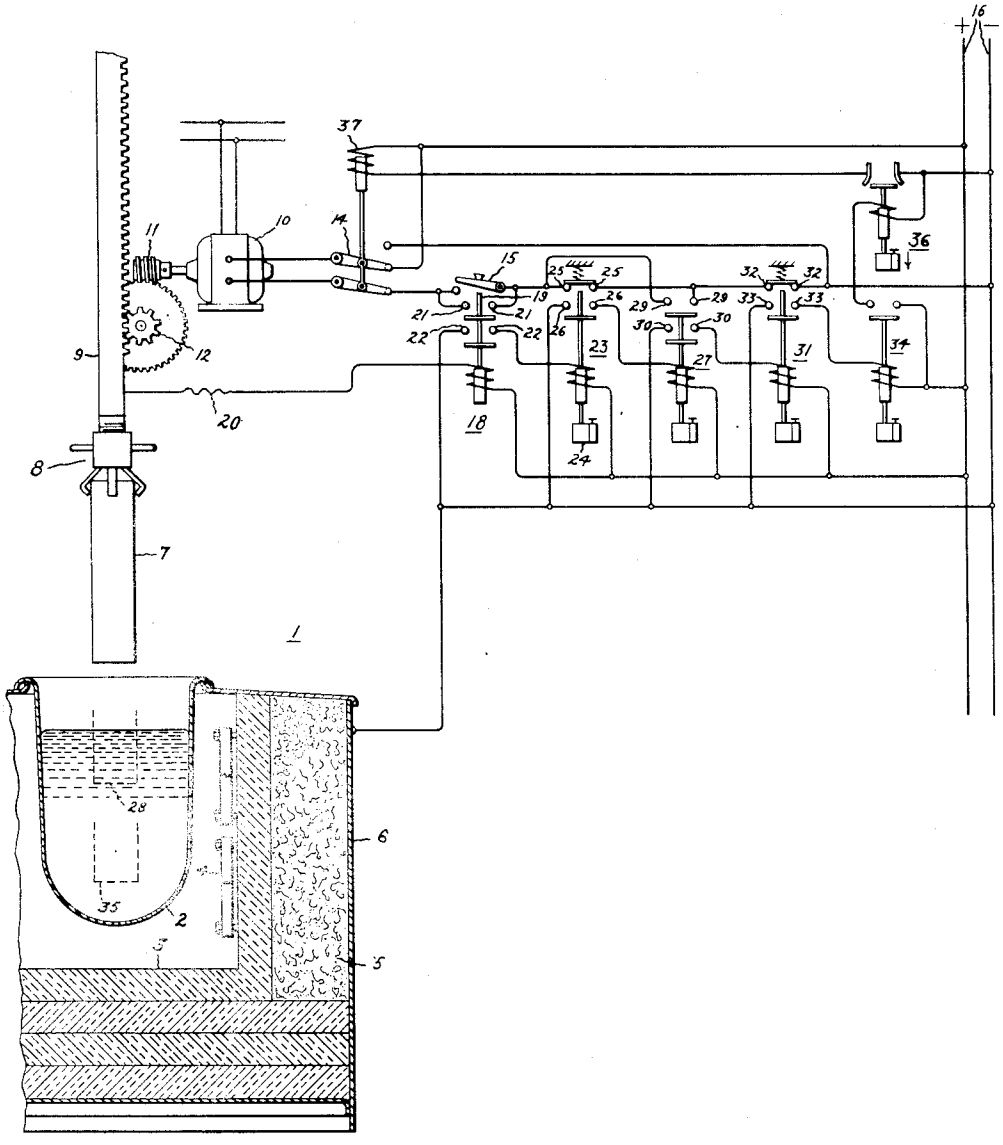
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HEAT TREATING APPARATUS

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Inventor:
Leon B. Rosseau,
by Harry E. Dunham
His Attorney.

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HEAT TREATING APPARATUS

Leon B. Rosseau, Lower Merion Township, Montgomery County, Pa., assignor to General Electric Company, a corporation of New York

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My invention relates to apparatus for the heat treatment of articles by immersion in a liquid or molten bath. The practice for such heat treatment as followed in the past has been to lower the article into a furnace containing the molten bath so as to immerse it in the bath to the desired depth, to maintain it immersed for the desired time and finally to withdraw it from the furnace all under the manual control of the operator. In certain cases it is desirable for the proper heat treatment of the article that the immersion be carried on in successive steps of various depths, the article being held for various time intervals between the successive steps.

Difficulty has been experienced in the past, particularly in those cases in which an exact immersion depth and time schedule must be adhered to where dependence for the carrying out of such a schedule has rested entirely upon the operator. The immersion depth in particular has not been sufficiently closely regulated since the exact depth to which the article was lowered into the furnace has been determined heretofore solely by the observation of the operator. This has been made the more difficult because of the fact that the liquid level of the bath does not remain the same but varies during the day since more or less of liquid clings to each article.

It is the object of my invention, therefore, to provide improved apparatus for such heat treatment whereby the above-mentioned difficulties are avoided.

My invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the single figure of the drawing which is a combined side view and circuit diagram of a preferred embodiment of my invention, 1 represents the furnace and 2 the crucible therein containing the molten lead. The furnace is of a well known construction having a fire-clay tile inner portion 3 upon which the electric heating units 4 are supported and having a thick layer of heat insulating material 5 surrounding the tile, the entire assembly being enclosed in the sheet steel casing 6. The upper end of the crucible has a flange by which it is supported by the outer casing of the furnace. Since the crucible in this case is metallic, being preferably formed of an alloy, the lead bath is in electrical connection with the outer casing of the furnace.

At 7 I have represented an article such as a steel forging which is to be heat treated in the furnace. The article 7 is shown supported by means of the chuck 8 from the rack 9 which it will be understood is mounted in suitable guides, not shown, for vertical movement. For lowering the article 7 into the lead bath and subsequently raising it therefrom I have shown the shunt wound electric motor 10 which connects with the rack 9 through the worm gearing 11 and the spur gear 12. The armature circuit of motor 10 is shown connected through the solenoid actuated reversing switch 14 and the manual switch 15 with the source of direct current supply 16. With the switch 14 in the position shown on the drawing a closing of the switch 15 will cause the motor 10 to operate in a direction to lower the article 7 into the furnace.

In accordance with my invention as soon as the article 7 makes contact with the molten lead in the furnace the manual control of the motor is disconnected and an automatic control thereafter is substituted. This substitution of control is effected through the relay 18 having the rod 19 which when the relay is energized engages the switch 15 to move it to open circuit position. One end of the winding of relay 18 connects with the positive side of the source of supply 16 and the other end of the winding connects by means of the flexible connection 20 with the rack 9; hence it is electrically connected with the article 7. The negative or grounded side of the source of supply connects directly with the outer casing 6 of the furnace which also is suitably grounded through its supporting structure, the rack and the associated parts of the structure being insulated from ground. If desired, the rack may be grounded and the furnace insulated in which case the connections to the source 16 would be reversed; however, such an arrangement is subject to the production of static because of leakage from the heating units employed, the static shocks sometimes interfering with the efficiency of operators when engaged in adding metal to the crucible. I prefer, therefore, to connect the apparatus in the manner shown. When, therefore, the motor is operated by the manual closure of switch 15 the article is lowered until it engages the surface of the molten lead at whatever height it may be at which time the circuit of relay 18 is closed rendering the manual control inoperative and substituting therefor an automatic control for the further immersion of the article.

Various forms of apparatus may be employed to control the depth at which the article is immersed in the lead, the number of steps by which it is immersed, and the length of time which it is maintained immersed at each step. I shall now

describe a simple form of such control apparatus by which the article is automatically immersed in the liquid in two steps and maintained stationary at those steps for predetermined lengths of time after which the article is withdrawn from the furnace.

The energization of relay 18 not only opens the switch 15 but closes a shunt circuit around that switch at the contacts 21 whereby the motor 10 continues to operate to lower the article 7 into the lead. Relay 18, also, by its energization closes at its contacts 22 a circuit which includes the winding of the time delay relay 23, which relay is provided with the dash pot 24 having means for variably controlling the upward movement of the movable contacts when the relay is energized. This relay functions in the manner of a limit switch whereby after the motor 10 has operated to lower the article 7 for a predetermined time it opens the motor circuit at the contacts 25 and simultaneously closes at the contacts 26 the circuit of the time delay relay 27. This relay is provided with a controlled dash pot like that of relay 23 and serves to determine the length of time at which the article remains immersed in the first step, the depth of immersion being represented, for example, by the dotted lines 28. At the expiration of that time the relay 27 recloses the motor circuit at the contacts 29 and simultaneously at the contacts 30 closes the circuit of the time delay relay 31. This relay is likewise provided with a controlled dash pot and functions as a limit switch to control the distance at which the article is again lowered in the lead bath. At the expiration of the time for which this relay is set it opens the motor circuit again at the contacts 32 and simultaneously closes at the contacts 33 the circuit of the time delay relay 34 which like relay 23 is provided with a controlled dash pot. This relay like relay 27 controls the length of time that the article is immersed in the second step represented by the dotted lines 35. At the expiration of the time for which relay 34 is set it closes the circuit of the time delay relay 36 which is also provided with a controlled dash pot but the dash pot in this case operates in the reverse manner, that is, the relay operates without delay upon being energized but opens a circuit controlled thereby under the control of the dash pot. The operation of the relay 36 closes the circuit of the solenoid 37 which moves the reversing switch to the position opposite to that shown on the drawing whereby the direction of rotation of the motor is reversed and the article 7 is immediately withdrawn from the furnace. As soon as the article breaks connection with the bath the relay 18 becomes deenergized and accordingly each of the succeeding relays in turn becomes deenergized. After the brief time for which relay 36 is set, which time is sufficient for the motor to lift the article clear of the top of the furnace, the relay 36 functions to open the circuit of the solenoid 37 whence the reversing switch drops to the position shown. Since the motor circuit is open at the manual switch 15, the motor comes to rest.

The article 7 may now be disconnected from the rack 9 and another article substituted therefor, the control apparatus being in position for repetition of the operation just described.

From the above it will be seen that the depth of immersion of an article and the length of time it is held immersed is entirely independent of the operator and independent of the height of the liquid in the crucible. While the lowering of the article is initiated manually, as soon as it touches the surface of the bath the manual control is taken over by the automatic means for the control of the depth and time of actual immersion.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. In combination, a molten bath, means for lowering an article into engagement with said bath to be heat treated therein, a circuit arranged to be closed by the contact of said article with said bath and means responsive to the closing of said circuit for controlling the immersion of the article into the bath.

2. In combination, a molten bath, manually controlled means for lowering an article into engagement with said bath to be heat treated therein, a circuit arranged to be closed by the contact of said article with said bath and means responsive to the closing of said circuit for controlling the lowering of the article to a predetermined distance into said bath.

3. In combination, a molten bath, means for lowering an article into engagement with said bath to be heat treated therein, a circuit arranged to be closed by the contact of said article with said bath, means rendered operative by the closing of said circuit for controlling said lowering means after said article has engaged the bath and time delay means for controlling the time of immersion of said article in said bath.

4. In combination, a crucible containing molten lead, motor controlled apparatus for lowering an article into said lead, manual means for controlling said motor, a circuit connected with said crucible and with said article arranged to be closed by the contact of the article with the lead and means responsive to the closing of said circuit for assuming control of said motor.

LEON B. ROSSEAU.