INSTRUCTIONS for

MAGNETIC TRACERS

used on Oxweld

TRADE MARK

CUTTING MACHINES

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I. General Information

The magnetic tracer consists of two main parts: The Power-Supply, and the Tracer Head. Connecting cables, auxiliary switch, mounting bracket, etc., are supplied, providing a complete installation assembly.

A. Power-Supply

The Power-Supply is an electrical device which converts the alternating current (110-120 volts A.C., at 25 or 60 cycles) delivered by the shop power lines to low voltage direct current for use in energizing the electromagnet in the tracer head.

Cables for connecting the tracer head to the Power-Supply and the Power-Supply to the power line are supplied with the Power-Supply unit. Brackets and hardware for mounting the Power-Supply on the related cutting machine are supplied with the tracer head.

Two models of the Power-Supply are available: one for use on 25-cycle current and one for use on 60-cycle current. The physical difference between the two units is minor. The instructions which follow apply equally to both models.

Each Power-Supply is furnished with a remote control switch. This provides on-off control of the unit from a convenient operating position.

For replacement parts for the Power-Supply refer to Figure 43.

B. Tracer Head

The Tracer Head mounts in the normal tracer position in the machine drive unit. Essentially, it is an electromagnet. Its core is a rotatable shaft having a knurled roller at the lower end. When direct current is passed through the coil of the electromagnet, this core becomes energized and exhibits a strong magnetic attraction to iron and steel.

A steel or angle-iron templet, patterned to the shape of the desired cut, is positioned so that the knurled roller bears against the templet edge. When the drive shaft is rotated, the roller (held in firm contact with the templet by the magnetic attraction) rolls steadily along the edge of the templet. The cutting machine is thus caused to trace an accurate reproduction of the templet outline.

C. Remote Control Switch

The magnetic tracer power-supply is provided with a receptacle into which the plug on the connecting cable for the remote control switch may be inserted. The shunting switch in the power-supply unit cabinet, alongside the receptacle, should be turned to the "Remote Control - In" position when the remote control switch is used, or to the "Remote Control - Out" position if the remote control switch is omitted.

The remote control switch is provided with an 11-ft. length of three-conductor flexible cable for locating the switch at any point on the shape-cutting machine which is most convenient for the operator. In selecting a location, make certain that no interference will be encountered with the switch at any point in the travel of the machine. Make sure also that it will be possible to run the connecting cable from the switch to the power-supply unit so that it will not interfere with travel of the machine.

For example, if the switch were mounted on the front truck of the lower carriage of the CM-23 machine, provision must be made to support the cable in such manner as to accommodate the slack resulting from movement of the power-supply unit, which is located on the upper carriage. Suggested locations for installing the switch are given in the instructions which follow. Certain machines are supplied with mounting holes drilled at these locations.

In some cases the cable from the power-supply unit to the auxiliary switch can be run inside of the body of the machine and the switch can be installed and connected as shown in Figure 9. In other cases the cable may be run externally and can be connected into the switch box, as shown in Figure 8.

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II. Magnetic Tracer Installation Procedure

A. CM-15-18 and CM-15-36 Cutting Machines

![Diagram of the magnetic tracer for CM-15 Machines]

Fig. 1 - MAGNETIC TRACER for CM-15 Machines


(a) Disconnect the cutting machine from the shop power line.

(b) Install the Power-Supply mounting bracket on the machine chassis as shown in Figure 2. Four tapped holes are provided for this purpose at the rear of the chassis. (NOTE: In CM-15-18 machines bearing serial numbers up to 440786, these tapped holes are not provided. On these machines it will be necessary to drill and tap four 1/4-inch-20 holes for the attaching screws. The mounting bracket may be used as a templet for locating the holes.)

![Diagram of wiring connections and mounting bracket]

Fig. 2 - WIRING CONNECTIONS AND MOUNTING BRACKET - CM-15 Machines

(c) Attach the Power-Supply base plate (Figure 3) to the bottom of the Power-Supply unit, using four of the 10-24 x 1/4-inch filister head screws supplied.

![Diagram of installing power-supply]

Fig. 3 - INSTALLING POWER-SUPPLY - CM-15 Machines

(d) Mount the unit on its bracket, as shown in Figure 3, using four of the 10-24 x 1/4-inch filister head screws supplied.

(e) On the top of the machine chassis, alongside

![Diagram of inserting power-supply cable]

Fig. 4 - INSERTING POWER-SUPPLY CABLE - CM-15 Machines
Fig. 5 - POWER-SUPPLY PLUG CONNECTIONS - CM-15 Machines

the power cable bushing, is a plugged hole. Remove the plug and insert in its place the strain-relief bushing which is furnished with the Power-Supply, as indicated in Figure 2. (See also Figure 4.) Fasten it in place with the locknuts provided.

(NOTE: In CM-15-18 machines bearing serial numbers up to 440786 there is no plugged hole in the chassis. On these machines it will be necessary to drill a 43/64-inch hole for the strain-relief bushing.)

(f) Insert the Power-Supply cable through the bushing as shown in Figure 4.

(g) Pull the cable through underneath the chassis, and connect the three leads as shown in Figure 2. The green wire goes to the ground con-

Fig. 7 - INSTALLING CM-15 MAGNETIC TRACER HEAD

nection, the white wire to the lower end of one fuse mount (either one will do), and the black wire to the lower end of the other fuse mount.

(b) Insert the plug on the Power-Supply cable into the matching receptacle in the Power-Supply unit. (See Figure 5.)


NOTE: Before installing the Tracer Head on CM-15-18 machines bearing serial numbers up to 440786, it will be necessary to convert the drive barrel. Instructions for converting the drive barrel are packed with the conversion kit (Part No. 20V55).

(a) Remove the line tracer assembly from the machine as follows:

(i) Lower the tracer so that it contacts the table.

(ii) Remove the lower boot retaining spring (Figure 6).

(iii) Raise the boot and remove the three screws holding the line tracer in place.

(iv) Raise the loosened tracer assembly to bring the drive barrel to the uppermost position, and allow the plunger of the stop assembly to drop into place.

(v) Lower the tracer assembly and its traction spring from the end of the drive barrel. Remove the leather boot also.

(b) With the drive barrel in its highest position, place the magnetic tracer head under it.

(c) Line up the key on the drive barrel (Figure 7) with the keyway in the sleeve of the tracer head, as shown in the Figure.

(d) Raise the tracer head into position. It may be necessary to rotate the knurled roller at the bottom of the tracer head, so that the
cross-pin (Figure 7) in the roller shaft will align with the slot in the drive barrel shaft.
(e) Insert the three mounting screws to hold the tracer head in place.
(f) Run the tracer head cable along the hose loop from the transverse arm to the rear of the chassis. Tape the cable to the hose.
(g) Cut the cable to the required length.
(h) Attach the plug to the cable.
(i) Insert the plug in its matching receptacle in the power-supply.

3. THE REMOTE CONTROL SWITCH

(a) Installing the Remote Control Switch on the CM-15-18 Cutting Machine

On the CM-15-18 machine the suggested location for the switch is on the transverse arm, between the tracer head and the pivot joint on the torch side of the machine.

To install the switch assembly proceed as follows:

(i) Insert the plug on the end of the three-wire cable (supplied with the switch) into the matching receptacle in the power-supply unit cabinet.
(ii) Run the wire from the plug up along the hose loop to the transverse arm, taping the wire to the hose to hold it in place.
(iii) Using the switch box as a template, mark on the transverse arm the locations for the two No. 10-24 tapped holes for the attaching screws. Drill and tap the holes, using a No. 25 drill (.1495-in. diam.).

(iv) Remove the switch from the switch box.
(v) Drill a 9/16-in. diam. hole in the "ON" end of the switch box (centrally located), and tap to a 3/8-in. tapered pipe thread. Tap the thread just deep enough to engage the threads on the end of the strain relief bushing. Care must be taken to try the threads frequently as the hole is tapped, so that the end of the bushing will not project more than 1/16-inch inside the switch box when it is screwed in the hole. (See Figure 8.)
(vi) Cut the cable to length, leaving sufficient excess for making connections to the switch.
(vii) Connect the cable to the switch. Then replace the switch in the switch box. Refer to Figure 8. Make sure that the fiber insulator is in place. The locating washer must be so assembled that the switch cannot turn in the box.
(viii) Attach the switch box to the transverse arm, using the two No. 10-24 round-head screws supplied.

(b) Installing the Remote Control Switch on the CM-15-36 Cutting Machine

The suggested location for the remote control switch is on the top of the transverse arm, on the torch side of the machine. Concealed wires are provided in the chassis and arm for connecting the switch. To use these wires, the switch must be located between the drive head and the pivot joint on the torch side of the transverse arm. Installation is as follows.
Fig. 9 - Remote Control Switch Installation - Cable Inside of Chassis

(i) At the point where the switch is to be located, drill a 3/4-in. diam. hole in the transverse arm.
(ii) Pull the loose ends of the blue wire and the yellow wire in the tracer arm out through the hole.
(iii) Insert the rubber grommet in the hole around the wires.
(iv) Place the switch box over the grommet and use it as a template for marking the locations for the two No. 10-24 holes for the attaching screws. Drill and tap the holes as located. Use a No. 25 drill (.1495-in. diameter).
(v) Connect the blue wire and the yellow wire to the switch terminals. See that the fiber insulator is in place and that the locating washer is so assembled that the switch cannot turn in the box. (See Figure 9.)
(vi) Attach the switch box in place with the No. 10-24 round head screws supplied.
(vii) Remove the plug from the hole in the top of the chassis of the machine, near the power-supply cable connection. Remove the shield from the bottom of the chassis. Insert the strain-relief bushing in the hole, fastening it with one locknut on top of the chassis and one underneath.
(viii) Insert the plug on the three-wire cable into the matching receptacle in the power-supply unit cabinet.
(ix) Pass the free end of the cable down through the strain-relief bushing and cut the cable to length. Splice the two live leads (the black lead and the white lead) to the free ends of the blue wire and the yellow wire under the chassis. Cover each splice with friction tape. The grounding lead in the three-wire cable is not used in this installation and may be cut off short.
B. CM-23, CM-23-V, and CM-23 (Series 3) and (Series 4) Cutting Machines

1. INSTALLING THE POWER-SUPPLY ON CM-23, CM-23-V AND CM-23 (SERIES 3) AND (SERIES 4) CUTTING MACHINES

NOTE: There are several versions of the CM-23 style machines in the field. Installation for the magnetic tracer head and Power-Supply varies according to the model of the machine.

The instructions which follow apply only to the late-model CM-23-V and the CM-23 (Series 3) and (Series 4) Cutting Machines. For earlier model machines (not converted to the later type), a copy of "Installation Instructions, Magnetic Tracer Assembly for OXWELD CM-23 and CM-23-V Shape-Cutting Machines" (F-5531-C) should be ordered.

For a means of quickly distinguishing between machines, refer to Figure 11. Note the turntable lock and the magnetic tracer rotational lock. For machines equipped with both these locks, follow the instructions below. For all others, follow the instructions given in the above-mentioned booklet.

(a) Bolt the Power-Supply mounting bracket to the rear of the upper carriage as shown in Figures 12 and 13. Tee bolt clamps are supplied for this purpose (Figure 10).

(b) Fasten the Power-Supply unit to its base plate (Figure 10) using four of the 10-24 x 1/4-inch fillister head screws supplied.

(c) Fasten the unit to its mounting bracket, using the four 10-24 x 1/4-inch fillister head screws supplied.

(d) On the top rear of the upper carriage, a short distance in front of the vertical post, is a 3/8-inch pipe plug in a tapped hole. Remove this plug and insert in its place the strain-relief bushing furnished with the Power-Supply (Figure 10).

(NOTE: Early model machines may not have this tapped hole. On these machines it will be necessary to drill and tap a 3/8-inch hole for the bushing, in this case.)

(e) Insert the three-wire power cable into the bushing and pull it through inside the carriage body (Figure 13).

(f) Connect the three power cable leads as shown in the diagram in Figure 13.

2. INSTALLING THE TRACER HEAD ON CM-23-V AND CM-23 (SERIES 3) AND (SERIES 4) CUTTING MACHINES

(For installation on earlier models of the CM-23, see "Installation Instructions, Magnetic Tracer Assembly, for OXWELD CM-23 and CM-23-V Shape-Cutting Machines," Form 5531-C.)

(a) Remove the line tracer assembly, if it is installed. If the templet tracer assembly is (Continued on Page 9.)
Fig. 13 - POWER-SUPPLY CONNECTIONS - CM-23 Machines
(Continued from Page 7.)

installed, it may be raised to the locked position and left in place, if desired. In cases where it is seldom used, it may be advisable to remove it to obtain greater clearance under carriage.

(b) Install the side mounting bracket on the machine, if it is not already in place. (See Figure 11.)

(c) Remove the upper spring-guide ring by loosening the three socket head setscrews which hold it in place (Figure 14).

(d) Insert the magnetic tracer head in the turntable platform sleeve. The tracer head should be inserted as far as possible and locked in place by means of the rotational lock knob (Figure 15).

(e) Place the drive unit assembly on the turntable so that the lifting cam post is in line with the lifter lug on the magnetic tracer. The guide roller on the turntable should engage the key slot in the magnetic tracer floating bar on the side opposite the drive lifter lug. See that the jaws of the turntable rotational lock are opened and centered so that they are clear of the slot. This will permit the drive unit to seat squarely on the turntable.

(f) Insert the lifting lever in the lifting lever post. Make sure that the fork engages the lifter lug on the magnetic tracer.

(g) Insert and screw in the short lifting lever thumbscrew.

(h) Assemble the two adjusting setscrews (Figure 10) to the lifting cam lever supplied with the Magnetic Tracer Assembly. Then screw the two 1/4-in. -20 hex locknuts onto the adjusting setscrews. These setscrews provide adjustment to bring the tracer head to the proper height above the table top in the lowered position. The extra lifting lever cam is supplied so that it will not be necessary to remove the adjusting setscrews when changing back to hand tracer or template tracer operation. Installation of the appropriate lifting lever cam allows rapid change-over from one mode of operation to another.

Note that the rotational lock knob must be loosened before raising or lowering the magnetic tracer head or rotating the drive unit. With the rotational lock knob loosened, the drive unit may be rotated to any convenient position. When the tracer head is lowered into position for tracing, the rotational lock should be tightened to prevent wobble or lost motion.

(i) Move the front and rear hinge stops on the lower carriage to the inward position.

(j) The tracer head power cable is now cut to desired length. The cable is passed across the upper carriage and supported in a suitable manner to prevent its rubbing against the upper carriage rails.
3. INSTALLING THE REMOTE CONTROL SWITCH ON CM-23, CM-23-V AND CM-23 (SERIES 3) AND (SERIES 4) CUTTING MACHINES

The suggested location for the remote control switch is: on the side or top of the upper carriage body, at the front end, just ahead of the front control rod post. (See Figure 16.) Installation is as follows:

(a) The switch connecting cord is run from the power-supply unit through the upper carriage body, to a point just forward of the cutting oxygen valve. Here it is brought out and runs externally. (This is to avoid interference with the extension tube in the upper body.) Drill a 3/4-in. hole at this location as shown in Figure 16.

(b) Install the supplied grommet in the hole.

(c) Pull the cable through the grommet so that the end of the cable reaches the front end of the upper carriage body.

(d) Referring to Fig. 6 and Par. 3a, Items i to viii under the CM-15-18 machine (Page 5), provide a threaded hole in the switch box for the strain-relief bushing.

(e) Using the switch box as a templet, locate the holes for its mounting screws. Drill and tap the holes for No. 10-24 screws.

(f) Connect the cable to the switch as shown in Figure 8. Make sure that the fiber insulator is in place. The locating washer must be so installed that the switch cannot turn in the box.

(g) Fasten the switch box in place. Insert the plug in its matching receptacle in the power-supply unit.

4. ADJUSTING THE HEIGHT OF THE MACHINE TABLE RAILS

This adjustment is required only on CM-23 and early CM-23-V installations. The procedure is explained in Section II-D-1, Page 13.

CM-41 Cutting Machine

1. INSTALLING THE POWER-SUPPLY ON CM-41 CUTTING MACHINES

(a) As shown in Figure 17, assemble the right and left-hand brackets to the bottom-cover plate, using four of the small nuts and bolts supplied. Use a washer under the head and under the nut on each bolt.

(b) Bolt the Power-Supply to the above assembly, using the four nuts and bolts supplied. Use a washer under the head and under the nut on each bolt.

(c) Remove the electrical control box cover from the cutting machine by unscrewing the twelve screws which hold it.
(d) Set the Power-Supply assembly on top of the control box cover, so that the front edge of the bottom-cover plate is even with the back edge of the cover. (See Figure 19 for the position the assembly will occupy on the cover.) This will place the front of the Power-Supply about three inches back from the front of the control box cover.

(e) From the brackets, mark the location for the four holes on each end of the control box cover.

(f) Remove the Power-Supply assembly. Then drill and tap the eight holes for #10-24 screws.

(g) Replace the control box cover on the cutting machine, and fasten it in place with its twelve mounting screws.

(h) Mount the Power-Supply assembly on the control box cover and fasten in place with the eight #10-24 screws supplied.

(i) As shown in Figures 18 and 19, drill a 9/16-inch hole at the rear of the upper carriage. The location is to the right of the machine power receptacle, approximately 2-1/2-inches, center-to-center from the receptacle.

(j) Withdraw the two screws which hold the machine power receptacle in the carriage.

(k) As shown in Figure 19, pull out the receptacle. Do not detach the wires.

(l) Slide a rubber grommet onto the Power-Supply power cable. This cable is furnished with the Power-Supply. It is a 3-wire cable with one free end, and a female plug attached to the other end. This plug fits the 3-blade male receptacle on the Power-Supply.

(m) Insert the free end of the cable through the drilled hole in the carriage. Then pull it up through the hole from which the power receptacle was withdrawn. (See Figure 19.)

(n) Push the grommet into the drilled hole until it seats itself in place.

(o) As shown in Figures 19 and 20, wire the three cable leads to the back of the receptacle.

(p) Press the power receptacle back into its hole in the carriage and secure it with its two screws.

- Fig. 18 - Locating Power-Supply Cable - CM-41 Machine

- Fig. 19 - Connecting Power-Supply Cable - CM-41 Machine

(q) Insert the Power-Supply cable plug into the receptacle on the right side of the Power-Supply. (See Figure 18.)

2. INSTALLING THE TRACER HEAD ON CM-41 CUTTING MACHINE

(a) Release the knurled screw (Figure 21) that locks the yoke pivot shaft. While supporting whichever tracer assembly is in the drive head, remove the yoke pivot shaft. Then free the yoke from the drive unit housing.

(b) Withdraw the tracer assembly and its traction spring from the drive unit sleeve (Figure 21).

(c) Remove the cotter pin which holds the short shaft (Figure 21) connecting the lifting handle to the yoke clevis.

- Fig. 20 - Electrical Connections for Power-Supply Cable - CM-41 Machine
(d) Pull out the short shaft, thereby disengaging the clevis from the lifting handle.
(e) Install the magnetic tracer yoke and clevis (supplied with the magnetic tracer assembly).
(f) Reinsert the short shaft and replace its retaining cotter pin.
(g) As shown in Figure 22, insert the magnetic tracer head in the drive unit sleeve, carefully lining up the key on the tracer head barrel with the keyway in the sleeve.

Positive engagement must exist between the pin drive shafts inside the sleeve and the two ferrule shafts in the barrel of the tracer head. When properly engaged, the tracer head will slide freely up and down in the sleeve. If any difficulty is met in engaging the pin drive, turn the knurled roller of the tracer head (Figure 22) while lifting the head. Should the tracer head come in contact with the upper carriage rail frame, rotate the head until it clears the frame.
(h) Supporting the magnetic tracer head with one hand, insert the yoke between the yoke bearings (Figure 22) on the drive unit housing. Make sure that the slot in the yoke (see Figure) engages the locating key on top of tracer head coil housing.
(i) Replace the yoke pivot shaft and tighten its knurled locking screw.

With the lifting handle locked in the raised position, the top of the coil housing should touch the bottom of the drive unit sleeve. If it does not, remove the short shaft connecting the clevis to the lifting handle. Then loosen the locknut on the clevis, unscrew the clevis enough to obtain the right length, and retighten the locknut. Replace the yoke pivot shaft and retighten the knurled locking screw.

If the lifting handle does not lock in the raised position, yet the top of the coil housing is against the bottom of the drive unit sleeve, disconnect the clevis and shorten it.

(j) Cut the magnetic tracer cord to the desired length.
(k) Insert the plug into its matching receptacle on the magnetic tracer power-supply.

3. INSTALLING THE REMOTE CONTROL SWITCH ON CM-41 CUTTING MACHINE

On these machines the switch can be located on the forward end of the upper carriage, just back of the rearmost position of the tracing unit front lifting lever. See Figures 9 and 23. Installation is as follows:

(a) Drill a 9/16-in. diam. hole through the wall of the upper carriage body, in a suitable location for passing the switch cable into the body. Tap the hole to a 3/8-in. tapered pipe thread for the strain-relief bushing. (Refer to Figure 23.)
(b) Drill a 3/4-in. diam. hole at the switch position as shown in Figure 23. Insert the supplied rubber grommet in the hole.
(c) Place the switch box over the grommet, so that the forward edge of the "ON" end of the box is 1-1/4-inches from the centerline of the 3/4-in. hole. Locating from the switch box, drill and tap two No. 10-24 holes for attaching screws.
(d) Insert the plug on the three-conductor cable supplied with the switch into the matching receptacle on the power-supply unit.
(e) Draw the three-conductor cable through the upper carriage body and into the switch box, as shown in Figures 9 and 23. Be sure that the fiber insulator is in place in the switch box. The locating washer must be so assembled that the switch cannot turn in the box.
(f) Attach the switch box in place with the round-head screws supplied.
D. Adjusting the Height of the Table Rails for Magnetic Tracing

Adjustment of table rail height is necessary only on CM-23, and early CM-23-V Cutting Machines. No adjustment is necessary on the following: CM-15-18, CM-15-36, late CM-23-V, CM-23 (Series 3), and (Series 4), and CM-41 Cutting Machines.

1. RAIL HEIGHT ADJUSTMENT FOR CM-23 CUTTING MACHINES

(NOTE: The following instructions apply only to the earliest model of the CM-23 and to those which have been modernized into a CM-23-V in the field by means of a Conversion Kit. For identification, refer to Figure 11. The machines covered by the instructions below are those which do not have the turntable lock screw nor the magnetic tracer rotational lock on the side mounting bracket.)

A magnetic templet height of 13/16 to 7/8-in. is assumed.

For these models the tracing table rails should be raised to bring their top surfaces 5/16-in. above the surface of the table plate. Ordinarily, when the rails for these machines were installed, they were located with their top surfaces level with the surface of the table plate. In some cases, however, the rails were installed in a higher position. If the rails have been raised to a height greater than 1/2-in. above the surface of the table plate, magnetic templets of an over-all height greater than 7/8-in. should be used. As an alternative, a dummy plate of suitable thickness can be laid down on the existing table plate, under the magnetic templet.

2. RAIL HEIGHT ADJUSTMENT FOR EARLY CM-23-V CUTTING MACHINES

(NOTE: For identifications of the early CM-23-V machine, refer to Figure 11. The machines covered by the instructions below are those which are equipped with the magnetic tracer rotational lock shown in the figure, but do not have the turntable lock shown.)

A magnetic templet height of 13/16 to 7/8-in. is assumed.

On these machines the table rails should be raised to bring their top surfaces 1/8-in. above the surface of the table plate. Ordinarily, when the table rails for these machines were installed, they were located with their top surfaces 3/16-in. below the surface of the table plate. In some cases, however, the rails were installed in a higher position. If the rails have been raised to a height greater than 5/16-in. above the surface of the table plate, templets of an over-all height greater than 7/8-in. should be used. As an alternative, a dummy plate of suitable thickness can be laid down on the existing table plate, under the magnetic templet.
III. How to Prepare Magnetic Templet for OXWELD Cutting Machines

A. Size of Templet

In shape-cutting with the magnetic-tracer assembly, the centerline of the cutting nozzle follows the same path as the center of the magnetic-tracer roller in its path around the templet. The templet used, therefore, must be of the same shape as the part desired but larger or smaller by an amount sufficient to allow for (1) the radius of the magnetic-tracer roller\(^*\), (2) the width of metal removed during cutting, or kerf width, and (3) any stock necessary for finishing.

These three factors increase or decrease the size of the templet, depending upon (a) whether the tracing roller is to move outside or inside the templet and (b) whether the part desired is the shape cut out or the piece in which the hole is cut.

"Outside" and "Inside" Templets

An outside templet is one in which the magnetic-tracer roller engages the outside edge of the shaped templet, see Figure 25.

An inside templet is one in which the magnetic-tracer roller engages the inside edge of the shaped templet, see Figure 26.

Because the path of the center of the roller around the templet gives the actual shape of the cut, an outside templet must be smaller than the desired shape at all points by the radius of the roller, and an inside templet must be larger than the desired shape at all points by the radius of the roller.

Square and Round Corners

When a roller travels around a square outside corner on a templet (see Figure 25), the centerline of the roller turns the corner in a curved path. The radius of the path is equal to the radius of the roller being used. Consequently, the minimum radius turn that can be made on an outside corner of the templet is equal to the radius of the roller. Small diameter rollers are available for use when small radius turns must be made on templets with outside corners.

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\* See page 18 to determine the correct size roller to use.

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**Fig. 24 - Average KERF WIDTHS for OXWELD Cutting Nozzles**
On a templet with inside square corners, these corners can have a radius slightly larger than the radius of the roller. Then the centerline of the roller will follow a path as shown in Figure 26, tracing a square corner on the workpiece.

Where it is required to cut a square corner, a templet design which incorporates the corner as an inside corner can be used.

An alternate method of producing a square corner cut is by means of a gated templet, as shown in Figures 35 and 36.

An outside templet is always required to trace an inside square corner, see Figures 28 and 29.

An inside templet is always required to trace an outside square corner, see Figures 30 and 31.

**Kerf Allowance**

The entire kerf width must fall within the scrap material in order to produce the exact shape required. Therefore, if the shape being cut out is desired, the entire kerf must come from the material outside of it, and the templet must be larger at all points than the desired shape by one-half the kerf width. If the piece in which the hole is cut is desired, the templet must be smaller at all points by one-half the kerf width.

**Allowance for Finishing**

Any extra stock necessary for finishing is allowed for in the same way as the kerf since it is also waste material.

As a guide in making allowance for kerf width, the kerf width obtained with different sizes of nozzles is given in Figure 24. The kerf widths are average and are included to serve only as a guide. Where exact dimensions are required in the finished cut design, it is advisable to make trial cuts on the same material of the same thickness, using the same nozzle as will be used in the cutting operation. The width of the kerf produced on the trial cut is then used as a standard in laying out the templet.

**B. Layout of Templet**

In laying out the first templet, it is helpful to make the allowances separately for the roller radius, kerf width, and extra stock for finishing where necessary.

For example, the outline of the shape desired is represented by the dotted line in Figure 27. This may be drawn directly on the plate material. This shape has an outside right angle, so an inside templet is required; therefore, the roller radius is added to the templet outline at all points, as shown by the dash line in Figure 27. Next the kerf width must be allowed for, and since the part desired here is the shape to be cut out, the templet must be made larger at all points by one-half the kerf width as shown by the solid line in Figure 27.

This solid line is the final templet size unless stock is needed for finishing, in which case that too is added to the templet outline at all points. Since
the roller cannot follow into the sharp inside corners of the templet, the templet corners must be rounded with a radius at least 1/64-in. greater than the radius of the roller. Four typical examples of templet layouts, in which these individual steps of size allowance are combined are given in Figures 28, 29, 30 and 31.

**Treatment of Inside and Outside Templets**

In Figure 28 the outside templet is required because of the inside right angle. Since it is an outside templet and the piece in which the hole is cut is desired, the templet is smaller than the shape desired at all points by an amount which is obtained by adding one-half the kerf width to the roller radius. At the sections of the templet that will produce the square corner, the radius should be 1/64-in. larger than the roller radius to prevent stalling, jerking, or slippage.

In Figure 29 an outside templet is required to get the same square corner as in Figure 28, but here the piece cut out is to be saved. The kerf correction is opposite, and the templet is smaller at all points by an amount which is obtained by subtracting one-half the kerf width from the roller radius. Again the radius for the square corner is made 1/64-in. larger than the roller radius.

Figure 30 shows a square-cornered hole to be cut in a piece of material, in which case an inside templet is required to cut the outside square corners. This templet is made larger than the desired shape at all points by an amount which is obtained by subtracting one-half the kerf width from the roller radius. At the sections of the templet that will produce the right angle the radius should be 1/64-in.

Figure 31 also shows a square-cornered piece to be cut, but since the square-cornered piece is desired in this case, the templet is larger at all points by an amount which is obtained by adding one-half the kerf width to the roller radius.

Frequently, the shapes are not so limiting as those described, and either inside or outside templets can be used. In such instances the preference of the customer or the tooling limitations must be considered.

**Templet Corners**

As mentioned above, a square corner can be traced from a templet with inside corners. Care must be taken in laying out the corner profile in the templet so that the magnetic tracer roller will not “hang up” in the corner. If the roller comes in contact with the templet at two different points in its periphery in such manner that it must pull out of contact with one of the points in order to continue travel, and if the magnetic attraction at both points is about equal, the roller will hang up. This will occur if the inside corner radius of the templet is equal to or less than the radius of the roller. See Figure 32. This condition is prevented by making the radius of the templet corner at least 1/64-in. larger than the radius of the templet roller. Then the roller cannot touch at two places at once. This
Direction of Machine Travel

It may be noted that the direction of travel of the machine for a given direction of rotation of the tracer roller is different for inside and outside templets. Thus, if a particular direction of travel is required and the drive motor is non-reversible, the desired direction of travel can be secured by choosing one or the other of these templet types. (Assuming that the type of templet is not dictated by other considerations, such as square corner requirements.)

C. Templet Material

In order to complete effectively the magnetic path, the templet should be of low-carbon or "soft" steel, such as S.A.E. 1010 to 1020.

To obtain maximum pull, the templet should be made from a steel plate about 1/2-in. thick.

D. Making Templets

Templets made from steel plate may be cut out with an oxy-acetylene cutting torch. The templet may be used just as it is cut out or machined to obtain greater accuracy of finished cuts.

Templets for ordinary use may also be cut out with a contour saw. Where extremely accurate cuts are desired, the templets may be ground or milled to closer dimensions.

Templets can be made from angle iron (formed to shape) and riveted to a 1/16- or 1/8-in. thick sheet steel base or fastened to supporting spacer blocks (see Figure 34). Such templets are used where weight and economy are important factors.
E. Care of Templets

The accuracy of any cut with the magnetic tracer may depend upon the accuracy of the templet layout and the condition which the templet is in at the time of the cutting operation. The edges of the templet should be kept clean since dirt or nicks on the tracing surface affect the accuracy of the cut.

If the templets must be stored and used again, grease applied to the edges will prevent rust. Care should be taken not to bend or nick the templet in moving.

F. Attaching Templets

Plate-type templets can be fastened to prevent slipping, either by bolting or by clamping them to the table top with suitable hold down bars. A method that is frequently satisfactory for small plate-type templets consists of bolting or riveting to the underside of the templet a spacer consisting of a solid steel plate. This spacer plate must be smaller than the templet all around by approximately 1/4-in. to provide clearance for the roller. It should never be less than 5/16-in. thick. Generally the weight of such a templet is sufficient to prevent movement without bolting.

Templets made from angle iron riveted to sheet steel base or fastened to supporting spacer blocks are also heavy enough in some cases to prevent movement without bolting. If the templet is small, however, it may be clamped to the cutting-machine table.

Spacers. Four standard types of magnetic-templet setups are illustrated in Figure 34 and the approximate dimensions recommended for use in their construction are given. When templets are made from 1/2-in. plate, they are generally mounted on spacers at least 5/16-in. high to allow the magnetic-tracer roller sufficient clearance above the table top. However, the height of the spacers will vary in accordance with the height of the magnetic-tracer assembly above the table top, and with the thickness of the templet material as Figure 34 shows. To avoid an objectionable decrease in the magnetic full, the height of the spacers should never be less than 1/4-in., and if the templet plate is thinner than 1/2-in. the height of the spacers will increase. In this way the total height of the templet, including templet thickness, spacer thickness and base plate if used, should be 7/8-in. (except where 3/4-in. angle iron are mounted on a base plate as shown in Figure 34, setup C, when the total height is 13/16-in.).

As Figure 34 also shows, the distance between the bottom of the magnetic tracer coil housing and the top of the templet should be held to approximately 1/8-in. This dimension is a compromise between the clearance necessary to prevent mechanical interference between coil and templet and the maximum air gap permissible to assure dependable operation of the magnetic-tracer assembly. If the templet top can be kept level, this 1/8-in. space can be reduced with consequent increase in the performance characteristics of the magnetic-tracer assembly.

G. Templet Gates

To minimize the discrepancy at the start and finish of a cut, it is recommended that the cut be started in scrap metal and led into the desired path. Templet gates are employed to obtain this result. Figures 35 and 36 show types of gates commonly used. The gate should duplicate either the least critical section of the part being cut, or the section most easily adapted. Figure 36 also demonstrates the adaption of gating an outside templet to cut a sharp corner that would seem to require the use of an inside templet.

In making a gate templet, the gate insert shown in Figure 35 is cut out of the templet plate. An undercut insert mounting plate is then fastened to the templet with dowel pins to keep the templet from spreading. To start the cut the insert is removed, and it is replaced after the roller is past the entrance section.

H. Roller Sizes

The standard size roller for the CM-23 Cutting Machine is 1/2-in. in diameter, and for the CM-15, 3/4-in. in diameter. For certain shape-cutting re-
For cutting with an outside templet or an inside templet with large radii, a larger roller may be used to obtain more magnetic pull. For work which requires an inside templet with small radii, a small roller would be used.

The standard magnetic tracer roller will produce a cutting speed that is in agreement with the calibration of the governor speed-control dial. When rollers of a size different from the standard one for each machine are attached, a multiplying factor must be used to determine the correct setting as indicated in Tables I and II.

**TABLE I**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4-in.</td>
<td>1-1/2-24</td>
<td>1-15</td>
<td>1-1/2-9/12</td>
</tr>
<tr>
<td>3/8-in.</td>
<td>2-1/2-36</td>
<td>1-1/2-221/2</td>
<td>1-1/2-18</td>
</tr>
<tr>
<td>1/2-in.</td>
<td>3-1/2-46</td>
<td>2-30</td>
<td>2-1/2-181/2</td>
</tr>
<tr>
<td>5/8-in.</td>
<td>4-1/2</td>
<td>2-1/2-257</td>
<td>3-24</td>
</tr>
<tr>
<td>3/4-in.</td>
<td>5-1/2</td>
<td>3-45</td>
<td>3-1/2-28</td>
</tr>
<tr>
<td>1-in.</td>
<td>6-1/2-37</td>
<td>4-60</td>
<td>4-1/2-37-1/2</td>
</tr>
</tbody>
</table>

**TABLE II**

<table>
<thead>
<tr>
<th>Size of Roller</th>
<th>To find where to set the dial, multiply desired speed by factors below</th>
<th>To find actual running speed, multiply speed shown on dial by factors below</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4-in.</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3/8-in.</td>
<td>4/5</td>
<td>2</td>
</tr>
<tr>
<td>1/2-in.</td>
<td>1</td>
<td>3/2</td>
</tr>
<tr>
<td>5/8-in.</td>
<td>4/5</td>
<td>6/5</td>
</tr>
<tr>
<td>3/4-in.</td>
<td>2/3</td>
<td>1</td>
</tr>
<tr>
<td>1-in.</td>
<td>1/2</td>
<td>1/4</td>
</tr>
</tbody>
</table>

*With mechanical and eddy-current governor.

**IV. Operation of the Magnetic Tracer**

Operation of the magnetic tracer does not differ markedly from operation of the line tracer or strip-templet tracer. The chief difference is that a magnetic pull instead of a spring load is used to keep the roller in contact with the templet. Turning on the power-supply switch activates the electromagnet in the tracer head. This causes the tracer roller to be held tightly against the steel templet by magnetic attraction. When the cutting machine drive motor is turned on, the roller rotates, traveling around the outline of the pattern as the other tracer heads do.

One precaution must be observed when using the magnetic tracer, however: The power-supply switch should not be turned on until the tracer roller has been placed in firm contact with the edge of the templet. If the electromagnet is activated when the roller is a short distance away from the templet, the magnetic pull will cause the roller to slam against the templet edge. This can damage the tracer head by bending the roller shaft, and may spoil the templet.
A. Remote Control Switch

The remote control switch is connected in series with the main-line switch on the power supply cabinet. To use the remote control switch, the shunting switch in the cabinet must be set for "Remote Control-In." (The shunting switch is the one just to the right of the receptacle for the remote control switch plug.) To turn the power supply on, it is necessary to turn both the main-line switch in the cabinet and the remote control switch to the "On" position. The unit can be turned "Off" by means of either switch. It can be turned "On" again only by the same switch used to turn it "Off."

When the remote control switch is located in a position that is more convenient than the switch on the cabinet, the main-line switch on the cabinet will generally be kept in the "On" position, and the unit controlled exclusively by the remote control switch.

B. Machine Cutting Speeds

The cutting speed of the machine will be affected by the diameter of the tracer roller used. The machine's speedometer therefore will not always indicate true cutting speed. When using the 1/2-inch diameter roller on the CM-23 and CM-41 machines, true cutting speed is indicated by the machine speedometer. When using the 3/4-inch roller on the CM-15 machines, true cutting speed is indicated by the machine speedometer. But when using rollers of other diameters, a conversion factor must be used to find the actual cutting speed of the machine. The necessary information is supplied in the tables on the following page.

C. Traction and Magnetic Pull

The amount of traction obtained with the magnetic tracer will depend upon the size of the tracer roller, as well as upon the electromagnetic force. Maximum traction is obtained with the 1/2-inch roller, practically as much with the 3/4-inch roller, somewhat less with the 1-inch roller. Traction obtained with the 3/8-inch roller is appreciably less than maximum. The 1/4-inch roller provides the least traction of the group.

For maximum magnetic pull, use the standard roller, a templet of 1/2-inch thickness, and make certain that the roller is positioned at optimum height as shown in figure 34. The standard size roller (1/2-inch for CM-23 and CM-41 machines, or 3/4-inch for the CM-15 machine) has the advantages of providing maximum traction and direct speed indication. A smaller roller may be necessary for producing a small radius turn on a templet with outside corners. Also, in unusual cases a smaller roller may be needed to meet clearance requirements in the templet construction. A larger diameter roller may be desirable for obtaining extra high speed of travel, or for making oversize parts from an existing templet. If, when the tracer assembly is properly adjusted, rollers under 1/2-inch in diameter are found to slip, a large roller must be used.

| TABLE I
Magnetic Tracing - Speed Ranges Multipliers and Dial Settings
FOR CORRECT DIAL SETTING, MULTIPLY THE DESIRED SPEED BY:

<table>
<thead>
<tr>
<th>Roller Size in Inches</th>
<th>CM-15-18 and CM-15-36</th>
<th>CM-23 and CM-23-V (Mechanical Governor)</th>
<th>CM-23-V and CM-23 (Series 3) &amp; (Series 4) (Eddy-Current Governor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3/8</td>
<td>4/3</td>
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<td>4/3</td>
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<tr>
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<td>1</td>
<td>3/2</td>
<td>1</td>
</tr>
<tr>
<td>5/8</td>
<td>4/5</td>
<td>6/5</td>
<td>5/4</td>
</tr>
<tr>
<td>3/4</td>
<td>2/3</td>
<td>1</td>
<td>2/3</td>
</tr>
<tr>
<td>1</td>
<td>1/2</td>
<td>3/4</td>
<td>1/2</td>
</tr>
</tbody>
</table>

| TABLE II
TO FIND ACTUAL RUNNING SPEED, MULTIPLY DIAL SPEED BY:

<table>
<thead>
<tr>
<th>Roller Size in Inches</th>
<th>CM-15-18 and CM-15-36</th>
<th>CM-23 and CM-23-V (Mechanical Governor)</th>
<th>CM-23-V and CM-23 (Series 3) &amp; (Series 4) (Eddy-Current Governor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>1/2</td>
<td>1/3</td>
<td>1/2</td>
</tr>
<tr>
<td>3/8</td>
<td>3/4</td>
<td>1/2</td>
<td>3/4</td>
</tr>
<tr>
<td>1/2</td>
<td>1</td>
<td>2/3</td>
<td>1</td>
</tr>
<tr>
<td>5/8</td>
<td>5/4</td>
<td>5/6</td>
<td>5/4</td>
</tr>
<tr>
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<td>3/2</td>
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<td>3/2</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>4/3</td>
<td>2</td>
</tr>
</tbody>
</table>
TABLE III
SPEED RANGES AVAILABLE WITH ROLLERS:

<table>
<thead>
<tr>
<th>Roller Size in Inches</th>
<th>CM-41</th>
<th>CM-15-18 and CM-15-36</th>
<th>CM-23 and CM-23-V (Mechanical Governor)</th>
<th>CM-23-V and CM-23 (Series 3) &amp; (Series 4) (Eddy-Current Governor)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>1 - 25</td>
<td>1-1/2 - 9-1/2</td>
<td>1-1/2 - 24</td>
<td>1 - 15</td>
</tr>
<tr>
<td>3/8</td>
<td>1-1/2 - 37-1/2</td>
<td>2 - 14</td>
<td>2-1/2 - 36-1/2</td>
<td>1-1/2 - 22-1/2</td>
</tr>
<tr>
<td>1/2</td>
<td>2 - 50</td>
<td>2-1/2 - 18-1/2</td>
<td>3-1/4 - 48-1/2</td>
<td>2 - 30</td>
</tr>
<tr>
<td>5/8</td>
<td>2-1/2 - 62-1/2</td>
<td>3 - 23</td>
<td>4 - 61</td>
<td>2-1/2 - 37-1/2</td>
</tr>
<tr>
<td>3/4</td>
<td>3 - 75</td>
<td>3-1/2 - 28</td>
<td>5 - 73</td>
<td>3 - 45</td>
</tr>
<tr>
<td>1</td>
<td>4 - 100</td>
<td>4-1/2 - 37-1/2</td>
<td>6-1/2 - 97</td>
<td>4 - 60</td>
</tr>
</tbody>
</table>

Multipliers are shown as improper fractions in the above tables. Note that the multiplier for finding true speed from dial speed (Table II) is the reciprocal of the multiplier for finding the dial setting that will produce a desired speed (Table I).

V. Magnetic Tracer Maintenance and Replacement Parts

NOTE: In the replacement parts pictures shown in this section, eight-digit hardware numbers (example 6430-0110) are used for simplicity. A full description of each hardware item will be found in the Hardware List on page 27. For economy as well as convenience, it is recommended that replacement hardware be purchased locally by the customer.

A. Mechanical Failure

The tracer head and power supply are of simple construction. A mechanical failure is usually easily located. Common causes of trouble are: Binding of the roller shaft due to its being bent or to lack of lubrication, and actual breakage from being struck. Replacement parts pictures are supplied in this section for identifying defective parts. See Figures 37 to 43. Disassembly of the tracer head is as follows:

1. CM-15 MACHINES (See Figures 37 and 38.)
   (a) Remove the roller by withdrawing its retaining screw.
   (b) Remove the adaptor assembly by withdrawing the four socket head screws which hold it on the top of the coil housing. Do not attempt to remove the lid of the coil housing.
   (c) Drive out pin 34W30.
   (d) Drive out the taper pin which holds collar 34W51 to its shaft.
   (e) Withdraw the shaft through the bottom of the body.

2. CM-23 MACHINES (See Figure 39.)
   (a) Remove the roller by withdrawing its retaining screw.
   (b) Remove the Sleeve and Bushing Assembly 10V60 by withdrawing the four socket head screws which hold it on the top of the coil housing. Do not attempt to remove the lid of the coil housing.
   (c) Drive out the two taper pins which hold the gears 22W63 to the tops of the shafts.
   (d) Withdraw the shafts through the bottom of the sleeve.

Fig. 37 - TRACER HEAD ASSEMBLY (CM-15 Machines) - 20V87
3. CM-41 MACHINES (See Figures 40, 41, and 42.)

(a) Remove the roller by withdrawing its retaining screw.
(b) Remove the Outer Sleeve Assembly 10V63 by withdrawing the four flat head screws which hold it on the top of the coil housing. Do not attempt to remove the lid of the coil housing.
(c) Remove plate 22W73 by withdrawing the two fillister head screws which hold it in the sleeve.
(d) Withdraw the shafts through the top of the sleeve.

B. Electrical Failure

(See Figure 44 for Circuit Diagram)

Electrical trouble usually shows itself as a lessening or a complete loss of magnetic pull. First check the magnetic force holding the tracer to the templct. If this is weak, the trouble is electrical. If the force is normal, then check the tractive force.

The magnetic force is checked as follows:

With the drive motor stopped and the coil energized, pull the tracer away from the templct with a

(Continued on Page 24.)
**Fig. 40 - Tracer Head Assembly (CM-41 Machine) - 10V64**

**Fig. 41 - Magnetic Tracer (CM-41 Machine)**

- Outer Sleeve - 10V63
- (2) Ferrule - 22W41
- (2) Screw - 6130-0088
- Plate - 22W73
- Washer - 81W4
- (4) Screw - 6130-3467
- Spline - 22W74
- Spline - 22W75
- Pin - 6223-0666
- Washer - 22W77
- Inner Sleeve - 10V62
- Shaft - 22W76
- Screw - 6134-0090
- ROLLER - 22W70
- Note: For various roller sizes see Fig. 37.

---

- 60 cycle power supply - 10V52
- 25 cycle power supply - 10V53
- Fig. 43
- See note

- 115 volt A.C. power supply

- Right hand bracket - 58W63
- Left hand bracket - 58W62
- Grommet - 81W54
- Liftiing Lever Assembly - 10V65
- Fig. 42
- Magnetic Tracer - 10V64
- Fig. 40

**Notes** - See Instruction Booklet - P-5533D for installation.

**Note 1** - Power Supply Unit is not supplied as part of 17V45. Order 25 or 60 cycle power supply units as per requirement.
spring scale. Note the reading to which the scale rises before the tracer leaves the templet. Using the 60-cycle power-supply, this pull should be approximately 35 pounds. With the 25-cycle unit the pull should be approximately 20 pounds.

To test the tractive force:

Assuming that the correct size roller is being used, and that it is correctly located with respect to the templet, a pull of 10 to 15 pounds should be produced with the 60-cycle power-supply. (For the 25-cycle supply this figure is 7 to 12 pounds.) Attach the spring scale to the drive head so as to measure the pull in the direction of travel along a straight section of the templet. (For full traction the templet section should be at least 2 inches wide.) Turn on the machine drive motor and allow the tracing head to draw out the spring scale until the tracer roller starts to slip. The reading of the scale at the point gives the tractive pull of the tracer.

If the tracing unit can be pulled from the templet by a force considerably less than stated above, check the power-supply unit and the coil as described in Section 1 below. If the tracer unit holds to the templet with proper force, but tractive pull is not adequate, check the items in Section 2 for possible causes.

1. POWER-SUPPLY ASSEMBLY AND MAGNETIC-TRACING COIL

(a) See that there is no excessive collection of dust in the power-supply unit, which may make it inoperative. The dust can be blown out with compressed air.

(b) Check the 1-amp. fuses to see that they are not burned out. Two spare fuses are provided in the clips within the power-supply cabinet. For description and part number of the fuses, see Figure 43.

CAUTION: Always replace the fuses with only the type and rating specified, as other types or ratings have been found unsatisfactory.

(c) In the 60-cycle unit the resistor is adjusted at the factory, so that the (d.c.) current to the coil is approximately 2 amp. when the coil is cold, dropping to approximately 1.8 amp. after the coil has been continuously energized for a period of two hours or more.

(d) In the 25-cycle unit the full resistor value is used in the circuit, and the coil current should be approximately 1.3 amp. after the coil has been energized for two hours or more. To facilitate measurement of current to the coil, terminals have been provided for insertion of a d.c. ammeter in the coil circuit. To measure the coil current, remove the cover of the power-supply unit by unscrewing the four attaching screws. Then remove the jumper (see Figure 43) across the two terminals on the terminal strip. Connect a d.c. ammeter across the terminals in place of the jumper. Be sure to replace the jumper after the meter is used. If the current varies considerably from the values given above, the electrical circuit and the line voltage should be checked. Higher values of current indicate an excessively high line voltage or a defective coil. Lower values indicate an excessively low line voltage or a poor connection in the wiring. The resistance of the coil and leads when cold should be 6.2 to 6.8 ohms. (CAUTION: In measuring resistance of the coil, never use and input voltage greater than 15 volts.) With the 60-cycle power-supply unit, if low current values are caused by low line voltages and not a defect, the variable resistor in the power-supply unit may be readjusted until the correct output is approximately attained.

NOTE: If a magnetic-tracer coil is found defective, it should be returned to the factory for repair. The coil housing should never be opened because the seal will break and possibly the coil may be damaged beyond repair.

2. OTHER POSSIBLE CAUSES OF INADEQUATE TRACTION OF MAGNETIC TRACER

(a) See that there is no outside interference or excessive hose drag. Test for free travel of tracing head in all directions.

(b) See that the templet edge is square, so that the magnetic roller makes line contact, not point contact.
Fig. 43 - MAGNETIC TRACER POWER SUPPLY

60-Cycle - 10V52
25-Cycle - 17V33

NOTE - FOR WIRING DIAGRAM (25 CYCLE) SEE PART NO. 44W66
NOTE - FOR WIRING DIAGRAM (60 CYCLE) SEE PART NO. 22W51
(c) If the edge of the templet is hardened, or has hard spots, the magnetic-tracer roller will slip readily. (This condition may be encountered in flame-cut templets when the edges are not machined. Flame-softening the edges of the templet will overcome the condition.)

(d) The roller may hang up on inside turns, if the roller radius is greater than the radius of the templet turn. This trouble becomes more pronounced after the tracer once stalls in the turn. This is because the roller, rotating in one spot, tends to mill the turn to its own radius. A recommended remedy is to undercut the templet on the trailing side of the turn as described in Section III-B on Page 19.

(e) If the roller is worn so that the knurl is not sharp, it should be replaced. Do not attempt to reknurl the roller.

(f) The roller may stall easily because of binding in the tracer unit or improper operation of the drive unit. See if the roller can be stopped easily with the fingers.
C. How to Order Replacement Parts

1. All replacement parts are keyed on the preceding drawings. Two types of numbers are used on these drawings:
   A. Standard Part Numbers. These are usually formed by two pairs of digits with a letter between (For example: 01N21, 18V69). A few parts may have special numbers. Each part number is accompanied by a descriptive word or words.
   B. Hardware Numbers. These are eight-digit numbers (For example: 6120-3910). Hardware numbers are usually accompanied on drawings, by a one word description.

2. Order standard parts by part number and part name, as shown on drawings. DO NOT ORDER BY PART NUMBER ALONE.

3. For hardware, look up number in hardware list below. You will find there a full description. "Hardware" items can usually be purchased locally.

4. When ordering, be sure to state quantity of each part needed.

5. Always state the series or serial number of the machine on which the parts are to be used.

6. Indicate any special shipping instructions.

7. Order replacement parts from the Linde Region Office near you, or your nearest Linde Distributor.

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HARDWARE LIST FOR MAGNETIC TRACER INSTRUCTION BOOK

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-1910</td>
<td>No. 10-32 x 3/8&quot; Lg. Round Head Brass Machine Screw</td>
<td>6134-0090</td>
<td>No. 1/4-in. – 20 x 1-in. Lg. Socket Head Cap Screw</td>
</tr>
<tr>
<td>6130-0087</td>
<td>1/4 in. -20 x 1/2-in. Lg. Fillister Head Machine Screw</td>
<td>6223-0666</td>
<td>No. 4/0 x 5/8&quot; Lg. Steel Taper Pin</td>
</tr>
<tr>
<td>6130-0088</td>
<td>1/4-20 x 5/8&quot; Lg. Fillister Head Machine Screw (Cad. Pl.)</td>
<td>6225-0029</td>
<td>E.S.N.A. Roll Pin No. 50-028-125-0875</td>
</tr>
<tr>
<td>6130-0849</td>
<td>No. 6-32 x 1/4&quot; Lg. Fillister Head Machine Screw (Cad. Pl.)</td>
<td>6230-0006</td>
<td>1/16-in. x 3/8-in. Lg. Cotter Pin (Sherardized)</td>
</tr>
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<td>6130-0900</td>
<td>No. 10-24 x 3/8-in. Lg. Fillister Head Machine Screw</td>
<td>6310-0917</td>
<td>No. 10-32 Hex Brass Nut</td>
</tr>
<tr>
<td>6130-0902</td>
<td>No. 10-24 x 1/2&quot; Lg. Fillister Head Machine Screw (Cad. Pl.)</td>
<td>6324-0121</td>
<td>5/16-in. – 18 Hex Jam Nut</td>
</tr>
<tr>
<td>6130-0969</td>
<td>No. 10-24 x 1/4-in. Lg. Fillister Head Machine Screw</td>
<td>6325-0916</td>
<td>No. 10-24 Sq. Machine Screw Nut</td>
</tr>
<tr>
<td>6130-1848</td>
<td>No. 6-32 x 3/16&quot; Lg. Round Head Steel Machine Screw (Cad. Pl.)</td>
<td>6328-0125</td>
<td>3/8-in. Octagonal Pipe Conduit Locknut</td>
</tr>
<tr>
<td>6130-1852</td>
<td>No. 6-32 x 1/2&quot; Lg. Round Head Steel Machine Screw (Cad. Pl.)</td>
<td>6330-0862</td>
<td>No. 6-32 Hex Steel Nut (Cad. Pl.)</td>
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<td>6130-1900</td>
<td>No. 10-24 x 3/8&quot; Lg. Round Head Steel Machine Screw (Cad. Pl.)</td>
<td>6334-0100</td>
<td>1/4-in. – 20 Hex Jam Nut</td>
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<td>6130-3467</td>
<td>No. 1/4-20 x 7/16&quot; Lg. Flat Head Steel Machine Screw (Cad. Pl.)</td>
<td>6410-0918</td>
<td>#10 Plain Brass Washer</td>
</tr>
<tr>
<td>6132-2810</td>
<td>No. 2 x 1/8&quot; Lg. Parker Kalon Round Head Drive Screw Type &quot;Z.&quot; (Cad. Pl.)</td>
<td>6420-4918</td>
<td>No. 10 Steel Washer</td>
</tr>
<tr>
<td>6134-0086</td>
<td>No. 1/4-20 x 3/8&quot; Lg. Hex Socket Head Steel Cap Screw (Cad. Pl.)</td>
<td>6430-2860</td>
<td>#6 Medium Weight Steel Lockwasher</td>
</tr>
<tr>
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<td>6430-2918</td>
<td>#10 Medium Weight Steel Lockwasher</td>
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<tr>
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<td>6430-4860</td>
<td>#6 SAE Standard Steel Washer Cadmium Plated</td>
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<td>6430-4918</td>
<td>#10 SAE Plain Steel Washer (Cad. Pl.)</td>
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<td>6430-8075</td>
<td>1/4 SAE Lockwasher (Cad. Pl.)</td>
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<td>7363-5856</td>
<td>Simplex Tires Cord, Type &quot;SO&quot;, 18 Ga. 2 Conductor</td>
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<td>7363-5863</td>
<td>General Electric Cord, Type &quot;SJ&quot;, 18 Ga. 3 Conductor</td>
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<td>(132 In.)</td>
<td>General Electric Cord, Type &quot;S&quot;, 18 Ga. 3 Conductor</td>
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<td>7363-5890</td>
<td>(60 In.)</td>
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