June 15, 1965 A. J. SUKAVA 3,188,704

AUTOMATIC MOLD CASTING MACHINE CONTROL APPARATUS

Filed Sept. 11, 1961 2 Sheets-Sheet 1

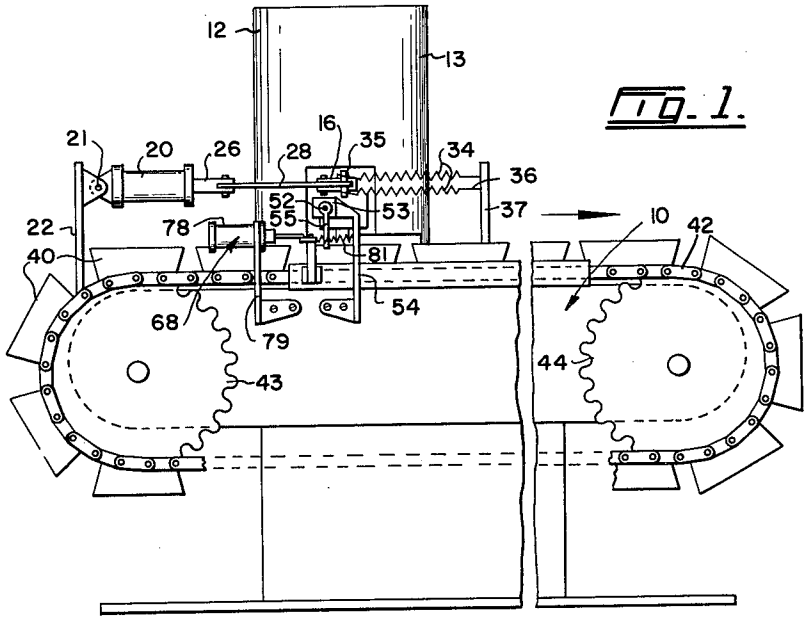


FIG. 1.

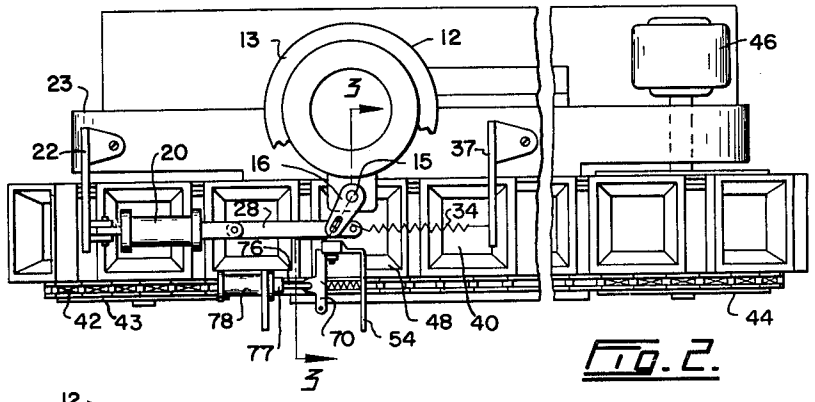


FIG. 2.

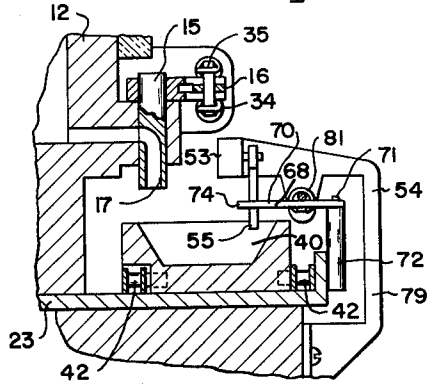


FIG. 3.

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AUTOMATIC MOLD CASTING MACHINE CONTROL APPARATUS

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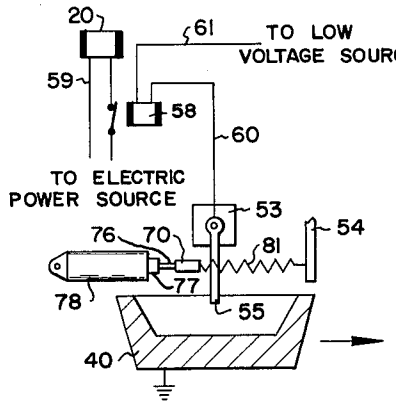


Fig. 4.

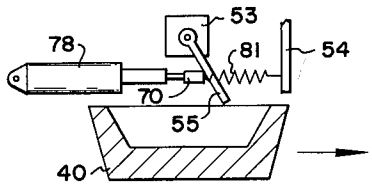


Fig. 5.

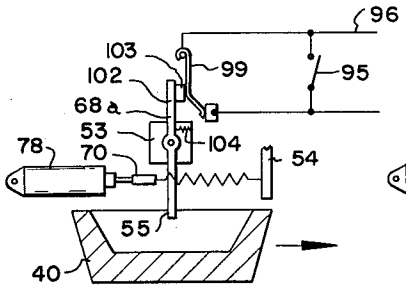


Fig. 7.

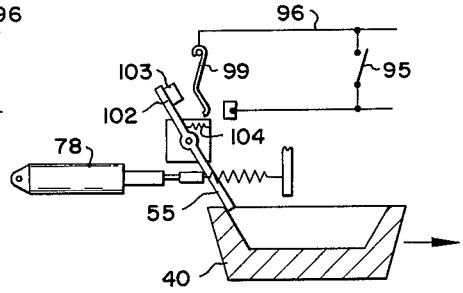


Fig. 8.

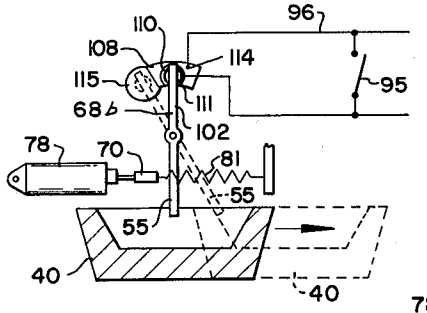


Fig. 9.

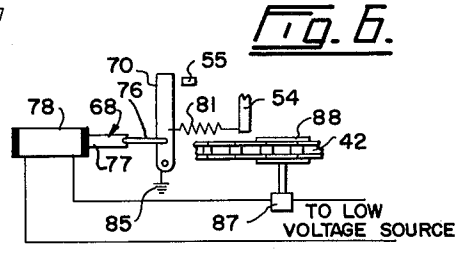


Fig. 6.

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AUTOMATIC MOLD CASTING MACHINE CONTROL APPARATUS

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Filed Sept. 11, 1961, Ser. No. 137,205
6 Claims. (Cl. 22—79)

This invention relates to control apparatus for automatic mold casting machines.

The control apparatus of this invention is particularly designed for automatic mold casting machines of the type described in United States Patent Number 2,891,292, dated June 23, 1959. In the casting machine, molds are moved along a path beneath a flow valve through which molten material is directed into the molds. The machine includes means for opening the flow valve when a mold moves into the pouring position beneath it, and closing the valve when the required amount of material is in the mold and the latter is moving out of the pouring position. The machine also has a contact finger mounted to extend into each mold when it is positioned beneath the valve, said finger being swung out of the mold path by each mold as the latter leaves the pouring position. When the contact finger is touched by a mold or by the molten material therein, after said material reaches a predetermined depth, the flow valve is instantly closed.

The original mold casting machine operates satisfactorily as long as it functions continuously till the supply of molten material is used up. However, if the mold-moving mechanism stops through failure or is stopped, there is always the possibility of the contact finger freezing into an ingot if the machine stopped while the finger was in contact with molten material.

An object of the present invention is the provision of control apparatus for swinging the contact finger out of a mold whenever the mold-moving mechanism stops. Means is provided for rendering the control apparatus inoperative as long as the molds are moving, but if the latter stop, the control apparatus moves the finger out of the mold if it is extending into one, and it also causes the flow valve to be closed.

A further development of the invention is the provision of apparatus which enables the casting machine automatically to produce uniform ingots by providing the same pouring conditions for each. A simple delay mechanism becomes operative if the machine is switched off while in the process of pouring an ingot. In such an event the molds will continue to move until the one being filled receives the correct amount of material. The starting and stopping operations are performed by automatic or manual manipulation of a control switch. Fully automatic operation of the casting machine by an ingot-handling machine may be envisaged, such that the casting machine is automatically started and stopped in response to ingot demand.

This further development is accomplished in a very simple but effective manner. A secondary switch is located in a circuit in parallel with a main switch which is opened and closed to stop and start the mold-moving mechanism. The contact finger is provided with means that keeps the secondary switch closed when the finger extends into a mold. If the main switch is opened at this time, the mold-moving mechanism continues to operate until the contact finger is swung out of the mold, at which time the secondary switch opens and the molds stop moving.

Examples of this invention are illustrated in the accompanying drawings, in which:

FIGURE 1 is a side elevation of a simple form of casting machine incorporating this invention, showing a mold in the pouring position beneath the flow valve;

FIGURE 2 is a plan view of the apparatus shown in FIGURE 1;

FIGURE 3 is a cross section taken on the line 3—3 of FIGURE 2;

FIGURE 4 diagrammatically illustrates the control apparatus illustrated in FIGURES 1 to 3, and including a wiring diagram associated therewith;

FIGURE 5 diagrammatically illustrates this control apparatus with the latter in a different setting from that shown in FIGURE 4;

FIGURE 6 is a diagram illustrating an electrical set-up for this control apparatus;

FIGURE 7 diagrammatically illustrates an alternative form of control apparatus in one setting;

FIGURE 8 diagrammatically illustrates the control apparatus of FIGURE 7 in another setting; and

FIGURE 9 diagrammatically illustrates still another form of control apparatus.

Referring to FIGURES 1 to 6 of the drawings, 10 is one form of automatic mold casting machine with which the present control apparatus is used. Molten material, usually molten metal, is contained in a pot 12 which may have a heating jacket 13 therearound. The pot has an outlet at the bottom thereof controlled by a flow valve 15 having a control arm 16 extending outwardly from the pot.

Control means is provided for opening and closing valve 15 as a mold moves into and out of the pouring position beneath valve discharge spout 17. This control means includes a solenoid 20 connected at 21 to a standard 22 projecting outwardly from a base 23. The solenoid has a movable core 26 projecting therefrom which is connected by a link or bar 28 to the outer end of arm 16. When solenoid 20 is energized, core 26 is drawn into it to swing arm 16 to open valve 15. Suitable spring means is provided for normally retaining the valve closed. In this example, a pair of springs 34 are connected at 35 to link 28, and at their opposite ends 36 to a standard 37 projecting upwardly from base 23. These springs normally swing arm 16 to close valve 15.

A plurality of molds 40 are moved beneath the spout of flow valve 15 in any convenient manner. In this example, the molds are mounted on spaced endless chains 42 which extend around spaced sprockets 43 and 44, either of which may be driven by a suitable source of power. It is preferable to use an electric motor 46 as a source of power. The molds are moved along a path or track 48 extending beneath flow valve 15.

The opening and closing of the flow valve is controlled by switch means 52 mounted above the path of movement of molds 40 and adjacent valve 15. This switch means includes an insulated block 53 supported immediately above the mold path by a support 54. A contact finger 55 projects downwardly from the switch block into the mold path. This finger is swingable relative to its mounting block, and it may be formed of flexible material for this purpose, or it may be formed of rigid material, in which case, a hinge is provided at its upper end. The contact finger is engaged by each mold as it is moved beneath the flow valve, and when the mold is in the proper pouring position, the finger projects downwardly thereinto, see FIGURES 3 and 4.

Contact finger 55 is electrically connected to solenoid 20 in such a manner that when the finger is in engagement with a mold or touched by the molten metal in a mold, the solenoid is de-energized to allow spring 34 to close the valve. An example of such an electrical connection is illustrated in FIGURE 4. A relay switch 58 is located in the circuit 59 of solenoid 20. The solenoid of switch 58 is connected by a wire 60 to contact 55, and when the latter engages a mold 40, or the molten metal in the mold, the

switch solenoid is grounded. Another wire **61** connects the solenoid to a low voltage source of electrical power, said source also being grounded.

The operation of the known casting machine **10** described so far is as follows. Springs **34** normally retain flow valve **15** in its closed position. As a mold moves beneath the valve, contact finger **55** engages the mold to keep solenoid **20** de-energized, since the solenoid of switch **58** is grounded so that the latter switch is open at this time. As soon as the finger clears the edge of the mold and swings into the latter, relay switch **58** closes, energizing solenoid **20**, which action draws core **26** thereinto. This moves valve arm **16** against the tension springs **34** to open the valve and allow the molten metal to flow into the mold therebeneath. When the level of the molten metal reaches the contact finger, or the back end of the mold engages said finger, relay switch **58** opens to de-energize solenoid **20**, thereby allowing springs **34** to close valve **15**. The contact finger is a little ahead of the flow valve with reference to the direction of movement of the mold. With this arrangement, the contact finger is bound to engage the back end of the mold before said mold moves from beneath the valve so that there is no danger of molten metal flowing without a mold being positioned to receive it. Furthermore, the finger is made long enough to remain in contact with the front end of the mold until sufficient of the latter is under the valve to receive the molten metal when valve **15** is opened and the metal starts to pour.

If the electrical power fails so that motor **46** stops, the solenoid is also de-energized and springs **34** close the valve. Each of these springs is strong enough to close the valve on its own should the other spring break. If the mold-moving mechanism stops through mechanical failure, or through a defect in motor **46**, the metal will continue to pour only until it reaches contact finger **55**, at which time solenoid **20** is de-energized, allowing the springs to close the valve. If the contact finger is in engagement with a mold at the time of stoppage, it will remain there so that the flow valve will not open. The molds are placed so close together that finger **55** rapidly snaps from the trailing edge of one to the leading edge of the next following mold so that the flow valve has not time to open during this action.

Casting machine **10** and its operation belong to the prior art.

Control apparatus **68** is provided in accordance with the present invention in order to lift contact finger **55** out of a mold should the molds stop moving for any reason whatsoever. If this is not done, the finger may freeze into the molten metal in a mold should the mold be stopped long enough to permit the metal to solidify.

Control apparatus **68** includes shifting means in the form of a horizontal arm **70** pivotally mounted at one end **71** on a vertical support **72** carried by base **23**. The opposite end **74** of this arm is located near but is normally spaced from contact finger **55** when the latter is in a vertical position. Arm **70** is connected by a link **76** to a movable core **77** of a solenoid **78** mounted on a support **79** carried by the base of the casting machine. A spring **81** has one end connected to arm **70** and its opposite end connected to support **54**. This spring tends to swing the arm towards finger **55**, while solenoid **78**, when energized, keeps the arm clear of the finger, which is its normal position when the machine is in operation.

FIGURE 6 diagrammatically illustrates the electrical set-up of control apparatus **68**. Arm **70** is grounded at **85**, and a governor-controlled switch **87** is connected in series with solenoid **78** in the electrical circuit of the latter. The governor-controlled switch is operated by a part of the mechanism for moving molds **40**. In this example, the switch has a sprocket **88** over which one of the chains **42** of the mold moving conveyor runs. When the conveyor is in operation, switch **87** is closed to keep solenoid **78** energized, but this switch opens when the conveyor and molds stop moving, thus causing the solenoid to de-energize.

When casting machine **10** is operating normally and molds **40** are being moved along the path beneath flow valve **15**, arm **70** is held clear of contact finger **55** by energized solenoid **78**. However, should the mold conveyor stop moving for any reason, switch **87** opens, causing solenoid **78** to de-energize. This allows spring **81** to swing arm **70** into engagement with finger **55**. This shifts or swings the finger upwardly out of the mold **40** therebeneath, as shown in FIGURE 5, and arm **70** grounds the finger so that solenoid **20** is also de-energized, allowing valve **15** to be closed by springs **34**. Thus, the flow of molten metal is stopped, and the contact finger is swung up out of the mold so that it will not freeze in the metal in the mold should said metal solidify.

FIGURES 7 and 8 illustrate control apparatus **68*a*** which is the same as apparatus **68**, but includes means for manually or automatically stopping the movement of the molds while ensuring that the movement and the pouring of the molten metal do not cease until a mold being filled has received a predetermined amount of metal and has moved from the pouring position. In FIGURES 7 and 8, **95** is a main switch in the circuit **96** of motor **46**. Switch **95** may be manually or automatically closed and opened to start and stop the motor and, therefore, the movement of the molds. A secondary switch **99** is provided in circuit **96** in parallel with switch **95**. Switch **99** is spring loaded into its open position.

Contact finger **55** is provided with an extension **102** projecting upwardly therefrom above the pivot point thereof, said extension having an insulating block **103** which is adapted to close switch **99** when the contact finger hangs downwardly in a mold **40**. A spring **104** draws extension **102** into the switch-closing position at this time.

When main switch **95** is closed, casting machine **10** operates in the manner described above, and switch **99** has no influence on the operation. Should the power fail or the molds stop moving as a result of a mechanical failure, arm **70** will swing contact finger **55** upwardly as described above. However, if switch **95** is opened during the normal course of operation of the casting machine, the molds will continue to move because of the fact that secondary switch **99** is closed as long as finger **55** is hanging down into a mold. However, as soon as the back end of the mold swings the contact finger upwardly, as shown in FIGURE 8, block **103** is moved away from switch **99** so that the latter opens, breaking the circuit of motor **46** and stopping the movement of the molds. Finger **55** is grounded by the mold and/or arm **70** at this time so that the pouring stops also.

FIGURE 9 illustrates a variation of the form of the invention of FIGURES 7 and 8. Control apparatus **68*b*** is similar to apparatus **68*a***. Finger **55** has the extension **102** which operates a secondary switch **108** which is in parallel with main switch **95** in the circuit **96** of motor **46**. Switch **108** includes a contact **110** mounted on an insulating block **111** carried by the upper end of finger extension **102**. This contact is in sliding engagement with a stationary contact **114** having an insulating block **115** at an end thereof. Contact **110** is connected to one side and contact **114** is connected to the other side of circuit **96**.

When contact finger **55** is hanging downwardly in a mold **40**, contact **110** is in engagement with contact **114** so that switch **108** is closed. When finger **55** is swung upwardly, contact **110** slides over insulating block **115** to open switch **108**, at which time the motor circuit **96** is open if main switch **95** also is open.

If the mold conveyor stops moving as a result of a power failure or mechanical failure, solenoid **78** is de-energized so that arm **70** will swing contact finger **55** upwardly out of the mold, and switch **108** of control apparatus **68*b*** is opened at this time. As arm **70** grounds finger **55**, solenoid **20** is also de-energized to allow springs

34 to close flow valve 15. This is not necessary if the movement of the molds stops because of electrical failure, but it is necessary if the stoppage is the result of mechanical failure. In addition to the above, if switch 95 is manually or automatically opened, the mold conveyor will continue to move until finger 55 is swung upwardly by a mold, at which time switch 108 is also opened to break the motor circuit.

What I claim as my invention is:

1. In an automatic mold casting machine having means for directing molten material to a flow valve and electrical power means for moving molds in succession along a path beneath the valve; control apparatus comprising electrical actuating means connected to the valve operable when electrical current is supplied thereto to open said valve, closing means connected to the valve for closing the latter when the actuating means is inoperative, a contact finger mounted adjacent the flow valve and normally hanging in the path of the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, electrical means in circuit with the finger for cutting off the flow of current to the actuating means for rendering said actuating means inoperative when the finger engages a mold or the molten material in the mold reaches said finger thereby allowing the closing means to close the valve, shifting means removably engaging the finger when the molds are not moving and keeping it out of the path of the molds, electrical means connected to the shifting means operable when the molds are moving to disengage said shifting means from the finger to allow said finger to extend into the mold path, said electrical means being inoperative when the molds stop moving, a control switch in circuit with the power means to be opened and closed to open and close said circuit and thereby stop and start the molds, a secondary switch in said circuit in parallel with the control switch, and means on the finger for closing the secondary switch when said finger is extending into a mold, whereby the opening of the control switch when the finger is extending into a mold does not stop the molds, said finger moving the last-mentioned means to open the secondary switch when the finger is moving out of the mold path.

2. In an automatic mold casting machine having means for directing molten material to a flow valve and electrical power means for moving molds in succession along a path beneath the valve; a solenoid having a movable core therein connected to the valve, spring means connected to the valve and opposed to the solenoid for closing the valve, electrical means connected to the solenoid for energizing the latter, said solenoid when energized retaining the valve open against the spring means, a contact finger mounted adjacent the flow valve and normally hanging in the path of the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, electrical means connecting the finger to the solenoid for de-energizing said solenoid while the valve is open and the molten material in the mold reaches the finger or said finger engages a mold thereby allowing the spring means to close the valve, shifting means removably engaging the finger when the molds are not moving and keeping it out of the path of the molds, electrical means connected to the shifting means operable when the molds are moving to disengage said shifting means from the finger to allow said finger to extend into the mold path, said electrical means being inoperative when the molds stop moving, a control switch in circuit with the power means to be opened and closed to open and close said circuit and thereby stop and start the molds, a secondary switch in said circuit in parallel with the control switch, and means on the finger for closing the secondary switch when said finger is extending into a mold, whereby the opening of the control switch when the finger is extending into a mold does not stop the molds, said finger moving the last-mentioned means to open the secondary switch when the finger is moving out of the mold path.

3. In an automatic mold casting machine having means for directing molten material to a flow valve and means for moving molds in succession along a path beneath the valve; control apparatus comprising electrical actuating means connected to the valve operable when electrical current is supplied thereto to open said valve, closing means connected to the valve for closing the latter when the actuating means is inoperative, a contact finger mounted adjacent the flow valve and normally hanging in the path of the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, electrical means in circuit with the finger for cutting off the flow of current to the actuating means for rendering said actuating means inoperative when the finger engages a mold or the molten material in the mold reaches said finger thereby allowing the closing means to close the valve, a bar engaging the finger when the molds are not moving and keeping it out of the path of the molds, said electrical means rendering the actuating means inoperative when the finger is engaged by the bar, and electrical means connected to the bar operable when the molds are moving to disengage the bar from the finger to allow said finger to extend into the mold path, said electrical means being inoperative when the molds stop moving.

4. In an automatic mold casting machine having means for directing molten material to a flow valve and means for moving molds in succession along a path beneath the valve; control apparatus comprising electrical actuating means connected to the valve operable when electrical current is supplied thereto to open said valve, closing means connected to the valve for closing the latter when the actuating means is inoperative, a contact finger mounted adjacent the flow valve and normally hanging in the path of the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, electrical means in circuit with the finger for cutting off the flow of current to the actuating means for rendering said actuating means inoperative when the finger engages a mold or the molten material in the mold reaches said finger thereby allowing the closing means to close the valve, a bar normally engaging the finger and keeping it out of the path of the molds, said finger and the electrical means cutting off the flow of current to the actuating means when the finger is engaged by the bar, a solenoid having a movable core therein connected to the bar and when energized disengaging said bar from the finger to allow the latter to extend into the mold path, switch means in circuit with said solenoid and de-energizing the latter when operated, and means normally operated by the mold moving means connected to operate said switch means when the mold moving means stops moving to de-energize said solenoid to allow the bar to engage the finger to keep said finger out of the mold path.

5. In an automatic mold casting machine having means for directing molten material to a flow valve and means for moving molds in succession along a path beneath the valve; a first solenoid having a movable core therein connected to the valve, spring means connected to the valve and opposed to the solenoid for closing the valve, first

electrical means connected to the solenoid for energizing the latter, said solenoid when energized retaining the valve open against the spring means, a contact finger mounted adjacent the flow valve and normally hanging in the path of the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, second electrical means in circuit with the finger for de-energizing said solenoid and thereby allowing the spring means to close the valve when the molten material in the mold reaches the finger or said finger engages a mold, a bar engaging the finger when the molds are not moving and keeping it out of the path of the molds, said second electrical means de-energizing the solenoid when the finger is engaged by the bar, and third electrical means connected to the bar operable by the mold moving means when the molds are moving to disengage the bar from the finger to allow said finger to extend into the mold path, said electrical means being inoperative when the molds stop moving thereby allowing the bar to keep the finger out of the mold path.

6. In an automatic mold casting machine having means for directing molten material to a flow valve and means for moving molds in succession along a path beneath the valve; a first solenoid having a movable core therein connected to the valve, spring means connected to the valve and opposed to the solenoid for closing the valve, first electrical means connected to the solenoid for energizing the latter, said solenoid when energized retaining the valve open against the spring means, a contact finger mounted adjacent the flow valve and normally hanging in the path of

the molds and extending into each mold when it is beneath the valve as the latter mold passes beneath the finger, said finger being spaced from the bottom of the mold and normally being engaged by an end of each mold as said mold moves from beneath the finger to slide over said end and into the next succeeding mold, second electrical means in circuit with the finger for de-energizing said solenoid and thereby allowing the spring means to close the valve when the molten material in the mold reaches the finger or said finger engages a mold, a bar engaging the finger when the molds are not moving and keeping it out of the path of the molds, said second electrical means de-energizing the solenoid when the finger is engaged by the bar, a second solenoid having a movable core therein connected to the bar and when energized disengaging said bar from the finger to allow the latter to extend into the mold path, switch means in circuit with said second solenoid and de-energizing the latter when operated, and means normally operated by the mold moving means connected to operate said switch means when the mold moving means stops moving to de-energize said second solenoid to allow the bar to engage the finger to keep said finger out of the mold path.

References Cited by the Examiner

UNITED STATES PATENTS

2,763,904	9/56	Sukava	22—79
2,891,292	6/59	Sukava	22—79

WILLIAM J. STEPHENSON, *Primary Examiner.*

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