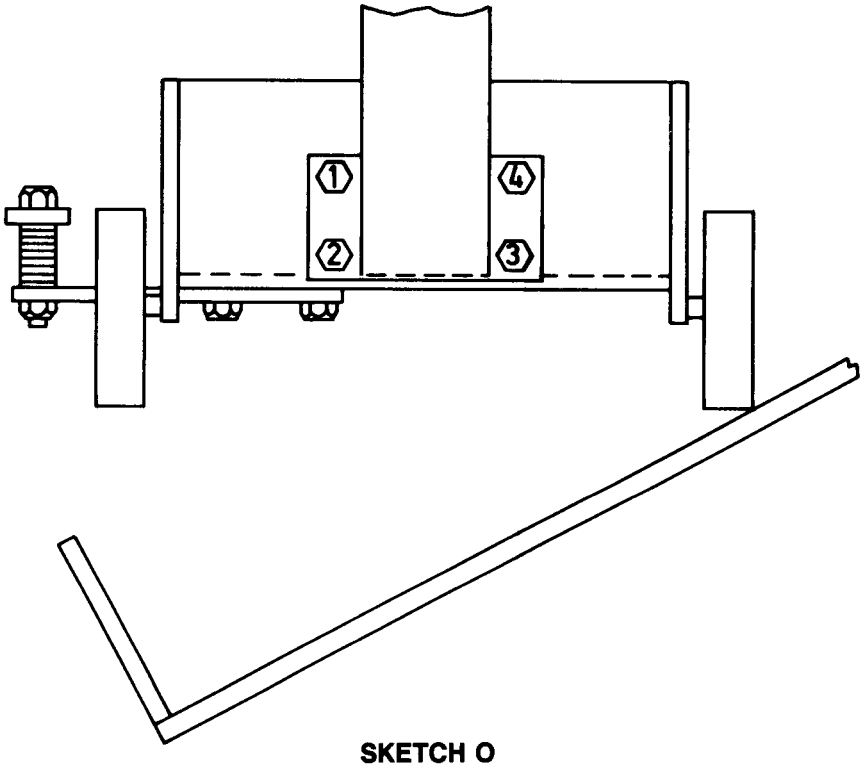
c. Remove the lower cross arm from the tractor frame. Remount the bar (at the desired angle) so that all the holes are to the left side, use the third and fourth hole from the left end to mount the bar. There are three mounting positions on the main mast — (1) horizontal, (2) 30° position, and (3) 45° position. (See Sketch N.)

d. Install the front flat fillet roller assembly (part of the flat fillet kit) to the left end of the lower cross bar. See Figure 7 or 8 for proper installation.

e. Install the front wheel and arm assembly to the lower cross arm at a distance of 2.00 inches from the right end of the bar. The front wheel and steering housing should be bolted to the left side of the support arm.



SKETCH N

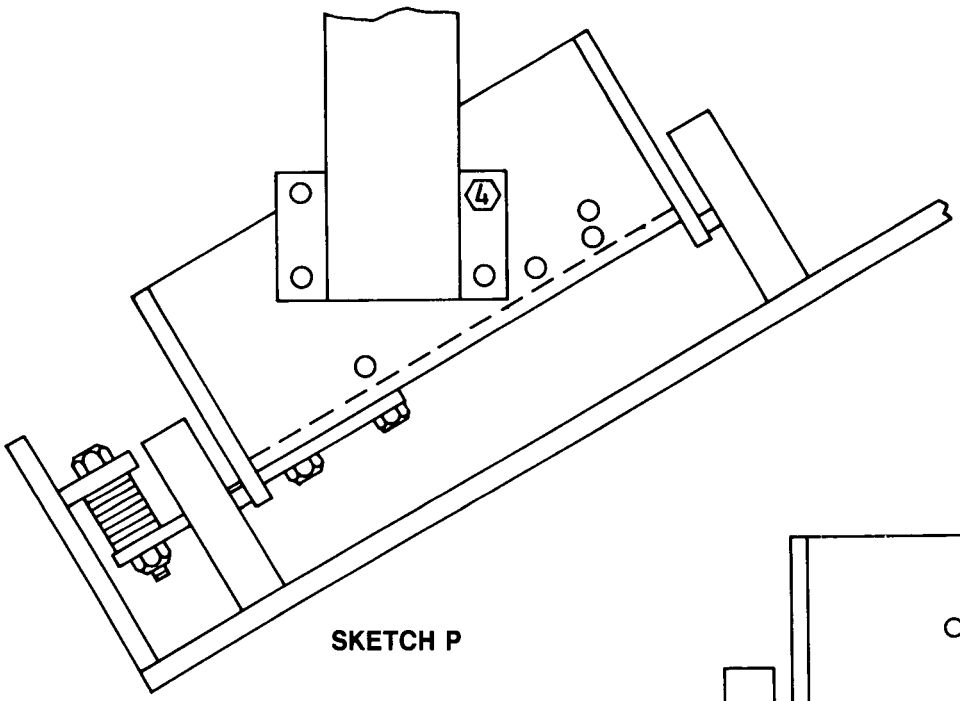


SKETCH O

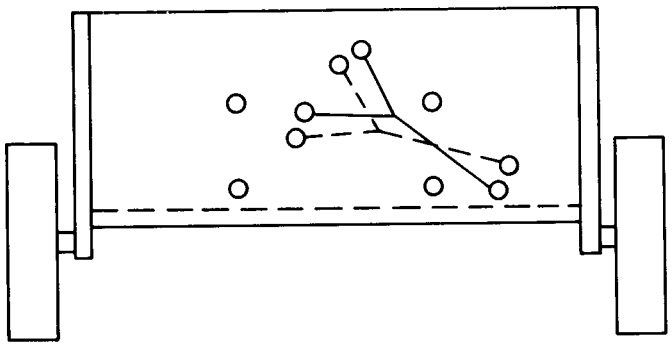
6. Lower the unit into the "angular parking platform" or into flat fillet segment to be welded. Lower the unit until the right rear wheel of the travel carriage touches the 30° or 45° inclined plane. (This will normally be the widest plate of the plates being welded.)

   a. Remove three of the four ½" screws which mount the mast to the carriage frame. (See Sketch O.) Remove screws numbered 1, 2, and 3.

   b. **Carefully** loosen the fourth screw; this will allow the travel carriage to pivot



SKETCH P



SKETCH Q

and come to rest on the inclined plane so that both wheels are now supporting the carriage frame. Remove the screw. (See Sketch P.)

7. On the front of the drive carriage mounting surface there are three sets of mounting holes. One set for the 90° position (four holes); one set of three holes for 30° position (shown connected by the dotted line); and one set of three holes for the 45° position (shown connected by the solid line). (See Sketch Q.)

   Move the main mast into position and fasten it to the drive carriage frame using the proper set of holes for the mode of operation desired. Use three of the screws taken out in Step 6; the fourth screw can be put into one of the unused holes so that it does not get lost.

8. Remove the hoist from the lift bale; the tractor should be self supporting at this stage.

9. Remount the upper cross arm and the complete heads and head mounting assembly.

   a. **30° mode of operation.** See Figure 8 for the proper positioning of the upper cross arm, vertical head lift, and the flux hopper support arm.

      With the upper cross arm in the No. 2 slot of the mast the maximum electrical stickout is 3.5 inches. If longer stickouts are desired the upper cross should be shifted to the No. 3 slot in the mast.

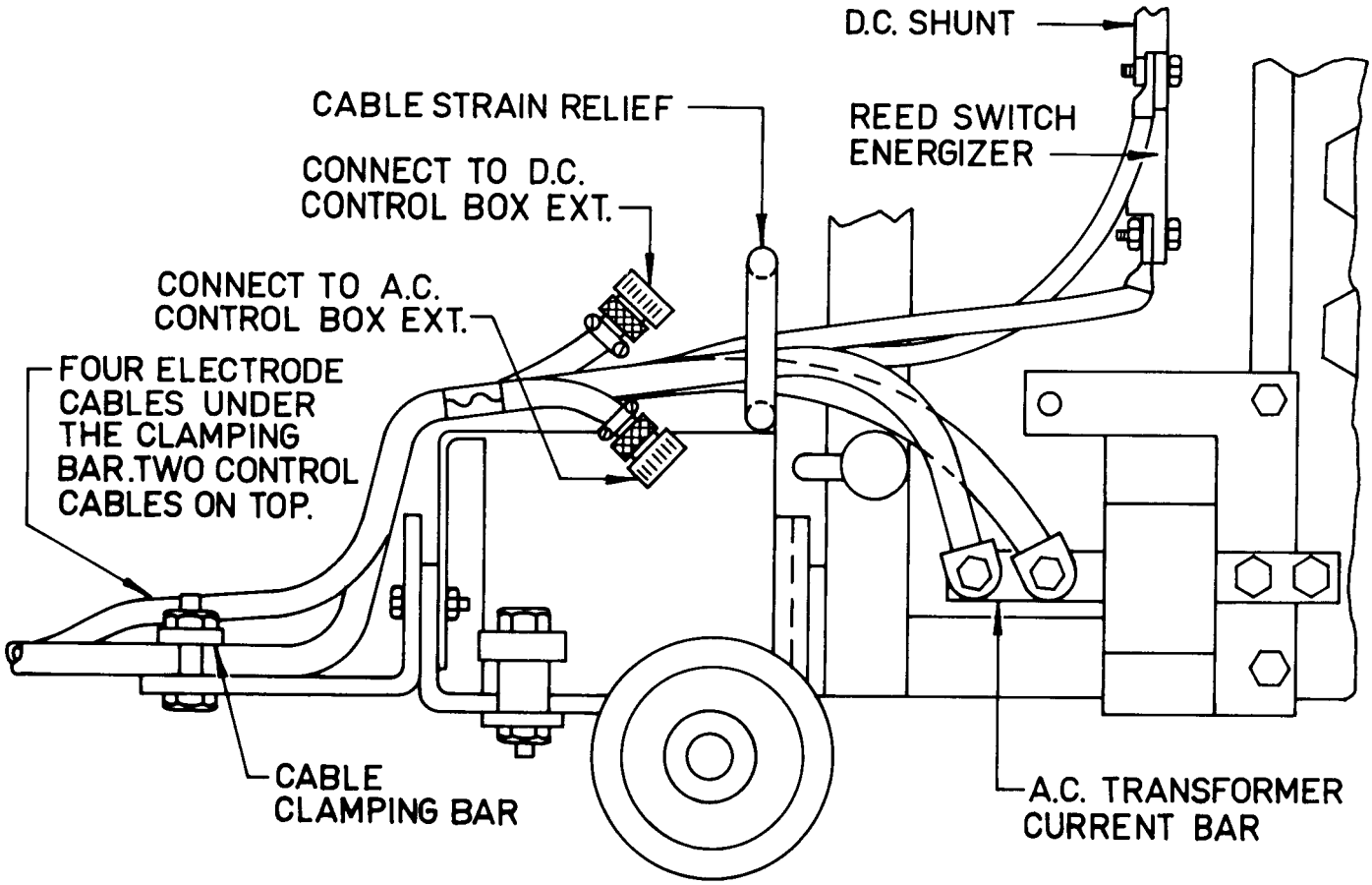
   b. **45° mode of operation.** See Figure 7 for proper component positions.

      With the upper cross arm in the No. 1 slot of the mast the maximum electrical stickout is 3.00 inches. For longer stickout move the upper cross arm into the No. 2 slot.

10. Control boxes should face to the left or toward the short leg of the weldment.

11. Plug in both the wire feeders and reconnect the electrode cables to the nozzles.

12. Set the heads for their proper stickouts, spacing, and electrode angles which are dictated by the procedure.



SKETCH R

II. INPUT CABLE INSTALLATION INSTRUCTIONS

A. Connection to the Power Source.

DC Head and Controls — See appropriate connection diagrams for power source.

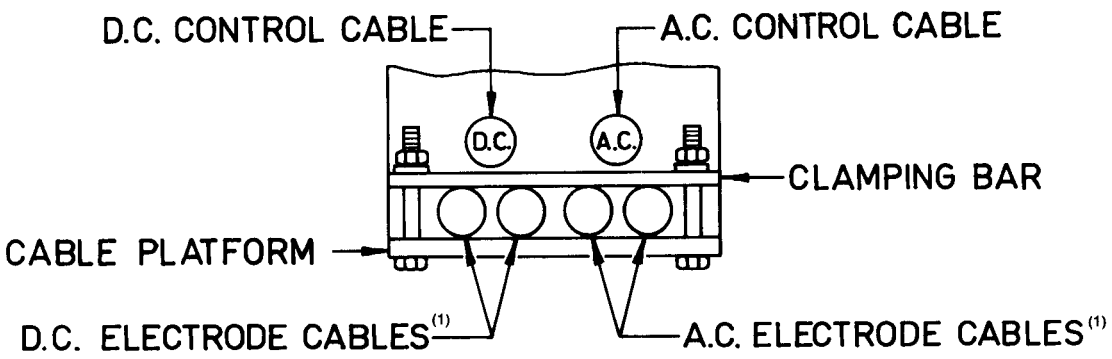
AC Head and Control — See appropriate connection diagrams for power source.

B. Input Control Cable and Electrode Cable Connection to Tractor

NOTE: AC welding current through the AC electrode cables can induce undesirable voltages into the control cable leads when bundled together. To avoid this problem, the control cables of **both** K215 cable assemblies must be separated from the electrode cable leads, then routed from the power sources to the tractor in a bundle separated by at least 2 feet from the electrode cable bundle.

Care must be taken to be certain the cables connected to the DC power source are connected to the DC shunt and DC control box on the tractor.

1. Remove the cable clamping bar from the rear cable support platform. (See Sketch R.) **NOTE:** Cable support bracket can have alternate positions for making butt welds. See Section I.A.3.e.
2. Starting with the DC input cables, feed the two electrode cables through the strain relief eyelet. Fasten one cable to each side of the reed switch energizer bar (lower flag). Make sure to clamp the flat side of the electrode cable lug against the conductor bar in each case. Tighten the bolt securely. For high current procedures, the additional electrode cables should be connected to the upper reed switch energizer flag.
3. Plug the DC control cable connector into the receptacle from the DC control box. Tighten the collar by hand securely, making sure that the plug is fully inserted.
4. Pass the two AC electrode cables through the strain relief eyelet. Fasten one cable to each side of the AC transformer current bar (see Sketch R.) Here again, make sure that the flat side of the lug is against the bar in each case. Tighten the bolt securely.



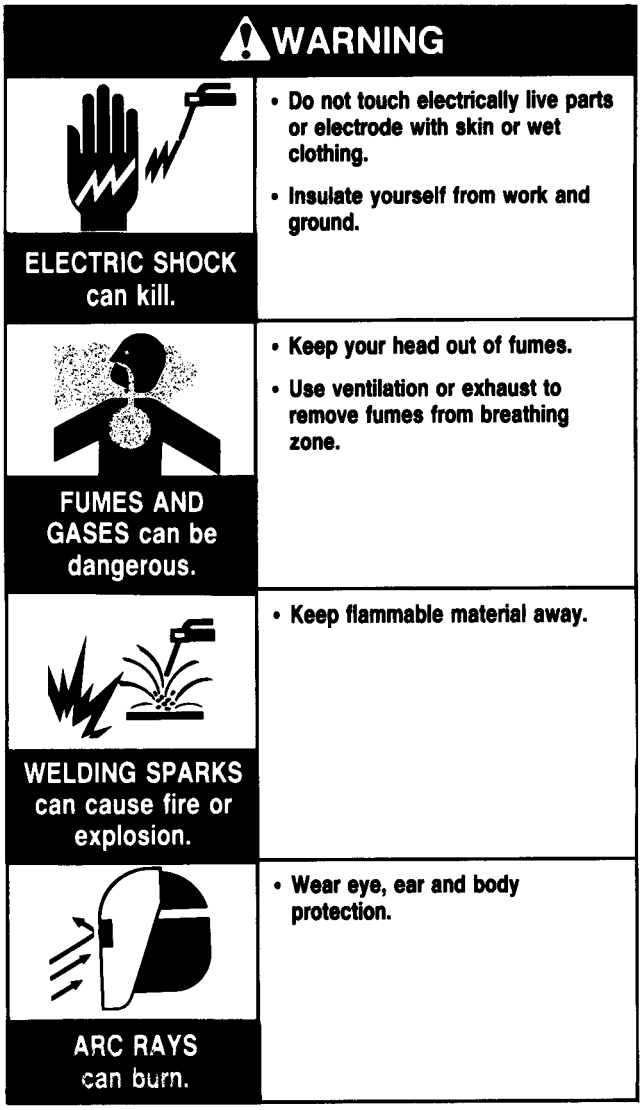
(1) When more than four electrode cables are being used, clamp two each of the AC and DC system as shown. All other electrode leads will be above the clamping bar and securely taped to the other cables.

SKETCH S

For high current procedures, the additional electrode cables should be connected to the second mounting hole on the AC current bar.

5. Plug the AC control cable connector into the receptacle from the AC control box. Tighten the collar securely by hand, making sure that the plug is fully inserted.
6. Bend the cable assemblies so that they conform to the rear support; allow a couple of inches of slack cable at the top bend. Slide the cable clamping bar under both the AC and DC control cables and over the four electrode cables (see Sketch S.) Tighten the clamping bar to secure the four electrode cables. Do not over-tighten.

OPERATION



I. POWER SOURCE SETTINGS

A. At the DC power source

Machine settings at the DC power source: (use information that is applicable to the type equipment installed).

DC-1500 or DC-1000

a. Set the toggle switch into the CC submerged arc position. (LT-56 tractor is shipped with its "mode" switch in the "CC" position.)

b. Set the output control switch into the "remote" position.

c. Set the "Electrode Polarity Switch" to the same polarity as the electrode cable connection.

B. At the AC power source

1. Set the toggle switch into the "remote" position.
2. Connect the AC electrode cable to the output studs of the desired current range.

C. At the LT-56

1. On each of the control boxes, turn the power "on-off" switch to the "on" position.
2. Loading the electrode.

   a. Load the reels with the proper size electrode; one reel must be loaded for clockwise dereeling and the other for counter-clockwise dereeling.

   NOTE: Cut and remove electrode tie wires in such a fashion as to cut the tie wire which holds the start end of the coil last, while holding the starting end of the coil. This will prevent wire "crossovers" and wire "tangling". Anchor the start end of the coil in one of the wire cover holes.

   b. Slip the reel which has the CCW coil onto the wire reel shaft on the right side of the tractor. Slip the other reel on the left side. Carefully secure the reels to their respective shafts with the flat washer and cotter pin provided.

   c. Thread the start end of each wire through the reel take-off arm and through the nylon wire guides.

   d. Straighten each wire end for approximately a foot; feed the wire down through the wire straightener, until the end touches the drive rolls. (Either reel can be fed to either head.)

   e. Press the inch button and feed the wire through the nozzle which has been equipped with the proper size tip.

   f. Inch the electrode through the system and set the wire straightener so that the wire coming out of the nozzle tip has a slight bow in it (approximately bow 1/8 to 1/4" in a 12" length). This insures good contact and longer tip life.

3. Locate the tractor at the weld starting point, and fill both flux hoppers.
4. Fully engage the travel clutch. (A slight forward movement of the tractor during the clutch engagement will ease the meshing of the drive gears.)
5. Make travel control box settings.
   a. Set the travel mode switch to "automatic".
   b. Set the travel switch to "forward".
   c. Set the rheostat dial to desired inches per minute.
6. DC and AC control box settings (for 5/32 or 3/16 wire).
   a. DC — Set current rheostat to Number 6 position; Set voltage rheostat to Number 7 position.
   b. AC — Set current rheostat to Number 5 position; Set voltage rheostat to Number 7 position.

   The above positions are approximate settings. Adjust controls to desired values after arc has been established.
7. Check that no part of the LT-56 gear boxes, nozzles, electrode wire reel, or cable terminals are touching any other part of the LT-56 frame. If so, undesired grounding will take place. Both the DC and the AC control boxes are equipped with a grounding lead protector to protect the tractor grounding lead should it carry welding current. This can occur if either of the wire feeders or either of the electrodes come in contact with the tractor frame. When this occurs, the grounding lead protector of the faulted unit will trip and that unit will shut down. If the DC unit shuts down, the travel will also stop. In the event of a shutdown of one unit of the LT-56 tractor, the stop button of the other unit should be pushed. The shut down unit **cannot** be restarted until the fault is cleared and the grounding lead protector circuit is reset as described below.
   a. Clear fault by eliminating source to frame.
   b. Turn the "control power" of the faulted unit to the "off" position and then back to the "on" position.
   c. The unit is now ready for operation.
8. Weld starting mode. (Cut the electrode to a sharp point for best starts.)
   a. **Cold Start**
      1. Inch electrode down until it touches the work and then stops. (Work contact area must be clean.)
      2. Weld bead will start at the contact point.
   b. **Hot Start**
      1. Do not inch the electrode all the way down.
      2. Weld bead will start a little beyond initial location.
9. Open the flux valves and allow the flux to flow. Cover the arc start area.
10. Push the DC start button. After the DC arc has been established and the travel has started, press the AC start button. (If the DC meter polarity is wrong, push the stop buttons. Tractors, as shipped from the factory, are connected for positive polarity. Recheck all electrode lead connections and polarity switches at the power source. If they are correct, shut power sources off and then reverse the leads at the DC meter terminals.) Adjust the current and voltage controls on each box to the desired values.
11. Adjust the flux flow valve so that the flux covering the arc is light enough to permit slight arcing to break through the top of the flux pile.
12. During the welding operation, the input cables should be moved along with the tractor so that the unit is not pulling more than 10 to 15 foot of the cable assemblies. **The control cable bundle (two cables) should be kept away from the electrode bundle by at least 2 feet.** This will prevent stray voltage pickup and erroneous meter readings.
13. At the end of the weld, push both stop buttons and the weld will stop and the electrodes will burn back.
14. Shut the flux valves off.

MAINTENANCE INSTRUCTIONS

WIRE FEED MOTORS AND GEAR BOXES

Once a year, recoat all the gear teeth with a non-fluid moly grease, such as a "Non Fluid Oil Corp.", lubricant A29 Special/MS. Check the motor brushes every six months. Replace the brushes if they are less than 1/4" long. For high usage applications, check the motor brushes more often.

WIRE DRIVE ROLLS

Check the sharpness of the driving teeth on the drive rolls periodically. When the rolls no longer put indentations into the wire surface, it is time to reverse them. Each drive roll has two driving surfaces so that maximum life can be obtained from each roll. After both sets of teeth are worn, then replace the set. The wire guide tubes should be periodically inspected for signs of milling in which case they should be rotated or replaced.

CONTROL BOXES

Every three months, inspect and blow out the control boxes with "dry" low pressure air. No other maintenance is required.

WIRE STRAIGHTENER

The top slide bushing and the incoming guide should be inspected periodically for signs of milling. The slide bushing can be reversed. Remove the cross adjustment screw, flip the slide bushing over and reassemble the adjustment screw. Add a drop of machine oil to each of the adjustment screw threads.

VERTICAL HEAD LIFT

Periodically add several drops of SAE 90 grade oil into the oil cup which is on the back side of the vertical adjuster.

HORIZONTAL ADJUSTER

Once a year, recoat the acme screw thread and the slide ways with a good grade of grease.

WIRE REEL MOUNTING

To prolong the life of the wire reel shafts, periodically coat them with a thin layer of grease.

TRAVEL DRIVE GEARS

Periodically blow the gear surfaces clean, relube the intermediate gear shaft and all gear surfaces with a dry lubricant such as a moly-disulfide powder (Lincoln E1281).

TRAVEL MOTOR — GEAR BOX

Check the brushes periodically and replace them when 3/16 of an inch or shorter.

The gear box gear teeth should be recoated with a layer of graphite grease (Lincoln E708) after each 2000 hours of operation.

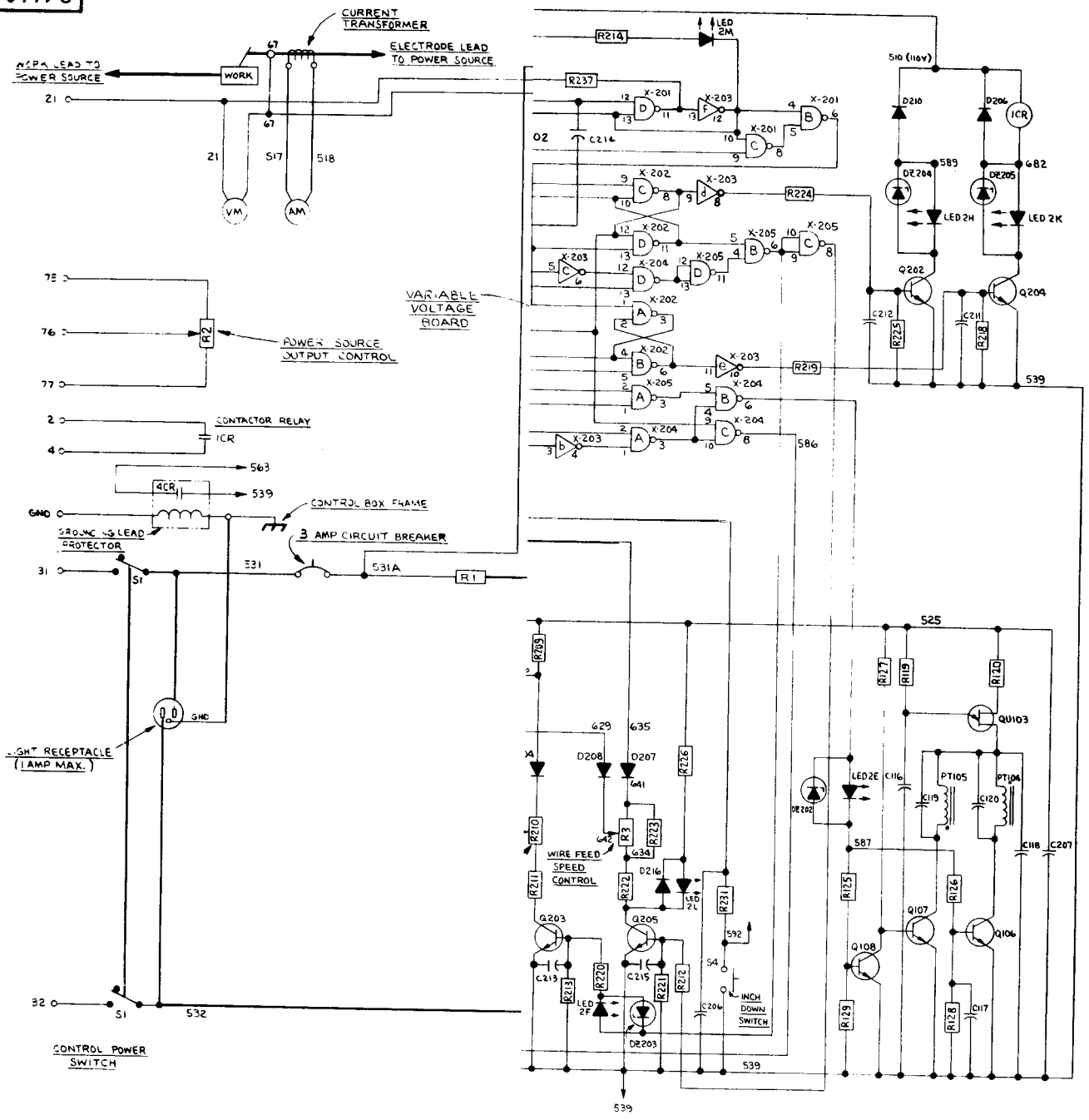
CONTACT NOZZLE

The life of the contact nozzle tips depends largely on the size, surface condition of the wire and the welding current. The wire straightener should be set so the electrode is not completely straight. Rusty or dirty wire is especially bad for contact wear.

The nozzle tip should be replaced when it no longer provides accurate wire location or when arcing between the wire and the tip becomes excessive. Should the tip end become fused over due to a poor start, remove the tip and redrill per the following table.

Wire Size	Tip Part No.	Drill Size
1/8	S-10125-1/8	#29 (.136)
5/32	S-10125-5/32	#20 (.161)
3/16	S-10125-3/16	#10 (.193)

G-1448



CONTROL CIRCUIT

C101	.47 MFD	R101	80 Ω, 12W	R128	47 K Ω
C102	50 MFD	R102	68 K Ω	R129	47 K Ω
C103	.047 MFD	R104	10 K Ω, 2W	R131	10 K Ω, 2W
C104	.047 MFD	R105	39 K Ω	R132	10 K Ω
C106	.047 MFD	R106	4.7 K Ω	R133	27 K Ω
C107	.1 MFD	R107	15 K Ω	Q101	2N5655
C108	1 MFD	R108	22 K Ω	Q102	MJ 3029
C110	1 MFD	R109	10 K Ω	Q103	2N 4123
C113	.15 MFD	R110	1.5 K Ω	Q104	2N 4123
C114	.15 MFD	R111	5 K Ω TRIMMER	Q105	2N 4123
C116	.047 MFD	R112	4.7 K Ω	Q106	2N 5816
C117	.02 MFD	R113	22 K Ω	Q107	2N 5816
C118	.02 MFD	R114	10 K Ω	Q108	2N 4123
C119	.02 MFD	R115	100 Ω	QU101	2N 6027
C120	.02 MFD	R117	47 Ω	QU103	UJT
C121	1 MFD				
C122	.02 MFD	R118	6.8 K Ω	LED 1A	RED LIGHT EMITTING DIODE
		R119	6.8 K Ω	LED 1B	
D101	16 A	R120	680 Ω	LED 1C	
D102	16 A	R121	2.7 K Ω	LED 1D	
D103	16 A	R122	47 K Ω	LED 1E	
D104 THRU D114, D116, D117	1A	R123	100 Ω	SCR 101	8A. 600 V.
		R124	100 Ω	SCR 102	8A. 600 V.
		R125	10 K Ω	SCR 103	12A. 400 V.
		R126	680 Ω	SCR 104	12A. 400 V.
DZ101	25 V.	R127	4.7 K Ω		
DZ102	3 V.				

TP 101 TRANSIENT PROTECTOR
F101 1/2 A SLOW BLOW FUSE
F102 2/10 A FUSE
PT101 PULSE TRANSFORMER
PT104 PULSE TRANSFORMER
PT105 PULSE TRANSFORMER

C201	.02 1	
C202	2 M	CONTROL
C203	.02 M	CONTROL
C204	10 M	
C205	10 M	
C206	.02 M	
C207	50 M	
C208	2 M	
C209	4.7 M	
C210 THRU C215	.02 1	
D201 THRU D213, D216, D217, D218	1A	
LED 2B THRU LED 2M	Y REDRU LIGHPower EMIT DIOI	ATED BY
Q201	2N5	
Q202	2N 4	
Q203	2N 4	
Q204	2N	
Q205	0.5	
QU201	UJT	

AC CURRENT SENSOR CIRCUIT

C501 1 MFD

D501 1A
D502 1A
D503 1A
D504 1A

R501 10 K Ω

Q501 2N4123

T501 CURRENT TRANSFORMER

ELECTRICAL SYMBOLS PER E-1537

N.A. TO OPERATE UNIT WITHOUT VARIABLE VOLTAGE BOARD JUMPER G37 TO 539 & 635 TO 636

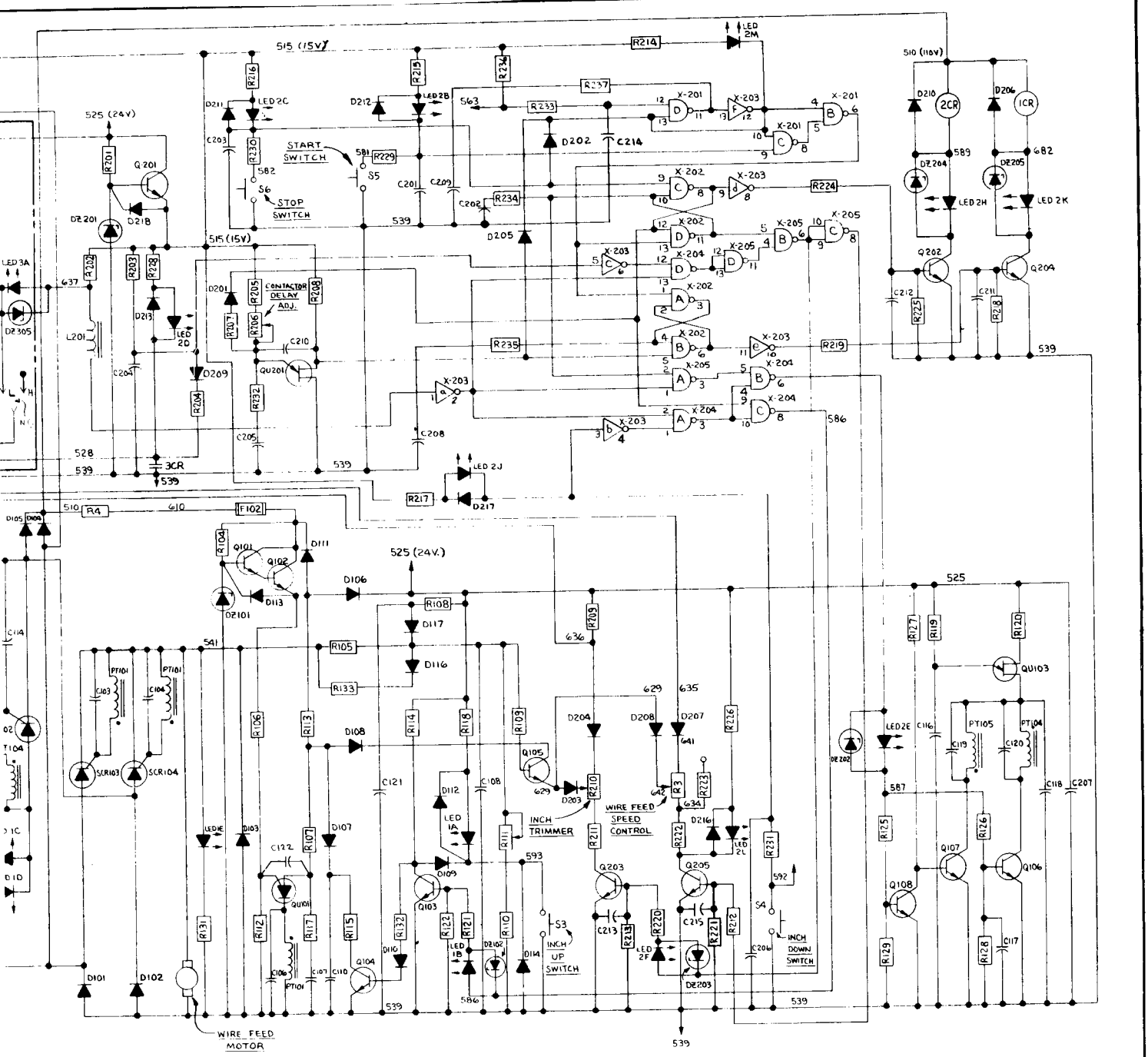
N.B. X201 THRU X205 - PIN 7 CONNECTED TO 539
PIN 14 CONNECTED TO 515

N.C. WHEN CONTROLS ARE USED WITH R3S POWER SOURCES OF THE TYPE WHICH USES TAPS CONNECTED WITH TRIANGLE PLATE FOR MAJOR VOLTAGE ADJUSTMENTS, JUMPER TO BE CONNECTED TO PIN 'L'. FOR ALL OTHER POWER SOURCES JUMPER TO BE CONNECTED TO PIN 'H'.

NOTE: SINCE COMPONENTS OR CIRCUITRY ON A PRINTED CIRCUIT BOARD MAY CHANGE WITHOUT AFFECTING THE INTERCHANGEABILITY OF A COMPLETE BOARD, THIS DIAGRAM MAY NOT SHOW THE EXACT COMPONENTS OR CIRCUITRY OF CONTROLS HAVING A COMMON CODE NUMBER.

Sheet No. 2C-R/M 6-14-ASN

TYPE LT-56 TRACTOR
SUBJECT A.C. OPERATING SCHEMATIC
SUPS'D (G-1359) DR [illegible] CHK [illegible] SHEET NO. G-1448



TRAVEL CIRCUIT

C401	18 MFD	R419	40Ω, 12W
C402	1.8 MFD	R420	470Ω
C403	.005 MFD		
C404	1 MFD		
C405	.1 MFD	D401	1A.
		D402	1A., 1000 V.
C406	.01 MFD	D403	1A., 1000 V.
C407	.047 MFD	D404	16A.
C408	.047 MFD	D405	16A.
C409	39 MFD		
C410	50 MFD	D406	16A
C411	.02 MFD	D407	1A., 1000V
C412	.005 MFD	D408	1A, 1000V
C413	.02 MFD	D409	1A.
R401	10KΩ	D410	1A.
R402	10KΩ	D411	1A.
R403	4.7KΩ	SCR	TRAVEL REVERSING RELAY
R404	3.9KΩ		
R405	27KΩ	TP401	TRANSIENT PROTECTOR
		TP402	TRANSIENT PROTECTOR
R406	15KΩ	PT401	1:1:1 PULSE TRANSFORMER
R407	4.7KΩ	DZ401	20V
R408	4.7KΩ, 5W	DZ402	10V
R409	4.7KΩ	SCR401	12A. 400V. SCR
R410	2KΩ TRIMMER	SCR402	12A. 400V. SCR

COMPONENTS NOT ON P.C. BOARD

R1 2Ω, 50W
R2 10KΩ, 2W POWER SOURCE OUTPUT CONTROL
R3 5KΩ, 2W WIRE FEED SPEED CONTROL
R4 250Ω, 25W
R5 2Ω, 25W
R6 5KΩ, 2W TRAVEL SPEED CONTROL
R7 1.3Ω 10W

S1 DPST CONTROL POWER SWITCH
S2 SPDT TRAVEL CONTROL SWITCH
S3 SPST INCH UP SWITCH
S4 SPST INCH DOWN SWITCH
S5 SPST START SWITCH
S6 SPST STOP SWITCH
S7 DPDT (REV.) TRAVEL DIRECTION SWITCH

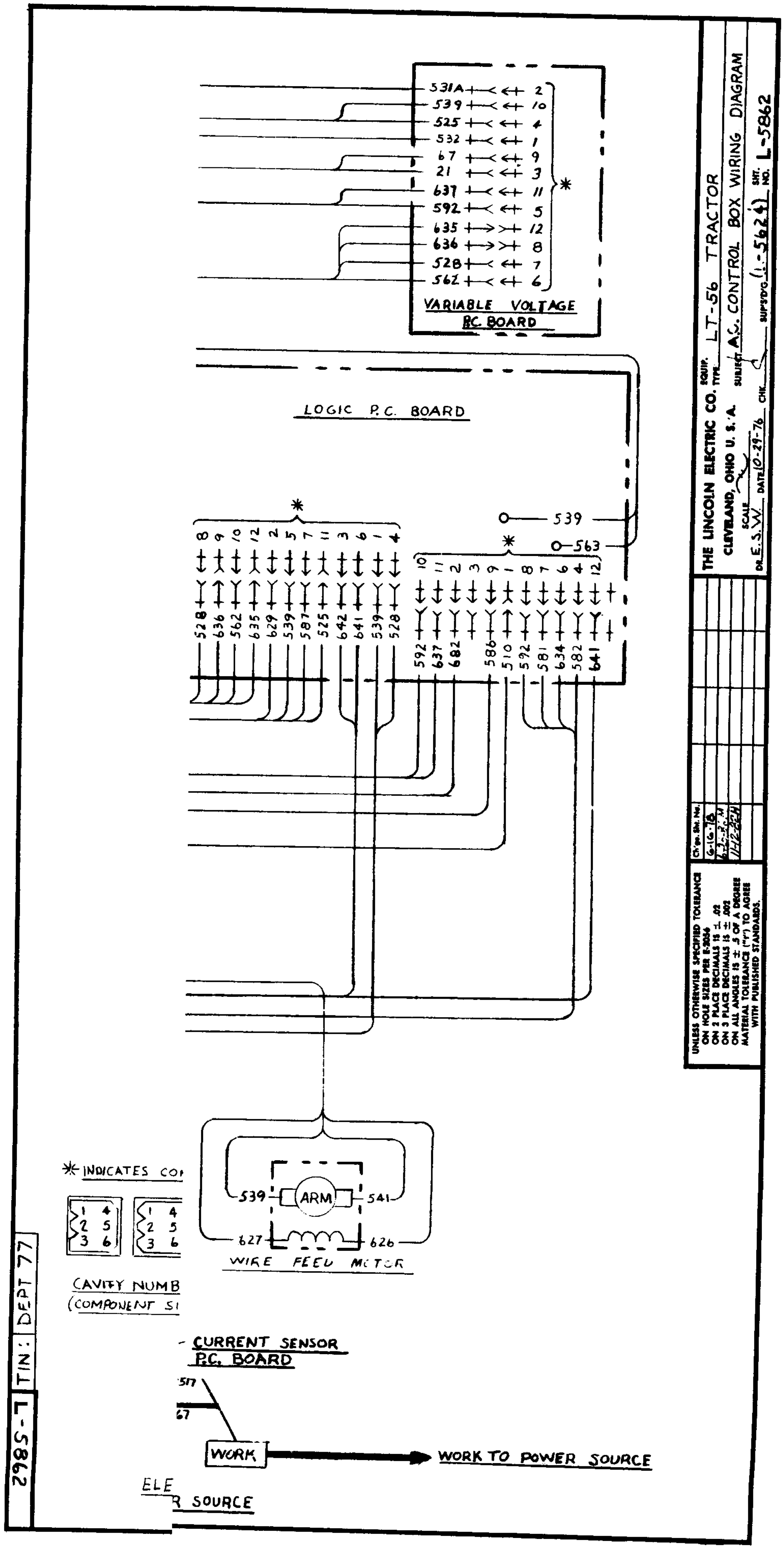
1CR SPST, 110 VDC COIL
2CR SPST, 110 VDC COIL
3CR REED SWITCH ACTUATED BY WELDING CURRENT
4CR REED SWITCH ACTUATED BY FAULT CURRENT THRU GROUNDING LEAD TO POWER SOURCE FRAME.

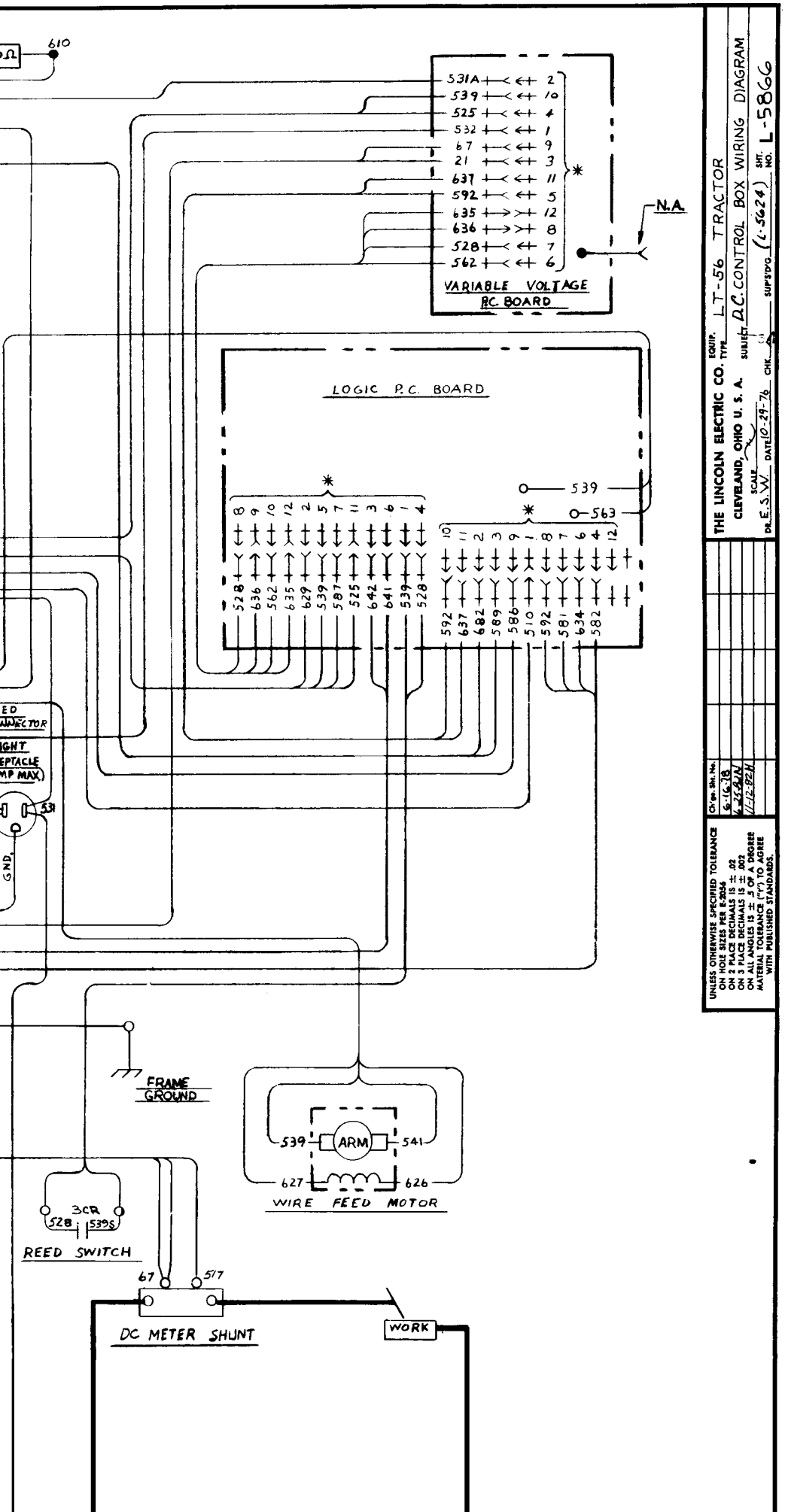
ELECTRICAL SYMBOLS PER E-1537

N.A. TO OPERATE UNIT WITHOUT VARIABLE VOLTAGE BOARD JUMPER 637 TO 539 & 635 TO 636.

N.B. X201 THRU X205 - PIN 7 CONNECTED TO 539 PIN 14 CONNECTED TO 515.

N.C. WHEN CONTROLS ARE USED WITH R3S POWER SOURCES OF THE TYPE WHICH USES TAPS CONNECTED WITH TRIANGLE PLATE FOR MAJOR VOLTAGE ADJUSTMENTS, JUMPER TO BE CONNECTED TO PIN 'C'. FOR ALL OTHER POWER SOURCES JUMPER TO BE CONNECTED TO PIN 'N'.


VARIABLE VOLTAGE P.C. BOARD
LOGIC P.C. BOARD
WIRE FEED MOTOR
ARM
* INDICATES CO
CAVITY NUMB
(COMPONENT S
CURRENT SENSOR P.C. BOARD
WORK
WORK TO POWER SOURCE
ELE
R SOURCE
L-5862
TIN: DEPT 77
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.
LT-56 TRACTOR
A.C. CONTROL BOX WIRING DIAGRAM
L-5862
DR. E.S.W. DATE 10-29-76
UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLE SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.

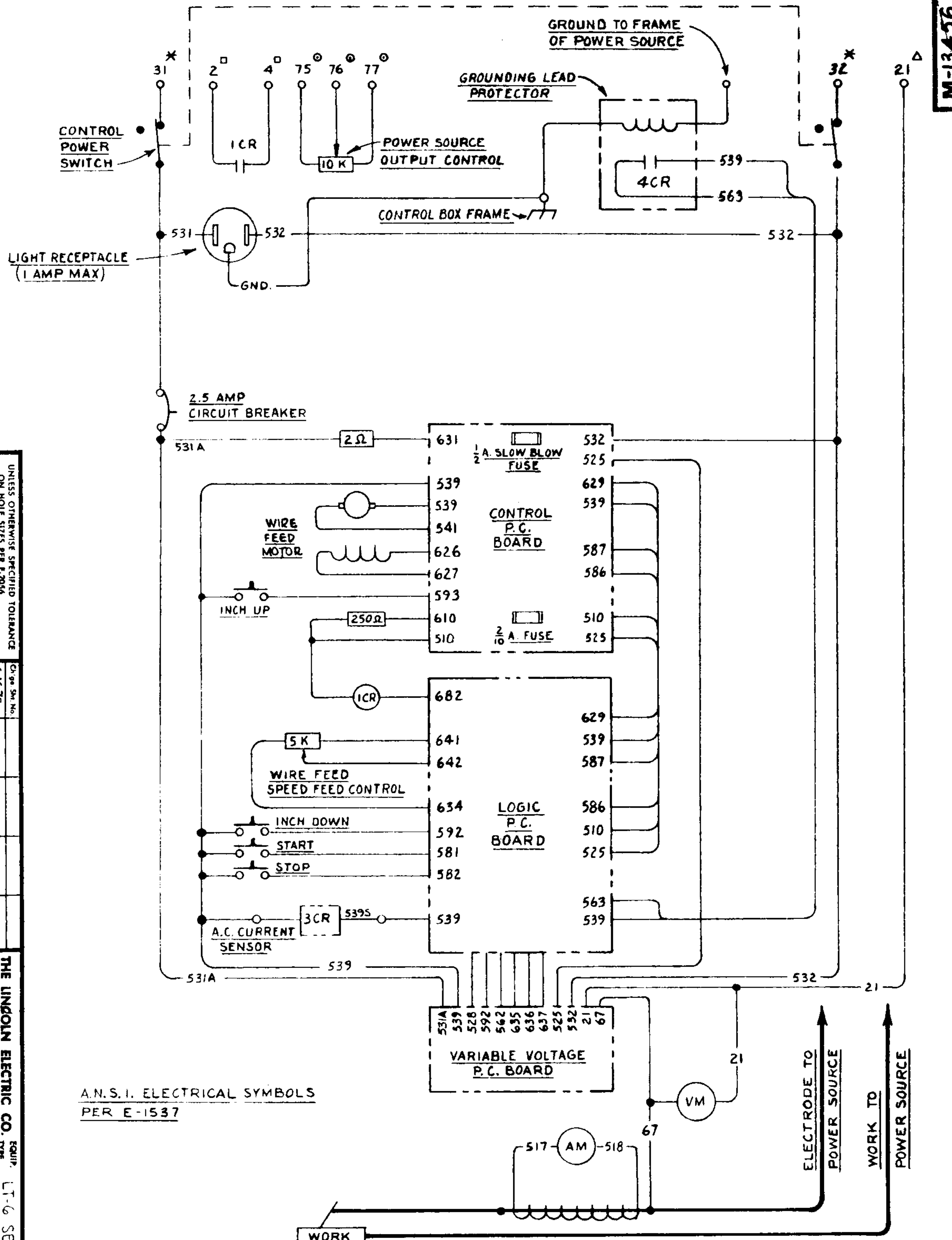


THE LINCOLN ELECTRIC CO. EQUIP. TYPE LT-56 TRACTOR
CLEVELAND, OHIO U. S. A. SUBJECT A.C. CONTROL BOX WIRING DIAGRAM
SCALE DR. E.S.W. DATE 10-29-76 CHK. SUP'S'D'G. (L-5624) SHT. NO. L-5866

Ch'gs. Shr. No.
6-16-78
6-25-80
11-12-82

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLE SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE (**) TO AGREE
WITH PUBLISHED STANDARDS.

M-13456



A.N.S.I. ELECTRICAL SYMBOLS PER E-1537

- * 31 - 32 115 V.A.C., 50-60 HZ
- □ 2 4 OPERATES POWER SOURCE CONTACTOR
- △ 21 TO * 21 TERMINAL (OR WORK STUD) ON POWER SOURCE
- ⊙ 75, 76 & 77 TO LINCOLN POWER SOURCE OUTPUT CONTROL CIRCUIT

- 1CR CONTACTOR RELAY
- 3CR A.C. CURRENT SENSOR ACTUATED BY WELDING CURRENT
- 4CR REED SWITCH (LOCATED AT BOTTOM OF CONTROL BOX AND ACTUATED BY FAULT CURRENT THROUGH GROUNDING LEAD TO POWER SOURCE FRAME.)

UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLE SIZES PER E-2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.

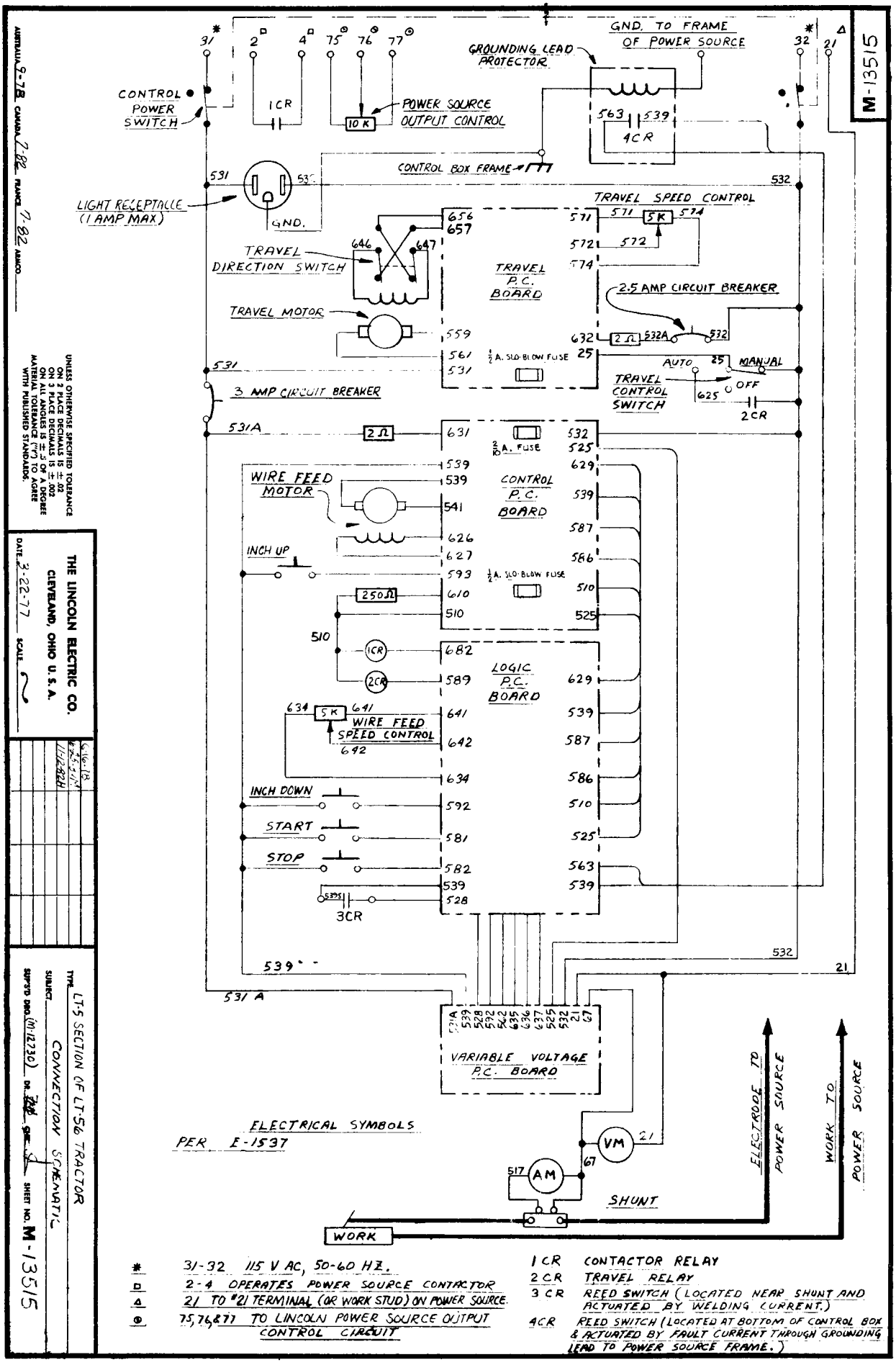
THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U.S.A.

EQUIP. TYPE: LT-6 SECTION OF LT-56 TRACTOR

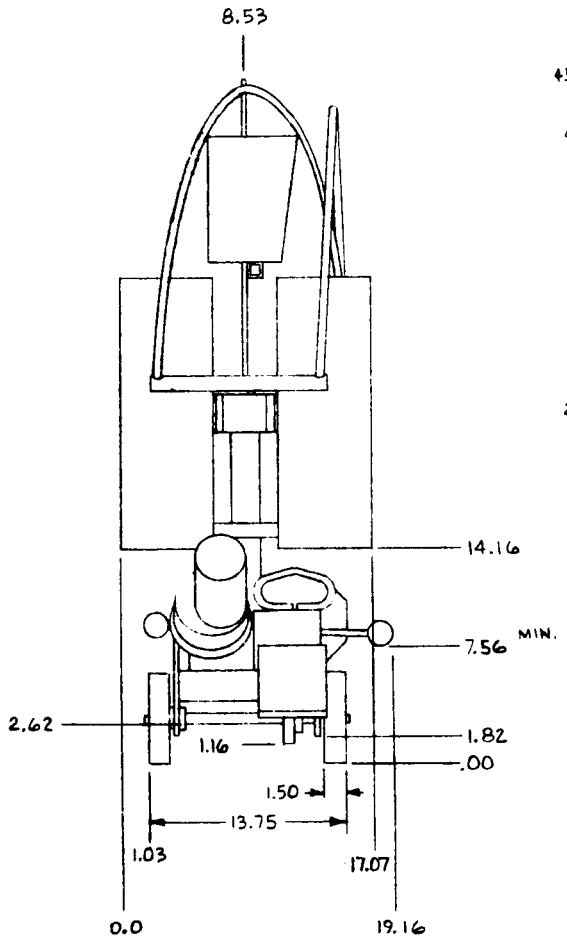
SUBJECT: A.C. CONTROL BOX CONNECTION DIAGRAM

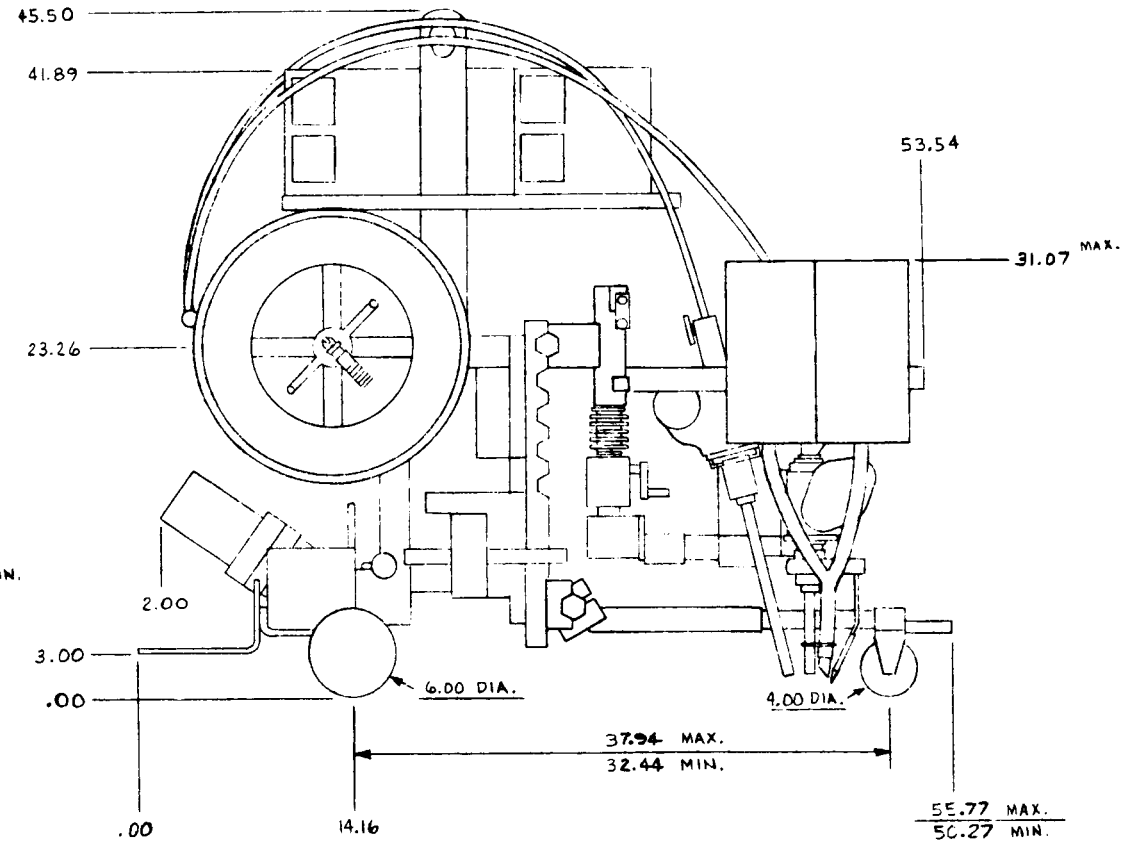
SCALE: N

DR. DEC DATE 10-28-76 CHK. SUP'S'D'G. (M-12730) SHT. NO. M-13456


M-13515
GND. TO FRAME OF POWER SOURCE
GROUNDING LEAD PROTECTOR
CONTROL POWER SWITCH
1CR
10K
POWER SOURCE OUTPUT CONTROL
563
539
4CR
CONTROL BOX FRAME
LIGHT RECEPTACLE (1 AMP MAX)
GND.
TRAVEL SPEED CONTROL
5K
TRAVEL DIRECTION SWITCH
TRAVEL P.C. BOARD
TRAVEL MOTOR
2.5 AMP CIRCUIT BREAKER
3 AMP CIRCUIT BREAKER
1/2 A. SLO-BLOW FUSE
AUTO
MANUAL
OFF
TRAVEL CONTROL SWITCH
2CR
2Ω
2/10 A. FUSE
WIRE FEED MOTOR
CONTROL P.C. BOARD
INCH UP
250Ω
LOGIC P.C. BOARD
WIRE FEED SPEED CONTROL
INCH DOWN
START
STOP
3CR
VARIABLE VOLTAGE P.C. BOARD
VM
AM
SHUNT
WORK
ELECTRODE TO POWER SOURCE
WORK TO POWER SOURCE
ELECTRICAL SYMBOLS PER E-1537
* 31-32 115 V AC, 50-60 HZ.
□ 2-4 OPERATES POWER SOURCE CONTACTOR
△ 21 TO #21 TERMINAL (OR WORK STUD) ON POWER SOURCE.
⊙ 75,76,77 TO LINCOLN POWER SOURCE OUTPUT CONTROL CIRCUIT
1CR CONTACTOR RELAY
2CR TRAVEL RELAY
3CR REED SWITCH (LOCATED NEAR SHUNT AND ACTUATED BY WELDING CURRENT.)
4CR REED SWITCH (LOCATED AT BOTTOM OF CONTROL BOX & ACTUATED BY FAULT CURRENT THROUGH GROUNDING LEAD TO POWER SOURCE FRAME.)
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.
DATE 3-22-77 SCALE
TYPE LT-5 SECTION OF LT-56 TRACTOR
SUBJECT CONNECTION SCHEMATIC
SUPSTD DWG (M-12230) DR
SHEET NO. M-13515

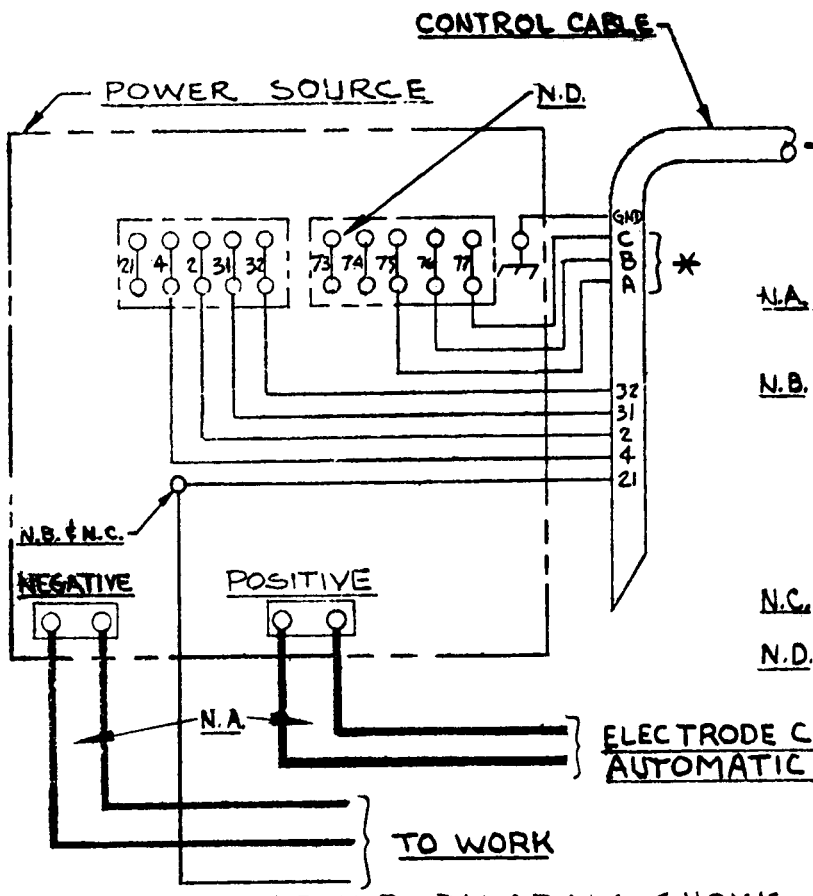
M-13765 | TIN: | DEPT 77





UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLE SIZES PER E-2056 ON 2 PLACE DECIMALS IS ± .03 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("Y") TO AGREE WITH PUBLISHED STANDARDS.	Ch'ge. Sht. No.					THE LINCOLN ELECTRIC CO. CLEVELAND, OHIO U. S. A.	EQUIP. TYPE LT-56 TRACTOR
	6-16-78						SUBJECT DIMENSION PRINT
	11-17-78C						
	4-6-79E						
	11-4-80A						
						DR. SCALE 1/2 DATE 5-1-78 CHK. SUP'SD.	SHT. NO. M-13765

S-15534



CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED ⏚ NEAR THE POWER SOURCE TERMINAL STRIP. THE POWER SOURCE MUST BE PROPERLY GROUNDED.

TO AUTOMATIC CONTROL BOX

*IF USING AN OLDER CONTROL CABLE: CONNECT LEAD #75 TO #75 ON TERMINAL STRIP, CONNECT LEAD #76 TO #76 ON TERMINAL STRIP, CONNECT LEAD #77 TO #77 ON TERMINAL STRIP.

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT AND DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.B. EXTEND LEAD 21 USING #14 OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S-16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION FOR CONVENIENCE, THIS EXTENDED #21 LEAD SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.C. TAPE UP BOLTED CONNECTION.

N.D. TERMINALS 73 & 74 NOT PRESENT ON EARLIER DC-1500.

ABOVE DIAGRAM SHOWS ELECTRODE CONNECTED POSITIVE. TO CHANGE POLARITY, TURN POWER SOURCE OFF, REVERSE THE ELECTRODE AND WORK LEADS AT THE POWER SOURCE AND POSITION THE SWITCH ON POWER SOURCE TO PROPER POLARITY. ALSO REVERSE THE LEADS ON THE BACK OF THE AMMETER AND VOLTMETER IN THE AUTOMATIC CONTROL BOX.

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLE SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("Y") TO AGREE WITH PUBLISHED STANDARDS.

Chge.	Sht. No.	
2-28-75	1-25-80	
10-10-75N	5-23-80	
6-18-76	2-26-82B	
2-24-78		
1-20-79A		

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.

EQUIP. TYPE CONNECTION OF NA-3, LT-5 OR LT-7 TO

SUBJECT IDEALARC DC-1000 & DC-1500

SCALE

DR GWR DATE 6-10-81 CHK SUPS'D'G 3-13-79 SHT. NO. S-15534

PRINTED

S-15602

AC-1200

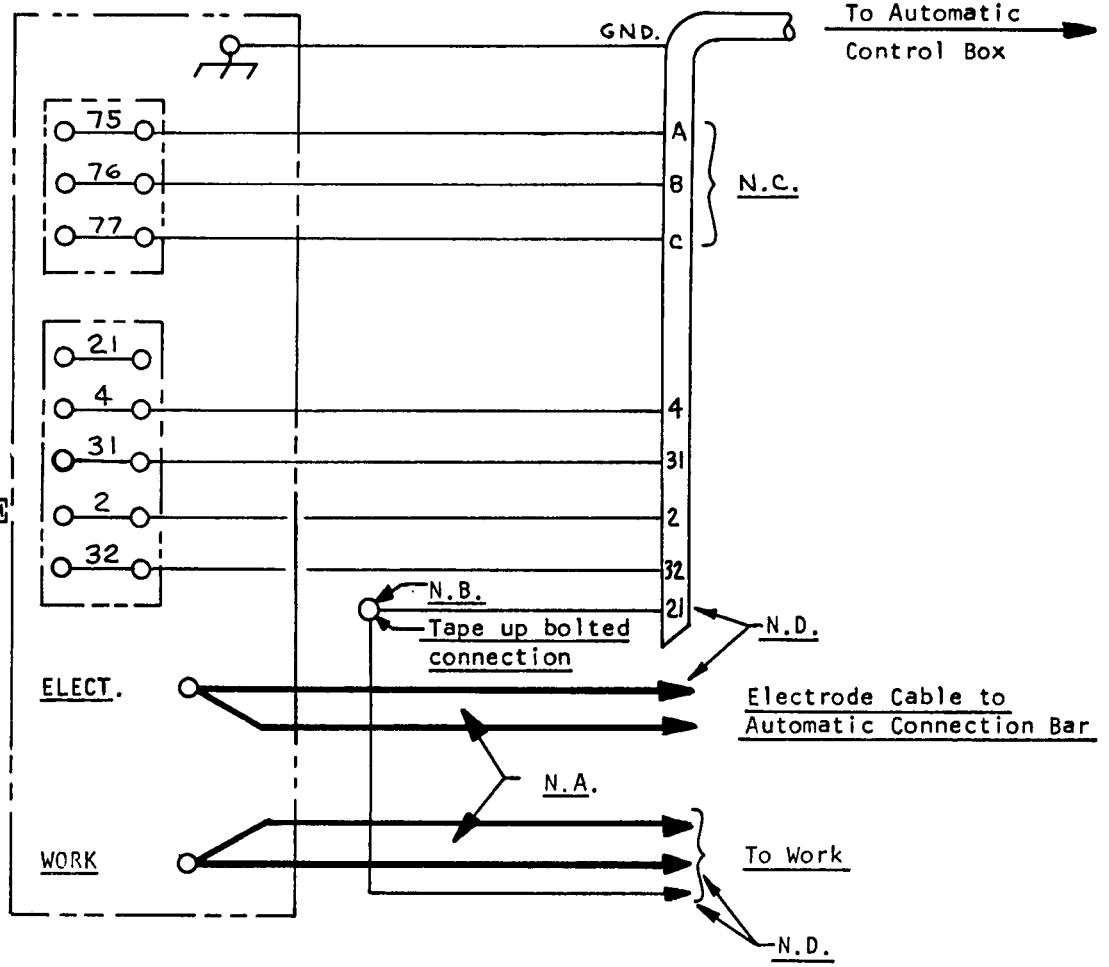
WARNING: Turn power source off before making these connections. Connect the control cable ground lead to the frame terminal marked ⏚ near the power source terminal strip. The power source grounding terminal (marked ⏚ and located near the power source input power connections) must also be connected to electrical ground per the power source Operating Manual.

N.A. Welding cables must be of proper capacity for the current and duty cycle of immediate and future applications. See the Operating Manual for proper sizes.

N.B. Extend lead 21 using #14 or larger insulated wire physically suitable for the installation. An S-16586-[LENGTH] remote voltage sensing work lead is available for this purpose. Connect it directly to the work piece keeping it electrically separate from the welding work lead circuit and connection.

N.C. If using an older control cable: connect lead #75 to #75 on terminal strip, connect lead #76 to #76 on terminal strip, connect lead #77 to #77 on terminal strip.

N.D. To avoid possible induced NA-4 or LT-6 meter reading error; keep the control leads, including the extended #21 lead separated from the A.C. welding cables by at least 12 inches.



UNLESS OTHERWISE SPECIFIED TOLERANCE ON HOLE SIZES PER E-2056 ON 2 PLACE DECIMALS IS ± .02 ON 3 PLACE DECIMALS IS ± .002 ON ALL ANGLES IS ± .5 OF A DEGREE MATERIAL TOLERANCE ("t") TO AGREE WITH PUBLISHED STANDARDS.	Ch'ge. Sht. No.	6-22-84H		
	3-7-75			
	6-18-76A			
	6-16-78A			
	4-20-79			
	1-25-80			

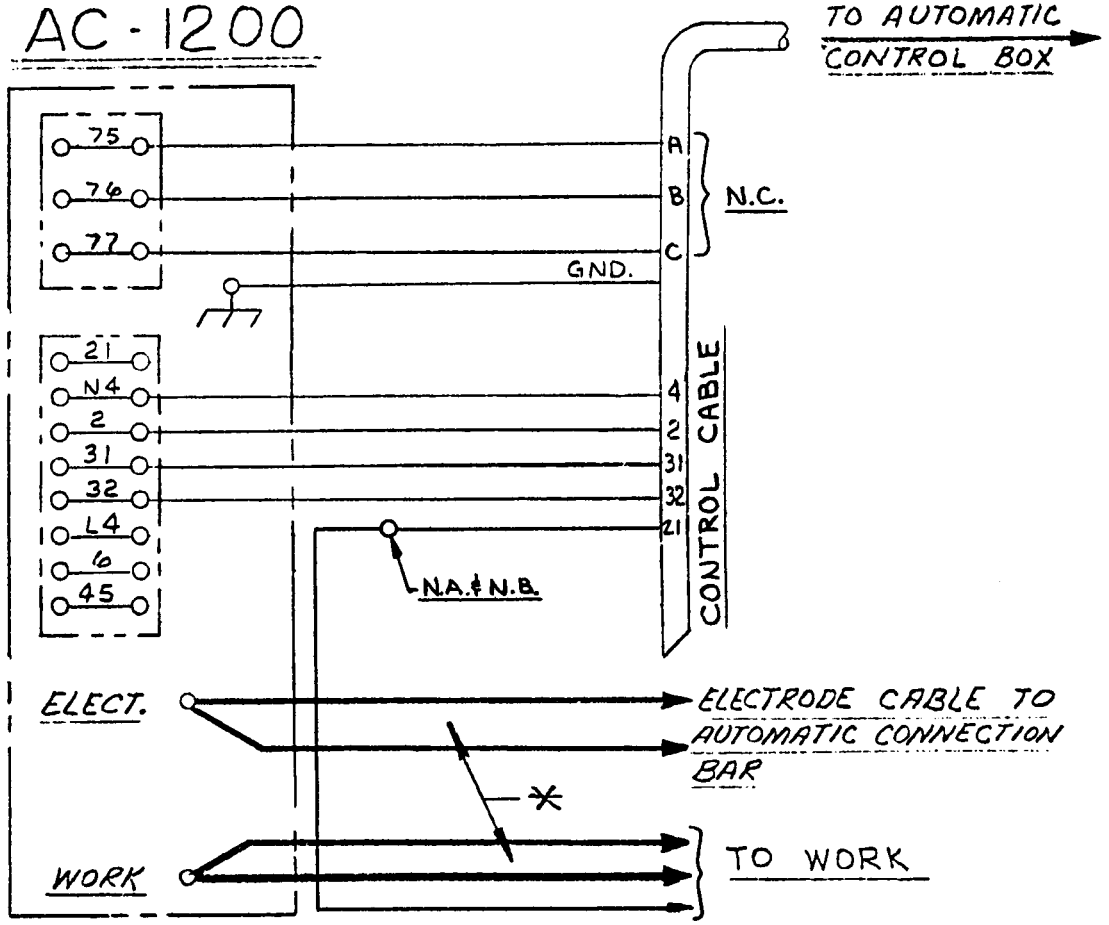
THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U. S. A.
SCALE —

EQUIP. TYPE Connection of NA-4 (Which has rheostat
SUBJECT for current control) or LT-6 to AC-1200

DR TJP DATE 9-22-83 CHK JRH SUP'S'D'G 3-13-79 SHT. NO. S-15602

E0951-S

AC-1200



CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED ⏚ NEAR THE POWER SOURCE TERMINAL STRIP.

THE POWER SOURCE MUST BE PROPERLY GROUNDED

* WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT & DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

N.C. IF USING AN OLDER CONTROL CABLE: CONNECT LEAD #75 TO #75 ON TERMINAL STRIP, CONNECT LEAD #76 TO #76 ON TERMINAL STRIP, CONNECT LEAD #77 TO #77 ON TERMINAL STRIP.

N. A. EXTEND LEAD 21 USING #14 OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S-16586-[ ] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION FOR CONVENIENCE, THIS EXTENDED #21 LEAD SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.B. TAPE UP BOLTED CONNECTION.

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLE SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("I") TO AGREE WITH PUBLISHED STANDARDS.

Ch'ge. Sht. No.			
3-7-75			
6-18-76A			
6-16-78A			
9-20-79			
1-25-80			

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U. S. A

SCALE

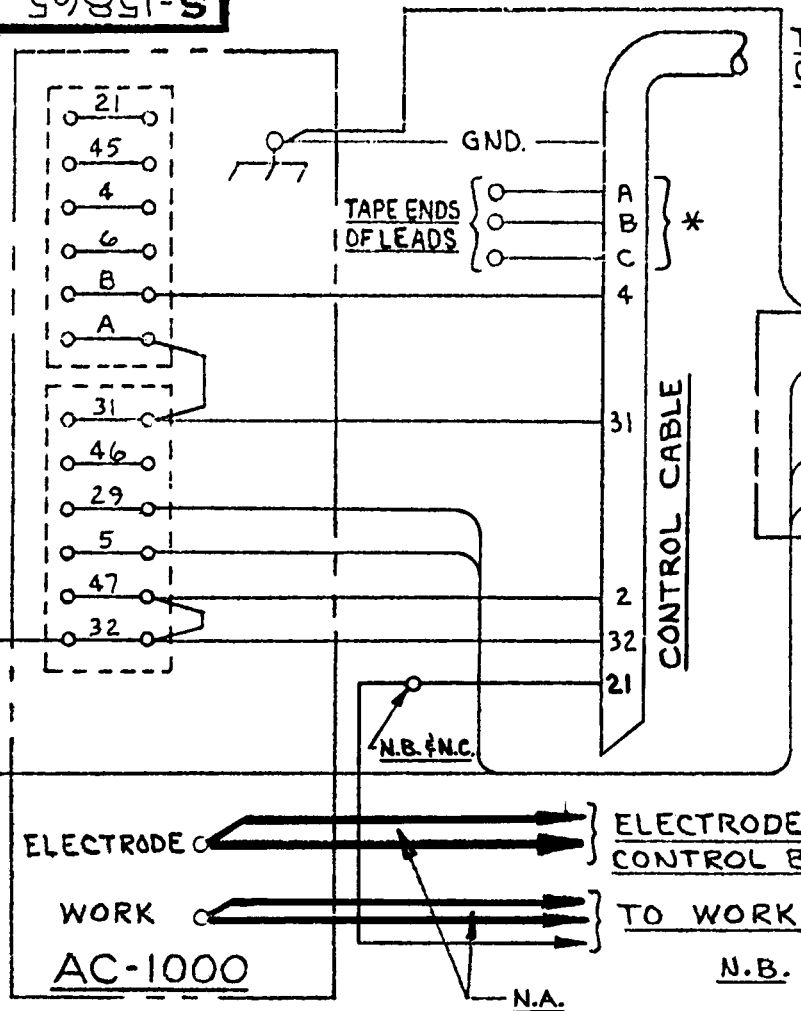
DR. GWR DATE 3-13-79 CHK SUP'S'D/C 11-6-74

EQUIP TYPE CONNECTION OF NA-4 (WHICH HAS RHEOSTAT FOR CURRENT CONTROL) OR

SUBJECT LT-6 TO AC-1200 WITH LT-34 & LAF-4 OPTIONS

SHT. NO. S-15603

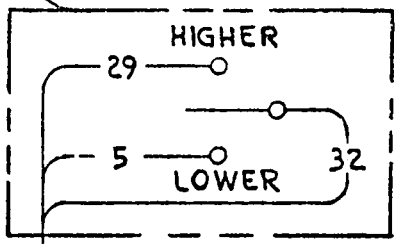
S-15865-S



TO AUTOMATIC CONTROL BOX

ALL THE CURRENT CONTROL RHEOSTATS ON THE CONTROL BOX WILL BE INOPERATIVE. TO AVOID OPERATOR CONFUSION THE KNOBS SHOULD BE REMOVED.

* IF USING AN OLDER CONTROL CABLE TAPE ENDS OF LEADS #75, #76 AND #77.



CURRENT CONTROL SWITCH

SPDT, CENTER OFF, MOMENTARY CONTACT TOGGLE SWITCH 10 AMP, 250 VAC RATING. (LINCOLN PART NO. S-9826)

SWITCH TO BE LOCATED IN SUITABLE GROUNDED ENCLOSURE AT AUTOMATIC CONTROL BOX. LEADS TO POWER SOURCE TO BE 18GA. OR LARGER.

ELECTRODE CABLE TO AUTOMATIC CONTROL BOX CONNECTION BAR

TO WORK

N.A. WELDING CABLES MUST BE OF PROPER CAPACITY FOR THE CURRENT & DUTY CYCLE OF IMMEDIATE AND FUTURE APPLICATIONS.

CONNECT THE CONTROL CABLE GROUND LEAD TO THE FRAME TERMINAL MARKED ⏚ NEAR THE POWER SOURCE TERMINAL STRIP OR TO AN UNPAINTED FRAME SCREW. THE POWER SOURCE MUST BE GROUNDED PROPERLY.

N.B. EXTEND LEAD 21 USING #14 OR LARGER INSULATED WIRE PHYSICALLY SUITABLE FOR THE INSTALLATION. AN S-16586-[illegible] REMOTE VOLTAGE SENSING WORK LEAD IS AVAILABLE FOR THIS PURPOSE. CONNECT IT DIRECTLY TO THE WORK PIECE KEEPING IT ELECTRICALLY SEPARATE FROM THE WELDING WORK LEAD CIRCUIT AND CONNECTION. FOR CONVENIENCE, THIS EXTENDED #21 LEAD SHOULD BE TAPED TO THE WELDING WORK LEAD.

N.C. TAPE UP BOLTED CONNECTION.

UNLESS OTHERWISE SPECIFIED TOLERANCE
ON HOLE SIZES PER E-2056
ON 2 PLACE DECIMALS IS ± .02
ON 3 PLACE DECIMALS IS ± .002
ON ALL ANGLES IS ± .5 OF A DEGREE
MATERIAL TOLERANCE ("M") TO AGREE WITH PUBLISHED STANDARDS.

Ch'ge. Sht. No.	1-25-80		
12-12-75 B			
6-18-76 A			
6-16-78 A			
8-20-79 A			
8-31-79 V			

THE LINCOLN ELECTRIC CO.
CLEVELAND, OHIO U.S.A.
SCALE

DR. GWR DATE 3-13-79

EQUIP. TYPE ONNECTION OF NA-4 (WHICH HAS RHEOSTAT
SUBJECT FOR CURRENT CONTROL) OR LT-6 TO AC-1000

SUP'S'D'G. 11-5-75

SHT. NO. S-15865

LIMITED WARRANTY

STATEMENT OF WARRANTY:

The Lincoln Electric Company (Lincoln) warrants to the original purchaser (end-user) of new equipment that it will be free of defects in workmanship and material.

This warranty is void if Lincoln finds that the equipment has been subjected to improper care or abnormal operation.

WARRANTY PERIOD:

All warranty periods date from the date of shipment to the original purchaser and are as follows:

Three Years:
Transformer Welders
Motor-generator Welders
Semiautomatic Wire feeders
Plasma-cutting power source
Engine Driven Welders (except engine and engine accessories) with operating speed under 2,000 RPM

Two Years:
Engine Driven Welders (except engine and engine accessories) with operating speed over 2,000 RPM

All engine and engine accessories are warranted by the engine or engine accessory manufacturer and are not covered by this warranty.

Equipment not listed above such as guns and cable assemblies, automatic wire feeders and field-installed optional equipment is warranted for one year.

TO OBTAIN WARRANTY COVERAGE:

You are required to notify Lincoln Electric, your Lincoln Distributor, Lincoln Service Center or Field Service Shop of any defect within the warranty period. Written notification is recommended.

WARRANTY REPAIR:

If Lincoln's inspection of the equipment confirms the existence of a defect covered by this warranty, the defect will be corrected by repair or replacement at Lincoln's option.

WARRANTY COSTS:

You must bear the cost of shipping the equipment to a Lincoln Service Center or Field Service Shop as well as return shipment to you from that location.

IMPORTANT WARRANTY LIMITATIONS:

- Lincoln will not accept responsibility for repairs made without its authorization.
- Lincoln shall not be liable for consequential damages (such as loss of business, etc.) caused by the defect or reasonable delay in correcting the defect.
- Lincoln's liability under this warranty shall not exceed the cost of correcting the defect.
- This written warranty is the **only** express warranty provided by Lincoln with respect to its products. Warranties implied by law such as the Warranty of Merchantability are limited to the duration of this limited warranty for the equipment involved.

LINCOLN ELECTRIC®

THE LINCOLN ELECTRIC COMPANY

World's Largest Manufacturer of Arc Welding Products • Manufacturer of Industrial Motors
Sales and Service Worldwide Cleveland, Ohio 44117-1199 U.S.A.
Toronto M4G 2B9 – Canada • Sydney 2211 – Australia • Rouen 76120 – France

Eff. Jan. '89 7-88 Litho in U.S.A.