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[54] **CONTROL DEVICE FOR STOPPER OF A CASTING CONTAINER**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **222/70,** 222/504, 222/559, 251/285

[51] **Int. Cl.** **B22d 37/00**

[58] **Field of Search** ..... 222/559, DIG. 3, 222/DIG. 5, DIG. 15, 70, 504; 251/144, 232, 234, 285; 74/110, 99, 96, 469

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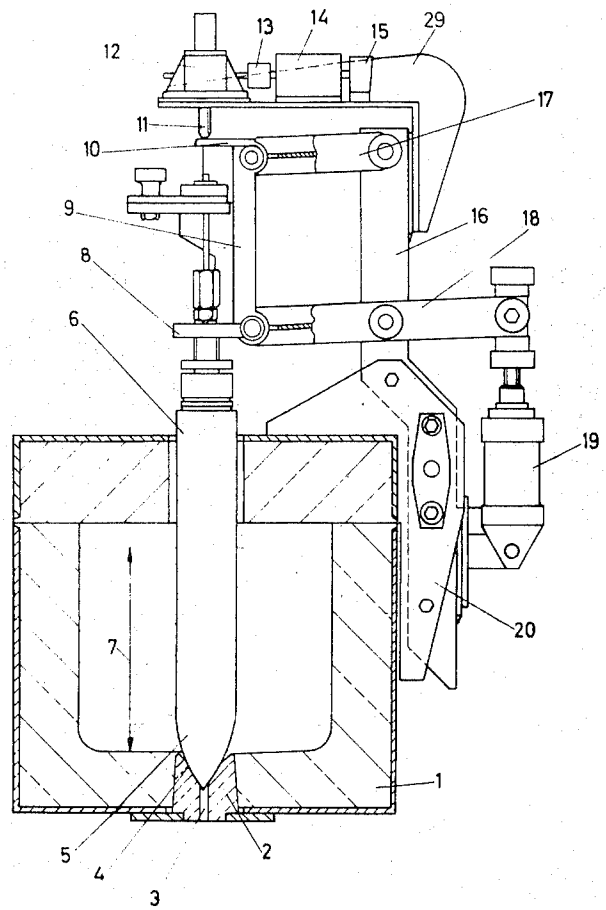
[57] **ABSTRACT**

Disclosed is a stopper container including a stopper rod which is coupled with a lifting and lowering mechanism. The vertical displacement of the mechanism is controlled by an adjustable limit stop the vertical position of which is adjusted for a predetermined time period by a programmed control device, defining the desired amount of the poured-out liquid metal.

8 Claims, 4 Drawing Figures



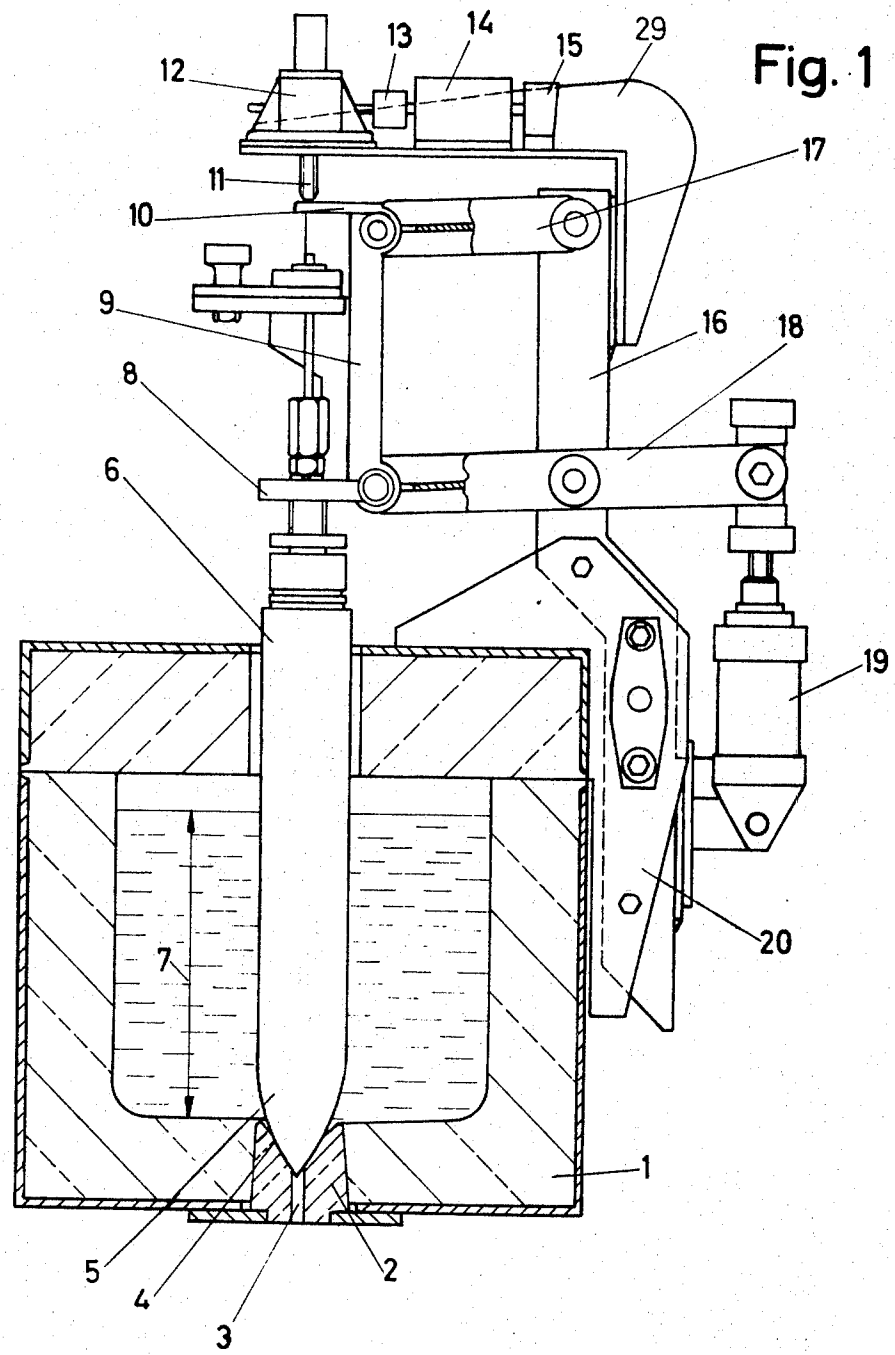


Fig. 1

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Fig. 2

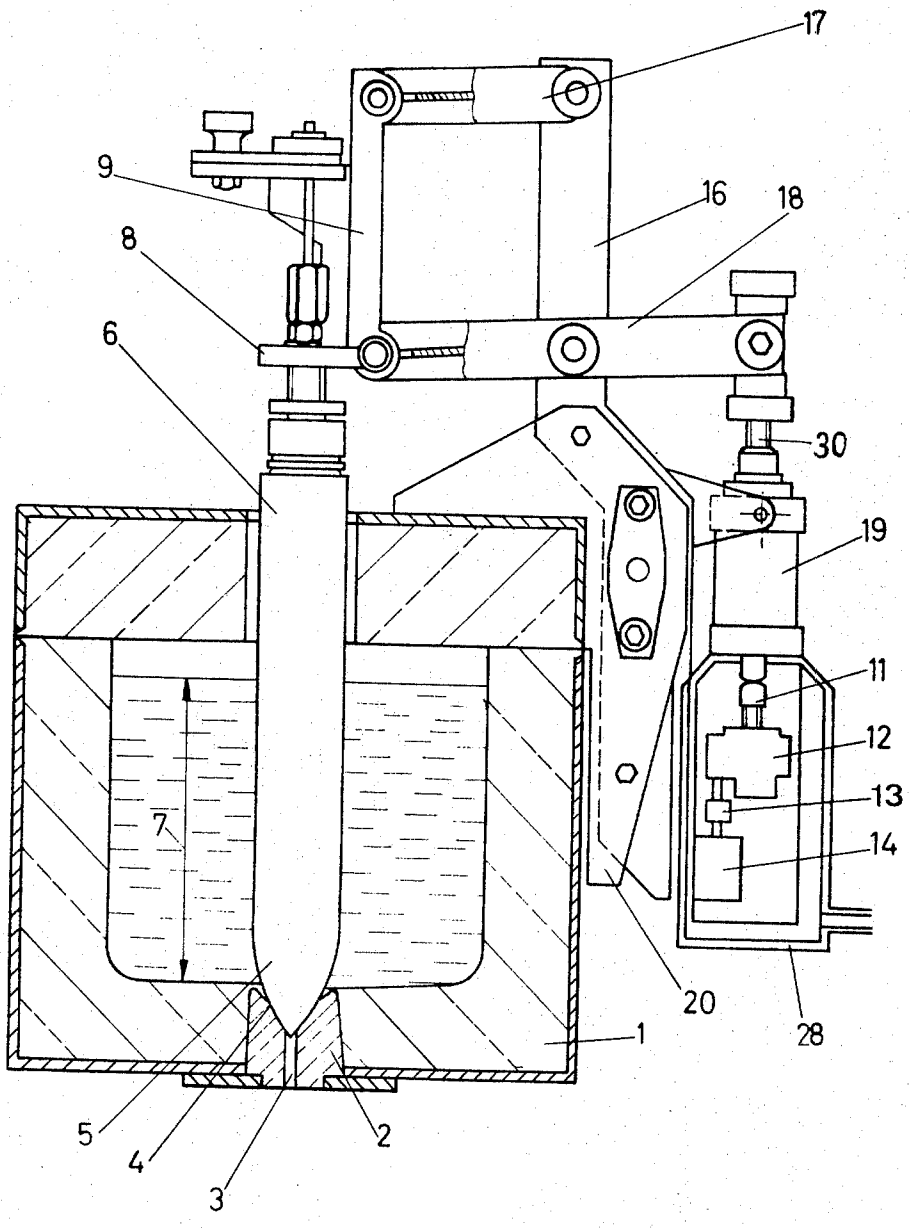

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Fig. 3

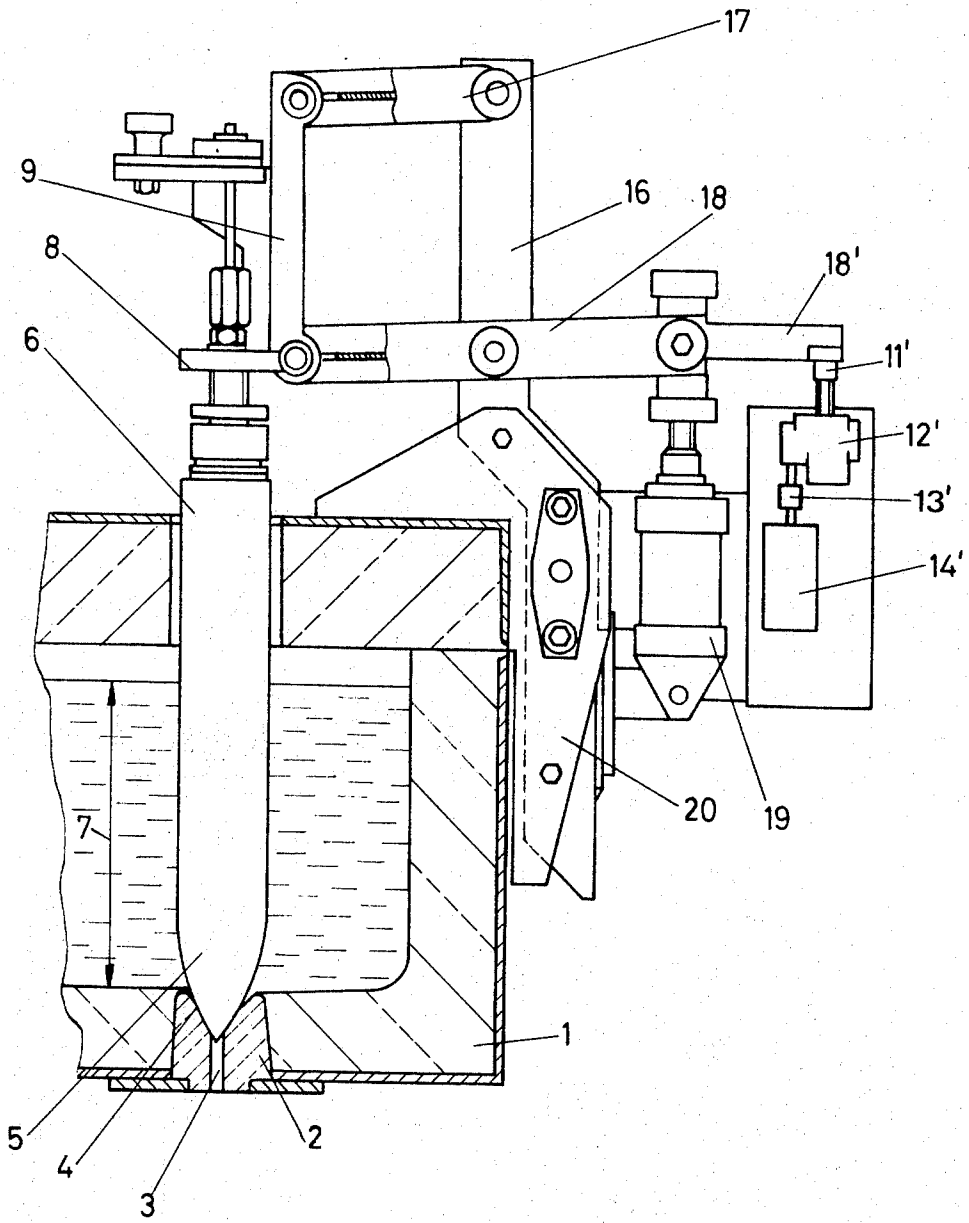

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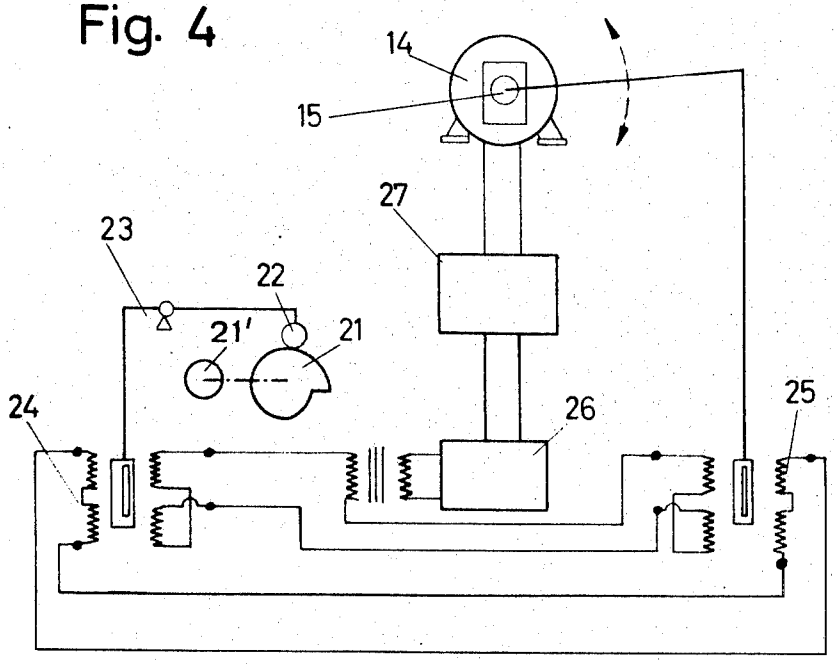
Fig. 4



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CONTROL DEVICE FOR STOPPER OF A CASTING CONTAINER

BACKGROUND OF THE INVENTION

This invention relates generally to casting control devices for casting in measured quantities and, more specifically, to a device for controlling a stopper of a casting container having a stopper lock which determines the quantity of liquid metal to be discharged.

Stopper control means at casting containers have the purpose that liquid metal which is discharged through a nozzle cooperating with a stopper lock can be fed into a mold in accurately measured quantities.

In prior art there are known devices in which a tiltable ladle is provided with a controlling tilting apparatus. The inclined position of the ladle is thereby adjusted in such a manner that during the tilting action the liquid metal is allowed to be discharged from a pouring lip in a quantity determined as a function of time.

The disadvantages of such prior art casting ladles are particularly in that the slag which is present on the surface of liquid metal becomes mixed up with the latter during the tilting unless special preventative measures are employed. In addition, in tiltable ladles or casting containers it is very difficult to control the direction of the casting stream to be poured into the mold.

It is, therefore, an object of this invention to remove the disadvantages of prior art casting devices.

More particularly, an object of this invention is to provide a control device for a casting container, which enables casting in accurately measured quantities without mixing slag with molten metal.

Another object of this invention is to provide a control arrangement which makes it possible to maintain the desired direction of the poured-out liquid metal charge.

SUMMARY OF THE INVENTION

According to this invention, the above objects are attained so that the stopper rod is operatively coupled with a lifting and lowering mechanism, and provided with a stop piece facing an adjustable limit stop. The vertical position of the limit stop is controlled by a programmed control device for such a time period as it is desired for the predetermined quantity of the poured-out liquid metal.

BRIEF DESCRIPTION OF THE DRAWING

The invention may be best understood by reference to the following detailed description of several exemplary embodiments thereof, taken in connection with the accompanying drawing in which:

FIG. 1 is an elevational view, partly in section, of one embodiment of this invention;

FIG. 2 is an elevational view, partly in section, of a modification of the embodiment of FIG. 1;

FIG. 3 is an elevational cut-away view of still another modification of the embodiment of FIG. 1; and

FIG. 4 is a schematical diagram of an example of a programmed control device for the stopper means as shown in FIGS. 1 to 3.

DETAILED DESCRIPTION

With reference to FIG. 1, there is illustrated a casting container 1 having a nozzle body 2 located at its bottom. The upper part of the nozzle body 2 is provided

with a downwardly tapering sealing seat 4 communicating with a casting nozzle 3. A conically shaped bottom end portion or nose 5 of a stopper rod 6 cooperates with the sealing seat 4 of the nozzle body 2 and thereby forms a controllable stopper lock. The top end portion of the stopper rod 6 is suspended in a guiding projection 8 which is fixedly connected to a guiding plate 9 of a lifting and lowering mechanism. This mechanism consists of levers 18 and 17 pivotally supported on a column 16 and jointed to the guiding plate 9 in the form of a conventional parallelogram guide. The lever 18 is a two-arm lever whose free arm is jointed to a piston of a lifting cylinder 19 which is fixedly connected to the column 16. A support 20 is integral with a wall of the casting container 1 and supports both a shaft of the angularly adjustable column 16 and trunnions of the lifting cylinder 19. According to one embodiment of this invention (FIG. 1) the top of the guiding plate 9 is provided with a projecting stop piece 10 the top surface of which faces a vertically adjustable limit stop 11. The limit stop 11 is fixedly mounted on a stationary bracket 29 and through a step-down gear 12 and a coupling 13 it is connected both to the rotor of a stepping servo-motor 14 and to a remote position indicator 15 which signals the vertical position of the limit stop 11. The servo-motor 14 is controlled in response to the signals of the position indicator 15 by means of a programmed control device which will be described in detail with reference to FIG. 4.

A modification of the arrangement of FIG. 1 is shown in FIG. 2. The control device includes similar parts 11, 12, 13, 14 and 15 as explained with reference to FIG. 1, but instead of employing a stop piece on the guiding plate, the piston of the lifting cylinder 19 is provided with a pass-through piston rod 30 whose bottom end cooperates with the adjustable limit stop 11 in the same manner as the stop piece 10 in FIG. 1. To protect the control device against the thermal radiation emanating from the casting container 1, a housing 28 shields the entire control arrangement.

Still another embodiment of the control device of this invention is shown in FIG. 3. The free arm of the two-arm lever 18 is provided with an extension 18'; an adjustable limit stop 11' with associated parts 12', 13' and 14' (corresponding to the aforementioned parts 11, 12, 13 and 14) are secured in an operative proximity below the extension 18, which functions similarly as the stop piece 10 in FIG. 1.

FIG. 4 illustrates an example of the programmed control device for adjusting the desired position of the adjustable limit stop 11 for a predetermined period of time. The function of the shown electrical control circuit is based on the so-called zero balance. A rotatable programming cam 21 whose profile determines in response to the angle of rotation the referende input for the adjustment of the limit stop 11, is angularly displaced according to a predetermined time plan by means of a servo-motor 21, for example. A cam follower 22 follows the periphery of the cam 21 and displaces via a lever 23 according to the resulting command variable, an originator of signals 24 such as, for instance, an inductive sender or a rotor or a servo-motor (selsyn). The generated signal is amplified in an amplifier 26 and fed into a converter 27 where it is converted into a proportional amount of drive pulses which drive a stepping motor 14 in one direction until the position indicator 15, associated with the limit stop 11,

displaces a counterbalancing signal originator 25 to a balance position. The signal generated by the signal originator 25 is connected to the signal originator 24 for counteracting the output signal of the latter.

In this manner, the control cam 21 determines the program for controlling the vertical position of the limit stop 11 and, consequently, the vertical displacement of the stopper rod 6. As soon as the stopper rod actuating means abut against the adjusted limit stop 11, the exit or discharging area of the nozzle body 2 is accurately determined; by the exit area is meant the annular gap resulting between the stopper nose 5 and the casting nozzle 3.

It is, of coures, possible to replace the above described electromechanical control device with a control arrangement operating on a different principle, for example, it is possible to apply hydraulical, pneumatical, purely mechanical or electrical control elements or combinations thereof for performing the control function as described with reference to FIG. 4.

The mode of operation of the device of this invention is as follows:

Molten metal is first fed through an inlet opening (not illustrated) into the casting container 1. The stopper lock 4 between the stopper rod 6 and the casting nozzle 3 is held in a locked position until the liquid metal reaches a level 7. Subsequently, a pressure medium, such as pressure air or pressure oil is applied to the lifting cylinder 19 and the piston of the latter acts via the parallelogram guide means 16, 17, 18 and the guiding projection 8 upon the stopper rod 6. The upward movement of the stopper rod 6 continues until the stop piece 10 abuts against the adjustable limit stop 11. In this elevated position of the stopper rod 6, the limit stop 11 is moved in or against the direction of the lifting force and in this manner it regulates the opening of the stopper lock 4 according to the predetermined program in the controlling device. The control cam 21 is set into rotary motion simultaneously with the start of the casting process and causes that the stopper rod 6 is vertically displaced up and down in accordance with the movement of the adjustable limit stop 11.

The profile of the control cam 21 as well as the rate of rotation of the latter can be optionally selected. Since the dimension of the casting container 1 is known and the discharge rate of the liquid metal can be determined by experiments or by technological calculations (as a function of the height of the level 7 and of the exit area which, at a constant diameter of the casting nozzle 3, is dependent on the lift of the stopper nose 5), there is no difficulty in proposing such a form of the control cam 21 which optimally fulfills all practical requirements for controlling a casting process. In this way it is possible to regulate a constant discharge irrespective of the instant height of the metal level in the container, or an increased discharge at the start of the casting process with subsequent throttling thereof, or even an interruption of the discharging action with subsequent reopening of the nozzle, or a discharge between two limits.

Instead of a rotating control cam 21, the reference input signal transmitter can be made in different ways; for instance, a slidable profiled cam can also be employed.

The advantages attained by means of this invention reside particularly in the fact tha accurately measured quantities of the discharged liquid metal and an accurately directed casting stream can be insured. It is also possible to pour out per a time unit from the container 1 practically a constant amount of the liquid metal irrespective of the decreasing level of the metal.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described, for obvious modifications will occur to a person skilled in the art.

Having thus described the invention, what I claim as new and desire to be secured by Letters Patent, is as follows:

1. A device for controlling the discharge of molten metal from a casting container including stopper means and a discharge nozzle means comprising in combination a stopper actuating device including a fluid cylinder and operable for lifting and lowering said stopper means against said discharge nozzle means, adjustable limit stop means arranged for limiting the lifting of said stopper means, and a programmed control device coupled to said adjustable limit stop means for adjusting the vertical position of said limit stop means in an automatic sequence whereby a predetermined sequence of flow rates for the discharge of said molten metal is obtained.

2. A device according to claim 1 wherein said adjustable limit stop means includes a vertically movable limit stop, a reduction gear coupled to said limit stop, a driving motor coupled to said reduction gear, and a position indicator for said adjustable limit stop.

3. A device according to claim 2 wherein said adjustable limit stop means is fixedly mounted above a movable part of said stopper actuating device.

4. A device according to claim 2 wherein said adjustable limit stop means is fixedly arranged laterally to said casting container and below a movable part of said stopper actuating device.

5. A device according to claim 2 wherein said stopper actuating device includes a projecting member and said limit stop being arranged in operative proximity to said projecting member.

6. A device for controlling the discharge of molten metal from a casting container including stopper means and a dischage nozzle means comprising in combination a stopper actuating device operable for lifting and lowering said stopper means against said discharge nozzle means, adjustable limit stop means arranged for limiting the lifting of said stopper means, and a programmed control device coupled to said adjustable limit stop means for adjusting the vertical position of said limit stop means, said adjustable limit stop means comprising a vertically movable limit stop, a reduction gear coupled to said limit stop, a driving motor coupled to said reduction gear, and a position indicator for said adjustable limit stop, said stopper actuating device comprising a lifting cylinder, having a piston with a piston rod passing therethrough and projecting at both ends of said lifting cylinder, and said adjustable limit stop means being arranged in operative proximity to said piston rod at the lower end of said lifting cylinder.

7. A device for controlling the discharge of molten metal from a casting container including stopper means and a discharge nozzle means comprising in combination a stopper actuating device operable for lifting and lowering said stopper means against said discharge nozzle means, adjustable limit stop means arranged for limiting the lifting of said stopper means, and a programmed control device coupled to said adjustable

limit stop means for adjusting the vertical position of said limit stop means, said programmed control device comprising a profiled cam means, a first signal originator operable by said cam means to generate a command drive signal for said drive motor, and a second signal originator operable by said position indicator to generate an opposite drive signal counteracting said command drive signal on a servo-balance principle.

8. A device for controlling the discharge of molten metal from a casting container including stopper means and a discharge nozzle means comprising in combination a stopper actuating device including a fluid cylinder and operable for lifting and lowering said stopper means against said discharge nozzle means, adjustable limit stop means arranged for limiting the lifting of said stopper means, and a programmed control device coupled to said adjustable limit stop means for adjusting the vertical position of said limit stop means in an automatic sequence whereby a predetermined sequence of flow rates for the discharge of said molten metal is obtained from a constant high flow rate to a constant low flow rate.

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