CHAPTER 13

Gas and Electric Metal Pot

HAVING DESCRIBED the preparation of the surface, consisting of matrices and spacebands, against which the hot metal is forced, also the mold in which the slug is cast, we now come to a description of the mechanism and manner in which this is accomplished. While closely related, the mechanism for locking the pot mouthpiece against the back of the mold and then retracting it, is an entirely separate mechanism from that which forces the molten metal into the cavity prepared to confine it.

POT CRUCIBLE AND JACKET

The pot crucible is a casting that contains, when full, about forty-four pounds of type metal. It is held in a jacket mounted on two rather crooked legs which extend down and forward and are mounted on the vise frame shaft which is on the frame of the machine. The lower end of each of these legs has in it an individually adjustable pot leg bearing so that the pot may be adjusted forward or backward with respect to the back of the mold and also may be canted at any angle necessary for alignment of the mouthpiece with the mold. Between the pot jacket and the crucible the space is filled with dry flake asbestos with the top sealed with a paste made of water and asbestos meal which becomes hard when dry. The object of this asbestos packing, which is a poor conductor of heat, is to retain the heat in the crucible. At the top of the pot jacket there is a cover having an opening through which pigs of metal can be dropped into the pot, or through which metal can be fed by an automatic metal feeder.

For many years gas-heated pots were mostly used, though the electrically heated pots are now fast displacing them. The Linotype Company has available a separate instruction book which explains in detail the installation, operation and maintenance of the Linotype electric pot.

The gas pot is heated by means of a burner using either natural, manufactured or bottled gas. The same pot can be fitted to be heated by a gasoline-kerosene burner in localities where neither gas or electricity can be obtained. The Linotype Company also publishes special descriptive literature on this subject.

The pot crucible contains a well in which there is a plunger. When the plunger is in normal position its bottom is just above two holes in the sides of the well, through which metal flows into the space below the plunger. These holes must be kept fully open. When the plunger descends below these holes it drives the metal forward and up into the throat of the crucible and through the holes in the mouthpiece into the mold.

The Pump Stop

The pump stop mechanism is obviously for the purpose of preventing the action of the pump, not only when there is no line of matrices and spacebands in front

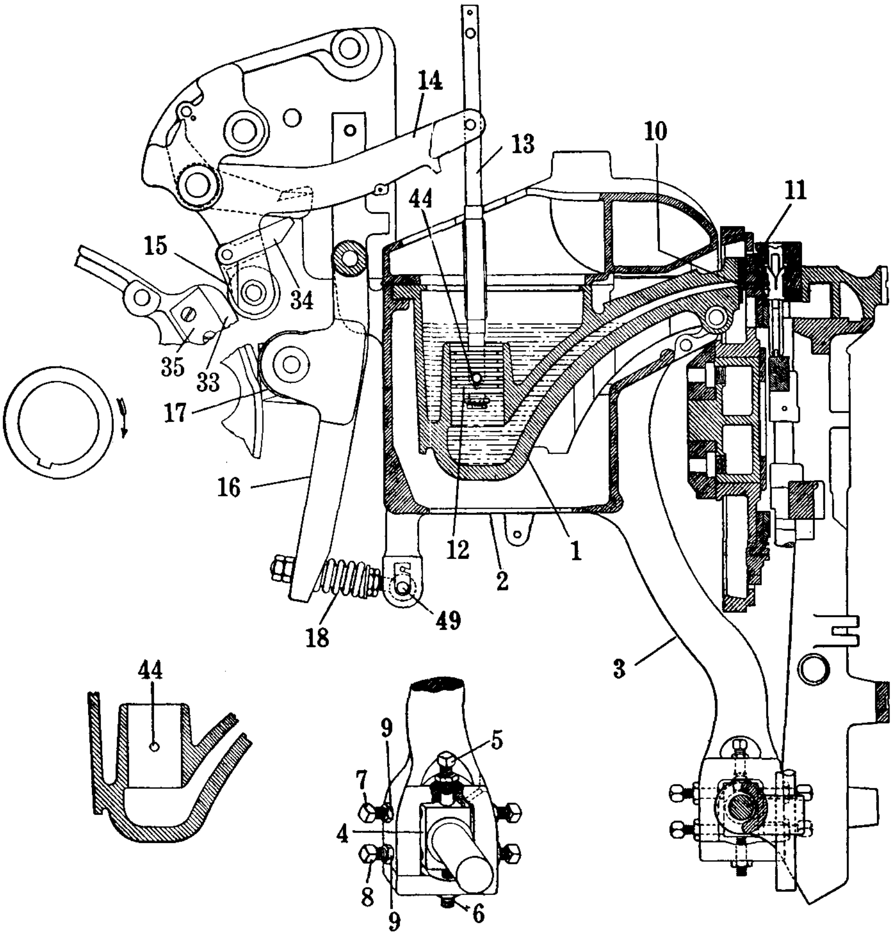


FIG. 1-13. View, partly in section, of the gas-heated metal pot, the mold, the first elevator jaw and the vise frame; also the levers which operate the metal pot and the pump. *1* is the metal pot, or crucible. *2* is the jacket which surrounds the metal pot. The jacket *2* is mounted on two long, crooked legs, *3*. These legs rest upon the vise frame shaft. *4* is a bearing in each leg and is adjustable up or down in the leg by means of screws *5* and *6*, and forward or back by means of screws *7* and *8*. All of these screws are locked in position, when adjusted, by lock-nuts *9*. *10* is the mouthpiece, through which the molten metal is pumped into the mold *11*. *12* is the pump plunger, which is operated through the pump plunger rod *13* by the pump lever *14*. The pump lever *14* has at its lower end the cam roller *15* which rides upon the surface of the pot cam. *18* is a compression spring which is between the end of the lever *16* and the lower part of the pot jacket *2*. The spring is very strong, and through it the pressure of the lever *16* is applied to the jacket and the metal pot against the back of the mold. If there is any unusual resistance, this spring may compress to allow the cam shaft to make its rotation. Thus, it is another safety device.

In this view the pump plunger is shown at the top of its stroke.

of the mold, but also when a line is insufficiently spaced out. It is, therefore, automatically operated to allow the pump lever to descend only when the full amount of space between the vise jaws has been filled out by the line; or it is manually operated when it is desired to cast a blank slug against the back surface of the left-hand vise jaw. In this latter case the manual operation consists of forcing the left-hand jaw as far as possible toward the right-hand jaw.

As has already been stated in Chapter 11, even though the right-hand jaw is not normally movable for adjustment of the length of line to be cast, it has a slight movement toward the right against a fixed stop which is on the knife block. This movement is imparted to it by the justification of the line between the vise jaws, and it is this slight movement of the right-hand vise jaw which removes from the path of the pump cam lever arm an obstruction which, when allowed to

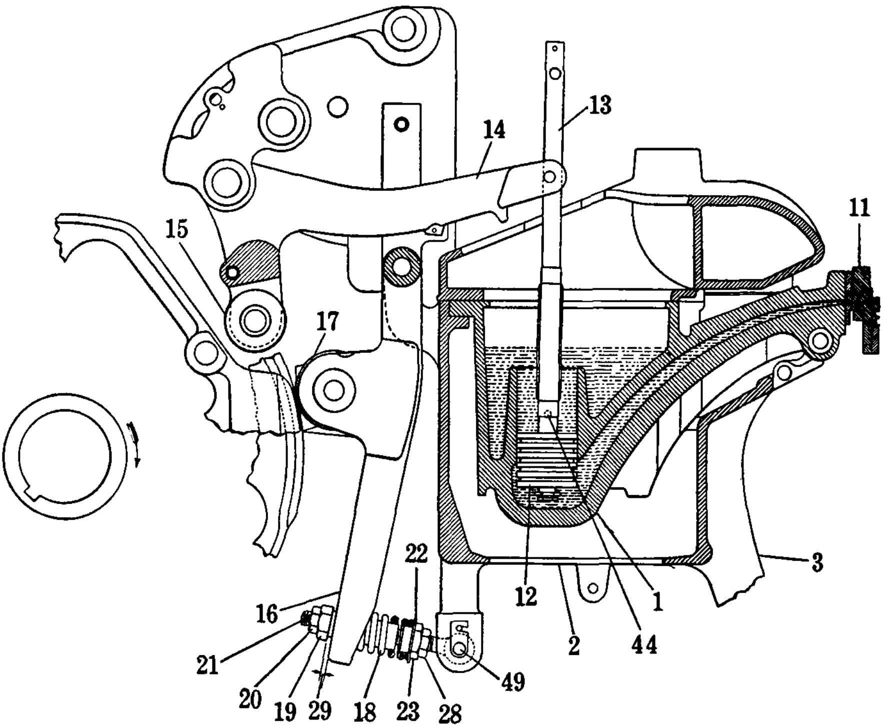


FIG. 2-13. View, partly in section, showing the metal pot held forward by the pot cam. The pump plunger *12* is shown at the bottom of its stroke.

On the side, near the lower end of the pump plunger, are two small vent holes. These openings may be regulated to control correct compression of the type metal for varied conditions of casting. Thus, the plunger makes a full stroke at every cast, constantly agitates the metal and prevents dross from accumulating in the well.

The spring *18* which cushions the lock-up, is adjustable for strength by means of an adjusting nut *23* against the washer *22* and locked by the nut *28*. There is a short piece of pipe pinned to the eyebolt *21* inside of the spring *18*, and a shoulder on the nut *19* is against the end of this piece of pipe, locked by the lock-nut *20*.

When the pot is in the position shown, there should be a clearance of $\frac{1}{16}''$ (as shown at *29*) between the back of the pot lever *16* and the surface of the nut *19*.

remain in the path of the lever arm, blocks the downward movement of that arm at the time the drop-off on the cam *31* reaches the pump cam roller *15* as the cam shaft rotates. It should be noted that, at the time this obstruction is removed from the path of the pump lever arm, the arm is not resting on it, but is held just above it by the concentric portion of the periphery of the cam *31;* therefore action of removal of the obstruction requires no more power than is necessary to overcome the light spring which returns and holds the parts in normal position at all times except when operated by the slight movement of the right-hand vise jaw to the right against its fixed stop.

Mounted on the right hand vise locking stud, just to the right of the mold disk, is a lever which moves in a horizontal plane, as shown at *36* in Fig. 4-13. This lever has on its forward short arm an adjusting screw *37* and a lock nut. The screw *37* is contacted by the right end surface of the right-hand vise jaw *38.* The

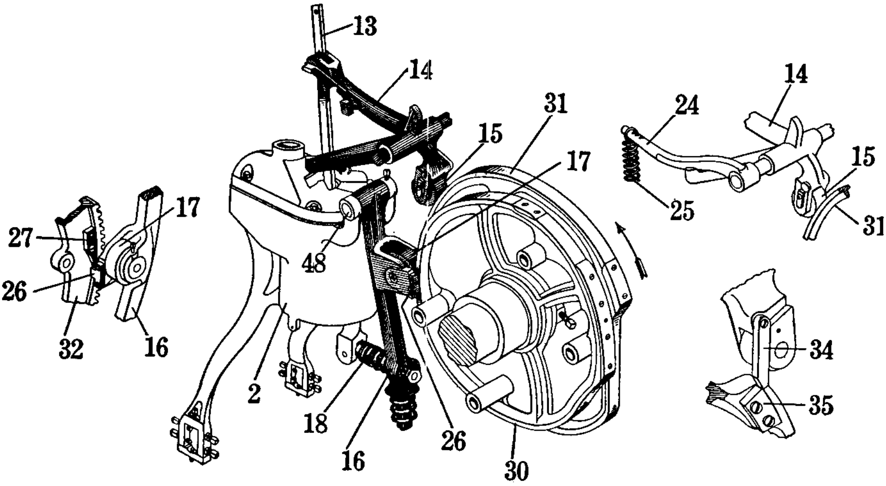


FIG. 3-13. View showing the pot cam *30,* the pot lever *16* and the spring *18* in their relation to the pot jacket *2.* This figure also shows the pump cam *31,* the pump lever *14,* the pump lever cam roller *15,* and the pump plunger rod *13.*

The shape of the pot cam surface *30* is such as to force the pot forward through the roller *17,* the lever *16* and the spring *18.* The pot moves forward at the proper time to effect the face alignment of the line of matrices and spacebands, then it goes back a little in order to remove its pressure from the line during vertical alignment. It then goes forward again to make a tight lockup at the time the slug is cast, finally returning to normal position after the cast.

Because the pot legs are far toward the front of the machine, and the weight of the jacket, the pot and its contents is toward the rear, the backward movements of the pot are the results of gravity alone, controlled by the pot cam *30.* But, if for any reason the pot does not go back of its own accord after the cast, the pot return cam *27* on the mold slide cam *32* engages the pot return cam shoe *26* on the lever *16* and pulls the pot backward.

The shape of the cam *31* is such as to hold the pump cam lever *14* stationary until the time when a cast is to be made. At that time, a very steep drop-off on the cam allows the pump spring *25,* through the lever *24,* to pull the cam roller *15* on the lever *14* very quickly toward the center of the cam and thereby causes the pump plunger to descend even more rapidly because it is operated by a longer arm on the pump lever than that holding the roller. Thus the molten metal is forced through the holes in the pot mouthpiece and into the mold with considerable pressure and speed.

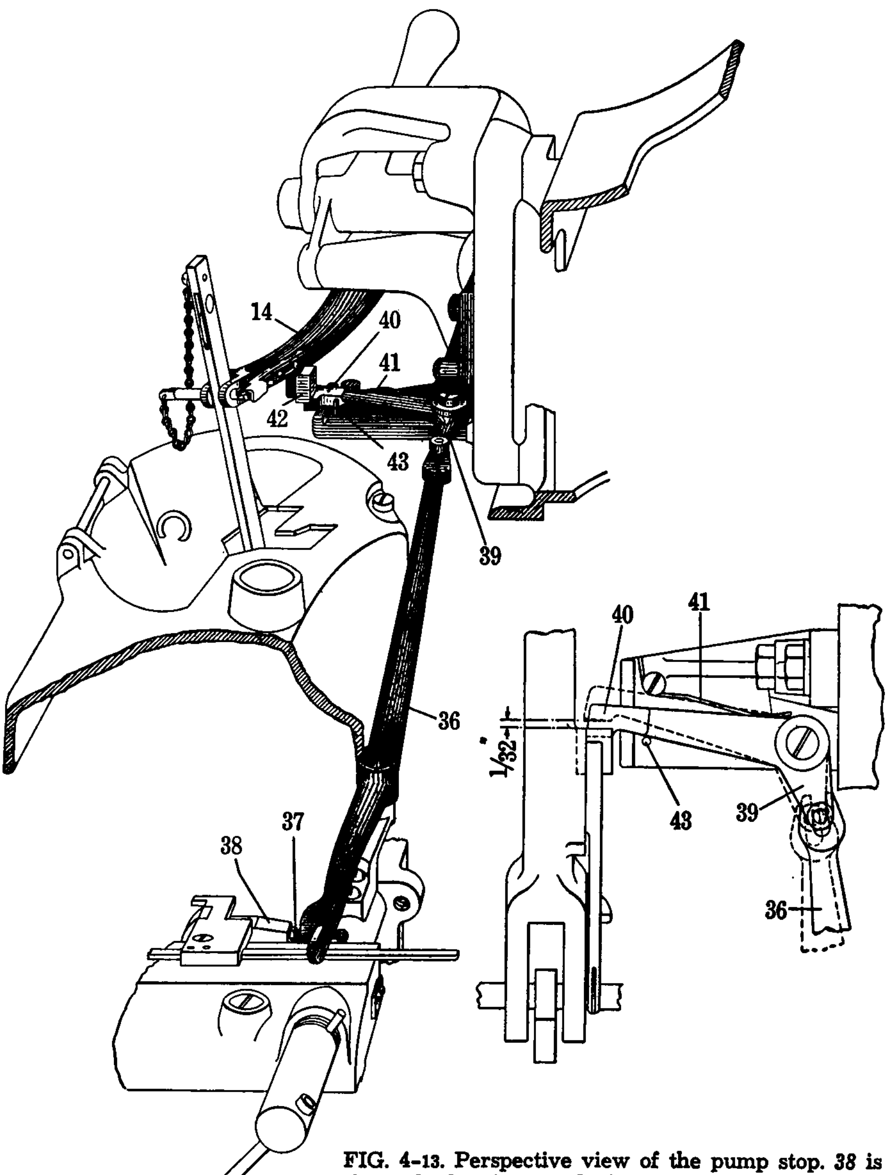


FIG. 4-13. Perspective view of the pump stop. *38* is the right-hand jaw which is mounted on the vise frame so as to have a slight movement. The jaw *38* strikes against a screw *37*. The screw *37* is adjustable and is mounted on the short arm of a lever *36*. The long arm of this lever *36* is connected to the short arm of another lever *39*; the long arm of the lever *39* has a finished surface *40* on its outer end which operates under a hardened block *42* mounted on the pump lever. The finished surface of the lever *39* is normally under the block *42*, being held there by a spring *41* against the stop pin *43*.

rearward long arm of lever *36* has a forked end which operates the forward arm of a bell crank lever *39* pivoted on a bracket which is mounted on the column of the machine. The other arm of the bell crank lever *39* has its end shaped so as to form a stop block *40* which is held normally under the block *42* mounted on the pump cam lever arm. The spring *41* serves to normally hold the bell crank lever arm containing the stop block *40* against a stop pin *43*, and to hold the right-hand vise jaw *38* toward the left slightly away from its fixed stop which is on the knife block. The stop block end *40* of the bell crank lever *39* is supported solidly by a horizontal arm of the bracket on which it operates. This support is strong enough to support the pump arm against the action of the pump spring.

When the line is justified, it presses the right-hand vise jaw to the right against its fixed stop and at the same time against the adjusting screw in the forward end of the lever *36* thereby removing the block *40* from under the block *42* so as to allow the pump lever arm to descend, actuated by the pump spring. It is manifest that if the line of matrices and spacebands, when justified (i.e., when the spaceband wedges have been driven up their full length of movement), does not fill out the line, the right-hand vise jaw will not be pressed to the right against its fixed stop; and, if the screw *37* in the lever *36* is properly adjusted, the pump lever will be blocked from descending. It is important that this be a fine adjustment, not only to prevent squirts, but to prevent metal from being forced between matrices or spacebands in the line.

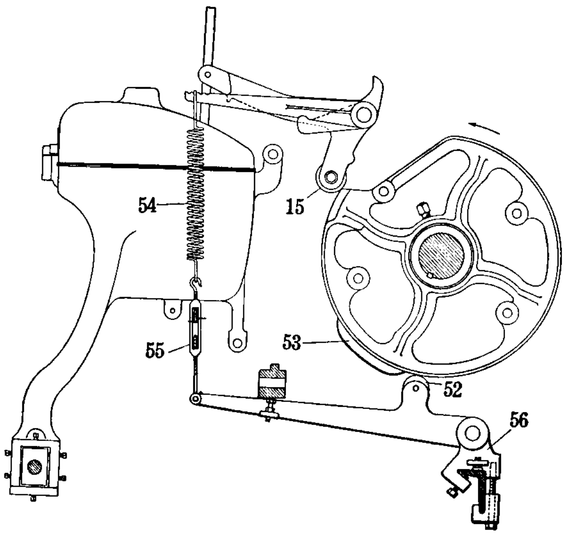


FIG. 5-13. The Pierson Pot Pump Spring Intensifier.

Therefore, when the right-hand vise jaw is held to the right against its fixed stop, the block *42* on the pump arm should not clear the block *40* on the end of the bell crank lever *39* by more than $\frac{1}{32}''$. This is also shown in Fig. 4-13.

On the latest model machines the adjustable screw *37*, shown in Fig. 4-13, has been fitted with a spring arrangement which makes it possible for the operator to hold the end of the lever *39* under the block *42* even when the line is fully justified.

Pot Pump Spring Intensifier

This device, shown in Fig. 5-13, helps to produce a more solid slug when extra hard metal is used, and also when continuously casting slugs of the larger sizes.

The illustration shows the plunger lever roll *15* about to leave the cam, and the instant it reaches the opening in the cam, the roll *52* on the intensifier lever comes in contact with the cam shoe *53* whereby the front end of the lever is forced down, carrying the spring with it, thus maintaining the initial pressure through the entire stroke. This differs from the ordinary spring which gets weaker as the plunger descends toward the bottom of the well.

When it is considered that the plunger on a machine running at normal speed has less than two seconds time to fill the mold, it can readily be understood that when large size slugs are being cast, it is difficult to keep them solid when the machine is run to its capacity.

In order to obtain a solid slug some operators will push the starting lever in and temporarily stop the machine to allow the plunger to travel its full stroke to the bottom of the well. The intensifier will give exactly the same result without retarding the speed of the machine.

The intensifier is of particular value on machines equipped with Mohr saws, where all slugs are cast to the widest measure of the mold.

The spring tension is easily adjusted with the turnbuckle *55*, and the universal clamp *56* fastens the intensifier to the Linotype without drilling or tapping holes.

The Pot Mouthpiece

The pot crucible mouthpiece, or more simply, the "mouthpiece," has in it a series of holes through which the metal is forced from the crucible into the mold and it also confines the molten metal at the base of the slug. It is a flat piece of steel, relieved on the front surface where necessary for clearance, and held to the end of the crucible throat by a number of screws (13 on a 30-em machine)

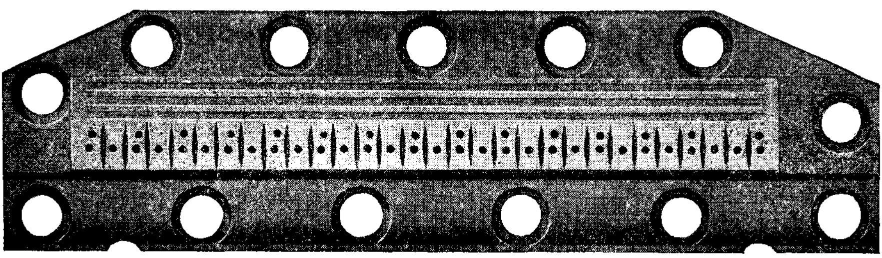


FIG. 6-13. View of Linotype pot mouthpiece of display type, showing extra holes to provide added flow of metal into ribs of slug. The horizontal grooves above the holes assure a square, non-rocking display slug.

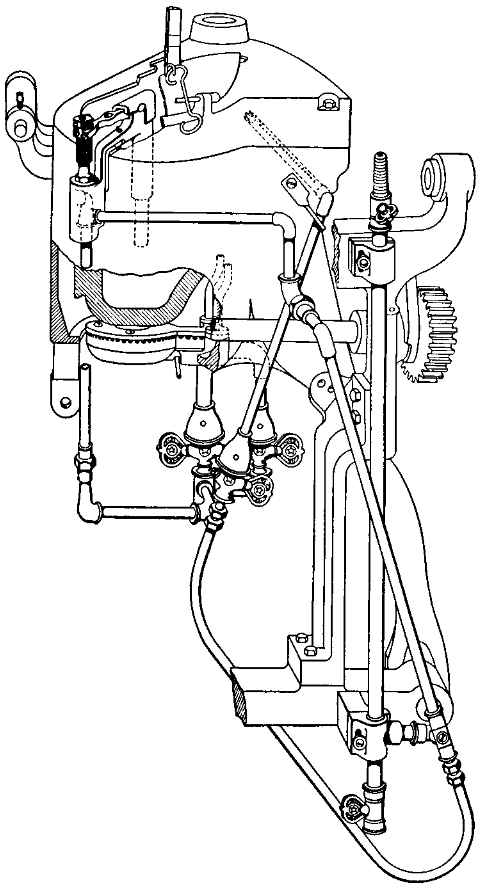


FIG. 7-13. View of the gas-heated metal pot with jacket broken away to show burner.

in order to make a tight joint between its back surface and the crucible. On the 30-em Linotype the mouthpiece has 30 holes in line, and also other holes to register with the recesses in recessed molds. Between these holes, on the front surface, are vents which serve to allow the air to escape from the mold cavity ahead of the molten metal being forced into it.

On display mouthpiece there are three horizontal shallow grooves milled across the face above the holes and vents. These grooves are located so that one will cast across the bottom of the ribs of a 24-point slug, two on a 30-point slug and three on a 36-point slug. Their purpose is to compensate for the unavoidable uneven shrinkage in large slugs by providing high spots on the ribs to be trimmed square and even by the back knife, thus insuring a slug that will stay "on its feet" in the form and give a good even impression.

GAS BURNER

The ordinary gas burner, Fig. 7-13, using illuminating gas is of the Bunsen type. and contains a device for mixing air and gas in proper proportion, so that the mixture will burn with a blue flame. A subsidiary pipe is carried to another burner directly underneath the mouthpiece. The control of the gas is by means of an ordinary stop-cock and a device known as a "thermostat governor."

Thermostat Gas Governor

The action of the thermostat and the method of regulating it should be thoroughly understood in order to get the best results from the gas burner.

The principle on which the thermostat operates is based on the difference in expansion of two metals under heat. That part of the thermostat which is immersed in metal, shown at *79* in Fig. 8-13, is made of drawn steel and has a hole or pocket in which is a rod *80* of invar steel. The invar has a low coefficient of expansion, that of the drawn steel casing is relatively high. When heat from the metal expands the casing *79* downward, the invar rod *80* is permitted to drop and the gas flow is decreased or shut off by spring pressure. As the metal cools, casing *79* contracts, thus raising rod *80*—and through lever action, increasing the gas flow.

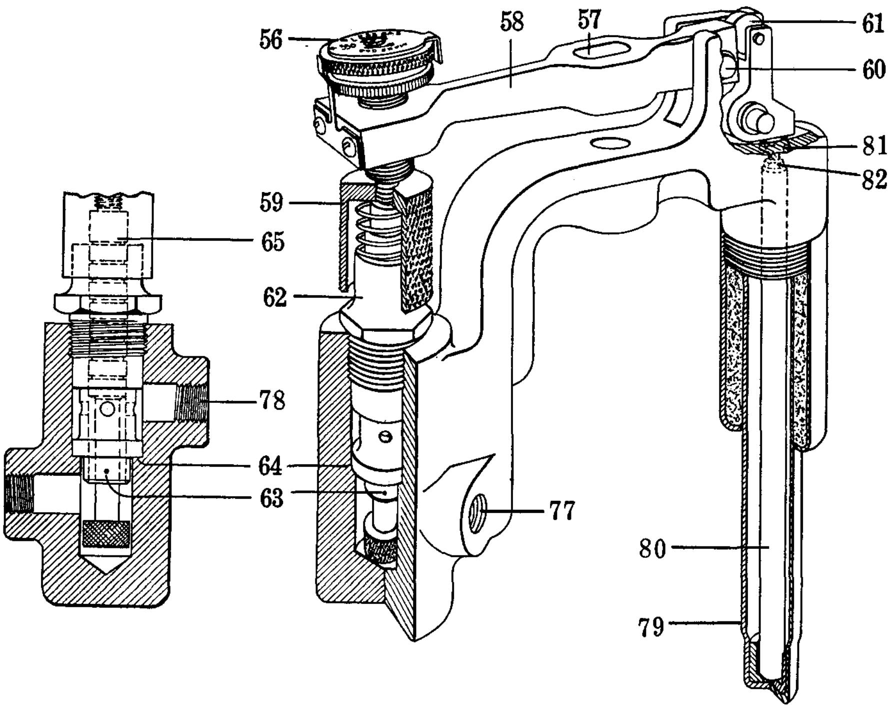


FIG. 8-13. View of the gas thermostat. 56 is the adjusting dial; 57, clearance hole for screwdriver; 58, lever; 59, spring cap; 60, fulcrum pin; 61, roller; 62, plunger guide; 63, by-pass; 64, seat for guide; 65, plunger; 77, gas inlet; 78, outlet; 79, steel casing; 80, invar rod.

Micro-Therm Gas Temperature Control

Referring to Figs. 9 and 10-13, this control consists of a casting *83*, with an extending arm which holds the control to the pot cover *85* by means of the pot lid pin *111*. Inside of this casting *83* a hole is bored to receive a brass sleeve *86* with two slots leading to the inlet port *98* and outlet port *99*. Inside of this sleeve *86* a piston *84* is operated by the expansion and contraction of the expansion bellows *87*. This piston *84* is held against the bellows *87* by a spring which acts against the piston *84* to take up any lost motion and to make sure it accurately follows the contraction of the bellows. (Expansion of the bellows from room temperature, approximately 72 degrees, to operating temperature of Linotype metal, 550 degrees, is about .110″.)

The expansion bellows assembly consists of a metal bulb *91*, to be immersed in the type metal, connected by a capillary tube *92* to the metal bellows *87* which expands and contracts. The system is entirely filled with a non-vaporizing liquid and hermetically sealed.

When the gas pot is lighted up and the temperature of the metal begins to rise, the piston *84* starts moving so that at about the time the metal reaches operating temperature, the piston has shut off the gas supply to the main burner. The burner is provided with a by-pass hole which allows sufficient gas to the main burner to assure a pilot light at all times.

The dial 89 is graduated to 520, 530, 540 and 550 degrees. When in operating position the dial may be turned almost a full revolution, a stop pin preventing more movement.

Plant Governors for Artificial Gas

This type of governor is used to control the pressure of artificial gas used for fuel to heat the metal in the Linotype pot. It will control any pressure up to four pounds and hold it within very slight variation.

The gas enters through the horizontal pipe and passes upward into the inner

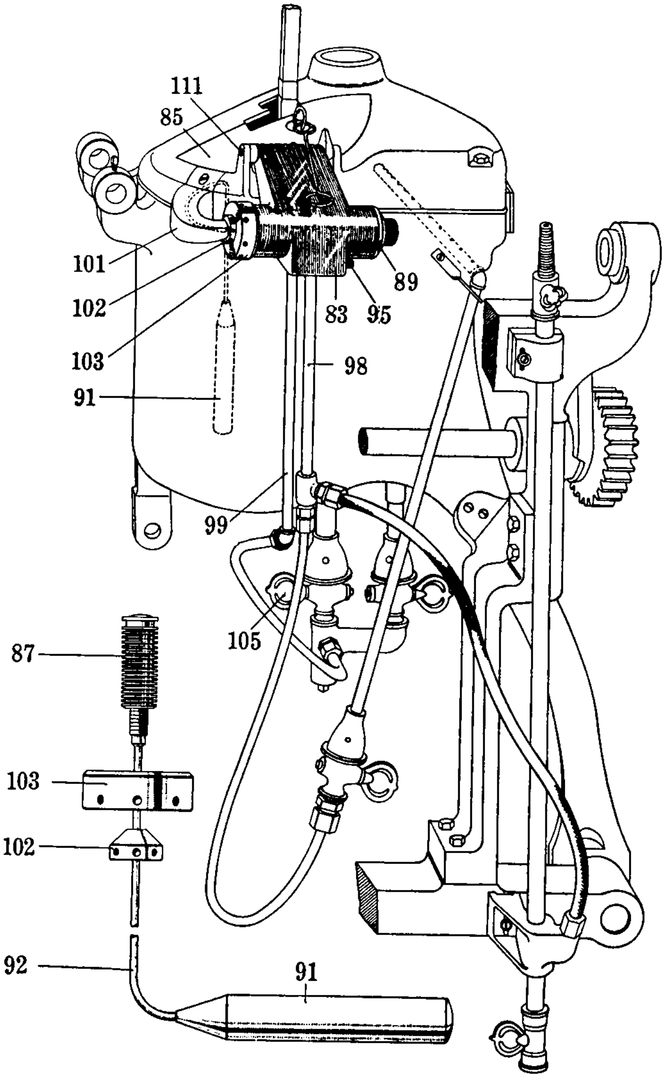


FIG. 9-13. View of gas-heated metal pot showing details and application of Micro-Therm Gas Temperature Control.

float, and at the same time downward through the valve opening, and fills the supply pipes ready for consumption. The surplus gas then passes upward through the small opening to the outside float, causing the floats to rise and close the valve.

The floats are attached rigidly to the valve stem, their lower edge being immersed in mercury, which fills the channels. The stem has a conical valve attached to its lower end, which passes through the opening in the upright hollow stem and the floor of the governor and extends through the cover, which acts as a guide to the floats and valve.

If the pressure of the incoming gas upon the float exceeds the weight of the floats and adjusting weights on the valve stem, both floats will be raised sufficiently to restrict the opening in the valve seat so as to allow only a proper flow of gas therefrom, and the gas from the outlet portion of the gas chamber will pass up by the pipe to the main float and act upon it, thereby controlling the pressure with unerring and absolute certainty at all times.

A dome separates the two channels, which is an additional safeguard in pre-

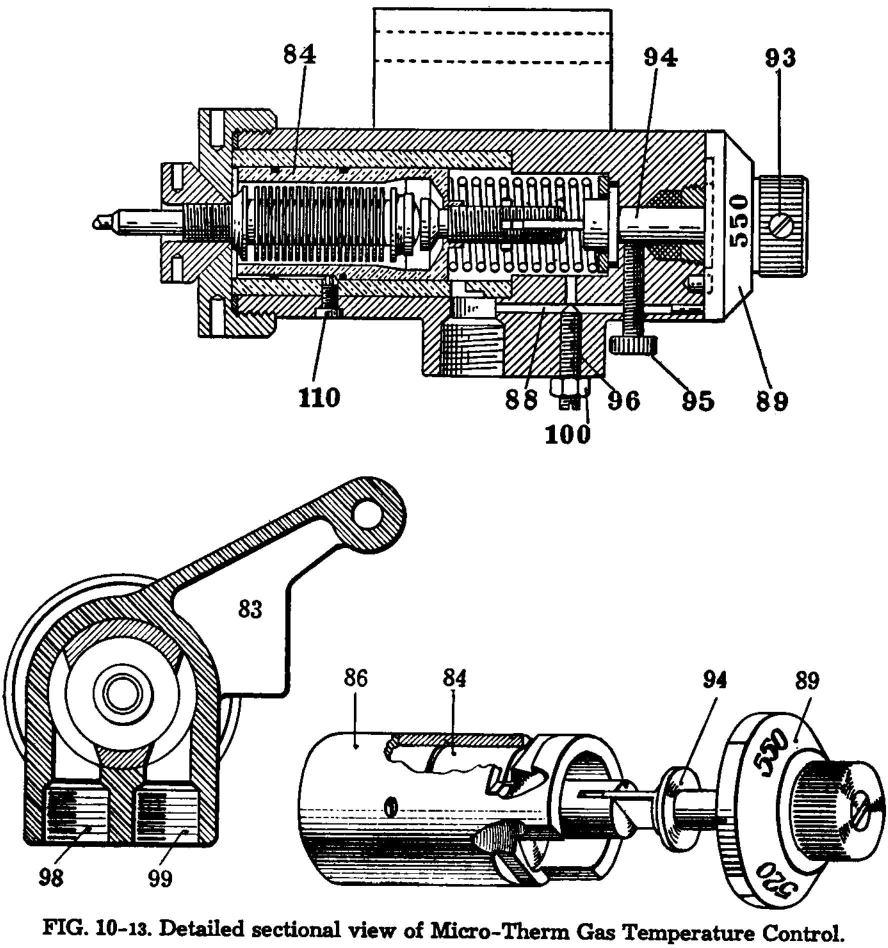


FIG. 10-13. Detailed sectional view of Micro-Therm Gas Temperature Control.

venting an abnormally high pressure of gas from unsealing the governor. In such a contingency the pressure would force the mercury from the inside channel over the dome into the outside channel, thus doubling up the seal, and when reduced back to normal, would flow through the slot in the dome to its proper channel and reseal the inside float. Artificial gas governors cannot be used on a natural gas line.

Plant Governors for Natural Gas

This governor is used to control the fluctuating pressure of natural gas used for fuel to heat the metal in the Linotype pot. These governors contain no mercury, their operation being dependent on a flexible leather diaphragm.

The gas enters the governor and passes through the valve to the outlet side. When the pressure at the outlet has risen to a predetermined point, set by adjusting the lock-nut by the acorn cap at the top of the governor, pressure is transmitted through a small tube near outlet and acts on diaphragm of governor, forcing it upward and closing the valve. Gas cannot pass through the valve until the supply in the feed system has been consumed. Valve then automatically opens and gas again passes directly through the regulator. By a special balancing or compensating device a definite and constant governor action is assured at all times. Natural gas governors cannot be used on an artifical gas line.

Linotype Gasoline-Kerosene Burner with Pressure Tank

A burner especially designed for either gasoline or kerosene, for use where electricity or gas is not available for fuel for heating the Linotype metal pot. Gives complete combustion in burning either gasoline or kerosene. Has no threaded joints, and therefore no leaking joints. It is equipped with a positive mouthpiece burner control. Can be taken apart for cleaning without removing screws.

The pressure tank is made of 18-gauge steel top and bottom, 20-gauge steel sides, and tested to a pressure of 100 pounds per square inch. Has capacity of five gallons. The tank is equipped with one or two outlet valves, pressure gauge, air pump, and two lengths of hollow feed wire, 3½ and 6 feet. The feed pipe extends to the bottom of the tank and is provided with a strainer to keep out all foreign matter. In addition to this a strainer is attached to the tank outlet valve. The hollow feed wire of the supply line connects to the strainer.

An air-control shutter is applied to the burner underneath the needle-valve, to control the air supply, and secure correct mixture of air and gasoline or kerosene. This prevents back-firing, if properly adjusted.

To comply with the underwriters' requirements a shut-off valve is connected at a convenient place in the supply line. This is to secure a shut-off independent of the tank valve.

Full instructions for the care and operation of the Gasoline-Kerosene Burner are furnished with each equipment.

LINOTYPE ELECTRIC POT

The Linotype electric pot has been widely used and favorably known throughout the trade for many years. The electrical features are simple and provide for a wide range of heat regulation and a considerable voltage fluctuation. All of the electrical controls are within easy reach of the operator's normal position. It follows closely the design of the standard gas pot and is interchangeable with any pot on all models of Linotypes. Installation can easily be made by a capable Linotype machinist. The electrical features of this equipment are few and simple and do not require the attention of an expert electrician. Close attention to our instructions for installation and maintenance assures uninterrupted satisfactory service.

The pot is the same size and capacity as the gas pot. It holds 44 pounds of metal, 15 pounds of which can be used without exposing the heaters.

The electrical equipment consists of four heaters, a thermostat and a unit control panel. The passage of electric current through the windings inside the heaters generates heat which melts the metal in the crucible and raises it to the proper operating temperature, while the thermostat and the control panel keep the metal at this predetermined temperature.

The heaters consist of strong, substantial, metal-encased units—called envelope heaters because of their appearance and construction and to differentiate them from the improved units described later as Lino-Therm heaters. Two of them are immersed directly in the metal and partially surround the pump well, heating the metal by direct contact. All of the heat generated is immediately transmitted to the metal exactly where it is required and there is no loss of heat due to faulty conduction. The mouth and throat heaters are clamped in close contact with the crucible throat to keep the metal at the operating temperature while being pumped from the crucible to the mold. The heating element or resistor of these heaters is composed of resistance ribbon wound on strips of clear mica. Strips of mica entirely surround the resistor, completely insulating it from the metal parts of the pots. As the resistors are protected by the strong metal casing which surrounds them they are not subjected to wear and tear and do not deteriorate in normal service.

The automatic temperature control which is attached directly to the pot responds to the temperature of the metal, connecting the heaters to the circuit when the metal begins to cool and disconnecting the heaters from the circuit before the metal becomes too hot.

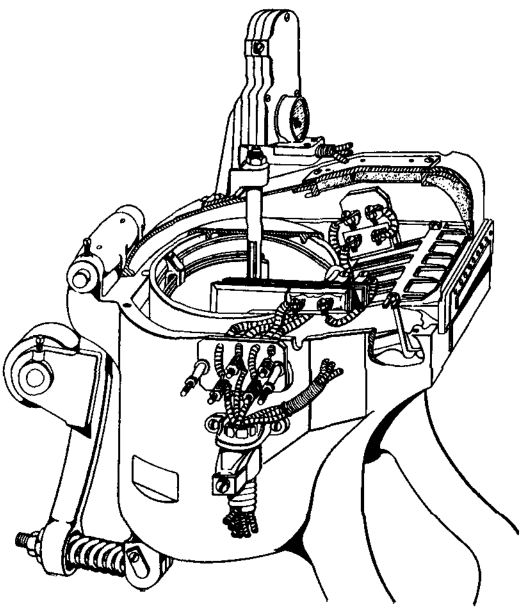


FIG. 11-13. View of the electrically-heated metal pot with cover removed to show envelope heaters and method of wiring.

All the electric terminals on the heating elements are well above the crucible top, so that overflowing the pot is not apt to ground them and cause a short circuit.

The unit control panel Fig. 17-13 consists of a magnet switch mounted on a slate panel, enclosed in a steel cabinet on which is mounted a rheostat for controlling the mouth and throat heater circuit. It also supports a suitable fuse cutout and the switches controlling both the pot and electric motor (if used) and places all controls within easy reach of the operator. Connection is made between the pot proper, the thermostat and the control panel by suitable wiring enclosed in a flexible conduit.

The large space between the crucible and the jacket of the pot is entirely filled with a special grade heat insulating powder which prevents radiation of heat into the room and insures a minimum current consumption.

These equipments are practically "universal" and are interchangeable (by making minor changes) on any commercial electric light or power circuit from

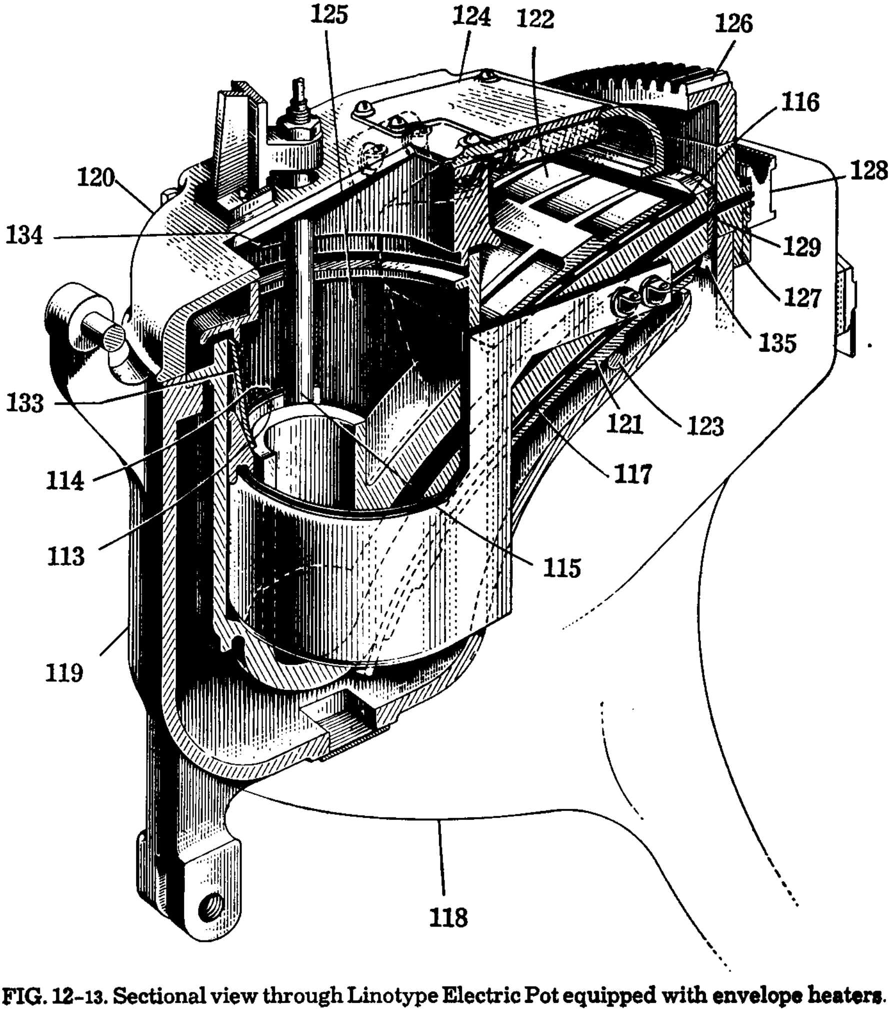


FIG. 12-13. Sectional view through Linotype Electric Pot equipped with envelope heaters.

100 volts to 260 volts direct current, or 100 volts to 260 volts alternating current of from 25 cycles to 100 cycles per second. All of the electrical equipment consists of standard fittings and materials arranged in accordance with present accepted practice and conform to the requirements of the National Electrical Code. This equipment has been approved by the National Board of Fire Underwriters.

The electric pot *118* is shown in Figs. 12 and 13-13 in both perspective sectional and cross sectional view.

The No. 2 crucible heater *113* and the No. 1 crucible heater *114* are inside the crucible *125* where they closely surround the pump well.

The thermostat rod *115* is located directly adjacent to this pump well so that it will register the temperature of the metal actually being used.

The throat heater *117* extends the full length of the crucible throat and is held

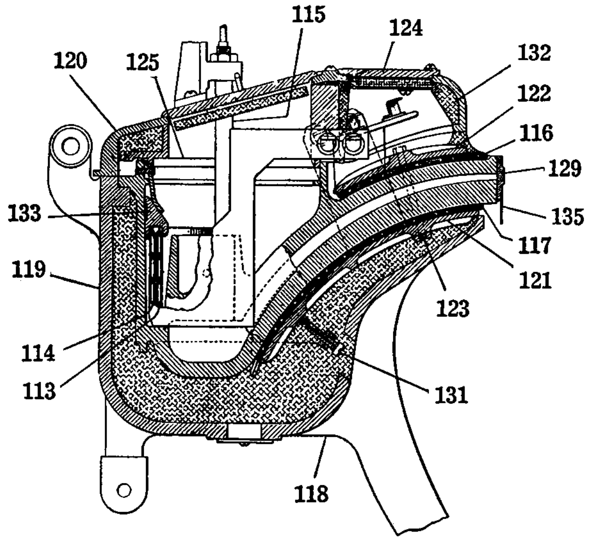


FIG. 13-13. Additional sectional view through Linotype Electric Pot.

in close contact with it by the throat heater clamping plate *121* assisted by clamp bolt *123* and clamping screw *131.*

The mouth heater *116* is clamped tightly to the mouth of the pot by the mouth heater clamping plate *122* and clamp bolt *123.*

Shown at *132* is heat insulating material entirely filling the large space between the pot jacket *119* and the crucible *125.*

The pot cover *120* may be removed by removing four screws.

Shown at *124* is the heater terminal inspection plate, which may be removed to test for shorts or grounds.

The mouthpiece *129* is shown in proper relation to the mold disk *126,* mold *127* and matrices *128.*

Shown at *133* is a clamp for holding the crucible heaters in place.

Shown at *134* is the cast iron splash guard which prevents careless splashes and holds the cover insulation securely in place. *135* is a drip guard to prevent metal from touching the throat heater.

Envelope Heaters

There are four heaters to each pot—the No. 1 crucible heater, No. 2 crucible heater, mouth heater and throat heater. The crucible heaters are immersed in the molten metal and closely surround the pump well.

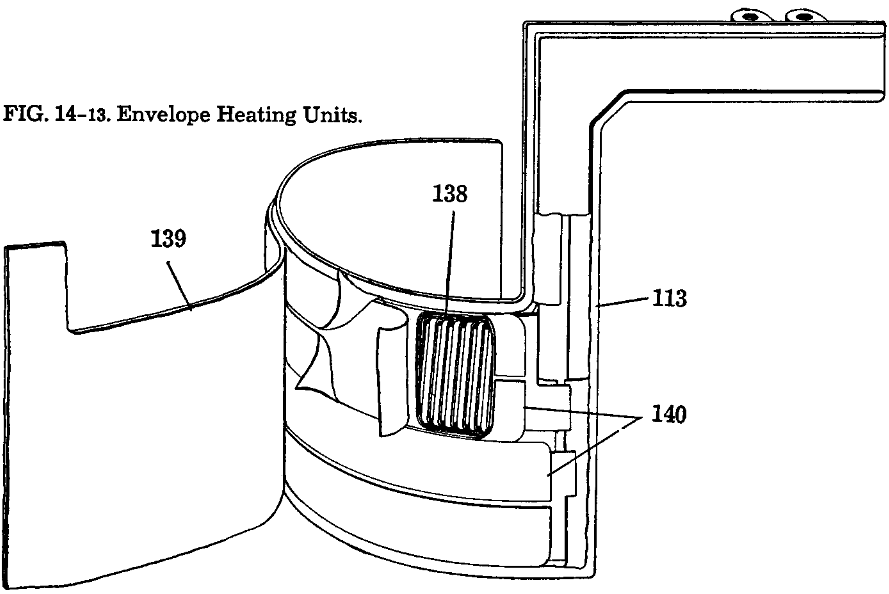
Since these crucible heaters are immersed in molten metal it is necessary that they be absolutely molten-metal tight. Fig. 14-13 shows a crucible heater with the metal envelope *139* cut open exposing the interior units *140,* one of which has been opened to show the construction of the heating elements. The heating element or resistor *138* is a resistance ribbon wound on mica strips enclosed in a sheet of mica insulation. The sheet metal envelope *139* is formed of a special grade of metal which resists corrosion. After the envelope is formed and the heating elements assembled inside, the edges of the envelope are sealed together by autogenous welding, thus making an absolutely liquid metal tight structure. In autogenous welding no spelter or foreign material is used, but the metal of the envelope itself is fused together so that the envelope at the point of the weld is just as impervious as the sheet metal itself.

Heating by direct contact with the metal inside the crucible by these immersion type heaters, increases the efficiency of the equipment and thermostat rod being immersed in the metal adjacent to the heaters and the pump well permits of a very close temperature regulation. As the metal is heated uniformly from within the crucible, and as the heaters extend nearly the full height of and pass through the top of the metal, a high temperature can be applied at the start and the metal quickly reduced to a fluid state without possibility of cracking the crucible.

When the metal begins to heat, it is that portion in direct contact with the heaters which first becomes molten.

Internal pressure is relieved by this melted pathway and the molten metal flows to the top of the pot.

FIG. 14-13. Envelope Heating Units.



If through abuse the metal envelope is punctured, molten metal will enter the element, result in a ground and destroy the unit. Metal in the crucible should always be kept at a level which completely covers the heating units. They are not designed for operation in air and continued exposure will cause them to burn out or ground. The crucible heaters are intended for heating the metal to the proper temperature and the mouth and throat heaters are only intended to keep the metal at the proper temperature while being forced from the crucible to the mold. The mouth heater and the throat heater are designed for operation in air but are protected from external injury by the same air-tight construction.

The throat heater extends the full length of the pot throat and is held in close contact with it. The mouth heater is clamped tightly to the pot mouth. Both heaters are surrounded with heat insulating material and are in good metallic contact with the pot throat and mouth, therefore, all the heat generated by these units is conducted directly into the path of the metal.

The crucible heaters are the same for all voltages; they are connected in *series* for 200 volt to 260 volt circuits and in *parallel* for 100 volt to 130 volt circuits.

The mouth and throat heaters are always connected in *series,* one set being used for 100 volt to 130 volt and another set for 200 volt to 260 volt.

Dynamic Thermometer

This thermometer, formerly supplied with all electric pots, was replaced by the mechanical thermostat described later. A brief description follows:

The dynamic thermometer, Fig. 15-13, consists of a metal bulb *154* connected by a small tube *155* to a flattened coiled tube *159.* The coiled tube is made of

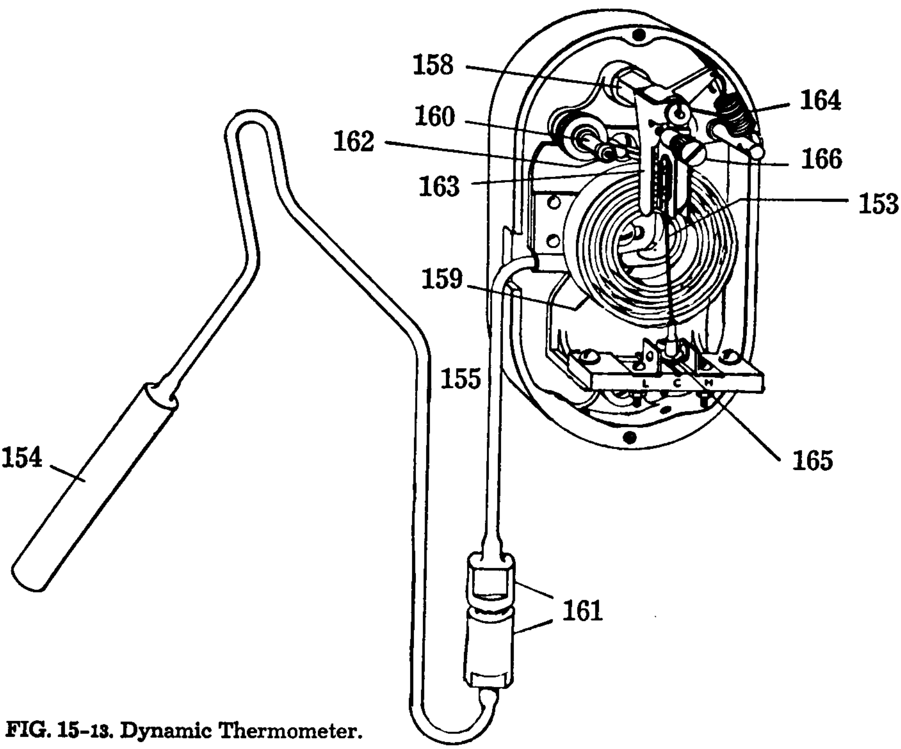


FIG. 15-13. Dynamic Thermometer.

spring metal and the bulb, tube and spring are entirely filled with mercury and are absolutely air tight. *161* is simply a coupling used by the manufacturer in the first assembly, and should under no circumstances be opened.

To the free end of the coiled spring tube is fastened an insulated pin *160* having a roller head *162* which rests against operating lever *163*. Operating lever *163* is held against the roller head *162* by the spring *164*, and moves contact lever *153* as the coiled spring tube expands or contracts. Contact lever *153* is made of spring wire and carries a roller head *165* at its lower end. Contact lever *153* does not carry current, the roller head simply rolls over contact *C* and makes an electrical connection between contacts *C* and *H* or *C* and *L*, as the coiled tube *159* expands or contracts.

Temperature regulation is obtained by adjusting screw *166*, which may be reached through a hole in the thermometer case. Turning the adjusting screw to the left increases the temperature of the metal, and turning it to the right reduces the temperature.

The bulb is immersed in the type metal near the pump well, and as the temperature of the metal rises the mercury in the bulb expands, causing the coiled spring tube to unwind, driving the contact lever *153* toward contact *H*. The tension on the spring wire contact lever *153* is such that when the temperature of the metal has reached 550 degrees F. the roller will roll over contact *C* and make contact between contact *H* and *C*.

By following the wiring diagram shown in Fig. 24-13 you will see that when roller head of contact lever *153* touches contact *C* and contact *H*, magnet switch coil *174* is short-circuited and magnet switch *170* will immediately fall open, disconnecting the crucible heaters *113* and *114* from the line and the metal will start to cool.

As the temperature of the metal falls, the mercury in the bulb contracts, allowing the coiled spring tube to recoil and resume its former position, and spring *164* pulls contact lever *153* over contact *C* and makes contact between contact *C* and contact *L*, when the temperature of the metal falls to 535 degrees F.

Now follow the wiring diagram shown in Fig. 22-13 and note that when the roller head *165* of contact lever touches contact *C* and contact *L*, current passes through magnet switch coil *174*, which immediately closes magnet switch *170* connecting crucible heaters *113* and *114* to the line, and they will start to heat the metal. This cycle will be repeated as long as the switch *168*, Fig. 17-13 is in the *on* position.

Care should be taken that the small tube *155* is not injured when feeding metal to the pot or that no sharp bends are made in it. The hole in this tube connecting the bulb *154* to the flattened coil spring *159* is very small, and sharply bending the tube or flattening it will close this hole and interfere with the proper functioning of the thermometer.

Mechanical Thermostat

This thermostat, Fig. 16-13 was furnished for many years until the advent of Micro-Therm control as regular equipment.

Due to its rigid construction, and short, strong leverage which holds the adjustments permanently, this thermostat was a decided improvement over the dynamic thermometer.

It consists of a tube *115*, Fig. 16-13, which is fastened to the housing *144* by the nut *149*. This tube has a low coefficient of expansion. Mounted in the tube *115* is the expansion element or rod, which has a high coefficient of expansion. This rod

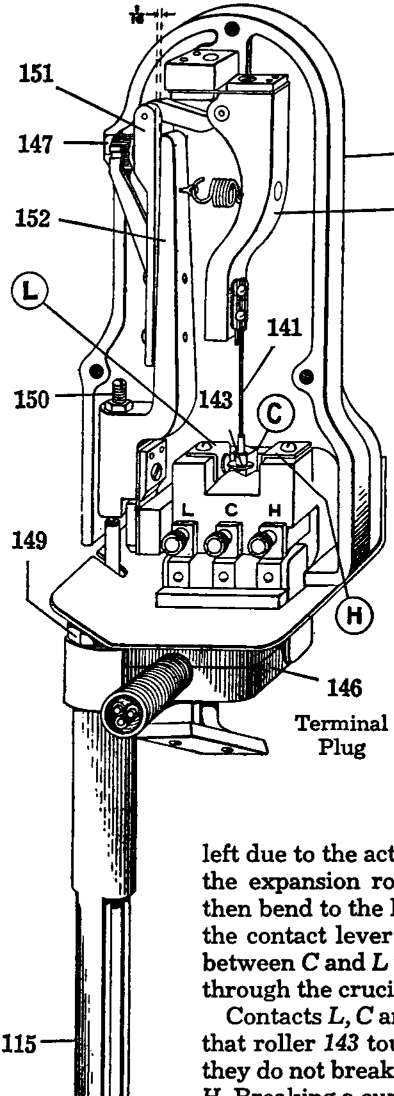


FIG. 16-13
Mechanical
Thermostat

is anchored to the lower portion of the tube so that it will expand upwards. To insure the quickest response to temperature change, the tube *115* is cut away on opposite sides, thus exposing the rod directly to the source of heat.

As the metal in the pot reaches 550 degrees F., due to the crucible heaters, the expansion rod elongates in an upward direction. This causes the upper tip of the expansion rod to press against the lower part of the adjusting screw *150*, thus rocking the fulcrum lever *152* on its spring pivot, and moving it to the right. The movement of this lever also causes contact lever *145* to move toward the right. Connected to contact lever *145* is a contact lever roller support *141* carrying a contact lever roller head *143* at its lower end. As the contact lever *145* moves to the right, it bends the contact lever roller support *141*, which is made of spring wire, until the tension of the contact lever roller support *141* is sufficient to snap the contact lever roller *143* over contact *C* to make an electrical connection between contacts *C* and *H*, thus instantly shutting off the electrical current flowing through the crucible heaters.

As the temperature of the metal lowers, after the current has been shut off, the levers *145* and *152* gradually move to the left due to the action of the spring pivots and the contracting of the expansion rod. The contact lever roller support *141* will then bend to the left until its tension becomes sufficient to snap the contact lever roller *143* over to contact *L*, making contact between *C* and *L* which instantly allows electric current to flow through the crucible heaters.

Contacts *L*, *C* and *H* do not carry current except at the instant that roller *143* touches contacts *C* and *L* or *C* and *H*, therefore they do not break a current when roller *143* leaves contacts *L* or *H*. Breaking a current at this point would cause burning or pitting, but by following the wiring diagram shown in Fig. 23-13, it is evident that as soon as magnet switch *170* closes, a maintaining contact is made at *173* which relieves contacts *C* and *L* of carrying current. By following the wiring diagram shown in Fig. 25-13, it is also evident that when magnet switch *170* is open no current can flow through contact *H* and contact *C*.

As mounted on the pot the working parts of the thermostat are thoroughly protected from mechanical injury by the cast iron cover, but the electric contacts are visible through the glass panel for convenient inspection at all times. These contacts, *L*, *C* and *H* should be kept clean and bright by occasional rubbing with No. 00 sand paper. Dirt and corrosion are electrical insulators, and if these contacts are allowed to get dirty, electrical contact may not be made as roller *143* touches contacts *C* and *H* when the temperature of the metal has reached 550 degrees F. The result would be that the magnet switch *170*, Fig. 23-13, would not open and the crucible heaters would continue to increase the temperature of the metal until the fuses are blown, the thermostat injured or the heating units burned out. On the other hand, when the metal has cooled to 535 degrees F. and contact lever roller *143* touches contacts *C* and *L*, and owing to dirt and corrosion no electrical contact is made, magnet switch *170* will not close, and the metal will continue to cool until it cannot be used.

The Control Panel

The control panel, Fig. 17-13, is mounted on the frame of the Linotype to the right and slightly to the rear of the keyboard, where it is within easy reach of the operator. It consists of a magnet switch *170* mounted on a slate panel *181*, enclosed in a steel cabinet *177*, on which is mounted a rheostat *182*, pot control snap switch *168* and fuse block *167*.

The double-pole clapper type magnet switch *170* is controlled by the thermostat. It consists of poles *171* and *172*, maintaining contact *173* and magnet switch coil *174*. This coil surrounds an iron magnet (not shown) and is wired directly to the thermostat contacts *C* and *L*, Fig. 16-13. When contact lever roller head *143* touches contacts *C* and *L* a current of electricity will flow through magnet switch coil *174* (see Fig. 22-13) energizing the magnet and immediately closing magnet switch *170*, which will remain closed until the contact is broken. When magnet switch *170* is closed the crucible heaters will be connected to the line and heating the metal in the crucible. As soon as the switch closes a contact is made

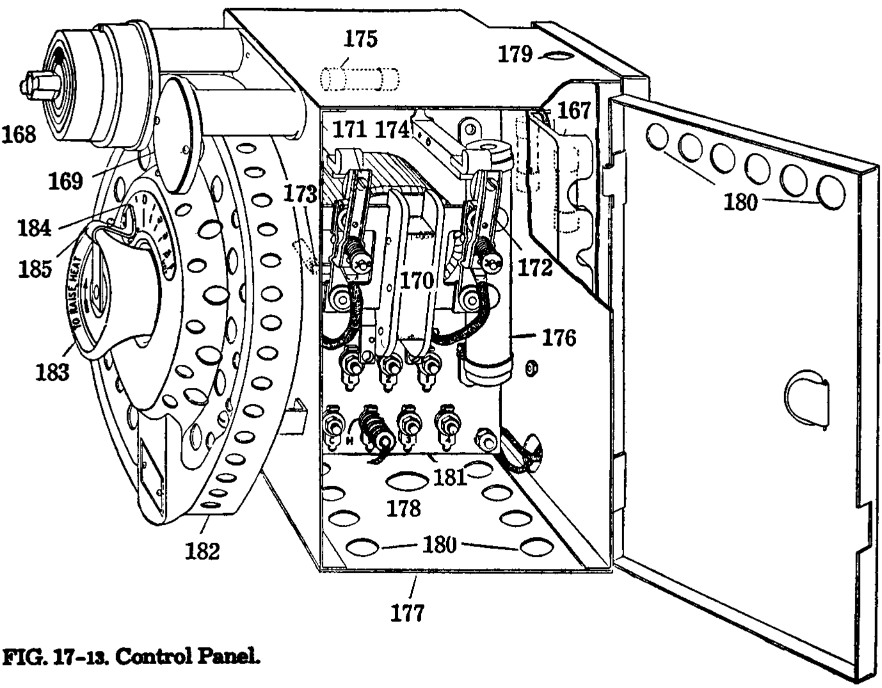


FIG. 17-13. Control Panel.

at *173* which maintains a current through magnet switch coil *174* (see Fig. 23-13) allowing contact lever roller head *143* to leave contacts *C* and *L*, without making a spark. If the flow of current through magnet switch coil *174* is interrupted as when contact lever roller head *143* touches contacts *C* and *H* (see Fig. 24-13) magnet switch *170* will immediately fall open, disconnecting the crucible heaters from the line, and remain open until a contact is again made. When magnet switch *170* is open the crucible heaters are not connected to the line and the metal in the crucible will begin to cool. The purpose of the maintaining contact *173* is to prevent the thermostat contacts carrying current while magnet switch *170* is closed and also to prevent the contacts arcing when they leave each other.

The rheostat *182* controls the mouth and throat heater circuit only. Turning the knob *183* to the right will increase the heat at the mouthpiece and turning the knob to the left will decrease it.

A rheostat scale is shown at *184* and *185* is a pointer to indicate the approximately correct adjustment for different work. This pointer should not be adjusted until the best position for the rheostat knob has been found by trial.

Pot control snap switch *168* connects the pot to the line when turned to *on* position and disconnects the pot from the line when turned to the *off* position. When switch *168* is in the *on* position the pot is "alive" and will heat the metal until turned to *off* position when the pot is "dead."

Fuse block *167* supports fuses *198* and *199* (see Fig. 20-13). These fuses protect the entire pot from overloads or accidents. *If these fuses are blown they should be replaced always with fuses of the same rating.*

Fuse *175* is in the mouth and throat heater circuit only to further protect this circuit from accidents. If this fuse is blown it should be replaced by a fuse of the same rating.

Resistance coil *176*, located on the control panel along side of the magnet switch, prevents a destructive rush of current through contacts *C* and *L* or *C* and *H* when roller head *143* touches them and it also restricts the amount of current consumed in magnet switch coil *174* when magnet switch *170* is closed.

Both resistance coil 176 and magnet switch coil 174 are different for various voltages and frequencies. All of the wiring is back of the slate panel where it is thoroughly protected from injury.

The magnet switch kick-out coil shown at *H*, is used for alternating current only. It is for the purpose of improving the action of the magnet switch and causing it to open promptly. The introduction of this coil in the thermostat circuit aids in preventing the magnet switch becoming magnetized.

Terminals *L*, *C* and *H* are for connecting to the wires leading from the temperature control and the other four terminals are for connecting to the wires leading from the same numbered terminals on the pot.

The cable connector *179* is used for connecting to the line, and cable connector *178* is for connecting the flexible cable from the pot.

The holes *180* are for cabinet ventilation and at *169* there is provision for mounting the switch to control the driving motor.

The Use of Incandescent Lamps as Resistance

When the magnet switch resistance coil, shown as *176* in Fig. 17-13, burns out or otherwise fails, it is usually possible to operate the equipment by substituting incandescent lamps, either singly or in bank, for this resistance, until another resistance coil can be secured. We do not recommend the use of lamps as we consider them only a makeshift for this purpose and their use is warranted only when some sort of wire-wound resistance near the correct value is not at hand.

Tungsten filament lamps, which are the only incandescent lamps readily obtainable, are not well suited for this purpose but may be used in an emergency. Because the resistance of their metallic filament depends upon the temperature at which the lamp is operating and as this temperature changes with the voltage, a slight voltage fluctuation changes the resistance of the lamps rapidly and to a considerable extent. It is impossible to get very close to the exact required resistance with any one lamp or with a small bank of lamps.

The main purpose of this resistance coil is to limit the current flow through the magnet switch coil and if this substituted resistance is not near the correct value or does not remain near the constant, it either imposes more load on the switch coil than it was designed for, and will in time cause it to burn out, or the closing of the magnet switch will not be positive, a condition which will sometimes result in cold metal.

Voltage and Frequency	*Resistance Required*	*Lamps in Watts*	
115 volt D.C.	280 ohms	1 50-watt or 2	25-watt in parallel
115 volt A.C. 25-30 cycle	80 ohms	1 150-watt or 2	75-watt in parallel
115 volt A.C. 40 cycle	64 ohms	 2	100-watt in parallel
115 volt A.C. 50 cycle	50 ohms	 2	125-watt in parallel
115 volt A.C. 60 cycle	40 ohms	 3	150-watt in parallel
230 volt D.C.	1000 ohms	 2	25-watt in series
230 volt A.C. 25-30 cycle	320 ohms	 2	40-watt in series
230 volt A.C. 40 cycle	250 ohms	 2	50-watt in series
230 volt A.C. 50 cycle	200 ohms	 2	60-watt in series
230 volt A.C. 60 cycle	160 ohms	 2	75-watt in series

Preceding, is listed equipment operating on some of the usual commercial voltages and frequencies and the lamps that may be substituted for the resistance coil. We have based this list on the 100-130 volt equipment operating on about 115 volts and the 200-260 volt equipment operating on about 230 volts. This tabulation is also based on using tungsten filament lamps trade marked "Mazda" which are usually correctly rated. There are many cheap lamps on the market which are not within 20% of their rated wattage.

Failure of Magnet Switch Resistance Coils

Magnet switch resistance coils seldom, if ever, fail or burn out except when they are subjected to very severe service caused by the disarrangement of other parts of the equipment. The coil is wound with a special wire which has a negative resistance coefficient, which permits the magnet switch coil to consume the maximum current at the time that the magnet switch is closing, but after the switch is closed and this resistance coil increases its temperature, the resistance of the circuit is also increased which in turn decreases the current consumption, and prevents this resistance coil and the magnet coil from overheating in normal service. We have investigated many coil failures and every time have been able to trace the failure to one or the other of two causes.

The principal purpose of this coil is to limit the current flow through the magnet switch coil. Therefore it is in service only when the magnet switch is in a closed position and no current flows through it when the switch is open. This coil is designed for intermittent service and will operate indefinitely under these normal conditions, but if the two wires that connect contacts *C* and *L* on the thermostat temperature control to the *C* and *L* contacts on the control panel are transposed or interchanged, this resistance coil will be in the circuit both when the switch is open and when it is closed and this constant service on a coil that is designed for intermittent service will soon cause it to burn out. All of these contacts are plainly marked and the wires are color coded so that transpositions are caused only by carelessness.

Another purpose of this resistance coil is to limit the flow of current when the magnet coil is short circuited by the action of the thermostat temperature control contact *C* touching contact *H* which permits the magnet switch to open. When these thermostat contacts close, the entire line voltage is thrown across this coil for the instant that the switch is opening. If the magnet switch does not open instantly this coil remains in circuit until the switch does open, and if kept in circuit very long it will burn out. Failure of the magnet switch to open promptly is caused by a rusty hinge pin, the switch not being level, or a magnet bound switch.

Wiring Diagrams

The Linotype electric pot has two separate and distinct electric heating circuits. One circuit is through the crucible heaters and is automatically controlled by the action of the thermostat on the magnet switch.

The other circuit is through the mouth and throat heaters and is controlled by manually adjusting the rheostat attached to the outside of the control panel cabinet.

A wiring diagram will be found on the inside of the control cabinet cover, but for those of our customers who are not familiar with electrical diagrams, eight simplified wiring diagrams, Figs. 21 to 28-13, are shown in this chapter.

The lines shown on these diagrams represent the wires on the back of the control panel. The electric circuits and the connections may be traced by following these lines.

The heavy lines show circuits carrying current. Arrows are used to assist in following the circuits. These lines are run straight and parallel or at right angles, but the actual wiring on the panel is usually run the shortest distance between terminals.

To make these diagrams clear, they are all shown with the crucible heaters wired in parallel but it should be understood that the crucible heaters in 200 volt to 260 volt pots are wired in series and only the 100 volt to 130 volt pots are actually wired in parallel. The mouth and throat heaters in all pots are always wired in series. This wiring applies to the envelope type of heaters only. It does not apply to the Lino-Therm heaters used in Micro-Therm Electric Pots and described later in this chapter.

In the first five diagrams the circuit through the crucible heaters only is considered and in the next diagram the circuit through the mouth and throat heaters is explained.

The seventh and eighth diagrams show the difference in the connection of the crucible heaters for series and parallel connections.

Definitions

The circuit is that part of the equipment which is intended to carry electric current, such as copper wires, resistance wires, switches, etc. They are insulated from the frame of the pot.

The current is the electricity passing through the equipment.

Amperes is the volume of current passing through.

Volts is the strength or pressure of the current.

A watt is the product of the volts multiplied by the amperes.

A kilowatt is 1,000 watts.

A kilowatt hour is one kilowatt of current used for one hour.

A ground is a bare part of the electric circuit accidentally touching the frame of the pot.

A short circuit is one or more grounds which allow the current to take a shorter path.

An open is an interruption in the electric circuit caused by a broken wire, etc.

Resistance is an obstruction in the electric circuit retarding the flow of current.

Series connection means that two or more units are connected in line with each other. Current enters one terminal, passes through the windings, out of the other terminal and directly into the next unit, through its windings and out to the opposite side of the line.

Parallel or Multiple connection means that two or more units are wired in such a way that each makes a complete circuit of themselves. Current enters a unit, passing through its windings and directly back to the line.

An electrical circuit carrying current can best be simply explained by considering an iron pipe through which water is flowing under pressure. The pipe represents the *circuit* and water passing through it represents the *current*. The volume of the water flowing represents the *amperes* and the pressure of the water represents the *volts*. A leak that allowed the water to escape would represent a *short circuit* and a valve in the pipe partially closed would represent *resistance*.

Installation

In ordering the equipment, the electrical characteristics of the supply line must be given; we supply an equipment to meet those requirements. Both the pot and the control panel are shipped completely assembled and wired, but the connecting conduit and wires are not attached. For safety in shipping, the thermostat has been removed from the pot. Each wire in the flexible conduit is different in color scheme and care must be used in connecting them to the proper terminals. The pot is installed in the machine in the same manner as the gas pot, the same adjustments being used for the lockup and alignment.

To remove a gas pot and install an electric pot, you should remove the pump plunger and dip out the molten metal. Lower the first elevator to the casting position and let vise down to second position, disconnect the mold cam lever and the ejector lever link, ejector blade connector link and link rod, when the mold disk and slide can be removed. Take off the pot leg caps, turn out front adjusting screws in the pot legs, back off the nut on the pot lever eyebolt to release the spring tension, take out the pot lever shaft, remove the pot lever and take off the mold disk shield and pot pump stop lever bracket. The old pot jacket and crucible can now be lifted out. To do this to the best advantage, put a rope through the supports on the jacket for the pot lever shaft, so that you can raise up the jacket while it is being guided out and away from the machine by taking hold of the bottom of the pot jacket legs.

The electric pot can now be placed in position and the parts that were removed and disconnected can again be placed in position and connected up. After it is placed in position it is ready to wire up and can be brought into proper position in relation to the mold through the adjusting screws.

The holes in the mouthpiece should be made to line up just above the edge of the mold body, so that they will be in the center of a 6-point slug. This adjustment, if you have a pot mouth aligning gauge, is made by turning the machine until the first elevator is in the lowest position, when the vise should be opened, the mold removed and the gauge placed between the vise jaws.

If you do not have the gauge, remove the mold cap, so that you can watch carefully the location of the mouthpiece holes. Raise the first elevator, blocking it up with a piece of wood, one end of which should rest upon the upper end of the vise automatic stop rod. Close the vise, unlock the mold cam lever and move the mold disk forward by hand so that the studs will enter the bushings.

If using the pot mouth aligning gauge, have the two lugs in the gauge resting on the seat of the mold pocket in the disk and turn the machine by hand until the mouthpiece advances to within one-quarter of an inch of the gauge. Force the pot forward against the gauge, using a bar at the back.

If using the mold as a gauge, proceed in the same way and bring the mouthpiece up by hand against the mold, raise or lower the pot so lower edge of mouthpiece holes are in line with top of gauge or mold body, by using the top and bottom adjusting screws in the pot legs, being careful to bring the end hole inside of 30-em liners in the mold. When the correct position is secured tighten up the check nuts.

To adjust the pot so that the mouthpiece will lock up square with the mold have the machine in the same position as when adjusting the height. Place two pieces of thin paper between the mouthpiece and the gauge or the mouthpiece and the mold, as the case may be, one at each end. Adjust with the front and back screws in the pot legs so that both pieces of paper will be held tight. When this adjustment is secured, tighten up the check nuts. (See the maintenance section of this chapter for complete instructions on testing the lock-up.)

The control panel cabinet may now be placed in position. It is provided with a bracket for mounting in the proper location on the machine and should be mounted level to insure correct operation of the magnet switch. The flexible conduit is threaded through the pedestal of the machine, care being taken that it does not touch any moving parts of the machine. By the use of the conduit clamps one end of the cable is made fast to the pot and the other end to the panel cabinet, bringing both ends of the seven wires in proper position to connect to their respective terminals. Remove the terminal cover on the pot and the cover of the temperature control to expose the terminals at the pot end. You will notice that the terminals on the pot and temperature control are marked the same as those on the panel. The wires are coded so you will connect each terminal on the panel to the terminal on the pot or temperature control with the wire bearing the same colored thread.

The line connection from the control panel cabinet to the current supply may be of any approved construction, such as "Greenfield" flexible conductors, but the two wires to each pot should not be smaller than No. 10 B&S, the distance to a junction box should be short and the main lines should be of ample size.

The pots in all cases are two-wire. On a single-phase circuit connect direct to the two wires of the circuit. On the two-phase circuit a pot is connected to the two wires of one phase only, the two wires of the other phase being disregarded entirely, and where several pots are used the phases can be balanced by connecting to alternate phases. On a three-phase circuit a pot is connected to any two of the three wires of the circuit and the phases may be balanced in the same manner as in the two phases.

On a two-wire direct current circuit, connect direct to both wires. On a three-wire direct current circuit, connect to the two outside wires or to the neutral and one outside wire, depending of course upon the voltage of your pot.

A wiring diagram will be found on the inside of the door of the control panel cabinet. After the connections are completed, but before turning switch *168*, Fig. 17-13, to the *on* position, a test should be made for grounds. A magneto should be used for this purpose and the current should not be turned on until it is certain that the equipment is properly wired and free from grounds.

Operation

When this equipment is shipped from the factory the pot contains only a small amount of metal and the first step is to melt down sufficient metal to fill the crucible. On the first heating standard ingots should not be used, but the pot should be filled by means of slugs or small flat pieces of metal that will fit down into contact with the heaters. These will melt down much quicker than ingots and with less possibility of overheating the crucible heaters which are not designed for operation in air, but should be covered by metal at all times when the current is on.

When the slugs are placed in contact with the units, turn the current on by turning snap switch *168* on the control panel, Fig. 17-13, to the *on* position and turn rheostat knob *183* to moderate heat position. About one hour will be required to melt down and bring the metal up to operating temperature. After the first melting down, however, the pot should heat up to operating temperature in about fifty minutes from the time of turning on the current.

Starting up from cold, the contact lever roller head *143* is touching contacts *C* and *L*. When snap switch *168* is turned to *on* position a current passes through these contacts and through magnet switch coil *174* which will immediately close magnet switch *170* connecting the crucible heaters to the circuit. The passage of current through the windings of the crucible heaters will heat the metal in the crucible. When the temperature of the metal reaches 550 degrees F., the contact lever roller head *143*, Fig. 16-13, will roll over contact *C* and make contact between contacts *C* and *H*. When contact lever roller head *143* touches contacts *C* and *H* current passes through these contacts instead of through the magnet switch coil *174* which permits magnet switch *170* to open. When magnet switch *170* opens it disconnects the crucible heaters from the circuit and the metal begins to cool. When the metal cools to 535 degrees F., the contact lever roller head *143* will roll over contact *C* and make contact between contacts *C* and *L*. This closes the magnet switch *170* and the crucible heaters begin to heat the metal again. This cycle is repeated as long as the snap switch *168* is left in the *on* position.

With ordinary work and after the metal is at operating temperature the current will be on and the crucible heaters will generate heat for about three minutes, then off, and not generate heat for about twelve minutes, and will repeat this cycle as long as snap switch *168* is left in the *on* position.

The temperature control is normally set for a maximum of 550 degrees F. and a minimum of 535 degrees F.; that is, with normal operation the temperature of the metal will always be between these limits. This is found to give the best all around casting results for average metal. In case it is desired at any time to change the operating temperature this can be done by turning adjusting screw *147*, Fig. 16-13, to the left for cooler metal and to the right for hotter metal. The head of this adjusting screw projects through the temperature control cover.

If the temperature control is adjusted to keep the metal in the crucible at the proper temperature and the rheostat *182*, Fig. 17-13, adjusted to compensate for irregular voltage or for widely different output, no trouble should be experienced with imperfect slugs.

If the voltage is irregular and remains too high for some time or a speedy operator casts large slugs at a rapid rate continuously, the mouthpiece is apt to become overheated and the slugs will have hollow bottoms. In this case it will be necessary to turn rheostat knob to the left, but if the voltage remains low for some length of time or a slow operator casts small slugs slowly, the mouthpiece may become cold and the slugs will have poor faces, in which case rheostat knob should be turned to the right.

When casting large slugs in rapid succession the mold may become overheated, but attempting to regulate the temperature of the metal in the crucible to overcome the heating of the mold will fail because the electric pot is a heating unit only and cannot offset an overheated mold.

The contacts *L, C* and *H* and the contact lever roller *143* that are visible through the glass panel on the temperature control case should be kept clean. *Corrosion or dirt is an insulator and if allowed to accumulate at this point will interfere with temperature regulations.*

It is important that the pot never be filled with metal above the under side of the ring cast on the inside of the crucible.

It is also important that the crucible heaters be entirely covered with metal at all times. If they are not, that portion exposed to the air will get very hot and continued exposure will burn out and destroy them.

Troubles—Testing

Few interruptions to continuous operation are likely to occur, but every abnormal condition that might develop will be described, together with the easiest method of detection and relief.

The main electrical troubles found are "opens," "grounds" and "shorts."

Before doing work of any nature on any part of the electrical equipment always turn snap switch *168,* Fig. 17-13, to the *off* position.

When disconnecting any wiring always mark each wire and its corresponding terminal clearly so that it may be correctly replaced. Experienced electricians who are familiar with ordinary simple testing of this nature may devise their own means, but the inexperienced are strongly advised to closely follow these instructions.

The equipment necessary to make all electrical tests is inexpensive and ordinarily is at hand in an electrically lighted building.

The best method is to use a magneto when testing for grounds and a lamp in series when testing for opens and short circuits.

The Magneto—A hand operated magneto may be borrowed from your local power house. If the size of the installation justifies the expense, a magneto may be purchased for a few dollars.

Before testing with a magneto the two bare tips of the lead wires should be held together while the crank is turned briskly to see that the bell rings distinctly.

In testing for grounds with a magneto, hold one bare tip of a lead wire on a clean part of the metallic surface of the pot or unit being tested and touch the other bare tip of the other lead wire to an electrical connection of the part being tested; now turn the crank briskly and if the bell of the magneto rings, the part under test is grounded, and if the bell does not ring it is not grounded.

Care should be taken that the tips of the leads are clean and that they touch a clean metallic surface. Dirt or corrosion is an insulator.

The Lamp in Series—For testing for open circuits or short circuits a lamp in series is the best equipment. It may readily be made from an incandescent lamp of your regular voltage, a keyless lamp socket, a convenient length of ordinary lamp cord and an attachment plug.

Connect the lamp cord to the attachment plug and the keyless socket in the ordinary way, then cut one of the two strands of the lamp cord a few inches from the lamp socket. Remove the insulation for one inch from the two ends of this strand of the lamp cord and twist the wires tightly. (See Fig. 18-13.)

Before making a test with this equipment, screw the lamp firmly into the socket, connect the attachment plug to a convenient outlet and touch the two bare tips of these wires together. The lamp should now light.

When testing for opens, connect the two bare lamp cord wire tips to two different electric terminals of the units under test. If the lamp lights it indicates that

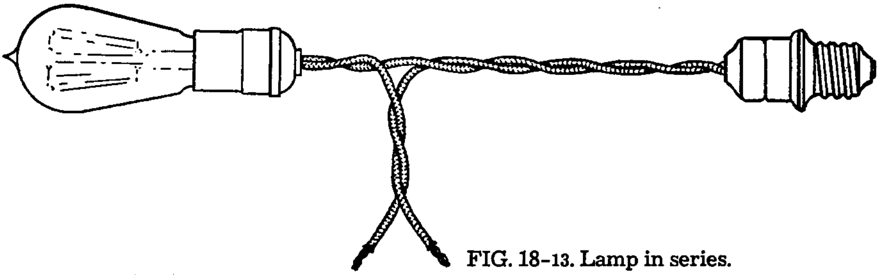


FIG. 18-13. Lamp in series.

the units are not open. When making the above test all interconnecting wires to the units being tested must be disconnected.

Pot Will Not Heat Up—See that switch *168,* Fig. 17-13, is in the *on* position. Make sure that fuses *198,* Fig. 20-13, are intact. Test the line to make sure you have current up to fuses *198.* See that contact lever roller head *143,* Fig. 16-13, touches contacts *C* and *L* and that these contacts are clean. Note that magnet switch *170,* Fig. 17-13, closes when switch *168* is turned to the *on* position and falls open when this switch is turned to the *off* position. If the pot still does not heat, it indicates an open in the connecting wires or in the crucible heater units. Turn the current off by turning switch *168,* Fig. 17-13, to the *off* position, remove the pot terminal cover and test from terminal post No. 2 to terminal post No. 3. If your lamp testing outfit will not light between these two terminals it indicates that one or both crucible heaters are open and they must be removed and replaced. Test from terminal No. 3 in panel box to terminal No. 3 on the pot and if the light does not light, the wire in the cable is broken. The same test should be tried for the terminals marked No. 2. An open wire should be replaced with a new one of the same size which is No. 14 R. C. wire. When making the above test if magnet switch *170,* Fig. 17-13, does not close when switch *168* is turned to *on* position it indicates that either magnet switch coil *174* or resistance coil *176* is open. You should test these coils out in the same manner as the crucible heaters by connecting the lamp testing outfit to their respective terminals. They may easily be replaced.

Continued extremely high voltage may cause magnet switch coil *174* or resistance coil *176* to open and *continued low metal in the crucible, exposing the crucible heaters to the air might cause them to burn out and open.*

Abnormally high pot temperature caused by dirty contacts *L, C* or *H,* Fig. 16-13, or grounded heater terminals, if permitted to continue will cause crucible heaters to burn out.

The Pot Heats Slowly—On a 100 volt to 130 volt pot one of the crucible heaters may be open, the other one in good condition. One heater will melt the metal in sufficient quantity to operate at ordinary speeds but will require nearly three times the normal length of time to heat up. To locate the open crucible heater, remove the pot cover, disconnect the wiring from both heaters and test with lamp testing outfit. The open heater, of course, must be replaced. Slow heating may be caused by improper adjustment of *147,* Fig. 16-13, for if the temperature control keeps disconnecting the heating units from the line before the temperature of the metal has reached 550 degrees F., it will require a longer time for metal to reach operating temperature.

If the crucible heaters have been found correct, use a glass rod thermometer and adjust *147,* Fig. 16-13, until temperature control operates between 535 degrees F. and 550 degrees F.

Abnormally low voltage may cause the pot to heat slowly but this is very seldom the case. If the voltage of the line is 15 per cent less than the voltage of the pot, it would require about 20 per cent longer time to bring the metal up to operating temperature.

The Pot Overheats—The pot may overheat from any one of several causes.

At the first indication that the pot is overheating the equipment should be inspected and the cause found and remedied.

The magnet switch *170,* Fig. 17-13, should open promptly with the closing of the temperature control contacts *C* and *H,* Fig. 16-13. This magnet switch carries the electric current from the main line to the heaters and if it does not open promptly, the temperature of the pot will rise to a dangerous point and the crucible heaters may be burned out or the temperature control injured.

At the first indication of excessive heat examine the equipment as follows:

Be sure that the control panel cabinet which contains the magnet switch is hanging level. This switch opens by gravity and if it is not hanging level it may not open promptly when the temperature control contacts *C* and *H* close.

Examine the contacts of the temperature control and be sure that they are clean. Dirt and corrosion are electrical insulators and if present on these contacts it may prevent the magnet switch from opening.

Examine the hinge pin *186,* Fig. 19-13, which passes through the magnet switch. If this pin is rusted or corroded the action of the switch will be sluggish and may not open promptly when the temperature control contacts *C* and *H* close.

If certain parts of the electrical circuit become grounded due to squirts or splashes of metal the temperature control may not control the magnet switch. A ground may be located by means of a magneto. These grounds must be found and corrected before normal operation can be resumed.

Sometimes, either through wear or because of poor alignment of the metallic parts the magnet switch may become magnetized; that is the armature or moving part of the switch may be held closed against the magnet or fixed part of the switch by residual magnetism in the switch core itself.

In order to explain clearly this rare occurrence we refer to Fig. 19-13. This figure shows two views of the magnet switch. The upper pole of the laminated iron core *187,* is surrounded by the magnet switch coil *188* and to the lower pole is hinged the armature *189* which carries the contacts *190* of the main circuit and the compression springs *192.*

When a current of electricity passes through the magnet coil *188,* due to the closing of the temperature control contacts *C* and *L,* magnetism pulls the upper part of the armature *189* against the upper pole of the core *187,* thus closing the contacts *190* and *191* of the main circuit. The upper pole of this magnet core (which is surrounded by the magnet switch coil) and the upper part of the armature are ground flat and true. Note carefully that this point is the only place that the iron parts of the armature should touch any of the iron parts of the core structure.

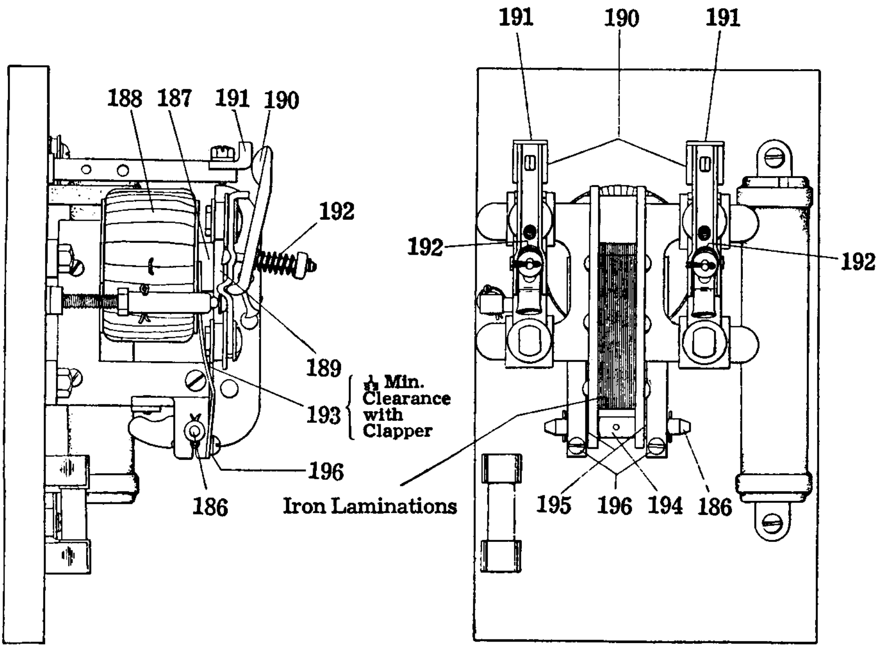


FIG. 19-13. Side and front view of Magnet Switch.

Note especially that the lower part of the armature must not touch the lower pole of the core. There should be a clearance of at least 1/32″ maintained at this point as shown at *193*. If there is not sufficient clearance the armature may be removed and filed until the clearance indicated is obtained.

Where the armature is hinged to the core there is a brass tube *194* which passes through the lower end of the armature and through which the hinge pin passes. This brass tube is beaded over at both ends as shown at *195* and this beading prevents any lateral movement of the armature so that the armature does not touch any part of the switch core when the switch opens or closes. If this beading is worn or is insufficient, brass, copper or fibre washers may be inserted at this point. Iron or steel washers must not be used.

Be sure that the lock washers *196* do not touch the armature when the switch is closed and prevent the prompt opening of the switch. These washers may be filed if they interfere.

If a dynamic thermometer is being used and if the pot has been overheated the dynamic thermometer bulb or tube are likely to be expanded by the expansion of the mercury to such an extent that the bulb or tube is permanently injured. *Do not replace a damaged dynamic thermometer bulb and tube without first clearing up grounds.* The new one will also be injured.

The bulb may be punctured by jamming ingots of metal down upon it in the pot, or a sharp bend or kink in the tube may close the small hole in it.

The Mouthpiece Will Not Heat—The mouth and throat heater circuit is separate from the crucible heater circuit. It is not automatically controlled by the temperature control but it is regulated by adjusting the rheostat mounted on the outside of the control cabinet. These two heaters, the mouth heater and the throat heater, are in series with each other, that is, current passes from the line through one and then through the other, back to the line (see Fig. 26-13). If one is open, current cannot pass through either. The fuse protecting this circuit is shown as *175,* Fig. 17-13. It should be tested first. If the crucible heater circuit is operating properly but the mouthpiece will not heat, proceed to test as follows: Touch one bare tip of the lamp testing outfit to terminal marked 1 and the other bare tip to terminal marked 4. If there is an open in the mouth or throat heaters, in the rheostat, or in the wiring that connects them, the lamp will not light. To determine whether it is the mouth heater or throat heater that is open, remove the pot cover and attach the test lamp tips to the mouth heater terminals which you will find exposed to your view. If the mouth heater tests correct, the throat heater or connecting wires must be open.

Sometimes the mouthpiece seems too hot or too cold when the real trouble is that the metal in the crucible is too hot or too cold.

Mouthpiece Gets Too Hot or Too Cold—Rheostat *182,* Fig. 17-13, located on the outside of the control panel cabinet, is intended to control the mouth and throat heater circuit, compensating for irregular voltages or differing output. Ordinarily this rheostat is turned to an intermediate position but if the voltage is high or a fast operator casts large slugs continuously, it may be necessary to turn rheostat knob *183* to the left and if the voltage remains low or small slugs are cast slowly the rheostat knob may have to be turned to the right.

Do not confuse a hot mold with a hot mouthpiece. You cannot control the temperature of the mold by adjusting the temperature of the mouth and throat heaters. If you are casting large slugs continuously you should use a water-cooled mold disk.

The Fuses Blow—Grounding—If fuses *198,* Fig. 20-13, keep blowing it indicates that some part of the equipment's electric circuit is grounded or short circuited and it will be necessary to locate and rectify this condition before normal operation can be resumed.

Splashed metal is the cause of most grounds, and splashes are caused by careless operation.

Operating the pot with the molten metal above the ring on the inside of the crucible or dropping ingots of metal carelessly into the pot will splash the metal over the crucible walls into the heat insulation.

This splashed metal may ground the crucible heater terminals or mouth heater terminals by a direct splash.

The sheet metal envelope of the crucible heaters may become punctured by forcing ingots of metal down upon them or from other causes. They will immediately fill with molten metal, short circuiting the heater and grounding the pot.

The temperature control terminals may become grounded, caused by a break down of the insulation. This will ground the pot.

A slight ground on some parts of the pot will not prevent its satisfactory operation, but a heavy ground or short circuit will prevent its operation and blow the fuses.

Most commercial lighting and power circuits are permanently grounded on one side at the generating station or transformer and the pot frame is usually grounded by the line wiring connections.

If the accidental ground occurs on the same side of the wiring that is purposely grounded, it will cause no harm but if it occurs on the opposite, the fuses will be blown, therefore some serious grounds may be eliminated simply by interchanging the line wires where they are connected to the fuse block *167,* Fig. 20-13.

In testing for grounds switch *168*, Fig. 17-13, should be turned to the *off* position and the pot terminal cover should be removed. Touch one lead wire from the magneto to a clean part of the pot (paint or rust is an insulator) and the other lead wire to each of the wire terminals in succession. If the magneto does not ring when the crank is turned briskly the pot is not grounded. If the pot is grounded, which is indicated by the magneto bell ringing with the above test, it will be necessary to locate the particular part of the system grounded. In most cases you should remove the pot cover inspection plate and ring out the different heaters separately. Disconnect the wiring and test from the frame of the pot directly to the terminals on the heaters. If the heaters are grounded they will ring.

If each heater itself tests free of grounds and the pot is still grounded you must test each lead wire inside the pot separately. Metal splashed into the heat insulation surrounding the crucible will sometimes burn through the electrical insulation on these wires grounding the pot.

In disconnecting any wiring, be sure that it is properly marked so that it may be reconnected in exactly the same way. *When fuses are replaced, care should be taken that they are of the same ampere rating as the ones removed. Fuses 198, Fig. 20-13, are: for 100-130 volt equipment, two 20 ampere; for 200-260 volt equipment, two 10 ampere.*

Fuse *175*, Fig. 17-13, is in the mouth and throat heater circuit only, and if this fuse blows, it indicates a ground on this circuit. The heaters, their terminals, the rheostat or the lead wires may be grounded and must be located and replaced or repaired, by proceeding as in locating a ground in the crucible heater circuit. *Fuse 175, Fig. 17-13, for 100-130 volt equipment is 5 ampere rating and for 200-260 volt equipment is 3 ampere rating. Never use fuses above these ampere ratings.*

Humming Switch—On alternating current the magnet switch always makes a slight humming noise but it is usually not objectionable. The working surfaces of these switches are ground flat and true to permit close fitting and should be kept clean.

If corrosion or dirt collects on these ground surfaces, they will not come into close contact when the switch closes and the humming noise will be increased. If this noise becomes objectionable insert a strip of fine sand paper between the working surfaces and holding the switch closed, pull the sand paper back and forth until the metal parts are clean.

Fluttering Switch (Dynamic Thermometer)—If the pot leg bushing or pot lever shaft are not properly fitted and the metal is slightly cold when the mouthpiece leaves the mold, the pot has a jerky action. The spring to which the contact lever roller *165*, Fig. 15-13, is fastened should be so adjusted that it presses the roller *165* against the contacts *C* and *L* or *C* and *H*. Also be sure that the operating lever spring *164*, has tension enough to force the contact lever roller support *153* over so that the operating lever *163* is resting against the operating coil roller *162* of the insulated pin *160* when the metal in the crucible is between 535 degrees F. and 550 degrees F. Any lost motion due to weak springs will cause the contact lever roller support *153* to swing when the machine is in motion so that the contact lever roller *165*, will touch contacts *C* and *L* or *C* and *H* regardless of the temperature of the metal. Contact *173*, Fig. 23-13, should be kept clean. It maintains the circuit through magnet switch *170* after contacts *C* and *L* are released of carrying current and if it is not clean, the switch will not remain closed and will flutter in and out.

The small plunger and spring in the end of this contact post should be inspected and if the spring has set it should be renewed.

Fluttering Switch (Mechanical Thermostat)—The contact lever roller support, ***141,*** **Fig. 16-13, to which is attached the contact lever roller *143* should be adjusted so that it has tension enough to hold the contact lever roller in a constant position against the motions of the metal pot. Also maintaining contact *173,* Fig. 23-13, should be kept clean. It maintains the circuit through the double pole magnet switch *170* after contacts *C* and *L* are released of carrying current and if it is not clean, the switch will not remain closed and will flutter in and out.**

The small plunger and spring of maintaining contact *173* in the end of this post should be inspected and if the spring has set, it should be renewed.

Testing Control Panel—Fig. 20-13 is a diagram of the control panel only, showing the wiring and the electrical connections. The lines on this diagram represent

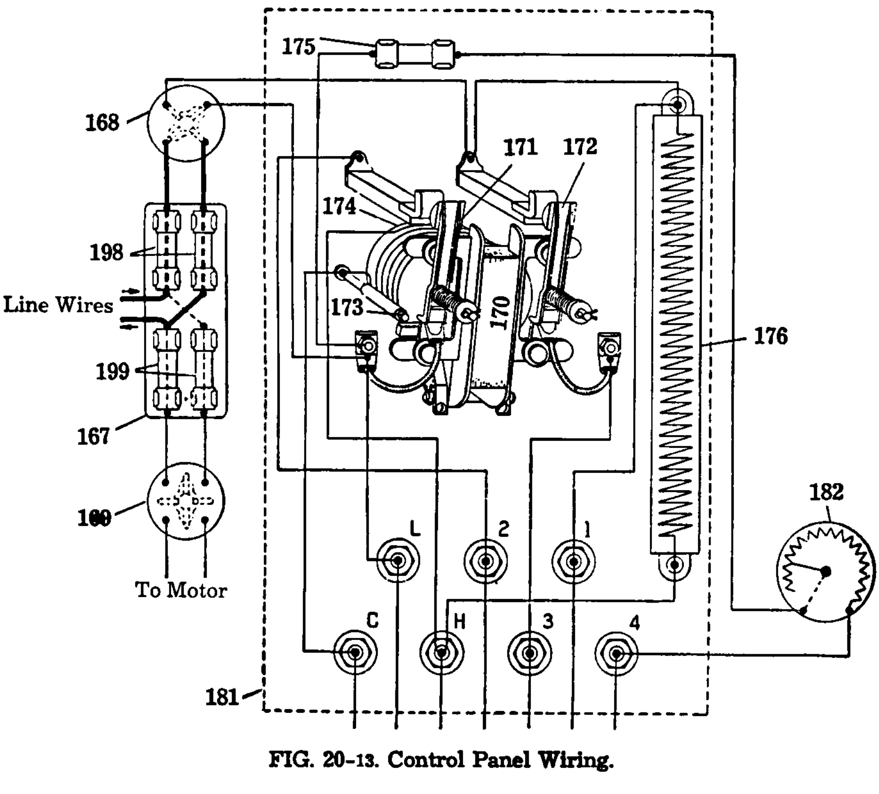


FIG. 20-13. Control Panel Wiring.

the wiring on the back of the slate panel *181.* The wires are here shown running straight and parallel or at right angles for clearness sake but the actual wires on the panel are usually run the shortest distance between connections.

In making a test for correct wiring and proper operation of a control panel, a "lamp in series" testing outfit should be used as described and illustrated in Fig. 18-13.

Disconnect all outside wiring from the panel and turn switch *168* off. Test between terminal *H* and terminal *C*; if the lamp lights the magnet switch coil *174* is in operating condition. ***See that this coil is correct for your current.***

Test between terminal *H* and terminal No. 1; if the lamp lights the resistance coil *176* is in operating condition. *Be sure that this resistance is correct for your current.*

Test between terminal No. 4 and terminal *L* and if the lamp lights the rheostat *182* and fuse *175* are in operating condition. *Be sure that this rheostat is marked for your proper voltage.*

The lamp should light between terminal No. 2 and the upper left-hand contact on the magnet switch. Between terminal No. 3 and the lower right-hand contact on magnet switch. Between terminal No. 4 and the lower left-hand contact on magnet switch. Between terminal No. 1 and the upper right-hand contact on magnet switch.

If you have available a circuit of the same voltage and frequency as marked on the control panel, connect to fuse block *167* in the ordinary way, be sure your fuses are O. K., close switch *168* and touch terminals *C* and *L*, with a piece of metal. The magnet switch should close and remain closed until you touch terminals *C* and *H* with a piece of metal, when it should drop open.

Replacements

Occasionally some of the parts that have been subjected to abuse or neglect such as the heaters, temperature control parts or wiring inside the pot must be replaced.

It is seldom that both crucible heaters will be burned out at the same time, so if your pot is a 100-130 volt equipment and one of the crucible heaters tests open or grounded, and must be removed and replaced, the metal in the crucible may be heated by the crucible heater that is in good condition. If the defective heater is grounded you must disconnect it from the circuit because if you do not it will continue to blow fuses.

If your equipment is 200-260 volt and one crucible heater burns out or otherwise becomes damaged, disconnect it from the circuit and then connect a line from a 110 volt lighting circuit to the remaining heater; or, after you have disconnected the defective heater, connect the one you intend using to replace the damaged one in series with the one that tests correct. This new heater may be laid upon the floor, protected by sheet iron or asbestos, or any place where there is a free circulation of air.

No. 2 Crucible Heater

To Remove—Heat the metal to operating temperature and dip the molten metal out of the crucible until the tops of the heaters are exposed. Make sure that the current is turned off and remove the pot cover *120,* Fig. 12-13, and the crucible heater clamp *133* which holds the heaters in place. Disconnect the wiring to the heater and with a screwdriver and a pair of pliers remove the heater by carefully prying up with the screwdriver and pulling up with the pliers. Immediately replace with a new heater before the metal cools.

To Replace—First warm the new heater somewhat with a torch or by other means, so that it will not cool the metal when placed in the crucible, then it may be forced into place by careful use of a piece of fibre or soft wood and a small mallet.

When in its proper place reconnect the wiring exactly as it was before and replace the crucible heater clamp. Replace the pot cover and cement around the mouthpiece.

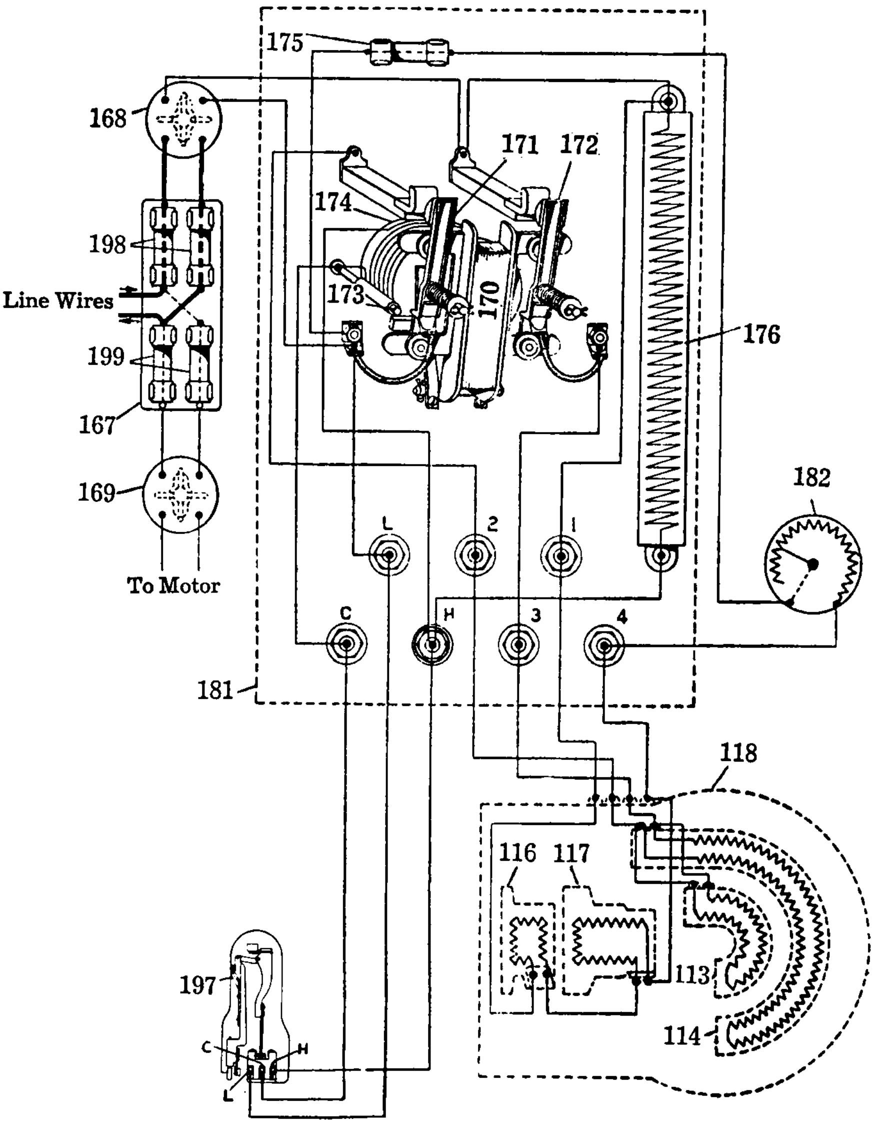


FIG. 21-13. This diagram shows the electric connections of the pot with the control switch *168* turned to *off* position and the Linotype metal cold. Current cannot pass switch *168*, therefore the whole pot is dead. Note that the temperature control roller contact is now touching contacts *C* and *L*.

If switch *168* is turned to the *on* position, current will pass through the temperature control and magnet switch circuits, as shown in Fig. 22-13.

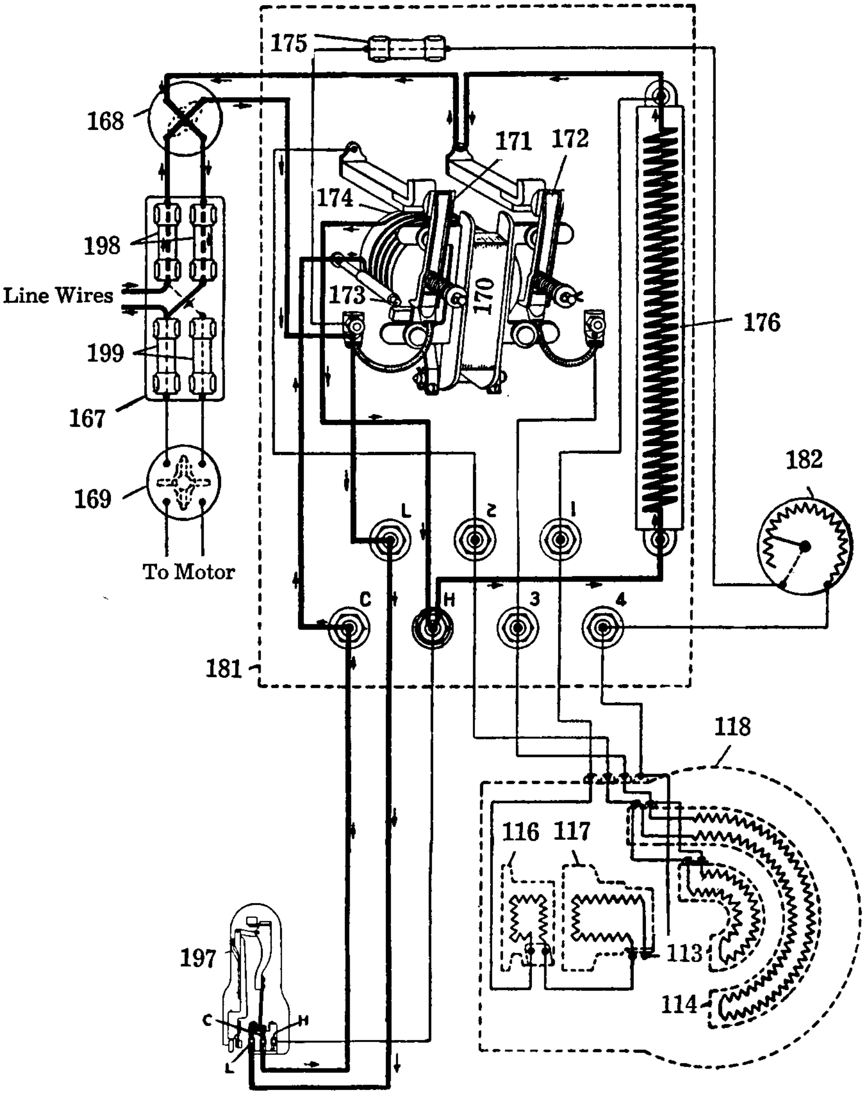


FIG. 22-13. This diagram shows switch *168* turned to the *on* position. Current immediately flows from the line through switch *168* to terminal *L* on the panel and then to temperature control contacts *L* and *C* and back to terminal C on the panel, then through magnet switch coil *174* to terminal *H* on the panel. Current then passes through the resistance coil *176*, and then directly back to the opposite side of the line through switch *168*.

As soon as the circuit is complete, as above, the magnet switch *170* immediately closes, connecting the crucible heaters *113* and *114* to the line and also making a contact at *173* as shown in Fig. 23-13.

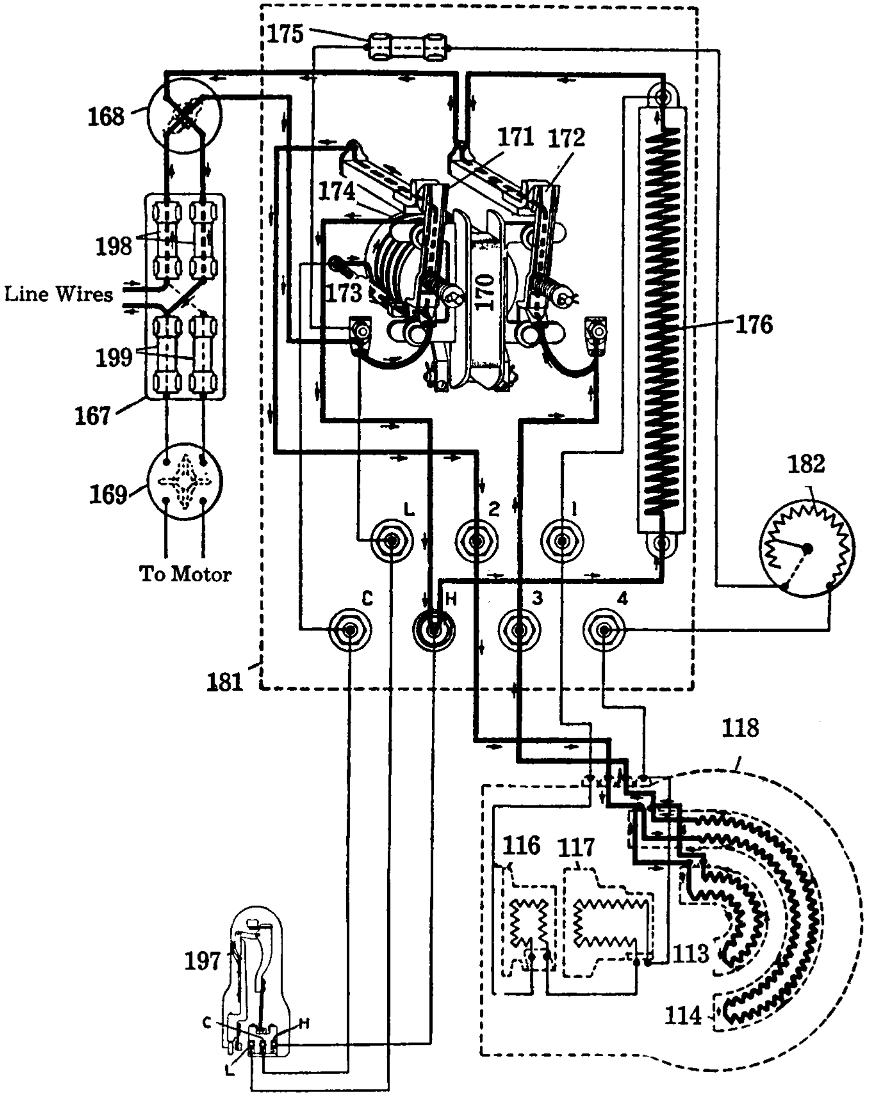


FIG. 23-13. When magnet switch *170* closes, the contact that is made at *173* short circuits the temperature control circuit and relieves it of carrying current. A circuit is still maintained through coil *174* by contact *173*, which holds the magnet switch *170* closed. The crucible heaters *113* and *114* are now connected to the circuit and will begin to heat the metal. When the temperature of the metal rises to about 550 degrees F., the temperature control roller contact will leave contact *L*, pass over contact *C* and make a circuit between contacts *C* and *H*, and the circuit will be as in Fig. 24-13.

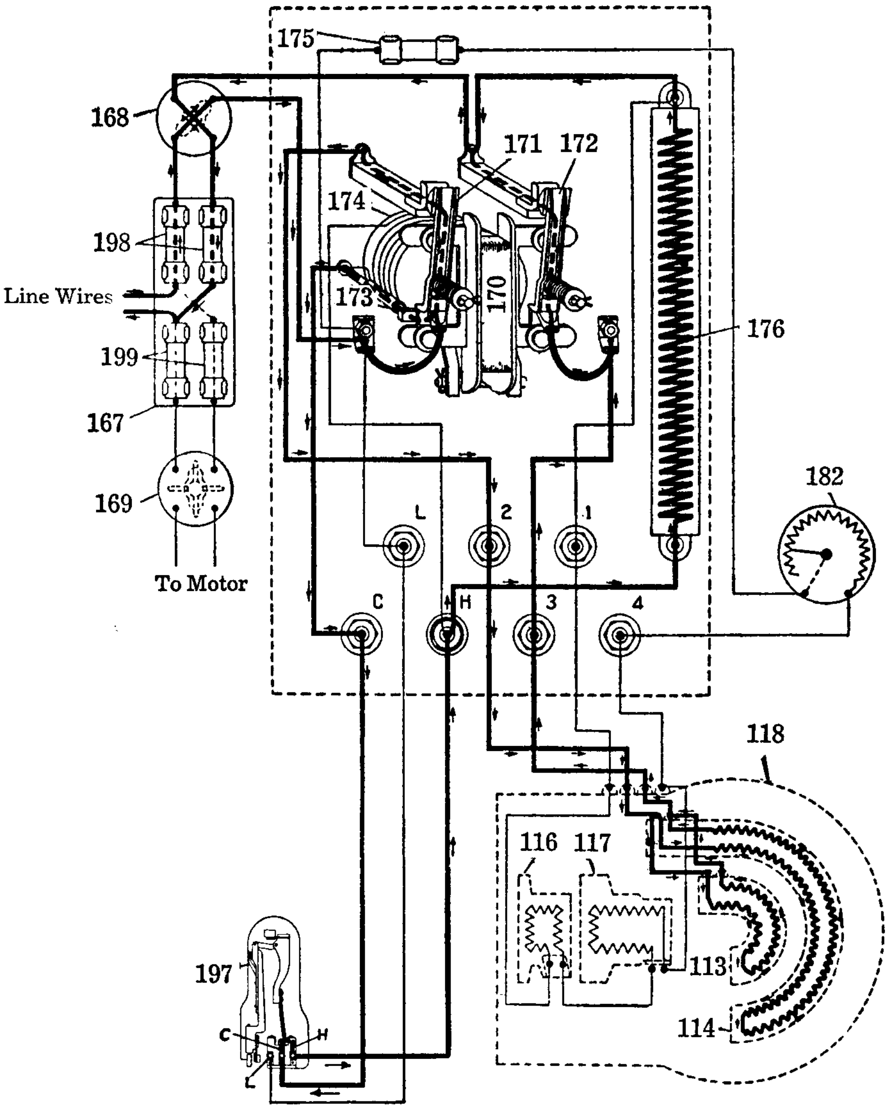


FIG. 24-13. Shows the current when the temperature of the metal has just reached 550 degrees F. Note that the temperature control roller contact is touching contacts C and *H,* which short circuits magnet switch coil *174.* No current will pass through the magnet switch coil, because the path of least resistance is through the thermostat contacts. The magnet switch *170* immediately opens, disconnecting the crucible heaters *113* and *114* from the line and also interrupting the temperature control circuit as shown in Fig. 25-13.

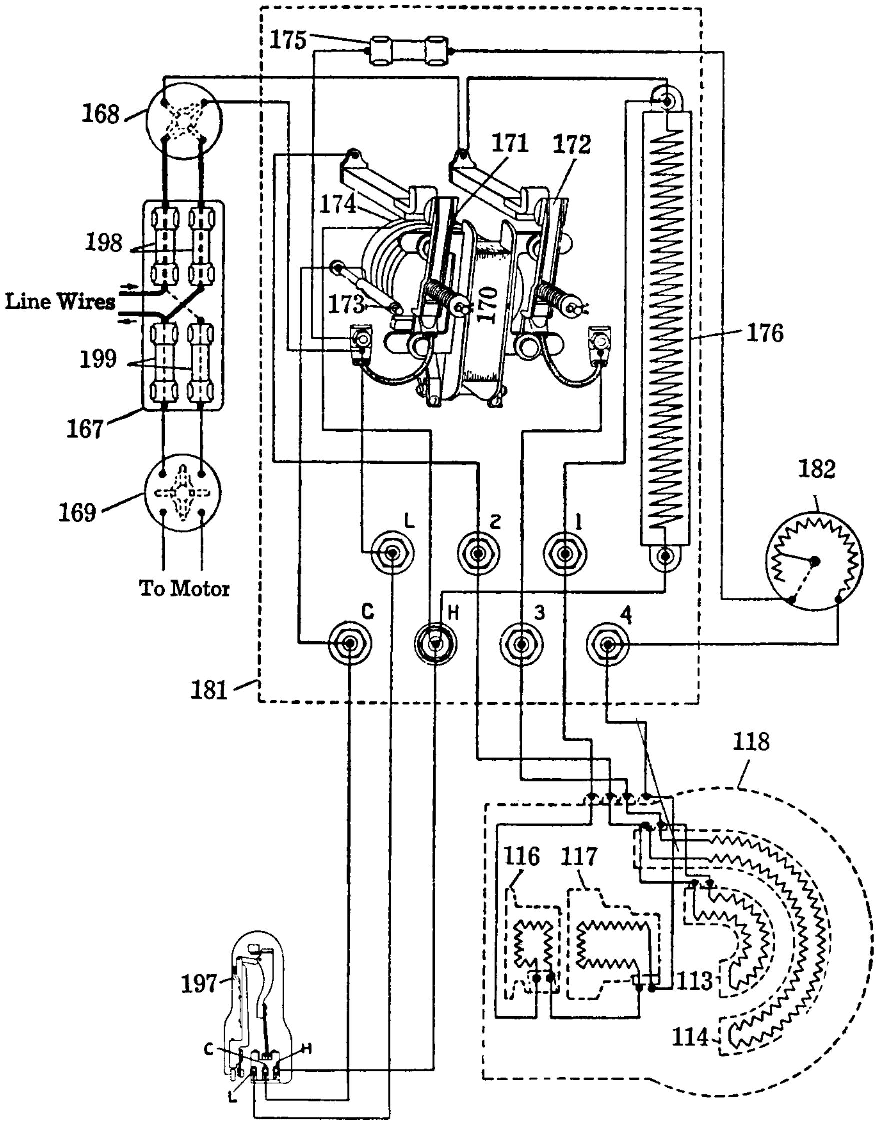


FIG. 25-13. When magnet switch *170* opens it disconnects the crucible heaters *113* and *114* from the circuit and the metal begins to cool. This diagram is like Fig. 21-13 except that switch *168* is shown in the *on* position and the temperature control roller contact is touching contacts *C* and *H* instead of contacts *C* and *L*.

When the temperature of the metal has fallen to about 535 degrees F., the temperature control roller contact will leave contact *H*, pass over contact *C* and make a circuit between contacts *C* and *L*, which again completes the circuit as shown in Fig. 22-13.

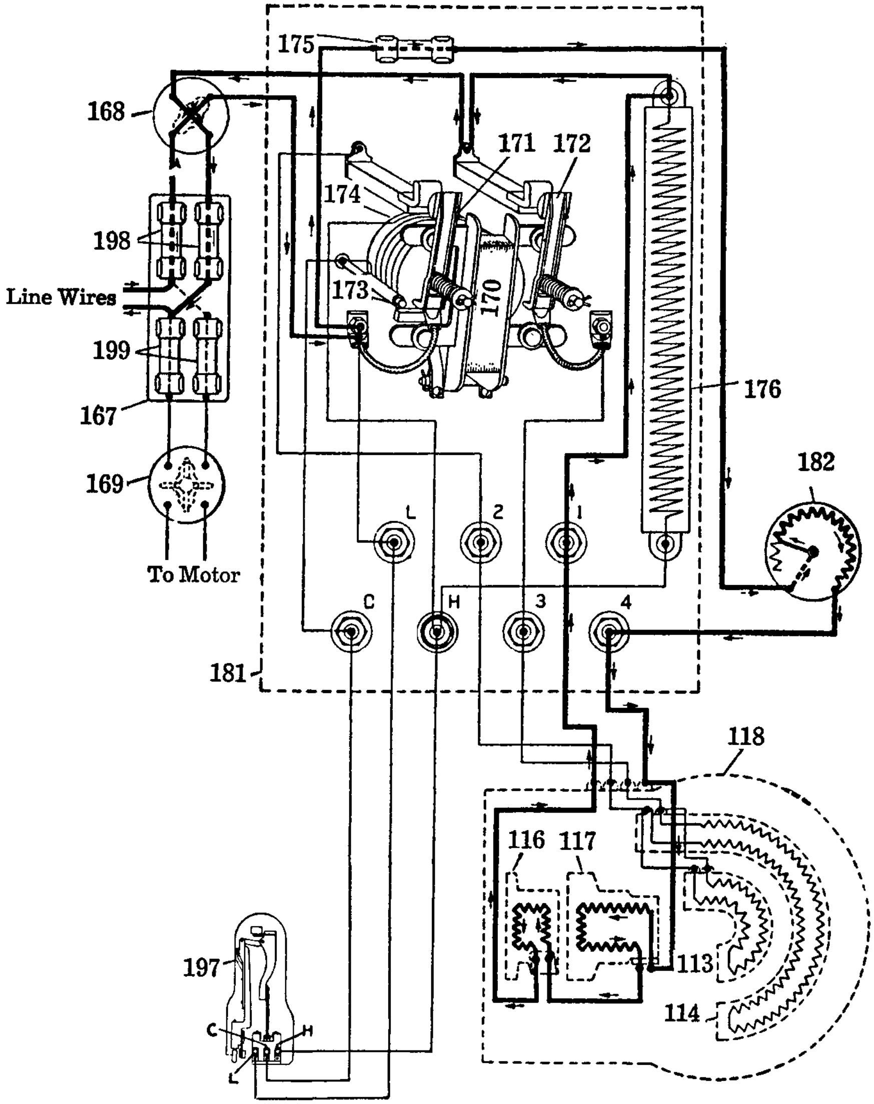


FIG. 26-13. Explains the mouth and throat heater circuit only. Note that this circuit does not pass through the magnet switch *170*, and, therefore, the heating of the mouth and throat of the pot is not controlled by the action of the temperature control *197* or the position of magnet switch *170*. The heat in this circuit is controlled by manually adjusting the rheostat *182* which is placed on the outside of the control panel cabinet.

Turning rheostat knob to the right increases the heat at the mouth and turning it to the left will diminish the heat.

No. 1 Crucible Heater

To Remove—The No. 1 crucible heater cannot be removed alone. The No. 2 crucible heater must be removed with it even if it is not defective. Proceed as in the case of the No. 2 crucible heater but pry out both heaters together.

To Replace—Proceed as in the case of the No. 2 crucible heater, replacing both heaters in the crucible at the same time, while the metal is melted.

Mouth Heater

To Remove—Turn switch *168,* Fig. 17-13, off—Refer to Fig. 12-13. Take off the pot cover *120.* Remove the two nuts from the upper end of clamp bolt *123* and remove mouth heater clamping plate *122.* Disconnect the wiring and lift out the heater.

Be careful that clamp bolt *123* is not pushed down out of its guides when the heater is removed.

To Replace—Place the new heater in position observing carefully that there is no insulating material or dirt between the heater and the crucible casting. It is important that all metallic surfaces be clean and free from dirt and that they come in close contact when clamped together. See that there is good contact between the edge of the heater and the rear of the mouthpiece. Replace the mouth heater clamping plate and tighten the two nuts on clamp bolt *123.* After the pot cover is replaced the space around the front of the mouthpiece should be cemented.

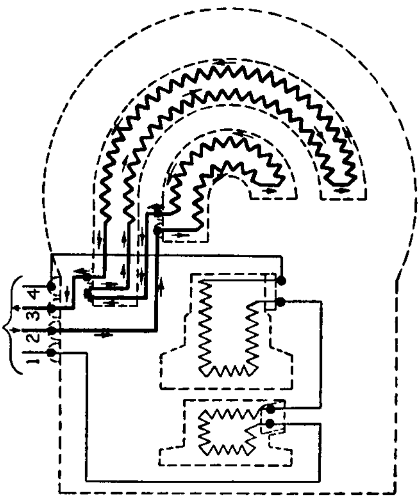


FIG. 27-13

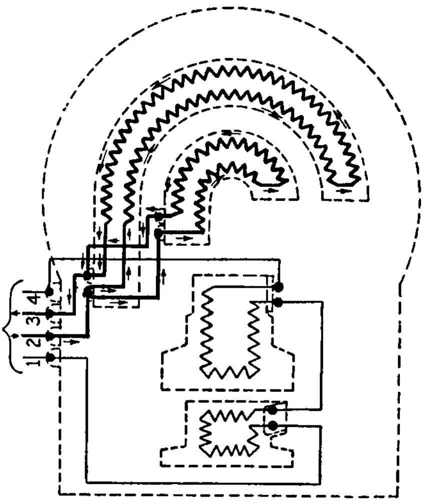


FIG. 28-13

FIG. 27-13. Shows the crucible heaters as connected in a 200-260 volt pot. The heaters are in *series.* Following the arrows shows the current entering at terminal *No. 2,* passing through one heater and directly into and through the other heater, and back to the line through terminal *No. 3.*

FIG. 28-13. Shows the crucible heaters wired as in the 100-130 volt pot. The heaters are in *parallel.* Following the arrows, you find that the current enters terminal *No. 2,* flows through each heater separately and then back to the line through terminal *No. 3.*

Throat Heater

To remove or replace a throat heater it is necessary to remove the crucible from the pot, so you should proceed as follows:

Turn off switch *168*, Fig. 17-13. Remove the pot cover, *120*, Figs. 12 and 13-13. Allow metal to cool. Remove all wires from the heater. Break away as much of the asbestos insulating material packed between the crucible and the jacket as is possible. Loosen the set screw that holds the crucible in location. Remove the crucible from the jacket. Remove the two nuts from the clamp bolt *123* which hold clamp plate *122*. Loosen throat heater clamp screw *131*. Remove both clamp plates *121* and *122* and clamp bolt *123*. Remove mouth heater and throat heater. Clean the surfaces of crucible. Replace the throat heater with the new one and place the clamp plate *121* in position. Tighten screw *131*. Place mouth heater in position and the clamp plate *122* on top of the mouth heater and place the clamp bolt *123* on and fasten with the two nuts.

Be sure that the voltage is correct and that both heaters make a good close metallic contact with the crucible.

Place crucible in jacket and pack with asbestos heat insulation. Reconnect all wires, using the Figs. 27-13 or 28-13 as per your voltage. Replace cover and cement around the mouthpiece.

Dynamic Thermometer

To Remove—Heat the metal in the crucible to operating temperature and then turn off switch *168*, Fig. 17-13. Disconnect the wiring and dip out the metal to below the level of the dynamic thermometer bulb *154*, Fig. 15-13. Take off the pot cover and remove the two screws fastening the dynamic thermometer case to the bracket. Grasp the dynamic thermometer case with the hand and the bulb *154* with a pair of pliers and raise up and out. Replace the dynamic thermometer while the metal in the crucible is still hot.

To Replace—Place the dynamic thermometer in position with bulb *154*, lying on top of the throat casting, extending to the left of the well. See that the bulb does not project out from the casting so as to interfere with the insertion of ingots of cold metal. Press the tube firmly but carefully into place over the edge of the crucible being careful not to injure it. Fasten the case to the bracket and reconnect the wiring.

Adjust the instrument (using a glass rod thermometer for comparison) by turning on the current and heating the metal to 550 degrees F., then turn the adjusting screw *166* until the magnet switch opens. Now adjust spring wire *153* so that roller head *165* will roll over contact *C* and make contact between contact *C* and contact *L* when temperature has dropped to 535 degrees F. Turning this adjusting screw *166* to the right, or clockwise, will lower the temperature of the metal, and turning it to the left, or counter-clockwise, will increase the temperature.

A little patience in adjusting this spring wire and moving the adjusting screw will place the instrument in perfect adjustment, and it will require little attention thereafter.

Mechanical Thermostat

To Remove—Heat the metal in the crucible to operating temperature and then turn off switch *168*, Fig. 17-13. Remove the front cover of the thermostat case and disconnect terminal plug *146*, Fig. 16-13, by removing the three nuts. Remove the two screws holding the thermostat to the pot cover and lift out the thermostat. Replace the thermostat while the metal is still hot.

To Replace—Mount thermostat on pot cover and secure with the two holding screws. Assemble terminal plug *146* to terminal on thermostat with three nuts. Replace front cover of the thermostat case.

Wiring

Wiring for control panel is No. 14 Slow Burning. For the connecting cable it is No. 14 Rubber Covered. For the heaters in the pot it is No. 12 Rockbestos Monel Wire Covered Advance.

Note: Rubber covered or slow burning wire is not satisfactory for the heater wire.

Lino-Therm Heaters for Linotype Electric Pot

These heaters embody many desirable features such as more rugged construction and less possibility of failure due to short circuits or other injuries resulting from rough handling, overheating or other causes. They are interchangeable with the envelope heaters they displaced as standard equipment with only a very slight change on the pot crucible—drilling and countersinking of one hole for a screw which holds a small clamp bracket on the outside circumference at the top

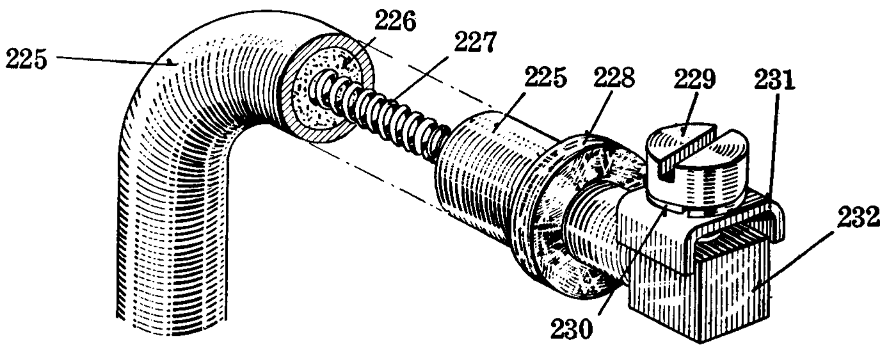


FIG. 29-13. View showing a short section of a Lino-Therm heater with terminal *232* attached. The outer tube *225* is calorized (alloyed with aluminum) to prevent oxidation which would cause the tube to waste away gradually. The magnesium oxide *226* between the nickel-chromium resistance wire *227* and the inside of the tubing is a most stable chemical compound which acts as an ideal electrical insulator. This view shows the following parts; tube *225*, insulation *226*, resistance wire *227*, mica washer *228*, screw *229*, lock washer *230*, clamp *231* and terminal *232*.

of the crucible, to which bracket the ends of both the top crucible heater and the bottom crucible heater are firmly clamped.

Four separate heaters are employed. Two of them are immersed directly in the metal and partially surround the pump well. Another pair which serve to heat the crucible throat and mouth, not only contact the top and bottom of the throat, but the vertical sides as well. This added feature insures adequate heat for the type metal entering both ends of the mold when casting full length slugs, a very distinct advantage over every method of heating heretofore employed. Each of the four heaters consists of a length of steel tubing enclosing a length of spirally wound nickel chromium resistance wire surrounded by a special insulation of magnesium oxide which protects the resistance wire from contact and thereby electrically insulates it from the outer tubing. Terminals are fastened to the ends of the resistance wire in a manner which insulates them from the outer tubing and also seals the ends to prevent leakage of the magnesium oxide. When formed as shown in Figs. 30 and 31-13, these units are very rugged and efficient heaters for the Linotype metal pot. Fig. 29-13 shows a short section of a Lino-Therm heater, partly in section. It also illustrates a terminal attached.

The method of holding these heaters in contact with the throat is practically the same as that for holding envelope heaters, with the addition of two side clamping plates and a clamp for holding the four ends of these two heaters to the clamping plate on top of the throat.

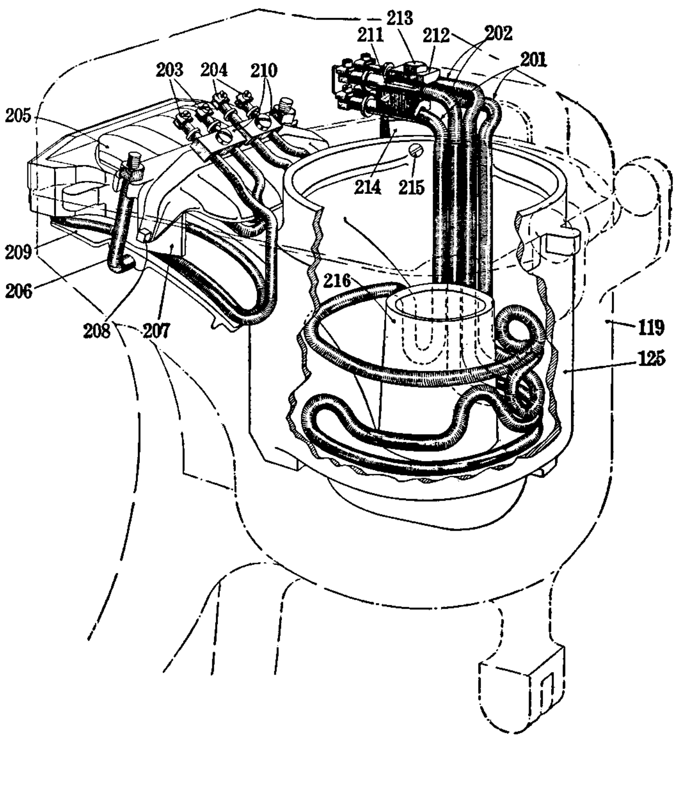


FIG. 30-13. Sectional view through the 30-em Linotype electric pot equipped with Lino-Therm heating units. This view illustrates the following parts: crucible *125*, pot jacket *119*, top crucible heater *201*, bottom crucible heater *202*, right-hand throat heater *203*, left-hand throat heater *204*, mouth heater clamping plate *205*, throat heater clamp bolt *206*, mouth heater side clamping plate *207*, mouth heater side clamp screw *208*, throat heater clamping plate *209*, mouth and throat heater end clamp *210*, crucible heater end clamp *211*, crucible heater end clamp cap *212*, crucible heater end clamp cap screw *213*, crucible heater clamp bracket *214*, crucible heater clamp bracket screw *215* and pump well *216*.

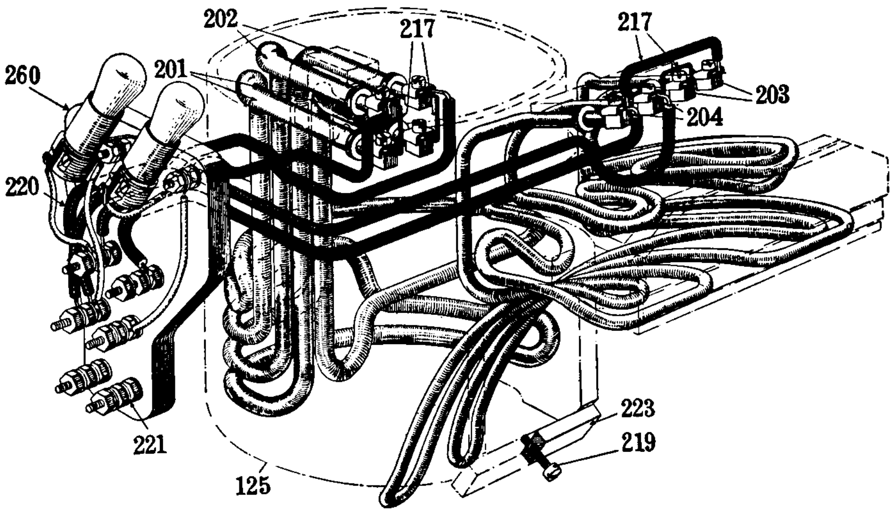


FIG. 31-13. View of the 30-em Linotype 110 volt A.C. electric pot equipped with Lino-Therm heaters, showing method of wiring to connect all four heaters in parallel. The method of connection between the heaters and the terminal block is the same for 100-130 volt or 200-260 volt, either alternating or direct current, the characteristics of the heaters changing for voltage. The only change in the terminal block connections is the inclusion of resistors for 200-260 volt A.C. current, condensers for 100-130 volt D.C. current, and resistors and condensers for 200-260 volt D.C. current.

Likewise, this method of connection is applied also to the 42-em pots and of course, requires two different sets of four heaters each for those pots. The outside terminal block *260* is the same for all pots. This view shows the following parts: crucible *125*, top crucible heater *201*, bottom crucible heater *202*, right-hand throat heater *203*, left-hand throat heater *204*, jumper or connector *217*, outside terminal block *260*, throat heater clamp screw *219*, insulated electric wire *220*, terminals *221* and the throat heater clamping bar *223*.

The two crucible heaters are not designed for operation in air, and continued exposure to air will cause them to burn out or ground. Metal in the crucible should always be kept at a level which completely covers them. The two throat heaters, even though they are designed for operation in air, are protected from external injury by means of asbestos packing and clamps.

Micro-Therm Electric Temperature Control

The Linotype electric pot equipped with Lino-Therm heating units is readily controllable by the same equipment in use for control of a pot equipped with envelope heating units. However, there has been developed a control which is not only simpler in theory and design, and more sturdy in construction, but is also more efficient than any heretofore employed for the purpose. This new equipment can also be applied to pots equipped with envelope heaters.

A comparison between this control and that in use on many Linotype electric pots and described in detail earlier in this chapter, shows differences readily discernible to the eye. Among these differences is the absence of the familiar thermostat or dynamic thermometer at the metal pot, the clapper type magnet switch controlled thereby, the large panel cabinet and the large rheostat for manual control of the temperature of the crucible throat and mouthpiece. This large cabinet which also contains the resistance coils and fuses has been entirely eliminated through this development made possible by the introduction of expansion bellows and automatic switches.

In this system for temperature control there are two separate and distinct control units. Each is automatic in its action and adjustable for control within very narrow limits of temperature. These units are similar in general design, construction, adjustment and theory of operation. Each contains an expansion bellows on the end of a capillary tube leading from an expansion bulb placed where the temperature is to be controlled; these parts assembled together and entirely filled with a non-vaporizing liquid hermetically sealed in, form a thermal expansion system in which a rise in temperature expands the bellows to cause a plunger at its end to press against a small lever to break the electrical contact in a very sensitive automatic switch. A lowering of the temperature at the bulb causes the bellows to contract sufficiently to allow a spring contact within the automatic switch to act to again close the electric circuit. Adjustment for exact timing of make-and-break of the electric circuit in each of the control units is accomplished by a manual control which is a very fine adjustment for the distance between the automatic switch itself and the plunger on the end of the expansion bellows.

Three indicating lamps are part of the equipment. The power indicating lamp

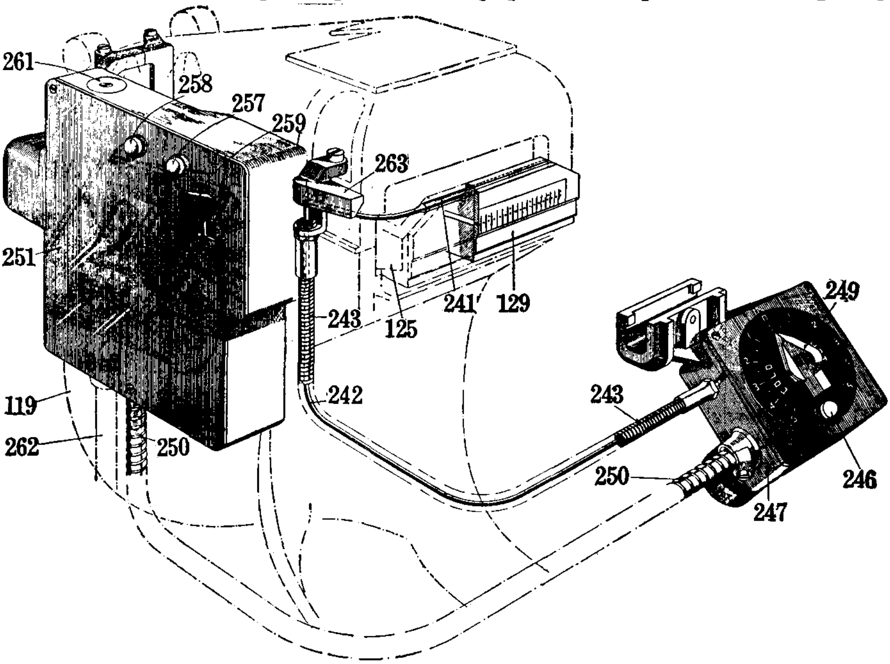


FIG. 32-13. View showing the 30-em Linotype electric pot with Micro-Therm temperature control units for both the crucible and the mouthpiece. In this are shown: crucible *125*, jacket *119*, mouthpiece *129*, mouthpiece expansion bulb *241*, mouthpiece bellows tube *242*, bellows tube conduit *243*, conduit bracket *263*, mouthpiece control unit *247*, control unit pointer *249*, control indicating light *246*, mouthpiece control armored cable *250*, crucible control box *251*, power indicating light *257*, crucible indicating light *258*, power switch *259*, pot crucible control adjusting screw and dial *261*, power line cable *262*.

remains lighted while the power switch is in the *on* position and there is current in the power line. Each of the other two lamps remain lighted only during the time its controlling automatic switch is closed.

The control for the crucible temperature is all in a control box mounted on the pot jacket and is entirely separate from the small mouthpiece temperature control unit which takes the place of the large control panel cabinet.

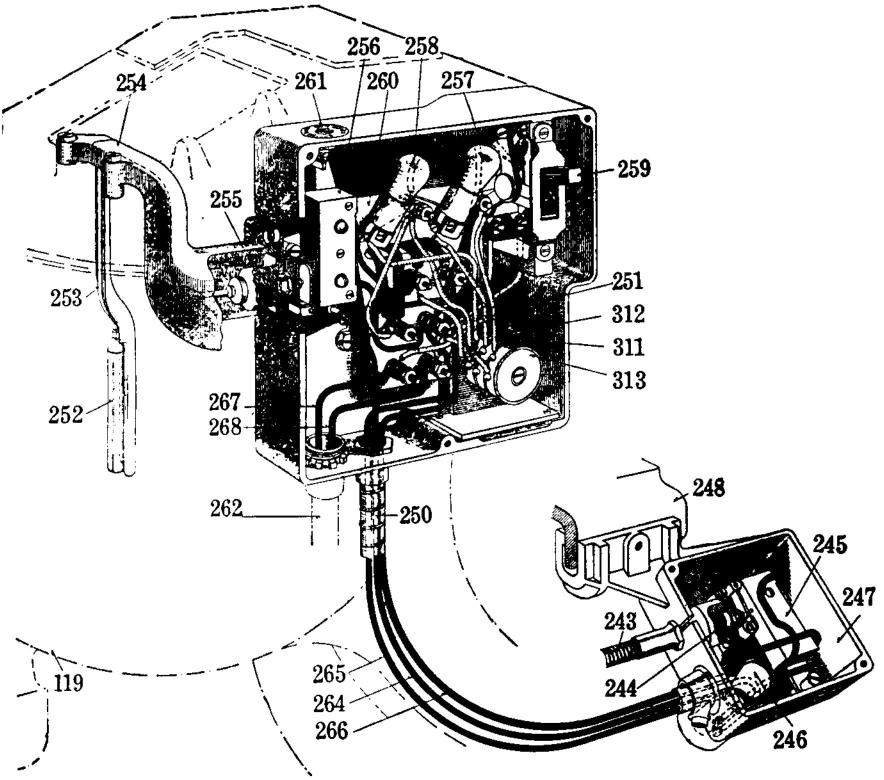


FIG. 33-13. View showing more in detail both the mouthpiece and crucible Micro-Therm control units for Linotype electric pots, wired for 220 volt alternating current.

In this view, the upper portion shows the crucible control unit, and the lower right-hand portion shows the mouthpiece control unit. Both units are shown with their cover plates removed.

This figure shows particularly the following parts: pot jacket *119*, pot control box *251*, crucible expansion bulb *252*, expansion bulb and bellows tube *253*, guard *254*, expansion bellows *255*, crucible automatic switch *256*, power indicating lamp *257*, crucible indicating lamp *258*, power switch *259*, terminal block *260*, crucible temperature control dial *261*, power supply cable *262*, white covered line live wire *267*, black covered line ground wire *268*, resistors *311*, *312*, *313*. One resistor is used for each indicating lamp.

In the armored cable *250*, connecting the mouthpiece control unit *247* to the binding posts on the terminal block *260*, are three wires numbered as follows: black and red covered wire *264*, red covered wire *265*, black covered wire *266*.

Attached to the machine base *248*, is the mouthpiece control unit *247* in which are shown: mouthpiece expansion bellows *244* connected by a tube *242* to the mouthpiece expansion bulb *241* (shown in Fig. 32-13). The tube is protected by the conduit *243*. Also shown are the automatic switch *245* and the mouthpiece indicating lamp *246*.

Mouthpiece Control

The mouthpiece control is operated by a mouthpiece expansion bulb, located in front of the mouthpiece heaters and directly behind the mouthpiece on top of the crucible casting. This bulb is connected by a copper capillary tube, protected by a strong flexible conduit, to an expansion bellows which in conjunction with an automatic switch serves to make-and-break the electric current through the throat and mouthpiece heaters within a predetermined narrow range of temperature. The automatic switch, bellows and small indicating light with the necessary wiring are housed in the above-mentioned mouthpiece temperature control unit, a small square box which is clamped to the machine base at the right side below the keyboard and within easy reach of the operator. A control adjusting pointer and scale are provided on the outside of the square box. The pointer is manipulated for temperature control the same as on the former large panel cabinet. Necessary electric wires, encased in an armored flexible cable, connect the mouthpiece temperature control unit and the pot crucible temperature control box, mounted on the side of the pot jacket.

Pot Crucible Control

The pot crucible temperature control is operated by a crucible expansion bulb located in the type metal in the crucible. This bulb is connected by a copper capillary tube, protected by a cast iron guard, to an expansion bellows similar to the one used for the mouthpiece temperature control. An automatic switch similar to the one used for the mouthpiece control is used to make-and-break the electric current through the crucible heaters within a predetermined narrow range of temperature. The automatic switch, bellows, power indicating lamp, crucible indicating lamp, power switch for both the mouthpiece and the crucible heaters, terminal block and the necessary wiring are housed in the pot temperature control box mounted on the left side of the pot jacket. An adjusting screw is adjusted by a screwdriver for control of the temperature of the metal in the crucible. The power switch is of toggle construction with an *on* and *off* indicator. The indicating lights provide visible indication of electric current flow for both the power line and the crucible line. A hole is provided at the bottom of the box for a power line cable and cable connector to be supplied by the customer.

Wiring Diagram

Electric wiring of the Micro-Therm control system is quite simple. It is the same for 200-260 volts A.C. as for 100-130 volts A.C., with the exception of the resistors, *311, 312* and *313,* Fig. 33-13, used for 200-260 volts. Three resistors are used for both alternating and direct current, one in series with each indicating lamp to reduce the voltage to 110 volts. All indicating lamps are of the 110 volt type. For direct current, the wiring diagram is the same as for alternating current, except for the addition of two electrical condensers, one of which is placed across each pair of terminals of the automatic switches. These condense the spark caused by the direct current which would otherwise tend to bridge the gap made as the switch contact points part to break the flow of current. Fig. 33-13 illustrates the wiring for 220 volt alternating current as it appears on the 30-em pot control. Fig. 34-13 illustrates the wiring for 110 volt direct current as it appears on the 30-em pot control. The most noticeable difference between these two illustrations is the addition of the two condensers *270* and *271* in Fig. 34-13, and the resistors for 200-260 volts in Fig. 33-13. The only other difference between the alternating and direct current units is the type of automatic switch. Condensers of different capacities are necessary for 100-130 and for 200-260 volts direct current.

Although tracing the wires shown in Figs. 33 and 34-13 is not difficult, the schematic diagrams Figs. 35, 36, 37 and 38-13, also the diagrammatic illustration Fig. 39-13, more clearly show the simple wiring for alternating and for direct current for both ranges of voltage in use.

In Figs. 35, 36, 37, 38 and 39-13, designating numbers for the various elements indicated correspond with the designating numbers in Figs. 33 and 34-13.

Application of Micro-Therm Control to Outstanding Linotype Electric Pots

The complete Micro-Therm temperature control unit as illustrated in Figs. 33 and 34-13 can be applied to all outstanding Linotype electric pots whether of the Cutler-Hammer or Mergenthaler type. This is the same crucible and mouthpiece unit which is applied to new electric pots.

The crucible control box fastens to the left side of the pot in the same location as the pot terminal box. The mouthpiece control unit fastens to the Linotype base

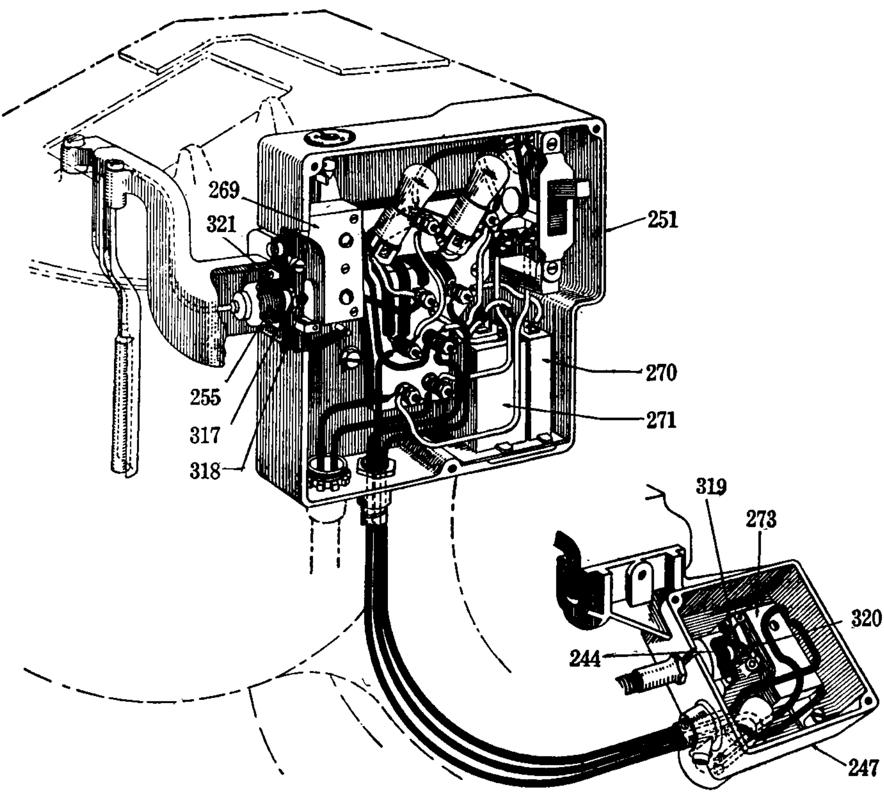


FIG. 34-13. Electrically heated pot with crucible and mouthpiece unit using 110 volt direct current. View shows: crucible automatic switch *269*, mouthpiece condenser *270*, crucible condenser *271*, expanding bellows *255*, mouthpiece automatic switch *273*, expanding bellows *244*.

Schematic Wiring Diagrams

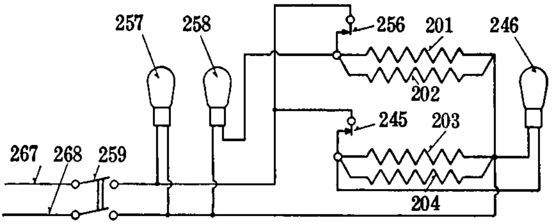


FIG. 35-13. Schematic diagram for 110 volts A. C. pot (electric) crucible and mouthpiece control for 30- and 42-em pots. View shows: power indicating lamp *257*, crucible indicating lamp *258*, live wire *267*, ground wire *268*, power switch *259*, crucible automatic switch *256*, crucible heaters *201* and *202*, mouth and throat indicating lamp *246*, mouth and throat heaters *203* and *204*, mouth and throat automatic switch *245*.

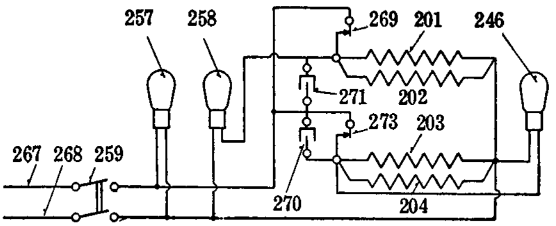


FIG. 36-13. Schematic diagram for 110 volt D. C. pot (electric) crucible and mouthpiece temperature control for 30- and 42-em pots. View shows: power indicating lamp *257*, crucible indicating lamp *258*, crucible automatic switch condenser *271*, crucible automatic switch *269*, crucible heaters *201* and *202*, mouth and throat lamp *246*, live wire *267*, ground wire *268*, power switch *259*, mouth and throat automatic switch condenser *270*, mouth and throat automatic switch *273*, mouth and throat heaters *203* and *204*.

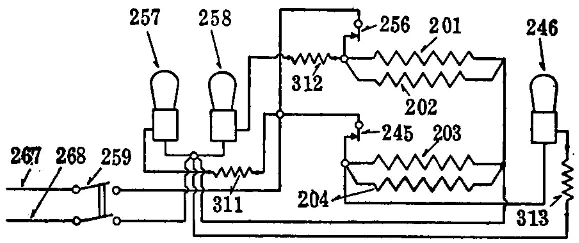


FIG. 37-13. Schematic diagram for 220 volt A. C. pot (electric) crucible and mouthpiece control for 30- and 42-em pots. View shows: power indicating lamp *257*, crucible indicating lamp *258*, live wire *267*, ground wire *268*, power switch *259*, crucible automatic switch *256*, crucible heaters *201* and *202*, mouth and throat lamp *246*, mouth and throat heaters *203* and *204*, mouth and throat automatic switch *245*, power lamp resistor *311*, crucible lamp resistor *312*, mouth and throat lamp resistor *313*.

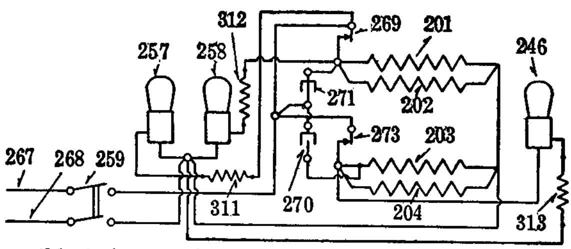


FIG. 38-13. Schematic diagram for 220 volt D. C. pot (electric) crucible and mouthpiece control for 30- and 42-em pots. View shows: power indicating lamp *257*, crucible indicating lamp *258*, crucible automatic switch condenser *271*, crucible automatic switch *269*, crucible heaters *201* and *202*, mouth and throat lamp *246*, live wire *267*, ground wire *268*, power switch *259*, mouth and throat automatic switch condenser *270*, mouth and throat automatic switch *273*, mouth and throat heaters *203* and *204*, power lamp resistor *311*, crucible lamp resistor *312*, mouth and throat lamp resistor *313*.

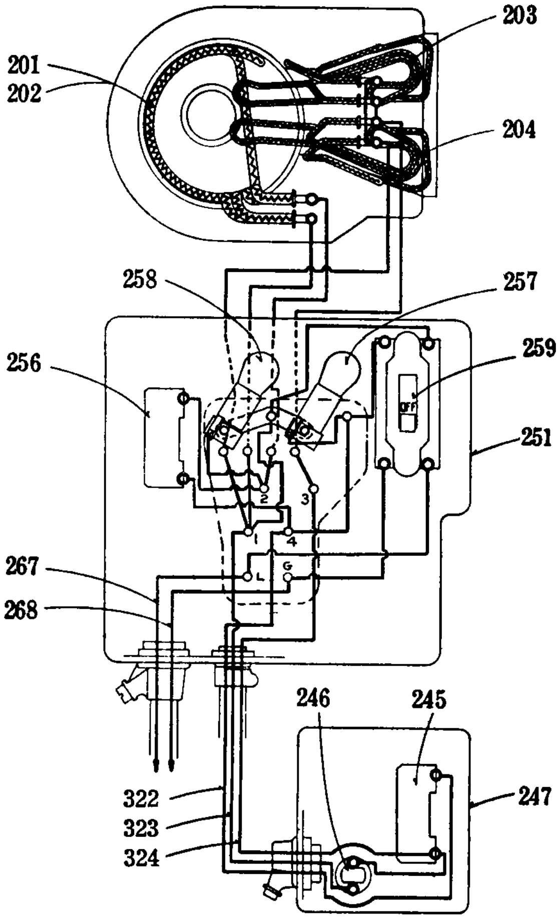


FIG. 39-13. Diagrammatic illustration showing the crucible and mouthpiece control unit together with the plan view of the Lino-Therm heating units. View shows: crucible heaters *201* and *202*, right-hand throat heater *203*, left-hand throat heater *204*, mouthpiece automatic switch *245*, mouthpiece indicating lamp *246*, mouthpiece control unit *247*, pot control box *251*, crucible automatic switch *256*, power indicating lamp *257*, crucible indicating lamp *258*, white covered wire *322*, red covered wire *323*, white and red covered wire *324*, line live wire *267*, line ground wire *268*.

This illustration shows the connections for 110 volt alternating current. For 110 volt direct current the wiring is the same except for the condensers across the crucible and mouthpiece automatic switches. For both 220 volt alternating and direct current, resistors are placed in series with the indicating lamps to reduce the voltage to 110 volts.

at the right of the keyboard. The mouthpiece expansion bulb is placed directly behind the mouthpiece on top of the crucible casting.

When this crucible and mouthpiece unit is applied to an outstanding machine, it replaces the dynamic thermometer, or mechanical thermostat, the connecting cables to the control panel cabinet and the complete control panel cabinet.

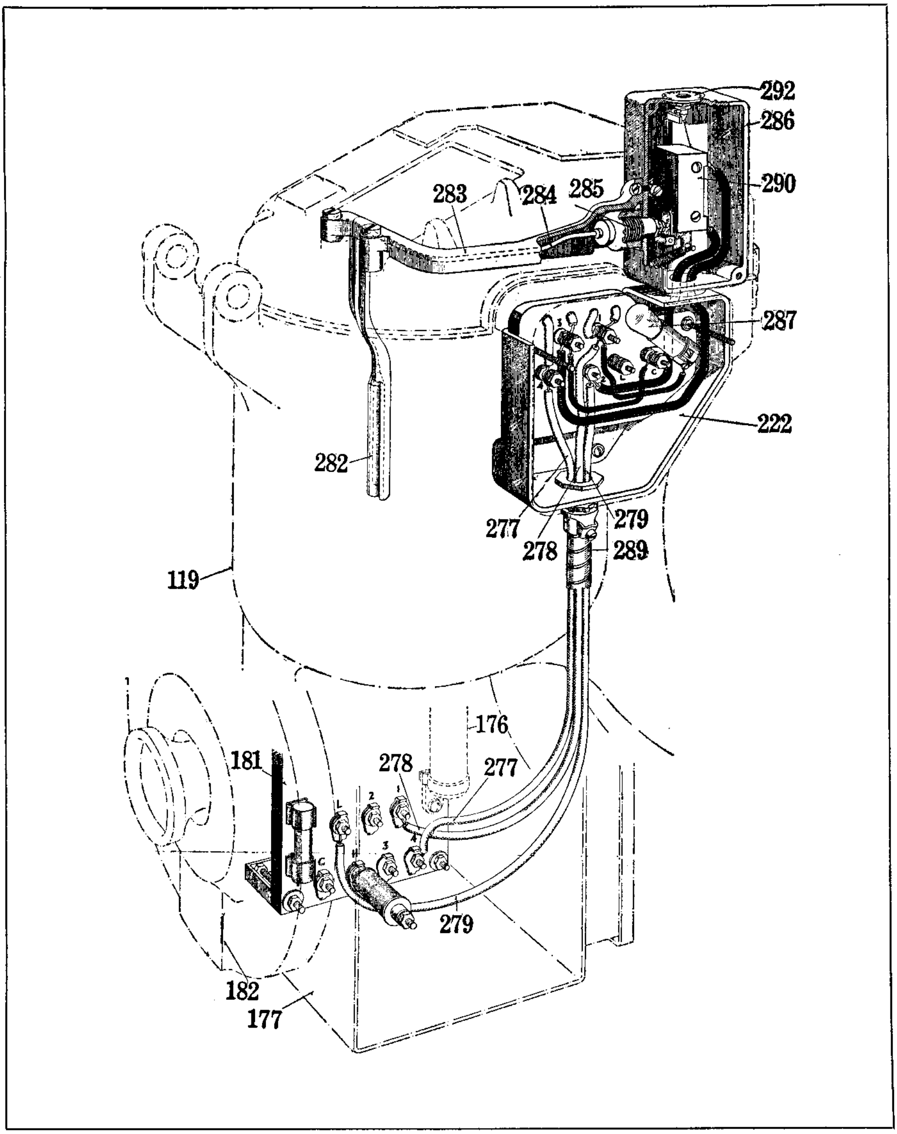


FIG. 40-13. View of 30-em Linotype electric pot equipped with Micro-Therm crucible temperature control for outstanding 110 volt alternating current installations. For 220 volt installations, a resistor, not shown, is placed in series with the indicating lamp to reduce the voltage across the lamp to 110 volts.

In this view are shown: pot jacket *119*, crucible bulb *282*, guard *283*, tube *284*, bellows *285*, Micro-Therm housing *286*, automatic switch *290*, temperature control and dial *292*, pot control box *222*, crucible indicating lamp *287*, maroon wire *277*, white wire *278*, dark brown wire *279*—these three wires pass through the steel conduit *289* to the binding posts on the panel *181* in the outstanding panel box *177*. The resistance coil *176* which is removed, is indicated here by dotted lines. The large rheostat *182* is used for outstanding mouthpiece temperature control.

For those who want to regulate the temperature of metal in the crucible of outstanding electric pots to the close limits provided by the Micro-Therm system of heat control, but who desire to retain their present rheostat control of mouthpiece temperature, the crucible control illustrated in Fig. 40-13 is supplied. This Micro-Therm temperature control can be applied to all outstanding machines equipped with electric pots. It replaces the dynamic thermometer or the mechanical thermostat, and all the parts in the control panel cabinet except the rheostat. The mouthpiece rheostat remains to control the mouthpiece temperature.

The construction, control and operation of this unit are all similar to the equivalent unit used in the arrangement for new installations, already described. There is a similar crucible expansion bellows *285*, automatic switch *290* and adjusting screw with dial *292*. A crucible indicating lamp *287* is provided. When 220 volt current, A.C. or D.C. is used, a resistor (not shown) reduces the current to the indicating lamp to 110 volts.

There are two types of these crucible controls. For outstanding machines having the type of pot control box *222*, Fig. 40-13, only the Micro-Therm control box complete, *286*, is furnished. If the machine does not have the *222* pot control box, the complete Micro-Therm control and pot control box are furnished, as illustrated.

The resistance coil *176* is removed from the control panel cabinet *177* thereby cutting the magnet switch out of operation. Also, the dynamic thermometer or

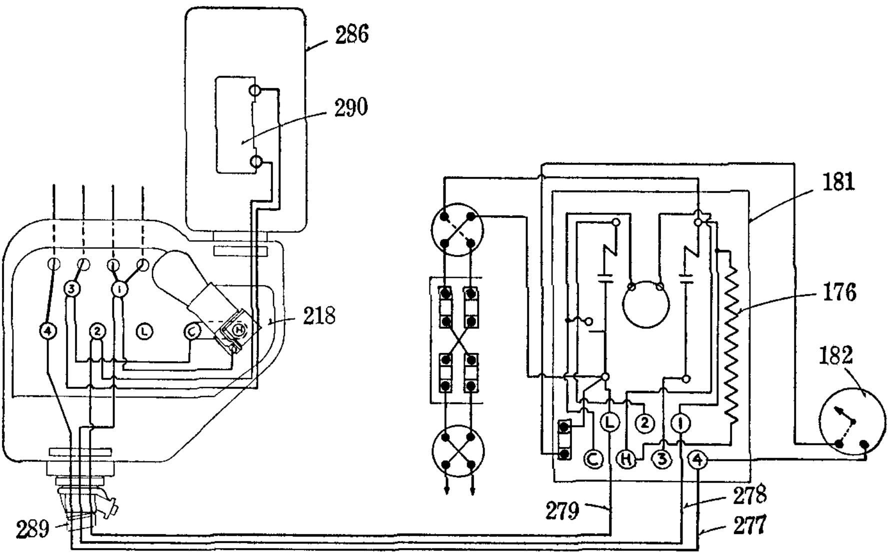


FIG. 41-13. Diagrammatic illustration showing Micro-Therm crucible temperature control for outstanding 110 volt alternating current installations.

As already stated, the resistance coil *176* is removed from the outstanding control panel cabinet. The outstanding flexible steel conduit is used but the wires are removed and three wires, *277*, *278* and *279*, furnished with the equipment, inserted in the conduit.

This diagrammatic illustration shows clearly these wires connected to their proper terminals. It also shows all other wires which are shown in the perspective view Fig. 40-13.

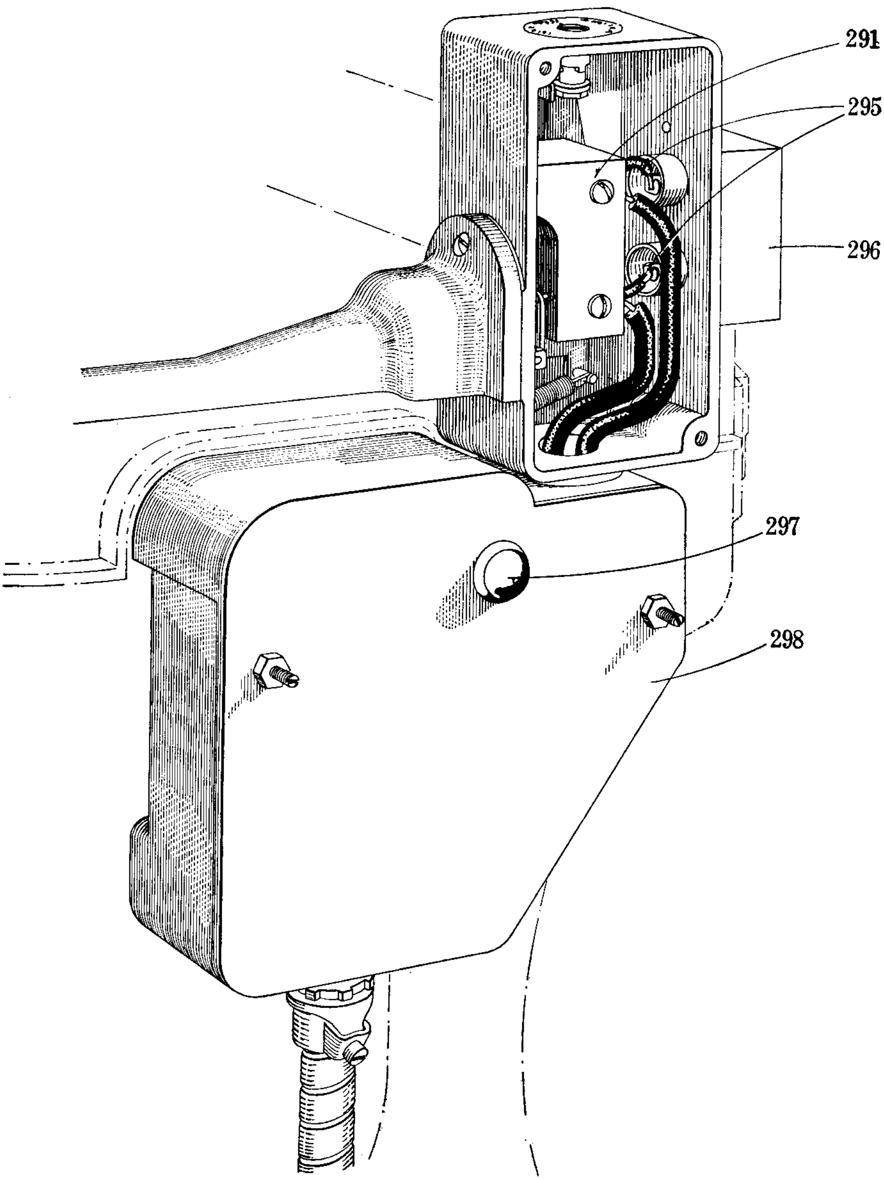


FIG. 42-13. View of 30-em Micro-Therm crucible temperature control unit for outstanding direct current installations. The main difference between the installation for alternating current and that for direct current is the addition of a condenser *296* to the latter. For other parts see Fig. 40-13.

Variations in types and sizes of parts as controlled by the electric current voltages are not shown. View shows: crucible automatic switch *291*, crucible automatic switch condenser wires *295*, automatic switch condenser *296*, crucible temperature control indicating lamp jewel *297*, pot control box cover *298*.

mechanical thermostat control is removed, being no longer required. The outstanding pot control panel flexible steel conduit is used but the wires are removed, being replaced by the three wires furnished with the equipment. Although not shown, the outstanding mouthpiece rheostatic control remains in use.

MAINTENANCE

The Pot Mouthpiece—Fig. 6-13 shows the 30-em pot mouthpiece, which is fastened to the pot crucible with 13 screws.

The vents in the mouthpiece are for the purpose of allowing the air to escape when the plunger is forcing metal into the mold, and they should be quite broad, with a small opening at the lower end. Scrape the vents occasionally to remove any accumulation of dross. The opening at the bottom of the vent should show a slight drip of metal at each cast and the amount of vent can be seen at the back of the mold if the machine is shut off just before the slug reaches the back knife.

A scraper for the vents can be made by grinding the end of a file to a V-shape. Always scrape the vents toward the bottom of the mouthpiece.

After the machine has been used for some time, the holes in the mouthpiece should be reamed slightly at the front end where the mouthpiece comes in contact with the mold. This will remove any burrs or dross deposits that may have formed, so that when the pot breaks away from the mold, the metal will adhere to the base of the slug instead of staying in the mouthpiece holes, and also when casting a slug of thin body size, the pot will break away from the mold much easier if the holes are reamed.

If no reamer is available, a small three-cornered file, with the end ground to give it an edge, will serve the purpose. The holes must not be enlarged: the reaming must be just enough to remove the burr. If the holes in the mouthpiece become clogged, drill out with a No. 52 drill. The holes in the mouthpiece have a slight taper; the original measurement is about .062″ at the back and .070″ at the front.

If it becomes necessary to remove the mouthpiece, use a pot mouthpiece screw loosener, listed in the Linotype parts catalogue as F-2860. Place the tongue of the loosener in the screw slot and with a hammer give it two or three raps against the screw head to ease it from its seat. Then with a heavy screwdriver with its end fitting closely in the screw slot, press firmly against the screw and give a quick snap to the screwdriver, which should loosen the screws.

Before replacing the mouthpiece, clean the surface of the crucible and the back of the mouthpiece—a fine oilstone having a straight surface or a piece of fine emery cloth placed on a block of wood may be used on the crucible. For the mouthpiece use emery cloth placed on a flat surface and rub until bearing shows even.

If the throat of the pot has become fouled with hardened dross, it can be removed with a pot throat cleaner, listed in the Linotype catalogue as F-4236.

When the mouthpiece is ready to be fastened in place, spread a small amount of heavy oil over the surface (do not use red lead on the back of the mouthpiece or on the screws), and tighten the screws evenly until they are in place.

Testing the Lock-up—When the machine leaves the factory, the pot legs are adjusted to bring the mouthpiece in perfect alignment with the molds, but after the machine is in daily use, the continuous heat may cause certain parts to warp, and it may not give a good lock-up, making it necessary to adjust the pot legs.

To make this test, open the vise to the first position, disconnect the mold slide and pull the mold disk forward. Then clean the surface of the mouthpiece by rubbing very lightly with a fine oilstone that has a straight surface, and also see that the back of the mold is clean. Then mix some powdered red lead with oil to make a paste and with a rag, cover the back of the mold with a light coating of the mixture. Push the mold slide back to normal position, with the mold that has been red-leaded at the top of the disk directly in front of the mouthpiece. Close the vise and remove the pot pump plunger pin for safety.

When making the lock-up, test in this manner: The mold disk must remain stationary until the machine has made a complete revolution to the normal position, and to accomplish this, pull forward on the mold disk pinion until it is out of mesh with the pin in the flange of the mold turning shaft, then pull the starting lever and with the handle hold the pinion out and keep it steady so that when the mold disk advances the locking studs will be in line with the stud blocks.

The pinion must be held fully out until the machine has come to the normal position, otherwise, if the mold disk was allowed to turn, the back knife would scrape the red lead from the back of the mold.

After the machine has completed its revolution, lower the vise, pull the mold slide forward so that the mouthpiece may be examined. The red lead now adhering to the mouthpiece will show how it aligns with the mold. If one end of the mouthpiece does not show any red lead, adjust that side forward or the opposite end backward, using the screws in the pot legs as shown in Fig. 1-13.

To bring the left-hand end of the mouthpiece forward, release the lock nuts *9*, loosen the rear screws *7* and *8* and tighten the front screws. Only a fraction of a turn should be made on these screws before making another test. When making these tests it should also be noted if the mouthpiece has the same bearing at the top and bottom. If the mouthpiece does not show a good bearing at the bottom, loosen the back screws on both pot legs as evenly as possible (the number of turns on the screws depending on how much the mouthpiece is out of line with the molds), and then tighten the front screws. Reverse this process if the bearing appears light at the top. Bring screws just against the pot leg bearings (not too tight) and fasten lock nuts. After the pot legs have been adjusted as closely as possible, the mouthpiece may show some high spots and it may be necessary to true it up with an oilstone. When making these tests the ejector blade should be set to the shortest width to prevent the blade from striking a mold liner.

The power lock-up as given above can safely be used when it is known that the alignment is only slightly off, but if a new pot and crucible are to be installed it is well to use the hand lock-up first to bring the mouthpiece in line with the back of the mold, and it is done in the following manner: Turn the machine ahead until the first elevator slide rests on the vise cap, then open the vise, disconnect the mold slide by removing the ejector lever link and pressing down on the handle of the mold cam lever, then pull forward on the mold slide. See that the back of the mold and the mouthpiece are both clean, then with a rag cover the back of the mold with a thin coating of red lead paste; push the mold slide back and see that the disk is properly meshed with the small driving pinion, close the vise and push the left-hand vise jaw to the right then pull the mold slide forward onto the locating studs with a thin bar placed between the pot lever and the bracket, force the pot all the way ahead two or three times to bring the red lead on the mold in contact with the mouthpiece. Then push the mold slide away from the locating studs, open the vise, pull forward on the mold slide and examine the mouthpiece, and if the red lead does not show evenly all the way across, adjust the pot legs in the same manner as previously described, until the mouthpiece is in correct alignment with the mold. It may be necessary to repeat the above operation to obtain a satisfactory lock-up.

The holes in the mouthpiece should come just above the base of the mold and the holes at each end must not be covered. This adjustment is made with the two screws *5* and *6*, also shown in Fig. 1-13.

The Pot Pump Plunger—The metal pot pump plunger should move up and down freely within the pot well but should fit closely enough to prevent any leakage of metal between these parts. The plunger must be kept clean so that when casting a line it will continue steadily on its downward stroke until it is raised by the cam. If it does not complete its full stroke a ring of dross may have accumulated in the well and it must be cleaned out.

A foul plunger may also bind at the top of the well and not allow the pot lever roll to drop against the cam after a slug has been cast, which would leave the pot ahead of its normal position, and the holes in the side of the well would be covered by the plunger, resulting in hollow slugs.

The holes in the sides of the well, shown at *44* in Fig. 1-13, must be kept fully opened to allow the metal to flow under the plunger when the machine is in normal position. A pot mouth wiper, F-304, is usually furnished with the machine and a hook on this wiper is used to open the holes.

Fig. 43-13 shows the vented pot pump plunger which is adjustable.

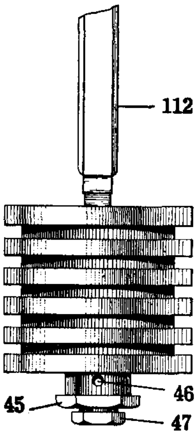


FIG. 43-13. Showing details of pot pump plunger vent adjustment. *45* is the vent adjusting screw lock nut; *46*, adjusting screw; *47*, vent hole; *112*, plunger rod sleeve.

On the bottom of the pot pump plunger there is a lock nut *45* and a hexagon head adjusting screw *46* with a hole drilled across the body in line with the vent hole *47* which is drilled horizontally across the projection at the bottom of the plunger. There is a hole drilled through the bottom of the plunger to meet this opening.

To adjust the size of the opening *47*, loosen the lock nut *45* and turn the screw *46* until the vent is the desired size.

When setting the smaller size slugs the vent acts as a relief valve to let excess metal escape upward through the plunger which goes deeper into the well and thus prevents dross from collecting on the plunger and the sides of the well.

In most cases the vent should be set to have the opening wide enough to insert a $\frac{1}{16}''$ wire. If too much vent is given, the plunger will not have enough force to fill the mold when casting the larger size slugs.

The plunger rod sleeve *112*, as shown in Fig. 43-13, acts as an insulator to prevent the accumulation of metal on the plunger rod. The sleeve is fitted at the ends with the center section expanded to form an air space.

The level of the metal in the pot should be maintained as evenly as possible, about ½″ below the top rim of the crucible. Various types of metal feeders are available which will keep the metal at the proper level continuously.

Back Squirts—A splashing of metal over the back of the mold disk is called a "back squirt" and may happen for various reasons.

The first thing to test when a back squirt occurs, is the lock-up of the mouthpiece against the mold in the manner described previously.

Causes of back squirts are: metal in pot too hot or too "cold"; mouthpiece overheated, or not hot enough to keep the metal from chilling on its surface. The compression spring *18*, Fig. 2-13, may be broken or too weak, or the adjustment may be wrong between the pot lever *16* and the shoulder nut *19*—the clearance should be $\frac{3}{16}''$ to give the spring the proper compression when the pot is locked against the mold.

It is also possible that one of the anti-friction rolls in the pot cam roll *17* may be broken. If it becomes necessary to remove the pot lever *16*, Fig. 2-13, take out the wing pin *49*, which holds the eyebolt *21* at its front end. At the top, the pot lever is held by a rod which extends through two lugs at the back of the pot jacket, and to disconnect, loosen the set screw and remove the rod, when the pot lever can be taken out without disturbing the adjustment of the compression spring.

The lever *36*, Fig. 4-13, which controls the pump stop, reaches to the end of the right-hand jaw *38* and has an adjusting screw *37* which rests against the jaw and should be adjusted so that the stop lever *40* will just clear the stop block *42* on the plunger lever when the line is fully justified. Too much clearance will allow a line that is not *quite* full to cast, and the slug will probably show hair lines.

The spring *41* on the stop lever should have sufficient strength to hold the lever under the stop block *42* in case a very short line is sent in, as this creates a slight pressure on the right-hand jaw when the justification levers operate and the spring on the stop lever must be strong enough to overcome it. Sometimes a slight splash of metal gets under the stop lever and causes it to bind; also, as various parts of the machine wear, the stop block *42* might not be lifted high enough to allow the stop lever *40* to come underneath. If such a condition should arise, the holes in the bracket could be elongated to lower it, as there are no dowels in the bracket.

At the first sign of a back squirt, push the starting lever in to shut off the machine, and if there is not too much metal behind the disk, lower the vise and pull out on the handle of the mold turning pinion and try to turn the mold disk backward to move the metal away from the back knife. Then disconnect the mold slide and pull the disk forward and with a steel hook and a screw driver, scrape the metal loose, being careful not to damage the molds. If the metal has wedged the mold disk tight, it may be necessary to pry it backward far enough to free the metal so it can be scraped out. After the metal has been removed, clean the mouthpiece with a rag, and examine the inside rim of the mold disk to make sure that no metal particles remain. Push the mold slide into place, having the small pinion and the mold disk in mesh so that the spots will be opposite to each other when the machine is turned to normal position.

Semi Quick-Drop—Referring to Fig. 1-13, *33* is the "semi quick-drop" pump cam shoe which is standard equipment on most new machines. The shape of this shoe gives more "snap" to the plunger action and helps to produce a better face. On some of the older machines, this shoe is rounded at the rear end and hence the plunger action is more sluggish. If the machine is equipped with the rounded shoe, the type face will be greatly improved if it is replaced by the semi quick-drop shoe, which is listed in the Linotype catalogue as C-1138.

Quick-Drop Attachment—The machine is also equipped with what is known as the "quick-drop" which is used only when casting display faces. This attachment causes the plunger to make a sudden drop, quickly forcing the metal into the face of the matrices. Fig. 1-13 shows the pot pump lever latch *34*, which swings on a screw attached to the plunger lever *14*. To put the quick-drop in operation, turn the latch down to the left, and when the machine makes a revolution the latch will be engaged by the pot pump lever latch cam *35* which is fastened directly under the pot pump shoe *33*, Fig. 1-13. When the contact between the latch and the cam ends abruptly, as in the lower right-hand view of Fig. 3-13, the plunger is allowed to drop suddenly, forcing the metal from the pot to the face of the matrices instantaneously.

Adjustment and Care of the Micro-Therm Crucible and Mouthpiece Controls—Refer to Figs. 33 and 34-13. Turn switch *259* to *on* position. This switch controls the current for both Micro-Therm units.

Lamps *257, 258* and *246* will light if pot is cold, and lamp *257* will remain lighted as long as current is *on*. Lamp *258* will remain lighted only as long as current flows to the crucible heaters, and lamp *246* will remain lighted only as long as current flows to the mouthpiece heaters.

After the metal has melted insert a glass rod thermometer. When it registers 535° F., light *258* should be off and the pointer on the adjusting screw *261* should point to 535° on dial. To increase temperature turn pointer on adjusting screw *261* toward "hotter" on dial, or to decrease temperature turn pointer on adjusting screw *261* to "colder" on the dial.

If it is necessary to change the temperature setting to obtain 535°, loosen lock nut *317* and turn adjusting screw *318* to left to reduce temperature or to right to increase temperature. Reset lock nut *317*. This procedure also applies to the mouthpiece control by using lock nut *319* and adjusting screw *320*.

To replace a damaged expansion tube and bulb assembly move switch *259* to *off* position, then remove expansion tube and bulb guard *254*, four round head screws *321* from the cover of expansion bellows *255*, lift old bulb from pot and remove adjusting screw *318* and lock nut *317*. Place new bulb in pot and reassemble. Mouthpiece control expansion tube and bulb assembly is replaced in similar manner.

Expansion tube and bulb assemblies must not be inserted into the pot until they have been exposed to room temperature (70°) for at least one hour.

All Micro-Therm controls have been carefully tested and adjusted at the factory, so there should be very little need to readjust when operating at normal temperature.

Do not permit the crucible or mouthpiece to overheat (600° F. for crucible, 525° F. for mouthpiece), it may damage the expansion tube and bulb.

Metal Temperature—The temperature of the metal on a gas pot should never go higher than 550 degrees, and it may give better results a trifle below that. The electric pot usually gives better results when operated at a temperature between 535 and 550 degrees. The temperature of the mouthpiece of both gas and electric pots should be adjusted as low as possible, but with sufficient heat to keep the slug from showing a chilled face.

Adjustment and Care of the Gas Pot Thermostat—This thermostat, like similar gas controlling devices, should be taken apart and cleaned occasionally. This can be done quickly and easily if the following instructions are observed:

Referring to Fig. 8-13, remove fulcrum pin *60* by loosening set screws, and then take out lever *58*. Unscrew and lift out plunger guide *62*. Hold the plunger guide in the hand, unscrew the spring cap *59* and remove the plunger *65*. These parts are assembled by hand in the factory and the use of tools or vise may disturb the alignment. Clean out by-pass *63*, wipe off and rub plunger *65* with a little graphite. When reassembling do not try to screw plunger guide *62* down to the hexagon head, as it seats on bottom, as shown. Lubricate fulcrum pin *60* with graphite. Do not use oil.

The thermostat is calibrated and the adjustment shown at *81* and *82* set at the factory, where the gas pressure may vary from that of other localities; therefore, test the thermostat by using a thermometer in the metal pot. When the thermometer registers 550 degrees Fahrenheit, loosen the screw at the top of the thermostat and turn the dial plate *56* until it corresponds with the thermometer.

Adjustment and Care of Micro-Therm Control for Gas—Expansion Bellows—To calibrate the Micro-Therm Control, place a glass thermometer in pot, loosen dial set screw *93* and shaft set screw *95*, Fig. 10-13. Then turn operating shaft *94* to the left, or counter-clockwise, to raise the temperature and to the right, or clockwise, to lower the temperature.

When thermometer reaches 550 degrees, adjust shaft *94* by turning to the right, or clockwise, until main burner flame is cut down to pilot flame. Line up the 550 degree graduation mark on dial *89* with one on the casting and then lock dial in position with lock screws *93* and *95*.

The pilot light can be adjusted by first loosening lock nut *100* and then turning the pilot light regulating screw *96* to the right, or clockwise, to reduce the flame or to the left, or counter-clockwise, to increase the flame. This will regulate the amount of gas flowing through the pilot light by-pass *88*. When making this adjustment the main inlet port *98* should be closed by turning operating shaft *94* clockwise as far as it will go. The by-pass flame should be adjusted just high enough to prevent it popping out.

To replace a damaged expansion bellows, shown at the lower left in Fig. 9-13, first turn the gas flame down, using the pot burner cock *105*. Remove the expansion bellows tube guard *101*, loosen bellows retaining nut *102* before loosening enclosing nut *103;* then remove bellows tube assembly and replace with new one. Tighten enclosing nut *103* and then tighten bellows retaining nut *102*. To clean, go through the same process with the addition of removing piston by loosening set screw *110*, Fig. 10-13. Clean thoroughly and wipe piston with graphite before reassembling. *107* and *106*, Fig. 10-13, are the packing and packing gland respectively.

Adjustment and Care of the Mechanical Thermostat—The thermostat has been accurately adjusted at the factory but must always be readjusted when placed in service. These adjustments should be made as follows:

1. Mount the thermostat on pot cover and secure with two holding screws. Be sure that thermostat tube clears the crucible heaters.
2. Fill pot with sufficient metal to cover the crucible heaters.
3. Remove the front cover of the thermostat case.
4. Assemble terminal plug *146*, Fig. 16-13, to terminal on thermostat and secure with nuts.
5. Turn the pot switch to the *on* position and note that contact lever roller *143* is touching contacts *C* and *L*. In this position the current is on the crucible heaters and the metal will begin to heat.
6. After the metal has melted, insert a glass rod thermometer and when it registers 550 degrees F., note that contact lever roller *143* has rolled over contact *C* and is now touching contacts *C* and *H*. In this position the current is off the crucible heaters and the metal will begin to cool.
7. When the metal has cooled so that the thermometer registers 535 degrees F., note that the contact lever roller *143* has again rolled over contact *C* and is now again touching contacts *C* and *L*.
8. The foregoing is the normal cycle of operations and will be continued as long as the pot switch is left in the *on* position.
9. The contact lever roller support *141* is made of spring wire and is set so that the contact lever roller *143* will easily roll over contact *C* and touch contact *H* when the thermometer registers 550 degrees F. and contact *L* when thermom-

eter registers 535 degrees F. The contact roller *143* can be adjusted by carefully bending the contact lever roller support *141*.

10. Temperature regulation above or below normal is controlled by the knurl-headed screw *147* which has a screwdriver slot and may be reached through a hole in the cover. Turning this screw to the left reduces the temperature and turning it to the right increases the temperature.

11. Screw *150* is also an adjustment, but is used only when replacing parts or making rough adjustments if the thermostat has been subjected to extremely high temperature, or after having been removed from a frozen pot.

12. It is important in making this rough adjustment with screw *150* that a clearance of at least $\frac{1}{16}$" be allowed between parts *151* and *152* to provide for the close adjustment to be made by screw *147*.

13. To remove the thermostat and pot cover from a frozen pot, remove nut *149* and the two screws holding thermostat to the cover. Disconnect terminal plug *146* by first removing the three nuts and lift off thermostat. The pot cover may then be removed in the regular way.