

O. A. COLBY,
ELECTRIC FURNACE,
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1,367,124.

Patented Feb. 1, 1921.
2 SHEETS—SHEET 1.

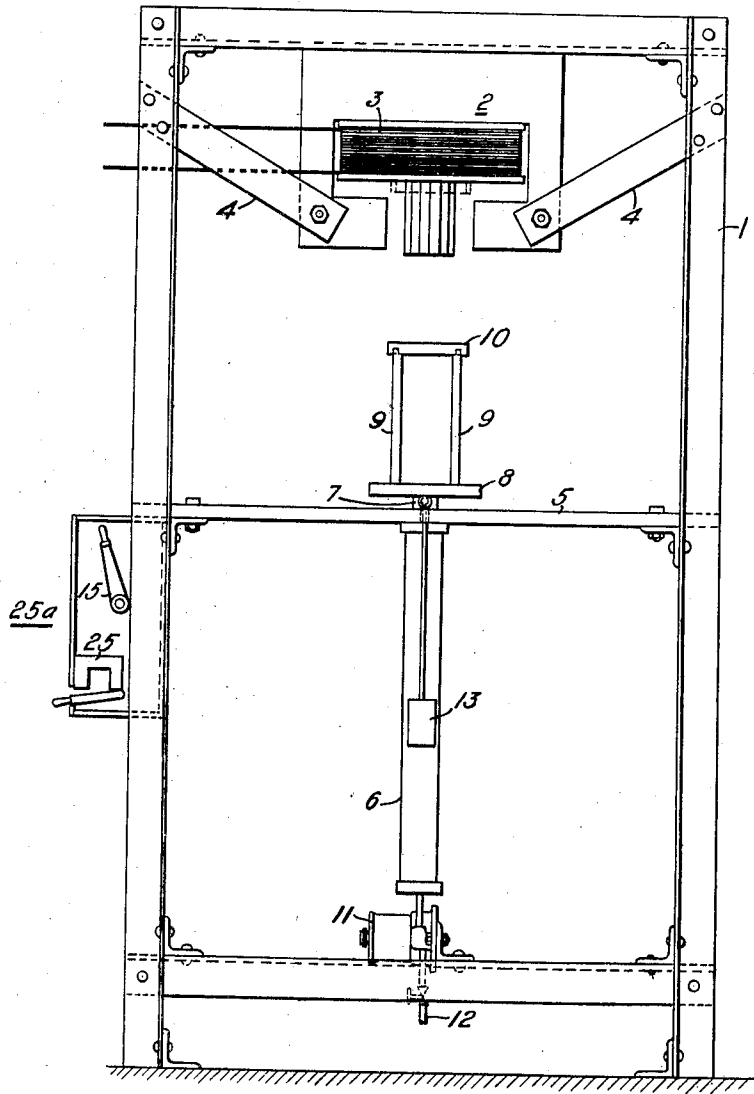


Fig. 1.

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2 SHEETS—SHEET 2.

Fig. 2.

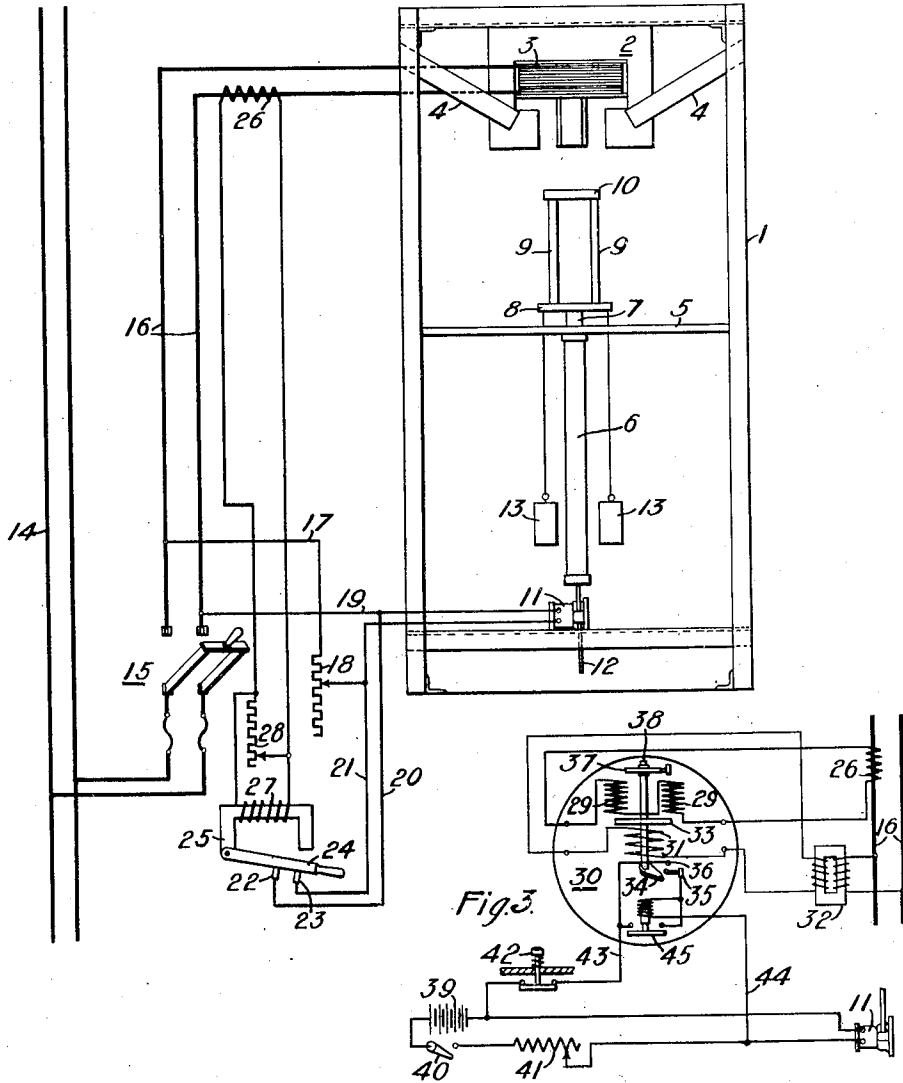
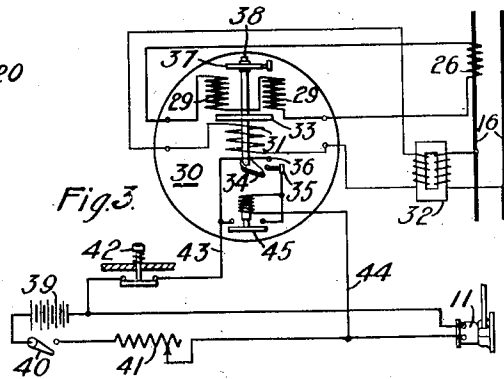


Fig. 3.



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ELECTRIC FURNACE.

1,367,124.

Specification of Letters Patent.

Patented Feb. 1, 1921.

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To all whom it may concern:

Be it known that I, ORA A. COLBY, a citizen of the United States, and a resident of Irwin, in the county of Westmoreland and State of Pennsylvania, have invented a new and useful Improvement in Electric Furnaces, of which the following is a specification.

My invention relates to electric furnaces and particularly to electric induction furnaces for heating metal bands.

One object of my invention is to provide a device that will heat metal bands, such as are used on shells or wheel rims, quickly and economically by electric induction.

Another object is to provide a device of this character that shall be simple in operation and that shall require the least possible number of motions on the part of the operator in handling the work to be heated.

Another object is to so control an induction furnace that, when a metal band has been heated to a predetermined temperature, the heating operation may be automatically discontinued.

According to my invention, I provide a transformer, of substantially E-shape, so mounted in an angle-iron frame that the intermediate core member is in a vertical position pointing downwardly. I provide, also, a pneumatically operated piston in vertical alinement with, and below, the intermediate core member of the transformer for moving the metal band to be heated into inductive relation to the transformer and holding it therein until it has been heated to the desired temperature. A valve magnet controls the admission of air into, and the release of it from, the air cylinder. The valve magnet is energized by a suitable source of electromotive force, and its operation is controlled by either a minimum-current relay or a watt relay.

When a relatively small metal band is to be heated, the change in the current required by the transformer is large enough to allow of using a current relay to actuate the valve magnet. When the metal band is relatively large, the current required by the transformer varies but little during the heating operation and the current relay cannot be used. However, the true watts input into the transformer increases with the temperature of the metal band, and a watt relay may be used to actuate the valve magnet.

When the valve magnet is short circuited by the operation of either the minimum-current relay or the watt relay, the air in the cylinder is permitted to escape into the atmosphere, and the piston will be moved to its lowered position through the agency of its own or added weight. The armature of the current relay may be manually raised to its normal position, or a push button, used in connection with the watt relay, may be operated to energize the valve magnet and cause the piston to rise and move the metal band into inductive relation to the transformer. When the metal band has been heated to the desired temperature, the current or watt relay operates to short circuit the valve magnet and release the air, and the piston is lowered, permitting the metal band to be removed and placed by the operator in position on the apparatus with which it is to be associated.

Figure 1 of the drawings is a front view of the device embodying my invention; Fig. 2 is a schematic diagram of connections, using the current relay, and Fig. 3 is a diagram of a portion of a similar system, using the watt relay.

Referring to Fig. 1, a suitable angle-iron frame 1 is utilized to support a transformer 2, having a core of substantially E-shape provided with a magnetizing coil 3. Metal bracing strips 4 are provided to hold the two outer core members of the transformer 2 in their proper positions. A metal table 5, that may be used to hold a supply of the bands to be heated, is provided at approximately the middle of the height of the frame 1. An air cylinder 6 is suitably secured to the frame 1 and contains a piston 7. At the upper end of the piston 7 is mounted a metal plate 8 that carries suitable supporting rods 9, electrically insulated from plate 8, for holding the metal band 10 that is to be heated. A valve magnet 11 is operatively connected to the lower end of the air cylinder 6 and controls the admission of air from the supply pipe 12 to the air cylinder. Counterweights 13 may be connected to the plate 8, when necessary, to return the piston 7 to its normal or lowered position, although, usually, the force of repulsion and the weight of the moving parts will be sufficient.

Referring to Fig. 2, a supply circuit 14 energizes the transformer coil 3 through the

switch 15 and the conductors 16. The valve magnet 11 may be energized from circuit 14 through a conductor 17, a suitable adjusting rheostat 18 and a return conductor 19. Conductors 20 and 21, connected to the conductors leading to the valve magnet 11, terminate in two contact terminals 22 and 23, respectively, that are so located as to be brought into contact with the relay armature 24 of the minimum current relay 25, when the same is in its open position. The winding 27 of the relay 25 is energized by means of a current transformer 26 connected to one of the conductors 16. A rheostat 28 is shown as being so connected in shunt to the coil 27 as to permit of adjusting the current value at which the relay will open, but any suitable means for obtaining a range of current values at which the relay will open, may be employed. The switch 15 and the relay 25 may be placed in a metal cover box 25^a and mounted on the side of the frame 1.

Fig. 3 shows the connections of the watt relay that is used to control the valve magnet 11, when relatively heavy metal bands are to be heated. The current coils 29 of the watt relay—indicated, as a whole, by the reference number 30—are energized by the current transformer 26 that is connected to one of the conductors 16 supplying energy to the transformer coil 3. The voltage coil 31 of the relay 30 is energized from the circuit 16 through a suitable transformer 32. A suitably supported shaft 38 that carries an armature 33 and a lever arm 34 is capable of a small turning movement in its bearings. The action of the magnetic fluxes set up by the current and voltage coils of the relay will cause the armature 33 to turn through a small angle, and the arm 34 will cause the movable contact arm 35 to engage the contact terminal 36. An adjustable spring 37, mounted on the shaft 38, tends to oppose such turning movement and, by its means, the watt relay may be set to operate at any desired energy input to the transformer 2.

The valve magnet 11 may be energized from a suitable source of electromotive force 39, through a manually operated switch 40 and a rheostat 41. One terminal of the valve magnet 11 is connected to the contact terminal 36 through a push-button station 42, that is normally held in a closed-circuit position, and the conductor 43. The other terminal of the valve magnet 11 is connected to the contact terminal 35 through the conductor 44 and the coil of a circuit-closing relay 45. The contact terminals of the relay 45 are connected, respectively, to the contact terminal 36 through the conductor 43, and to the contact terminal 35.

Assuming the position of the various parts of the device to be as shown in Fig. 2, using the current relay, if it is desired to place the same in operation, the switch 15 may be

closed and a metal band placed on the supports. If the relay armature 24 is manually raised to its normal position, the short circuit across the terminals of the valve magnet 11 will be removed, air will be admitted to the cylinder 6 that will cause the piston 7, the plate 8, the supports 9 and the metal band 10, to be raised until the metal band is in the position shown by the broken lines in Fig. 1 and held there. As the metal band constitutes a closed secondary coil of one turn, it will have relatively large eddy currents induced in it, tending to heat it, and the current in the transformer supply circuit 16 will become relatively large. The derived current in the current transformer 26 will magnetize the relay 25 and hold the armature 24 in its normal position. As the metal band is heated, due to the eddy currents, its resistance increases, and the eddy currents will, therefore, decrease, and the current in the transformer supply circuit will be correspondingly decreased. This decreased transformer current will result in a decreased current in the relay circuit until the relay is no longer able to hold the relay armature in its normal position. When the armature is released, it will engage the contacts 22 and 23 and short-circuit the valve magnet. This will release the air from the air cylinder, and the weight of the parts will operate to move the piston and the metal band to the position shown in the full lines in Fig. 1, when the metal band may be removed from the supports and placed upon the shell or wheel, as the case may be.

To control the temperature at which the heating operation will be discontinued, a rheostat 28 is provided in shunt to the relay magnet coil and, by adjusting the resistance in this rheostat, the heating operation may be discontinued at any predetermined temperature. The less resistance there is in the circuit of the rheostat, the sooner will the heating operation be discontinued and, therefore, the lower will be the final temperature of the metal band.

Fig. 3 shows the connections of the control circuit when using a watt relay for controlling the heating of relatively heavy metal bands. Assuming the position of the various parts to be as shown in Fig. 3, if it is desired to place the device in operation, switch 15 may be closed and a metal band placed on the supports 9. By closing the switch 40, the valve magnet 11 will be energized and will operate to admit air to the cylinder 6. The metal band 10 will, therefore, be raised by means of the piston 7, to the position shown in broken lines in Fig. 1 and will be heated by the eddy currents induced in it. The true energy input into the transformer coil 3 increases with the temperature of the metal band and, by properly adjusting the spring 37, the armature 33,

mounted on the shaft 38, will be precluded from any turning movement until the temperature of the metal band has reached a predetermined value. When the desired temperature has been reached, the value of the true energy input into the transformer will be such as to cause the armature 33 to turn through a small angle and this will operate to cause the lever 34 to bring the movable contact member 35 into operative engagement with the stationary contact member 36. This will close a circuit comprising the source of electromotive force 39, the rheostat 41, the conductors 43 and 44 and the coil of circuit-closing relay 45, and will operate to short circuit the valve magnet 11. The current flowing through the coil of the circuit-closing relay, will cause the same to close and short circuit the contact members 35 and 36. As the valve magnet 11 is short circuited, the piston 7 will drop, and the metal band may be removed from its supports and placed on the apparatus with which it is to be associated.

As the value of the true-energy input is now below that at which the watt relay will operate, the disk 33 and the lever arm 34 will be moved in the reverse direction by the action of the spring 37, and the watt relay is ready for another cycle of operation. No sparking can take place between the contact members 35 and 36 when the engagement between them is broken as they are short circuited by the circuit-closing relay 45.

A metal band may be placed on the supports 9, and the push button 42 be depressed, to break the circuit through the coil of the circuit-closing relay 45. As the contact-bridging member of the relay 45 drops and removes the short circuit across coil of the valve magnet 11, the air is again permitted to enter the cylinder 6 and the piston 7 is forced upwardly to bring the metal band into the proper inductive position on the transformer.

While I have shown a specific application, it will be seen that modifications may be made without departing from the spirit and scope of my invention, and I desire that only such limitations shall be placed thereon as are imposed by the prior art or are specifically set forth in the appended claims.

I claim as my invention:

1. In an electric furnace, the combination with a transformer and a supply circuit therefor, of means for supporting the work to be heated, and electric means for automatically controlling said supporting means in accordance with the electric characteristics of the circuit connected to the transformer.

2. In an induction furnace, the combination with a transformer, a supply circuit and means for bringing the work to be heated

into, and holding it in, inductive relation with said transformer, of electric means for automatically controlling said work-holding means in accordance with the electric characteristics of the circuit connected to the transformer.

3. In an induction furnace, the combination with an open-core transformer and a supply circuit therefor, of pneumatically operated means for holding the work to be heated, electric means for controlling said pneumatic means, and electric means for causing said control means to actuate said pneumatic means.

4. In an induction furnace, the combination with an open core transformer and a supply circuit therefor, of pneumatically operated means for bringing the work to be heated into, and removing it from, inductive relation to said transformer, electric means for controlling said pneumatic means, and electric means for causing said controlling means to actuate said pneumatic means.

5. In an induction furnace, the combination with an open-core transformer, and a supply circuit therefor, of pneumatically operated means for bringing the work to be heated into, and removing it from, inductive relation to said transformer, electric means for controlling said pneumatic means, and means for causing said control means to actuate said pneumatic means to remove the work from such inductive relation under predetermined temperature conditions of the work being heated.

6. In an induction furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit therefor, pneumatic means for holding the work to be heated, and electric means for controlling said pneumatic means, of electric means for actuating said control means, the current for said actuating means being derived from the transformer supply circuit and being in proportion thereto.

7. In an electric furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit, pneumatic means for bringing the work to be heated into inductive relation to one of said magnetizable members, and electric means for controlling said pneumatic means, of electric means for actuating said control means, the current for said electric actuating means being derived from, and in proportion to, the current in the transformer supply circuit and means for varying the ratio of the two currents.

8. In an induction furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit, and pneumatic means for holding the work to be heated in inductive relation to said transformer, of means, comprising a minimum-current relay, for causing said

pneumatic means to hold the work in said inductive relation until the work is heated to a predetermined temperature.

9. In an induction furnace, the combination with a transformer of substantially E-shape, a supply circuit, means for bringing the work to be heated into and out of position on one of said core members, and electric means for controlling said work-positioning means, of means, comprising a minimum-current relay, for actuating said control means under predetermined temperature conditions of the work being heated, the current for said relay being derived from the transformer circuit and being proportional thereto.

10. In an induction furnace, the combination with a transformer of substantially E-shape, a supply circuit, means for bringing the work to be heated into position on one of said core members, and electric means for controlling said work-positioning means, of means, comprising a minimum-current relay, for actuating said control means, under predetermined temperature conditions of the work being heated, to remove the work from said position, the current for said relay being derived from the transformer circuit and being proportioned thereto, and means for varying the ratio of the two currents, whereby the final temperature of the work may be controlled.

11. In an induction furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit therefor, means for supporting the work to be heated, and bringing it into, and re-

moving it from, inductive relation to one of said core members, and electric means for controlling said work-supporting means, of means, responsive to the power input into said transformer, for causing said control means to actuate said work-supporting means to remove the work from said inductive relation, under predetermined conditions.

12. In an induction furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit therefor, pneumatic means for bringing the work to be heated into position on one of said core members and removing it therefrom, and electric means for controlling said pneumatic means, of means, responsive to the power input into the transformer, for actuating said electric-control means under predetermined temperature conditions of the work being heated, to remove the work from said core member.

13. In an electric furnace, the combination with a transformer having a plurality of magnetizable core members, a supply circuit therefor, and pneumatic means for holding the work to be heated in inductive relation to said transformer, of means, comprising a relay responsive to the power input into said transformer, for causing said pneumatic means to hold the work in said inductive relation until the work is heated to a predetermined temperature.

In testimony whereof, I have hereunto subscribed my name this 24th day of Dec., 1918.

ORA A. COLBY.