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W. H. SCHWARTZ ET AL

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AUTOMATIC METAL MEASURING AND FEEDING DEVICE

Filed July 8, 1943

2 Sheets-Sheet 1

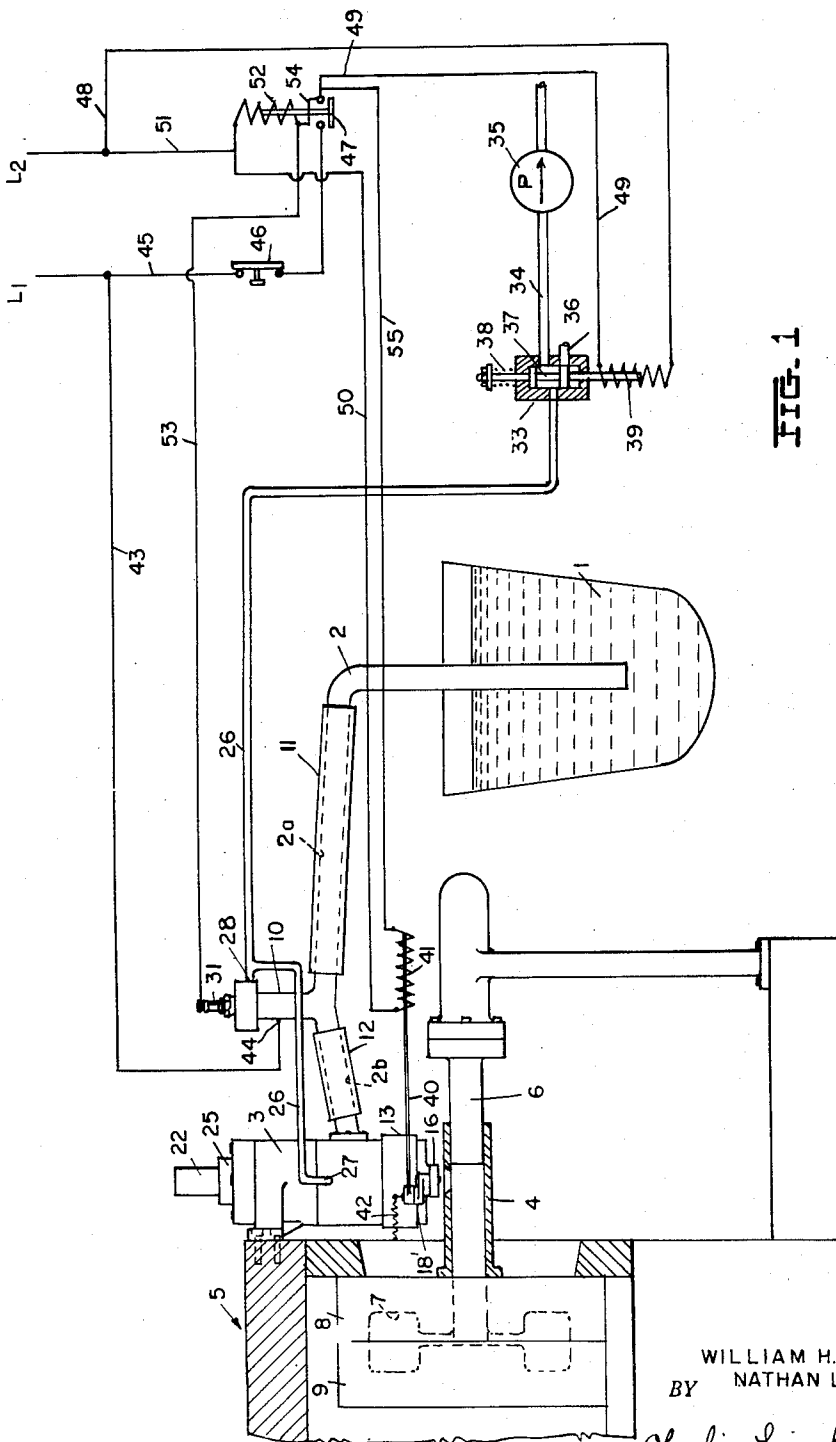


FIG. 1

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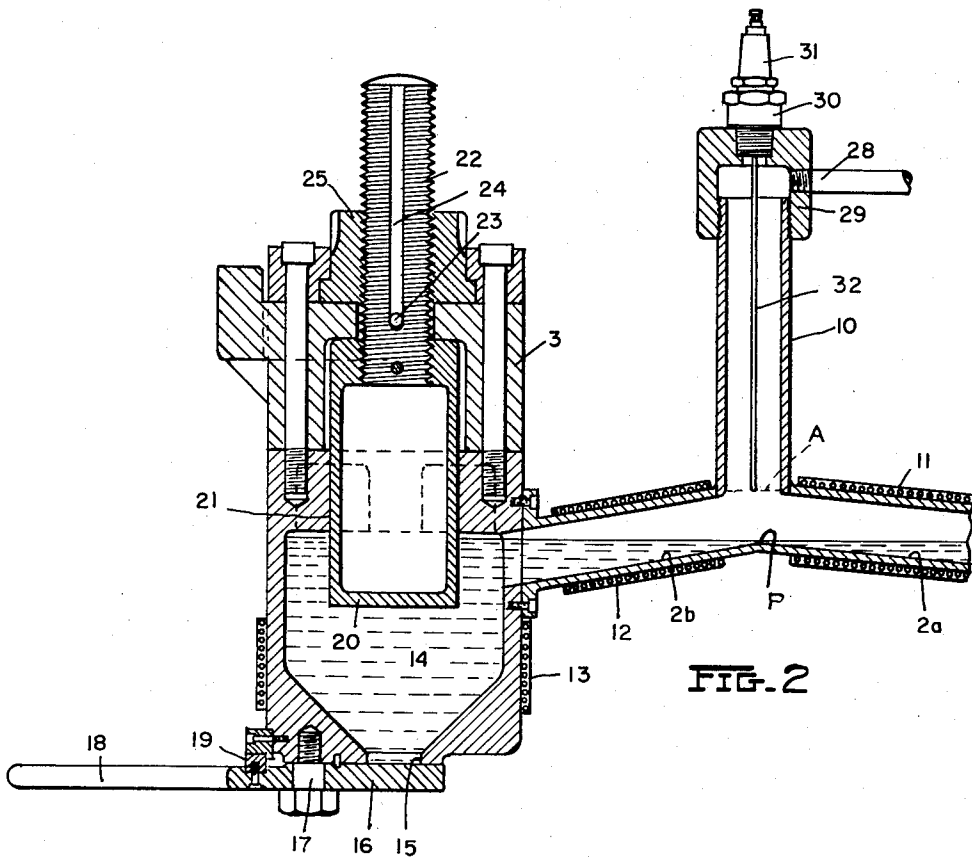


FIG. 2

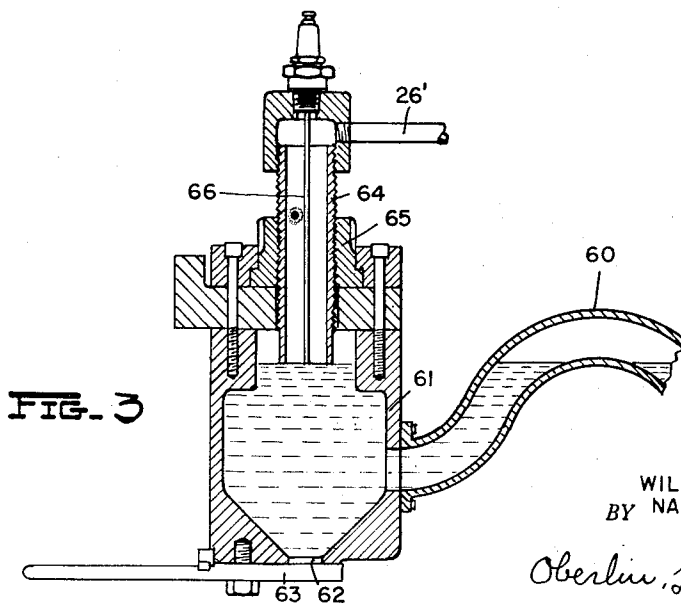


FIG. 3

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AUTOMATIC METAL MEASURING AND
FEEDING DEVICE

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14 Claims. (Cl. 22—79)

The present invention relates to a device for automatically extracting a desired quantity of molten metal from a bulk supply of same, such as from a melting pot, and delivering the measured quantity to a point where it is to be cast or formed into the required shape. Heretofore, in the metal founding art, considerable difficulty has been encountered, particularly when operating under quantity production methods, in transmitting the individual molten metal charges from the main supply to the point where casting or solidification of such molten charge is to take place. The simplest expedient, of course, has been to use a ladle of known volume capacity and merely to dip or ladle the individual molten metal charges out of the melting pot, crucible or other molten metal bath container. Mechanical lading devices for performing the same operation have also been known. Pneumatic pressure and vacuum systems also have been used for conveying charges of the molten metal from the melting pot.

However, all of these above generally outlined prior expedients have been subject to certain disadvantages, such as the spilling and splashing of the molten metal from the ladle, the solidification or freezing out of the metal in pneumatic pressure or vacuum lines, and the inability accurately to control within close limits the uniformity of the measured amounts of metal charges.

Our invention utilizes a vacuum lifting principle for educting the molten metal from the melting pot, together with an accurate and reliable control device for discontinuing the application of the vacuum when the desired amount has been withdrawn; and thus successfully overcomes the several disadvantages and difficulties heretofore encountered. Our invention also involves the operation of causing the molten metal to flow past a high point above the liquid level in the melting pot whereby the desired measured amount flows by gravity into a receiving chamber on one side of such high point and the excess metal flows in the other direction from the high point and back into the melting pot. This feature of our invention insures the complete and positive separation of the desired "batch" of molten metal and prevents the inadvertent diminution of this segregated amount of metal after the vacuum lifting force becomes inoperative or is disconnected.

Our invention also provides a novel controlling device for rendering the metal lifting or pumping means inoperative, and wherein the molten metal itself cooperates as an element of an electrically actuated control circuit.

Additional objects and advantages of our invention shall become apparent as the following description proceeds.

To the accomplishment of the foregoing and

related ends, said invention then comprises the features hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention, these being indicative, however, of but a few of the various ways in which the principle of the invention may be employed.

In said annexed drawings:

Fig. 1 is a partially diagrammatic view illustrating a device embodying the principle of our invention as applied to a pressure casting machine;

Fig. 2 is an enlarged, sectional view of a portion of the apparatus shown in Fig. 1; and

Fig. 3 is a view similar to Fig. 2 but showing a modified form of construction.

Now referring more particularly to the drawings, there are shown therein a main source of molten metal supply, such as the melting pot 1, having the eduction conduit 2 leading from a point substantially midway of its upper liquid level and bottom to the "batch" receiving chamber 3. The receiving chamber 3 is herewith illustrated as being mounted upon the frame of a pressure casting machine, the pertinent parts of which are generally indicated at 5. The chamber 3 is located immediately above the feed inlet into the pressure casting chamber 4 in which the plunger 6 is adapted to reciprocate. A die cavity 7 is formed between the separable die blocks 8 and 9 and constitutes the forming mold into which the withdrawn batches of molten metal from the melting pot 1 are ultimately transferred and solidified or cast.

The conduit 2 includes two upwardly inclined portions 2a and 2b which join at their highest point with the vertical riser 10. As will be seen from Fig. 2, this high point, indicated at P, is above the normal liquid level of the receiving chamber 3 and of the melting pot 1.

Heating means, such as the electrical resistance coils 11 and 12, are provided for the conduit portions 2a and 2b, respectively, and for the purpose of maintaining a temperature in the conduit 2 high enough to keep the metal therein in a molten condition. A heating coil as indicated at 13 is likewise provided for the chamber 3 and adjacent its internal, metal receiving cavity 14.

A discharge opening 15 is provided in the bottom of the cavity 14 and is adapted to be closed by the gate 16 which is pivotally mounted upon the bolt 17. The gate 16 is operated by the arm 18. A detent mechanism 19 is located between the arm 18 and the base of the receiving chamber 3 to aid in the holding of the gate 16 in opened and closed positions respectively.

A fluid displacement cylinder 20, slidably mounted in the annular flange guide 21, projects downwardly into the interior of the cavity 14 and

is mounted in the chamber 3 by means of the feed screw 22 which is held against rotation by means of the pin 23 engaging in the slot 24. The feed screw engages with the adjusting nut 25, so that rotation of the latter operates to move the feed screw and displacement cylinder 20 to the desired vertical position with respect to the interior of the cavity 14.

A pneumatic vacuum line 26 is connected to the cavity 14 of the receiving chamber 3 as indicated at 27 and also connected at 28 to the closure cap 29 on the top of the riser 10. An electric terminal plug 30 having the insulator portion 31 and the long depending electrode 32 is mounted in the top of the closure cap 29. As shown in Fig. 2, the electrode 32 extends down to the end of the riser 10 or to a point substantially coincident with the highest point of the inner surfaces of the conduit portions 2a and 2b.

The vacuum line 26 leads to the control valve 33 which is in turn connected to the line 34 leading to the vacuum pump 35. The valve 33 is also connected to the exhaust port 36 leading to the atmosphere. The stem 37 of the valve 33 is loaded by the compression spring 38 so that it is normally in the position shown in Fig. 1 wherein the line 26 is connected to the line 34 to the vacuum pump 35. The other or lower end of the stem 37 is connected to the core of the electric solenoid indicated at 39.

In the construction shown in Fig. 1, the operating lever 18' of the gate 16 is connected by means of the rod 40 to the core of the electric solenoid 41. A tension spring 42 urges the lever 18' toward closed position and against the movement of the solenoid 41.

An electric circuit, deriving electric power from the lines L₁ and L₂, controls the operation of the above described apparatus, and the connections of such electric circuit are as follows:

The line L₁ has one branch 43 grounded to the conduit 2, such as indicated at 44. The branch 45 from the line L₁ leads to the push button switch 46 to one of the terminals of the solenoid operated switch 47. The line L₂ has one branch 48 leading to the solenoid 39 which is in turn connected with the other terminal of the switch 47 by the line 49 and thence through the line 50 to the other terminal of the solenoid operated switch 47. The other branch 51 from the line L₂ leads to the winding 52 of the solenoid switch 47, then through the line 53 to the terminal of the mounting plug 31 of the electrode 32. The line 53 is shunted across from one end of the solenoid 52 to terminal of switch 47 to which the line 49 is connected, as indicated at 54. The solenoid 41 is connected in parallel with the solenoid 39, viz: by the line 55 connected to the same terminal of the switch 47 as the line 49.

The operation of the above described device and controlling circuit is as follows:

When the valve 33 is in the position as shown in Fig. 1, the vacuum pump 35 exhausts air from the cavity 14, the riser 10 and the conduit 2, thus causing molten metal from the melting pot 1 to be pumped up through the conduit 2 and into the receiving chamber cavity 14. When the level of the molten metal reaches the point A as indicated in Fig. 2, the electrode 32 is grounded, thus closing the circuit between the lines 43 and 53. In other words, the molten metal in contact with the end of the electrode 32 acts as a fluid conducting medium which closes the electric gap formed by the spacing and insulation of the electrode 32 from the surrounding metal parts which

are connected or grounded to the line 43. As this electric gap is closed, current then flows through the lines 43 and 53 to the solenoid 52 to the line 51, closing the terminals of the switch 47 and permitting current to flow from the line 45, through switch 46, to line 49 through solenoid 39 and thence through line 48, thus actuating the solenoid 39. As the solenoid 39 is actuated, the valve stem 37 is pulled downwardly connecting the vacuum line 26 to the vacuum exhaust port 36, thus relieving the vacuum in the conduit 2 and cavity 14, whereupon excess molten metal flows back into the melting pot 1 leaving the measured or predetermined amount of metal in the cavity 14 and in the conduit portion 2b.

Simultaneously with the actuation of the switch 47, current flows from the line 45, switches 46 and 47 through line 55, through solenoid 41 and thence through lines 50 and 51, thus actuating solenoid 41. The solenoid 41 moves the operating lever 18' and gate 16 to open position, permitting the fluid metal from the cavity 14 to be discharged into the casting cylinder 4. The return flow of the excess molten metal through the conduit portion 2a is quite rapid, so that by the time the gate 16 actually uncovers the discharge opening 15, all the excess metal to the left of the high point P (Fig. 2) has drained back to the right thereof.

To repeat the cycle of operations, the push button switch 46 is actuated, opening the circuit to the solenoids 41 and 39 and permitting the gate 16 to close and the valve 33 to be moved back to position where the vacuum line 26 is again connected to the vacuum pump 36, whereby another batch of metal is drawn into the receiving cavity 14.

The amount of metal withdrawn upon each cycle of operation is adjustably regulated by varying the position of the displacement cylinder 20. The lower the cylinder 20 is moved into the cavity 14, the greater the volume capacity of the latter is decreased and the amount of withdrawn molten metal received therein is correspondingly decreased.

It will thus be seen that a very accurate control of the amount of measured molten metal is obtainable. The discontinuance of the pumping action of the vacuum line 26 is entirely automatic, reliable and foolproof. It will be seen that there is no opportunity for molten metal to be drawn into the vacuum line 26 where it might otherwise solidify and cause a stoppage thereof, because as soon as the liquid level of the molten metal reaches the contact making point A, the vacuum is discontinued. The distance between the end of the electrode 32 and the vacuum line connection 28, determined by the length of the riser 10, thus functions as a "safety or neutral zone" which prevents any molten metal from entering into the vacuum line system, even though there might be a flow surge or momentum tending to carry some of the metal slightly higher up into the riser 10 even after the vacuum is shut off or opened to atmosphere. The brief period in which excess molten metal from the conduit portions 2a and 2b flows back into the melting pot 1 also automatically compensates for any such excess surge of metal into the receiving cavity 14, so that the same amount of predetermined measured quantity will be left in the cavity 14 upon each cycle of operation.

It will be apparent to those skilled in the art that equivalent means of forcing or pumping the molten metal from the melting pot 1 through the

conduit 2 and into the receiving chamber 3 can be employed than the vacuum system herein specifically shown and described. We intend that such equivalent molten metal pumping means shall be included within the scope of our invention.

In the alternative form of construction shown in Fig. 3, the riser housing the electric gap electrode is assembled in place of the adjustable displacement cylinders 20. Thus, in Fig. 3, the conduit 60 leads from the melting pot and has a high point above the normal liquid levels of the receiving chamber 61 and of the melting pot. A discharge opening 62 together with the gate 63 is likewise provided for the receiving chamber 61. The riser 64 threadedly engages with the adjusting nut 65 so that it can be moved to various vertical positions within the chamber 61. The upper end of the riser 64 is connected to a vacuum line 26' which in turn is connected to a control valve and electric actuating system similar to that previously shown and described in connection with Fig. 1.

The electrode 66 in the riser 64 projects to a point substantially in alignment with the bottom thereof. As shown in Fig. 3, when the liquid level of the molten metal within the chamber 61 reaches the bottom of the riser 64, the electrical contact is made across the electric gap formed by the electrode 66, thus shutting off the vacuum in the line 26' and the device then operated as previously described in connection with the form of construction shown in Figs. 1 and 2. Through the medium of the adjusting nut 65 the position of relative height through which the molten metal liquid level in the chamber 61 contacts the electrode 66 and thereby discontinues the vacuum pumping action determines the amount of metal received in the chamber 61. That is, by lowering the riser 64 and shutting off the pumping action at a relatively earlier time, a smaller quantity of metal will be received in the chamber 61; and conversely by raising the riser 64 and shutting off the pumping action at a relatively later time, a greater quantity of metal will be received into the chamber 61.

Other modes of applying the principle of the invention may be employed, change being made as regards the details described, provided the features stated in any of the following claims or the equivalent of such be employed.

We therefore particularly point out and distinctly claim as our invention:

1. A molten metal feeding device, comprising a molten metal reservoir, eduction means connected to said reservoir, said means including a conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir means for pumping molten metal from said reservoir through said eduction means, electrically actuated means for controlling the operation of said pumping means, and a normally open electric circuit gap connected to said electrically actuated means, said gap being located in said eduction means at the highest horizontal level reached by the molten metal flowing therein and adapted to be bridged and electrically closed by molten metal contained therein, whereby upon closing of the gap the pumping means is rendered inoperative.

2. A molten metal feeding device, comprising a molten metal reservoir, eduction means connected to said reservoir, said means including a conduit having ascending and descending portions with a high point above the normal liquid

level in said reservoir means for pumping molten metal from reservoir through said eduction means, electrically actuated means for controlling the operation of said pumping means, and molten metal contact means electrically connected to said electrically actuated means, said contact means being adapted to be actuated by contact with the molten metal pumped from said reservoir and located at a horizontal level above the normal flow level of molten metal in said eduction means whereby upon such contact of the molten metal, said pumping means is rendered inoperative.

3. A device for educting predetermined quantities of molten metal from a reservoir thereof, comprising an eduction conduit leading from said reservoir, means for forcing the molten metal from said reservoir through said conduit, electrically actuated means for controlling the operation of said forcing means, an electric circuit connected to said electrically actuated means, said conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir and means for closing said electric circuit located at such high level point in said conduit and adapted to be closed by contact with the molten metal contained in said conduit, whereupon said means for forcing the molten metal is rendered inoperative.

4. A device for educting predetermined quantities of molten metal from a reservoir thereof, comprising a receiving chamber, an eduction conduit leading from said reservoir to said receiving chamber said conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir and chamber, means for pumping molten metal through said conduit, electrically actuated means for controlling the operation of said pumping means, an electric circuit connected to said electrically actuated means, and molten metal contact means connected in said electric circuit, said contact means being adapted to be actuated by contact with the molten metal from said reservoir, thereby closing said electric circuit and rendering such pumping means inoperative said contact means being located at the highest horizontal level reached by the molten metal flowing in said conduit and in said chamber.

5. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber said conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir and chamber, suction means for lifting molten metal above such high point, and molten metal contact means for rendering said suction means inoperative when the liquid level in said receiving chamber reaches a predetermined height said contact means being located at substantially the same horizontal level as that of said high point.

6. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber said conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir and chamber, suction means for drawing molten metal from said conduit and into said receiving chamber, electrically actuated means controlling the operation of said suction means, and a normally open electric circuit gap connected to said electrically actuated means whereupon said suction means is rendered inoperative, and adapted to be closed by contact with molten metal withdrawn

by said suction means said gap being located at a level corresponding to that of said high point.

7. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having ascending and descending portions with a high point above the normal liquid level in said reservoir and chamber suction means for drawing molten metal from said conduit and into said receiving chamber, electrically actuated means controlling the operation of said suction means, and spaced electric contact means connected to said electrically actuated means, said contact means being located at such high point in said conduit and adapted to be electrically bridged by molten metal drawn into said conduit, whereupon said suction means is rendered inoperative.

8. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, a vertical riser connected to said conduit at such high point, a pneumatic vacuum line connected to the upper end of said riser, an electrode depending into the interior of said riser and insulated and spaced therefrom, a solenoid actuated valve for rendering said vacuum line inoperative, and an electric actuating circuit connecting the solenoid of said valve to said electrode and said conduit, whereby the bridging of the space between said electrode and said conduit by molten metal drawn into said conduit acts to close said circuit and operate said valve.

9. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, suction means for lifting molten metal above such high point, molten metal contact means for rendering said suction means inoperative when the liquid level in said receiving chamber reaches a predetermined height, and means for varying the volume capacity of said receiving chamber.

10. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, suction means for drawing molten metal from said conduit and into said receiving chamber, a discharge gate located in the bottom of said receiving chamber, electrically actuated means for simultaneously rendering said suction means inoperative and for opening said discharge gate, and a normally open electric circuit gap connected to said electrically actuated means and adapted to be closed by contact with molten metal withdrawn by said suction means.

11. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, suction means for drawing molten metal from said conduit and into said

receiving chamber, a discharge gate located in the bottom of said receiving chamber, electrically actuated means for simultaneously rendering said suction means inoperative and for opening said discharge gate, a normally open electric circuit gap connected to said electrically actuated means and adapted to be closed by contact with molten metal withdrawn by said suction means, and means for varying the volume capacity of said receiving chamber.

12. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, suction means for drawing molten metal from said conduit and into said receiving chamber, electrically actuated means controlling the operation of said suction means, spaced electric contact means connected to said electrically actuated means, said contact means being located at such high point in said conduit and adapted to be electrically bridged by molten metal drawn into said conduit, and means for varying the volume capacity of said receiving chamber.

13. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and of said receiving chamber, a vertical riser connected to said conduit at such high point, a pneumatic vacuum line connected to the upper end of said riser, an electrode depending into the interior of said riser and insulated and spaced therefrom, a solenoid actuated valve for rendering said vacuum line inoperative, an electric actuating circuit connecting the solenoid of said valve to said electrode and said conduit, whereby the bridging of the space between said electrode and said conduit by molten metal drawn into said conduit acts to close said circuit and operate said valve, and means for varying the volume capacity of said receiving chamber.

14. A molten metal feeding device, comprising a molten metal reservoir, a receiving chamber, a conduit leading from said reservoir to said receiving chamber, said conduit having a high point above the liquid levels of said reservoir and said receiving chamber, a discharge gate located in the bottom of said receiving chamber, a vertical riser connected to said conduit at such high point, a pneumatic vacuum line connected to the upper end of said riser and to the upper end of said receiving chamber, an electrode depending into the interior of said riser and spaced and insulated therefrom, a solenoid actuated valve for opening and closing said discharge gate, a second solenoid actuated valve for rendering said vacuum line inoperative, and an electrically actuated circuit connecting the solenoids of both of said valves to said electrode and to said conduit, whereby the bridging of the space between said electrode and said conduit by molten metal drawn into said conduit acts to close said circuit and to operate said valves, thereby simultaneously rendering said vacuum line inoperative and opening said discharge gate.

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