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F. G. CARRINGTON

1,776,541

CONTAINER FOR ROTARY CASTING APPARATUS

Filed March 3, 1927

FIG. 1.

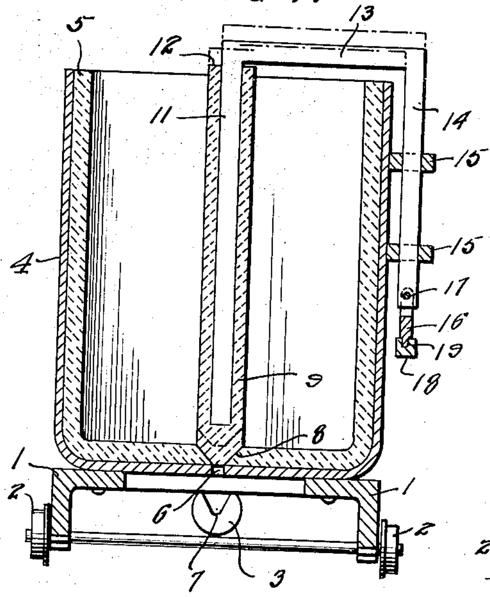


FIG. 2.

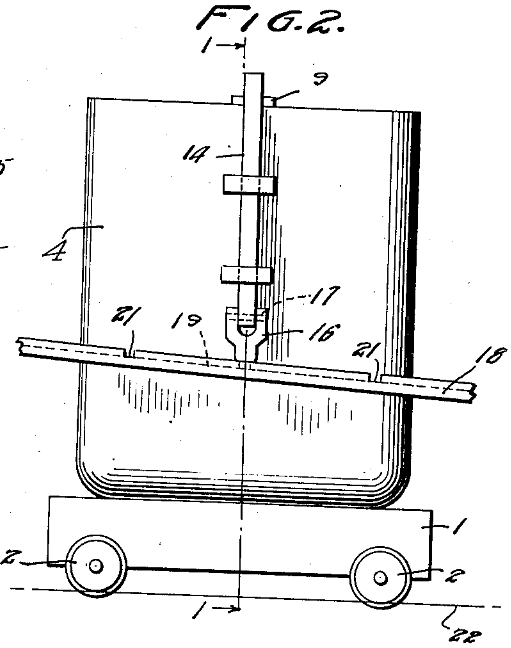


FIG. 3.

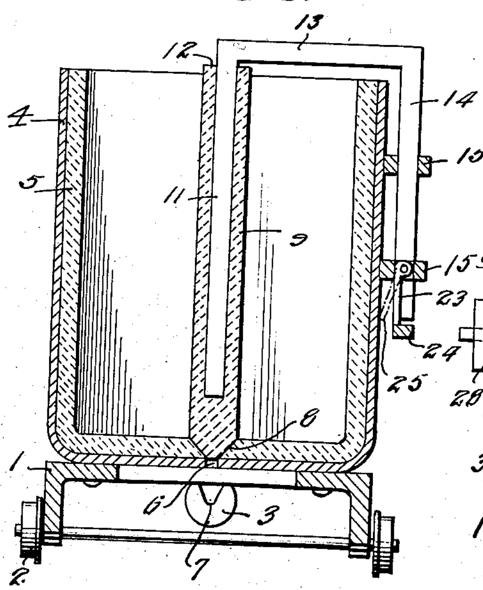
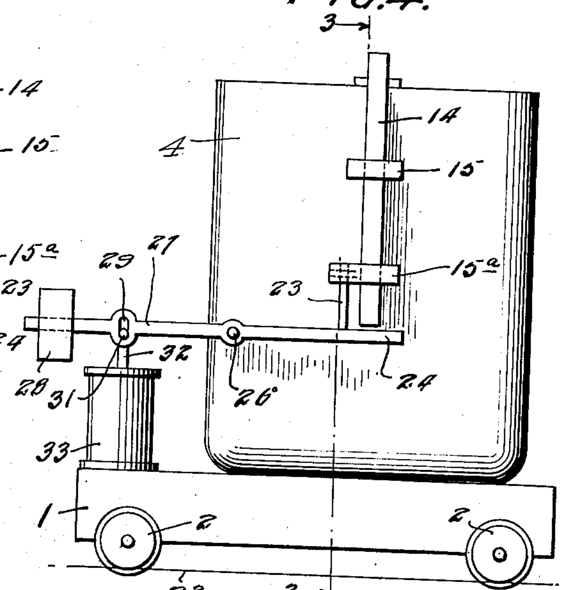


FIG. 4.



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UNITED STATES PATENT OFFICE

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CONTAINER FOR ROTARY CASTING APPARATUS

Application filed March 3, 1927. Serial No. 172,354.

This invention relates to an apparatus for casting and more particularly to apparatus for centrifugally casting metal pipes, comprising a ladle for discharging molten metal at a desired rate into a distributing agent.

Centrifugal or rotary casting involves the deposition of molten metal in a revolving mold and retaining the metal there until it has solidified. The mold is usually mounted upon trunnions and rotated at a desired rate of speed, the rotation, and attendant centrifugal force serving to maintain the molten metal upon the inner surfaces of the mold.

An essential, when using certain types of casting apparatus, is that the molten metal is distributed at a constant rate of flow and volume for the major portion of the operation. To accomplish this many precautions must be taken to insure that no element in the apparatus hinders, obstructs, or detains the flow of the metal. In this connection it is of course obvious that the desideratum, so far as a ladle is concerned, is a uniform rate of discharge of the molten metal, under the conditions above referred to, though it is to be understood that the ladle must be capable of varying the rate of discharge at certain points in the process or under varying conditions of operation.

Into the mold there extends a pouring or distributing trough, which conveys the metal from the reservoir or ladle to the desired point in the mold. This trough has a relative longitudinal movement with respect to the mold. Usually, though not always, the mold remains stationary while the trough is gradually moved with respect thereto, effecting the successive spiral depositions of the molten metal. In such a case the ladle which discharges the metal into the trough moves with the trough as the latter is withdrawn from the mold. The ladle may discharge the metal directly into the trough, or a chute may be employed as an intermediate agent.

Many types of ladle are used, all for the purpose of insuring a desired rate of discharge. The outlets may be positioned in various parts of the ladle, a very desirable arrangement, under certain conditions of operation, being one in which there is an outlet in the bottom or base.

The rate of dischrage is the result of various factors, among which are the size and shape of the outlet, the viscosity of the liquid and the pressure to which the liquid is subjected. In an ordinary apparatus the first three elements are substantially constant, the last alone varying. The variation in the pressure results from a decline in the head of the liquid as the latter is withdrawn from the ladle.

One of the results to be achieved, namely, a constant rate of discharge, is attained therefore by either maintaining constant the factors above mentioned, or varying some one, or more, to compensate for a variation in one, or more, of the other factors.

It may be generally said that the fluidity of the metal, which depends upon the temperature of the metal, has a negligible variance during a casting process. In fact it may be maintained constant by the use of a heating element, if desired, in or about the ladle.

There then remains the question of compensating for the decline in the hydrostatic head of the metal, or maintaining that head constant. If the latter is attempted, the same considerations which are present in discharging the metal from the ladle also govern the discharge of the metal from a reservoir into the ladle; namely the assurance that the rate of discharge remains the same. There is also a splashing when the metal poured from the reservoir strikes the metal in the ladle, which should be avoided.

An object of this invention is a method of ladling which insures a constant rate of discharge.

Another object of this invention is a method of compensating for a decline in the hydrostatic head of the liquid contents of a vessel.

A further object of this invention is to provide a ladle with means for varying the size of its outlet.

Yet another object of this invention is to provide a ladle with means for increasing the size of its outlet as the hydrostatic head of its contents decreases.

To accomplish the above and other important objects, as will more fully appear hereinafter, my invention comprises a container with an outlet and means for varying the outlet. As the metal is withdrawn the hydrostatic head is reduced, resulting in a decrease in the flow pressure. This in turn causes a reduction in the flow through the outlet, if the other factors remain constant. To prevent this, therefore, the size of the outlet is increased at a rate to offset the decrease of the head, insuring a constant discharge.

Reference is made to the accompanying drawings in which corresponding parts have similar numerals.

Figure 1 is a cross sectional view along the line 1—1 of Fig. 2, looking in the direction of the arrows;

Fig. 2 is a side elevational view showing one form of apparatus for regulating the size of the outlet;

Fig. 3 is a cross sectional view of a ladle along the line 3—3 of Fig. 4;

Fig. 4 is a side elevational view of the ladle showing an alternative apparatus for regulating the size of the outlet.

The form of ladle shown in the drawings is mounted upon a truck frame 1, having wheels 2, and capable of movement as a trough 3, diagrammatically indicated, is withdrawn from a mold (not shown). The truck moves with the trough as the latter is withdrawn from the mold. This movement may be effected either by providing synchronized means for moving the ladle with the trough, or the trough and ladle may be joined together. In the drawings there is depicted an apparatus having separate actuating means for the trough and ladle which are not shown.

The ladle is composed of a casing 4 lined with a suitable material 5 for withstanding the high temperatures of molten metal. In the bottom of this vessel there is provided an outlet 6 directly above the center of the channel 7 of the trough 3. This particular relative arrangement of the outlet and trough channel is important, for contact of the molten metal with any surface should be reduced to the lowest possible extent, in order to retain the internal heat of the molten metal. The upper portion of the outlet 6 has angularly disposed sides 8, the advantages of which will be later discussed.

Fitting into this outlet is a plug or stopper 9 of suitable material, having a rod or support member 11 extending longitudinally therein. It will be observed that the stopper 9 extends to 12, well above the top of the ladle walls, This serves to protect the support member 11 from the extreme heat of the molten metal.

The support member is bent forming a right angular member 13, and again bent to form a member 14, shown as of square cross section, downwardly extending and parallel to 11. While I shall refer to 11, 13 and 14 as a support member, and while I have shown 13 and 14 as being bent portions of 11, the support member may be composed of separate pieces suitably attached to form the arrangement set forth in the drawings.

The member 14 is slidably positioned in guides 15, suitably attached to the casing 4, permitting a vertical movement of the member 14 without allowing side play thereof or movement of rotation on its longitudinal axis. While I have shown guides for the rectangular member 14, other means may be employed to prevent any movement of the rod 14 except in a vertical plane.

All of the foregoing applies to both forms of ladles shown in the drawing. There are, however, various methods of operating the stopper 9 so that it is withdrawn at the proper rate.

In Fig. 2 I have shown one form of means for accomplishing this result. Pivotally attached to the lower end of 14 is a latch 16 secured by a bolt 17 or any other suitable member. When the latch 16 is dropped to form a continuation of 14, it rests upon a rod or rail 18 which, by conventional means not shown, is mounted stationary to a track 22 upon which the truck runs, or the immovable base of the complete casting apparatus. The latch is held in the desired position by conventional means. A key 19 on the latch fits into a corresponding keyway in the rod or rail 18, which serves to maintain the latch in operative position. Slots 21 are provided in the rail, affording means for disengaging the latch and rail at various points without raising the latch sufficiently to free the key from the keyway. It will be observed that the rod 18 is angularly disposed with respect to the track 22, and to the plane of movement of the ladle, and is held in that position by suitable supports, not shown.

As above stated, this invention is designed to withdraw the stopper 9 from its seat in the outlet 6 at a rate sufficient to permit the outflow of metal to compensate for the decline in the hydrostatic head of the metal. By forming the top of the outlet angularly, as at 8, and conforming the base of the stopper 9 to such shape, there can be effected a nicety of adjustment impossible if the bottom of the stopper 9 were rectangularly formed and the entire sides of the outlet were at right angles to the bottom of the vessel. The formation depicted also enables the molten metal to flow out of the vessel more nearly vertically and in a less angular course.

In operation the desired rate of flow is first ascertained and the required height of the stopper is determined, dependent upon the initial hydrostatic head. The size of the ladle should be such that the head of the contained liquid would not drop greatly during a single casting operation. Upon determination of the required height of the stopper, the latch 16 is freed from engagement with the rod or rail 18 and the ladle is moved to that point on the track where, when the latch 16 is forced to rest upon the rod 18, the stopper is raised to the proper point.

As the metal is discharged into the trough and thence into the mold, the ladle and trough are moved at a rate sufficient to deposit the metal poured from the trough into the mold in successive and adjacent spiral columns. In passing along the track provided, the support member 14 is forced by the slope of the rod or rail 18 upwardly, which in turn withdraws the stopper 9 from the outlet. The contour of the rail is of course adjusted so that the stopper 9 is withdrawn at a rate sufficient to compensate for the decrease in the hydrostatic head of the metal and thus insures a constant and uniform discharge of the metal into the trough. When the trough reaches the end of the mold, and it is desired to terminate the pouring operation, the latch 16 may be disengaged from the rail 18 and the weight of the stopper and support member will cause the stopper to fall and close the outlet.

As the rate of flow is theoretically the result of the square of the head, providing the viscosity of the liquid remains constant, it might be desirable to have the rail 18 curved instead of straight. Also, inasmuch as it might probably be necessary to vary the rate of flow, as for instance during the pouring of the bell of a pipe, the contour of the top of the rail 18 may be shaped accordingly. The size of the outlet depends upon the shape of the upper surface of the rail 18, and numerous variations may be made in the latter to secure any particular results desired.

In Figs. 3 and 4 there is illustrated another embodiment of my invention with different means for regulating the stopper 9. The lower guide member shown in Figs. 1 and 2 is replaced in the device depicted in Figs. 3 and 4 by the member 15ª, somewhat longer than the upper member 15. Pivotally mounted therein is the latch 23, when vertically disposed extending below the bottom of the member 14 and serving to maintain a lever arm 24 out of contactual engagement with the member 14. The latch may be released from contact with the arm 24, however, as indicated by the dotted line 25. At 26 a bolt or other suitable pivot passes through the lever and secures it to the side of the vessel 4. The other arm 27 of the lever has attached a counterweight 28 capable of longitudinal adjustment upon the arm 27 in order to vary its leverage effect. The particular method of adjustment is not shown, but any of the well known forms may be employed, such as by notching the upper surface of 27 and providing the weight 28 with engaging means. Into a slot 29 of the arm 27 there extends a pin 31 attached to an arm 32 of a dashpot 33.

In lieu of the dashpot there may be substituted any other timing element which would serve to lower the arm 29 at the desired rate. Such means might take the form of an escape movement, a motor driven device, or clock arrangement.

In Figs. 3 and 4, the means for regulating the stopper comprises the dashpot and lever mechanism. When the latch 23 is vertically disposed it counteracts the weight 28, but upon being released as shown by the dotted lines 25, the weight 28 forces the arm 27 down until the top of the slot 29 rests upon the pin 31.

The dashpot 33 is so regulated that the weighted arm 27 which rests upon the pin 31 is permitted to descend at only the desired rate. This, of course, means that the support member 14 and stopper 9 are raised at only a certain determined rate, depending upon the action of the dashpot 33. As in the case of the rail 18, adjustment of the dashpot 33 may be made in order to obtain any variations in the flow of metal desired. It may be adjusted to obtain a result corresponding to a curve in the rail 18, or it may be adjusted to withdraw the stopper at varying rates during the process to take care of additional amounts of metal desired at, for instance, the bell end of the pipe.

The importance of this invention will be appreciated when consideration is given to the necessity of obtaining a predetermined rate of distribution in the mold. Variation in the volume of distribution means not only a difference in thickness of the pipe, but means a difference in the texture of the casted object. The cooling of the molten metal in the mold is an intricate operation and depends, among other things, upon the thickness of the layer of metal deposited. Any change in rate of flow, therefore, would result in a variation in thickness and attendant variation in cooling. It is, of course, obvious that an irregular distribution would make for different degrees of strength and corresponding vulnerable points in the pipe.

The relative simplicity of this invention presents few opportunities for the apparatus to get out of order, and insures a consequent decrease in the length of repair time required, resulting in large savings of time, labor and money.

While I have shown and described the preferred embodiment of my invention, I wish it to be understood that I do not confine myself to the precise details of construction herein set forth, by way of illustration, as it is apparent that many changes and variations may be made therein, by those skilled in the art, without departing from the spirit of the invention, or exceeding the scope of the appended claims.

I claim:

1. A ladle for molten metal, said ladle being movable in a fixed direction, an outlet in the bottom of said ladle, a stopper movably positioned in the outlet, a rail positioned adjacent said track and inclined relative thereto and means connected with said stopper and cooperating with said rail for actuating the stopper.

2. A device for pouring metal in a mold comprising a trough, a ladle positioned above said trough and having an opening in the bottom thereof adapted to discharge metal into said trough, a stopper positioned in said opening, means carried by said ladle for actuating the stopper, said ladle being movable in a fixed direction and a rail positioned adjacent the path of movement of said ladle for operating said actuating means.

3. A molten metal ladle having an outlet in the base thereof, the size of said outlet being angularly disposed to the vertical, a stopper slidably positioned in the outlet and extending above the container support members for the stopper, and means coacting with said support members and adapted to be actuated by a cam-like rail positioned adjacent the ladle for withdrawing the stopper from the outlet at a rate compensatory for the decline in the head of the metal.

4. In a centrifugal casting apparatus, a ladle mounted on a movable trough and having an outlet positioned in its bottom, a stopper capable of being totally or partially withdrawn from the outlet, a support member for the stopper slidable in guides on the ladle, an inclined rail positioned adjacent said ladle and adapted to engage said support, said support being movable by the inclined rail upon movement of the ladle relative to the rail to vary the position of the stopper relative to the opening.

5. A movable casting ladle having a discharge opening formed in the bottom thereof, a closure for said opening, a rail positioned parallel to the path of movement of the ladle adjacent the ladle, a cam surface formed on said rail, a closure operating member carried by the ladle, said member being in engagement with the cam surface of said rail to vary the position of the closure relative to the opening as the ladle is moved.

6. A movable casting ladle having a discharge opening formed in the bottom, a closure for said opening, a rail positioned parallel to the path of movement of the ladle adjacent the ladle, a cam surface formed on said rail, a closure operating member carried by the ladle, said rail having a groove formed in the cam surface and extending longitudinally thereof, said rail also having a plurality of slots formed in the rail communicating with the groove, a latch carried by closure operating members adapted to enter said slots into said grooves so that the closure may be operated by relative movement between the rail and ladle.

7. A movable container for molten metal having an outlet in the bottom thereof, means for maintaining a determined rate of discharge comprising a stopper slidable in the outlet and having a portion extending above the top of the container, a support member associated with the stopper and mounted on said ladle, and stationary means engagable with the support member and adapted to coact with said support member to vary the opening of said outlet relative to the movement of said container.

8. A ladle for molten metal having an outlet in its bottom, a stopper positioned in the outlet, a support member for the stopper, a rail positioned adjacent to the ladle and in engagement with the support member, said ladle and rail being relatively movable, said rail being inclined to provide a cam surface, said support member being adapted to be actuated by the rail to withdraw the stopper from the outlet at a rate determined by the inclination of the rail.

9. In a centrifugal casting apparatus, a movable trough, a ladle movable with the trough and having an opening formed in the lower portion thereof through which metal is adapted to be discharged into said trough, means carried by the ladle and in engagement with a cam surface positioned parallel to the path of movement of the ladle to vary the size of the opening upon movement of the ladle to control the discharge of metal from the ladle.

In testimony whereof I affix my signature.

FRANK G. CARRINGTON.