Sept. 23, 1930. F. G. CARRINGTON 1,776,544

CASTING LADLE

Filed May 4, 1927 2 Sheets-Sheet 1

FIG. 1.

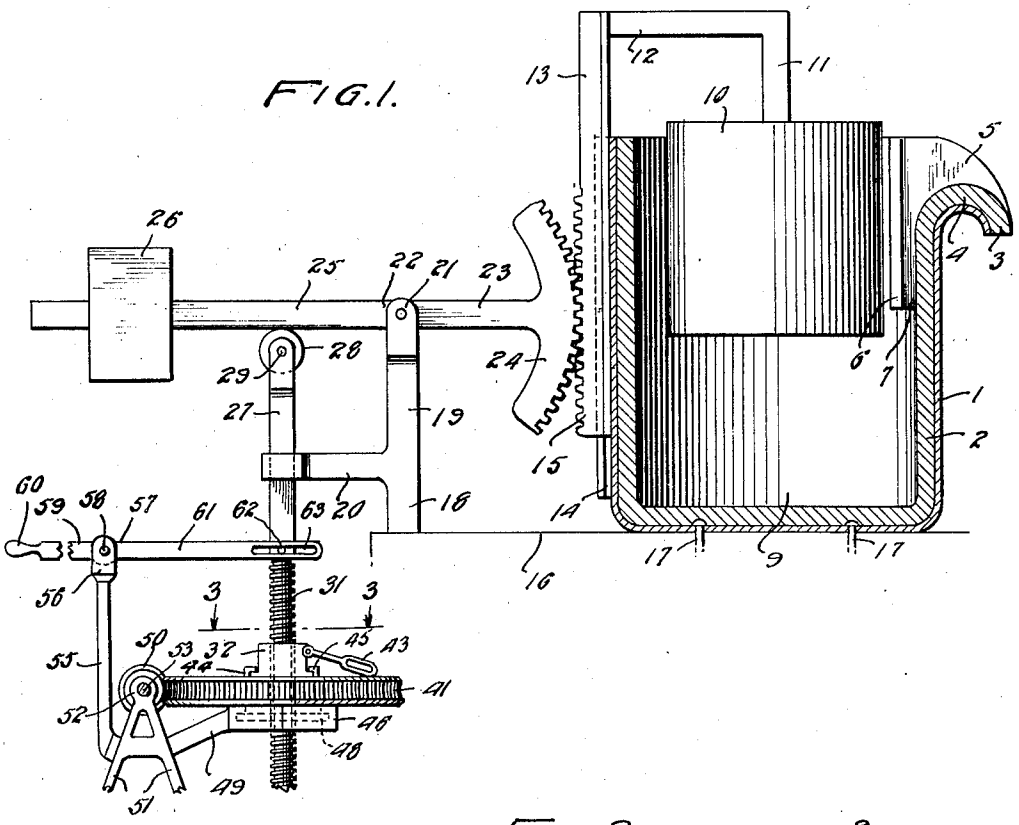
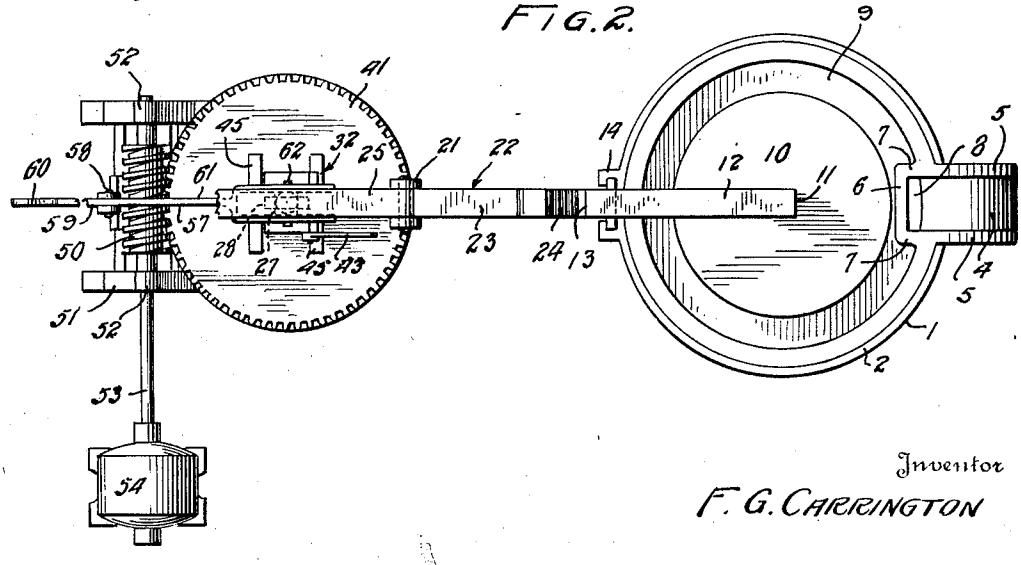


FIG. 2.



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Sept. 23, 1930. F. G. CARRINGTON 1,776,544

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Filed May 4, 1927 2 Sheets-Sheet 2

FIG. 3.

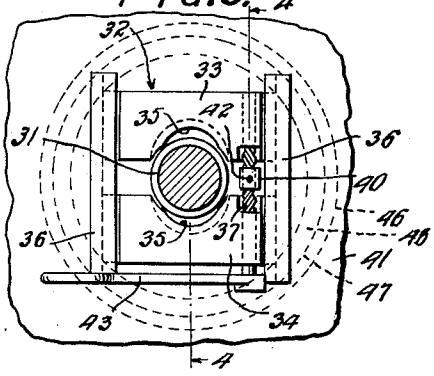


FIG. 4.

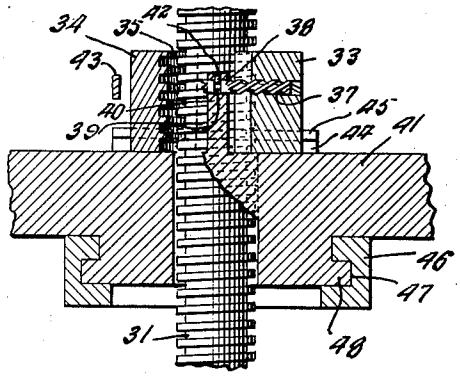


FIG. 5.

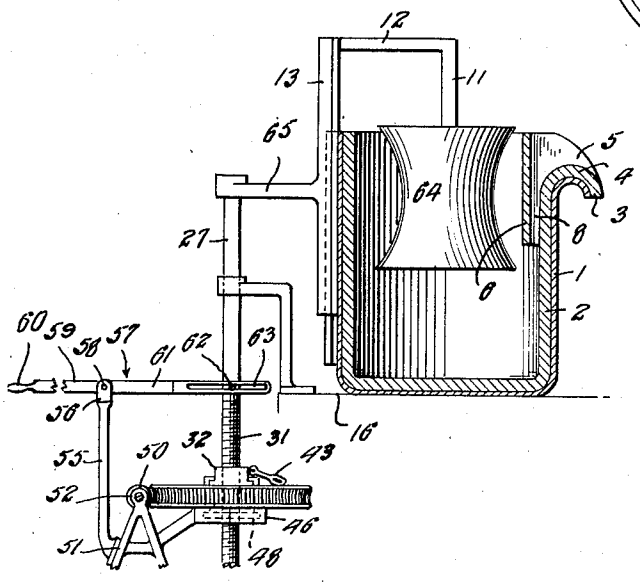


FIG. 6.

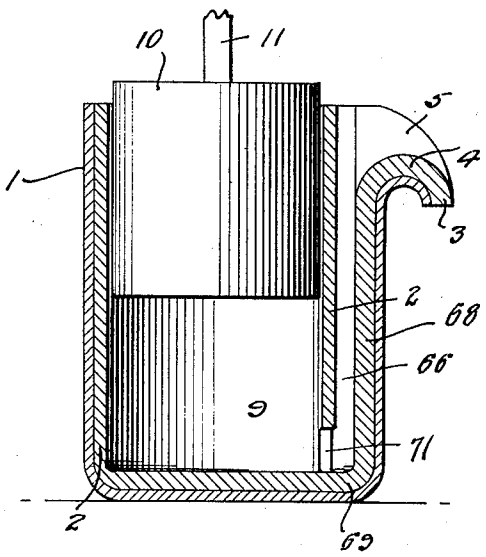
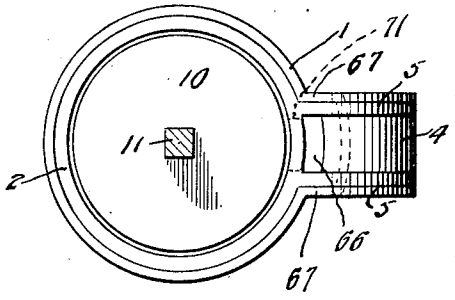


FIG. 7.



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1,776,544

UNITED STATES PATENT OFFICE

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CASTING LADLE

Application filed May 4, 1927. Serial No. 188,763.

This invention relates to a ladle and more particularly to a ladle for use in a rotary casting apparatus.

Annular objects may be cast by a rotary, or centrifugal, process. This process requires deposition of molten metal in a rotatable mold. Rotation of the mold generates centrifugal force which spreads, and maintains, the metal upon the inner surface of the mold.

Three general types of operation are followed. In the first type, in which the mold employed has a low heat conductivity, molten metal is poured just within one end of the mold. As there is a slow heat exchange between the metal and mold, the metal may be distributed by manipulation of the mold alone.

In the second type of operation, metal is poured over the side of a so-called dump trough substantially the length of the mold. The trough extends within the mold and is rotated to dump the metal. This mold may be so constructed that it absorbs too rapidly the heat of the poured metal to permit of any extended longitudinal adjustment after the metal is poured, and hence the necessity for this type of trough. Sufficient heat is retained by the metal, however, so that rotation of the mold does permit a circumferential adjustment of the metal.

In the third type of operation, which is preferable under most conditions, the heat of the poured metal is very rapidly absorbed, and practically no adjustment of the metal is possible. As each particle of metal must be deposited in substantially the same position in which it is found in the cast object, the metal is poured from the end of a trough over which the mold telescopes. As a result of the rotation of the mold and relative axial movement of the trough and mold, the metal builds up on the interior of the mold in successive and adjacent spiral columns. Each turn of the spiral column must be deposited before the preceding turn has solidified, in order that adjacent columns may coalesce and thus insure a casting of uniform thickness.

It is obvious, of course, that uniform thickness is desired throughout the barrel of the pipe and certain other determined portions, but that other portions of pipe, for instance the bell end, require a structure of greater thickness. One method of securing a pipe of uniform thickness is the deposition, at a constant rate, of metal in the mold. This may be accomplished by insuring that metal is uniformly poured from a ladle into the trough, which has been the manner heretofore used.

The thickness of the pipe is the function of the speed of rotation of the mold, the relative movement of the trough and mold, and the amount of metal discharged from the spout of the pouring trough.

A variation in any one of the three above enumerated factors may be compensated for by varying one or both of the other factors. In this invention I provide a ladle which discharges metal at a varying rate. In order to compensate for this variance, either the rotation of the mold, or the speed at which the mold and trough relatively move, may be varied accordingly.

When a ladle contains molten metal, slag and dross accumulate. In the absence of appropriate provisions, these undesirable substances will be discharged from the ladle with the molten metal, and their presence in the metal poured in the mold will render the casting defective. It is, of course, impossible to pass the molten metal through a sieve or strainer, and yet it is extremely desirable to prevent the discharge of the dross and slag with the molten metal. Heretofore no adequate means have been provided to accomplish this desirable result.

An object of this invention is to devise a method of ladling.

Another object is to devise a method of preventing the discharge of dross and slag from a ladle.

Yet another object is to provide a ladle.

A further object of this invention is to provide a ladle with means for discharging contents of the ladle.

A still further object is to provide a ladle with means for preventing the discharge of dross and slag from the ladle.

To accomplish the above and other important objects, as will more fully appear hereinafter, my invention comprises in general a ladle and means for discharging its contents, and yet preventing the discharge of dross and slag.

Referring to the accompanying drawings in which similar numerals indicate the same parts of the apparatus, but wishing it to be clearly understood that the scope of this invention is in no wise limited by the embodiments therein depicted:

Figure 1 is a side view of the complete apparatus, partly in section and partly in elevation;

Fig. 2 is a top plan view of the apparatus, a portion being cut away;

Fig. 3 is a top view of a locking device, along the line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a side view of the same device along the line 4—4 of Fig. 3, looking in the direction of the arrows;

Fig. 5 shows a modified form of a displacement body and operative means; the view shown being partly in section and partly in elevation;

Fig. 6 is a view partly in section of an apparatus with a modified means for preventing an efflux of dross and slag;

Fig. 7 is a top view of the apparatus shown in Fig. 6.

Referring more particularly to Figs. 1 and 2, there is shown a container 1 provided with a suitable lining 2 and discharge spout 3. The spout comprises a lip 4, shown as a curved continuation of the front wall and lining, and side members 5 to maintain the metal in the proper channel. These side members extend within the ladle, and there is suspended from the sides of the spout a baffle composed of a body portion 6 and angular side portions 7 joined to the interior of the front wall, all forming a channel 8 for the emission of the metal. The material is poured into the main body portion of the ladle 9. As the metal rises in the body portion there is a corresponding increase in the height of the metal in the channel 8 and the height of the liquid in the channel, therefore, may be regulated by varying the level of the metal in the body portion. All of the metal poured from the ladle must pass through the channel and over the lip 4 of the discharge spout. As dross and slag float on the metal, and as the efflux of metal from the body portion must pass under the baffle and through the channel, any dross or slag that collects in the body portion is retained there. This prevents the discharge of any impurities in the poured molten metal and insures that the casting will be free from alien matter.

A displacement body 10, shown in Fig. 1 as of uniform cross section, is supported by arms 11, 12 and 13. While I have shown these arms as being integral with each other, it is of course understood that they may be separate and properly joined. The arm 13 fits within a flanged guideway 14 on the exterior wall of the container. This guideway restricts movement of the arm to a vertical plane. The lower portion of this arm 13 is provided with a rack 15.

It will be noted that vertical movement of the racked arm 13 causes a vertical movement of the displacement body 10. As the displacement body is lowered in the contents of the ladle, the height of the liquid in the main portion of the ladle is increased. As above stated, this results in an increase in the height of the liquid in the channel 8, and when the height of the metal in this channel extends above the lip of the discharge spout 3, metal flows from the container into a pouring trough, not shown.

The ladle is mounted upon a base 16, and is affixed thereto by bolts 17, or other suitable fastening means. There is also mounted upon the base a support member 18 having two arms 19 and 20. The arm 19 of this support member serves as a pivot 21 for a lever 22. On one arm 23 of the lever 22 there is a segment 24 which meshes with the rack 15 of the arm 13. On the other arm 25 of the lever 22 there is a weight 26, which may be moved longitudinally of the arm to give the desired leverage, and is adapted to be held in a desired fixed position by any suitable means, not shown. Upward movement of the weighted arm 25 results, by means of the segment 24, rack 15 and supporting arms 11, 12 and 13, in a lowering of the displacement body 10. Movement of the lever, therefore, varies the height of liquid in the ladle and discharge from the spout 3.

The other arm 20 of the support member 18 serves as a guide for a vertical rod 27. This rod may be of rectangular cross section, or may be annular with means coacting with the support arm 20 to prevent its rotation, or any movement except in the vertical plane. At the upper end of the rod 27 there is mounted a roller 28 which rotates upon an axle 29 suitably supported in the member. This rod is adapted to slide vertically in the support arm 20. The weight 26, and its position on the work arm 25, is sufficient to offset the combined weight of the displacement body and its supports. The work arm 25, therefore, always rests upon the roller 28, and vertical movement of the rod 27 results in a clockwise rotation of the lever arm 25, which in turn is transmitted to the displacement body 10.

It is to be observed, however, that the weighted arm 25 in being raised or lowered describes an arc, and causes a variation of the angle between the work arm 25 and the rod

27. Above the horizontal this angle decreases, and there is a constantly decreasing speed of rotation of the lever about the pivot 21. The rate of immersion of the displacement body 10, therefore, constantly decreases. Below the horizontal the reverse is true. In other words, as the rod 27 is raised, movement of the lever arm 25 about its pivot 21 increases until the horizontal position is reached.

Assuming that the operation is begun with the plane of the lever arm below the horizontal, and assuming that the rate at which the rod 27 is raised remains constant, there is an increase in the rate of immersion of the displacement body 10 until the horizontal is reached, and above the horizontal there is a constant decrease in the rate of immersion.

The lower portion of the upright rod is provided with screw-threads 31. These screw-threads take in a lock nut 32 and, as rotation of the rod is prevented by the support arm 21, rotation of the lock nut effects an upward movement of the rod.

Referring more particularly to Figs. 3 and 4, the lock nut comprises two movable members 33 and 34 with recesses 35 which are threaded to correspond to the threads of the upright rod 27. The movable members are capable of horizontal movement and slide in guideways 36 provided for maintaining them in the proper path. One side of each of the movable members 33 and 34 is provided with an aperture which is threaded and adapted to receive a screw 37. This screw is provided with a smooth journal 38 having an annular groove 39. The journal is mounted in a bearing member 40, which is fixed to a ring gear 41. A set screw 42, or other suitable key, is inserted in the bearing member 40 and fits the groove 39, preventing axial movement of the screw 37, but permitting its rotation. A lever arm 43 is fixedly mounted on one end of the screw 37 and is capable of revolving the screw. The threads on the screw and lock nut are of a pitch sufficient to totally disengage the members when desired. Movement of this lever 43, therefore, separates or draws together the movable members 33 and 34 positioned in the guideways. When the lever is in the position shown in Figs. 1 and 2, the movable members are enthreaded with the rod 27.

By opening the movable members and disengaging them from the threads of the rod 27, the latter may be moved in a vertical plane free from any impediment. This is desirable, for at the commencement of a ladling operation it is necessary to immerse the displacement body at a rapid rate, and to a determined distance in the ladle, and then permit its subsequent immersion to be governed entirely by the mechanical movement of the rod 27.

The guideways shown in the drawings comprise two angle bars, the upright portions 44 of which confine movement of the members 33 and 34 of the lock nut to a single horizontal direction, and the overlapping portions 45 preventing vertical movement of the lock nut.

The guides are mounted upon the ring gear 41 which meshes with a worm 50. The ring gear is journaled in a bearing support member 46, which may be of the split type, positioned below it, which is provided with a channel 47 into which a corresponding lip 48 on the ring gear fits. This arrangement prevents any vertical motion of the ring gear but allows its rotation. The support member is held by an arm 49 which extends to support members 51 for a worm gear bearing 52. The worm 50 is mounted in appropriate bearings 52, and is driven by a shaft 53. An electric motor 54, or other appropriate driving means, rotates the shaft at a constant rate, though it is within the contemplation of my invention that the rate of rotation of the shaft 53 may be varied.

Mounted on the support members 51 is another support member 55 for a pivot seat 56. A lever 57 is rotatably fastened by a bolt 58, or other suitable means, to the pivot seat. The work arm 59 of this lever is provided with a handle 60, and the other arm 61 is attached to the rod 27 by means of the bolt 62 on the rod 27 and the slot 63 in the arm 61. This lever is employed to raise the rod 27 when the latter is not engaging the lock nut, in order to effect the desired rapid immersion of the body in the ladle.

When the ring gear 41 is rotated, and consequently the lock nut 32, mounted as it is on the gear so that movement of one effects a movement of the other, the rod 27 is raised, which causes the immersion of the displacement body. The apertures in the ring gear and support member 46 through which the rod 27 passes are not threaded, so that the rod may be raised or lowered without any obstruction being offered thereto provided the lock nut is open.

The various gearing and threads are so related that the desired rate at which the upright rod moves may be obtained. Variations in this of course may be made for any particular operation in order to obtain the desired rate of immersion of the displacement body.

In the operation of the apparatus shown in Figs. 1 to 4 inclusive, molten metal is poured in the body portion of the ladle until the desired height of the metal is obtained. This height is of course below the overflow lip of the ladle. The lever 43 for the lock nut is then thrown to the position shown in Fig. 3. The work arm 59 of the lever is lowered rapidly, so that the displacement body is suddenly immersed in the liquid. This raises the height of the liquid to the desired distance and overflow commences from the

discharge lip 3. The lock nut lever is then thrown to the position shown in Figs. 1 and 2. This closes the lock nut upon the threaded portion of the rod 27 and holds it securely there. The motor 54 is then started, and the rotation of the worm 50 turns the ring gear 41 and also the lock nut. The rod, incapable of rotation because of its mounting in the support arm, is therefore raised. This results in the segments being rotated clockwise, and lowers the support 13 accordingly. The displacement body is then immersed at the desired rate, depending upon the movement of the segment. As above pointed out the movement of the segment increases to the time when the lever is in a horizontal position and from thence on decreases.

In Fig. 5 there is shown a displacement body which is of nonuniform cross section, having concave sides 64. This displacement body is adapted to be used where the rate of its immersion is constant. As the displacement body is lowered in the liquid, the amount of displacement does not increase constantly, and as a result the discharge from the ladle varies. The same support members 11, 12 and 13 are employed with such a displacement body, but instead of rod 27 actuating the member 13 by means of rack 15 and segment, there is provided in this arrangement an arm 65 fixedly joining the rod 27 and the member 13. By transferring in this direct way the movement of rod 27 to the member 13, the latter moves at the same rate as the rod 27. The operation of a ladle having a displacement body of non-uniform cross section is the same as that followed in the case of the apparatus depicted in Figs. 1 to 4, the operation of which has been above described.

A modified form of ladle is illustrated in Figs. 6 and 7, which effectively skims the molten metal before discharge. A vertical chamber 66 is provided, extending to the base of the ladle, and is formed by bent portions 67 of the wall 1, a front wall 68, and a bottom 69. It is, of course, understood that the side walls 67 need not necessarily be continuations of the wall 1. In such event, they are properly joined to the wall 1. The lining 2 of the container forms the inner wall of the chamber 66. All of the walls of the chamber 66 are suitably lined. In the base of the lining 2, between the sides 67, there is an aperture 71 serving as a channel for the metal from the chamber 9 to the chamber 66. A discharge lip 3 is provided, as in the case of the other ladle.

Metal is deposited in the chamber 9 of the ladle in which the displacement body moves. As the height of the liquid in the chamber increases, the liquid in the discharge channel 66 is raised. When the ladle operation is commenced, the main displacement body is immersed in the liquid, raising the head of the liquid to the desired point at which overflow of the metal commences at the lip 3. All of the metal discharged, however, must pass through the opening at the bottom of the baffle, and as the dross and slag remain at the top of the metal, only pure metal passes through the opening.

It is of course obvious that many modifications may be made in the apparatus set forth in the drawings and described herein. One of the desirable results attained by this device is a mechanically actuated discharge of metal from a ladle. This rate may be altered at will. Various forms of displacement bodies may be employed to attain any desired variation in the rate of discharge, and, in conjunction with the movement of the trough, depositions of various thicknesses may be effected. This is often desirable for it is frequently necessary to deposit more metal at one point along the length of a mold than at others.

While I have shown and described my invention with particular reference to a casting apparatus, it is of course obvious that it may be employed with materials other than molten metal, such as concrete, plastics, or, in fact, any liquid.

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 casting ladle comprising a container, a displacement body, means for normally lowering the displacement body at a varying rate, and means for raising the body at any desired rate.

2. A casting ladle comprising a container, a displacement body, a rack attached to the displacement body, and coacting with the rack a segment and associated mechanism for lowering the displacement body at a varying rate.

3. In a ladle of the displacement type, a rack for raising and lowering the displacement body, and a segment meshing with the rack and pivotally mounted, and means for swinging the segment about its pivot at a varying rate.

4. A casting ladle comprising a container, a displacement body, a rack for raising and lowering the displacement body, a segment meshing with the rack and mounted upon a pivoted lever, and a rod supporting one end of the lever and adapted to be raised at a constant rate.

5. A casting ladle comprising a container, means for skimming the discharge contents of the ladle, a displacement body, a rack for

raising and lowering the displacement body, a segment meshing with the rack and mounted upon a pivoted lever, the opposite arm of the lever being weighted, and means adapted to be raised at a constant rate upon which the weighted arm of the lever is supported.

6. A casting ladle comprising a container, a displacement body, means for immersing the displacement body in the ladle and means to normally actuate the immersing means at a variant rate.

7. A casting ladle comprising a container, displacement body of uniform cross section, a source of power, means for lowering the displacement body and means to transmit power from the power source to the lowering means at a varying rate.

8. A casting ladle comprising a displacement body of uniform cross section, means for immersing the displacement body in the ladle, a source of power, and means including gears to transmit power from the power source to lowering means at a variant rate.

In testimony whereof I affix my signature.

FRANK G. CARRINGTON.