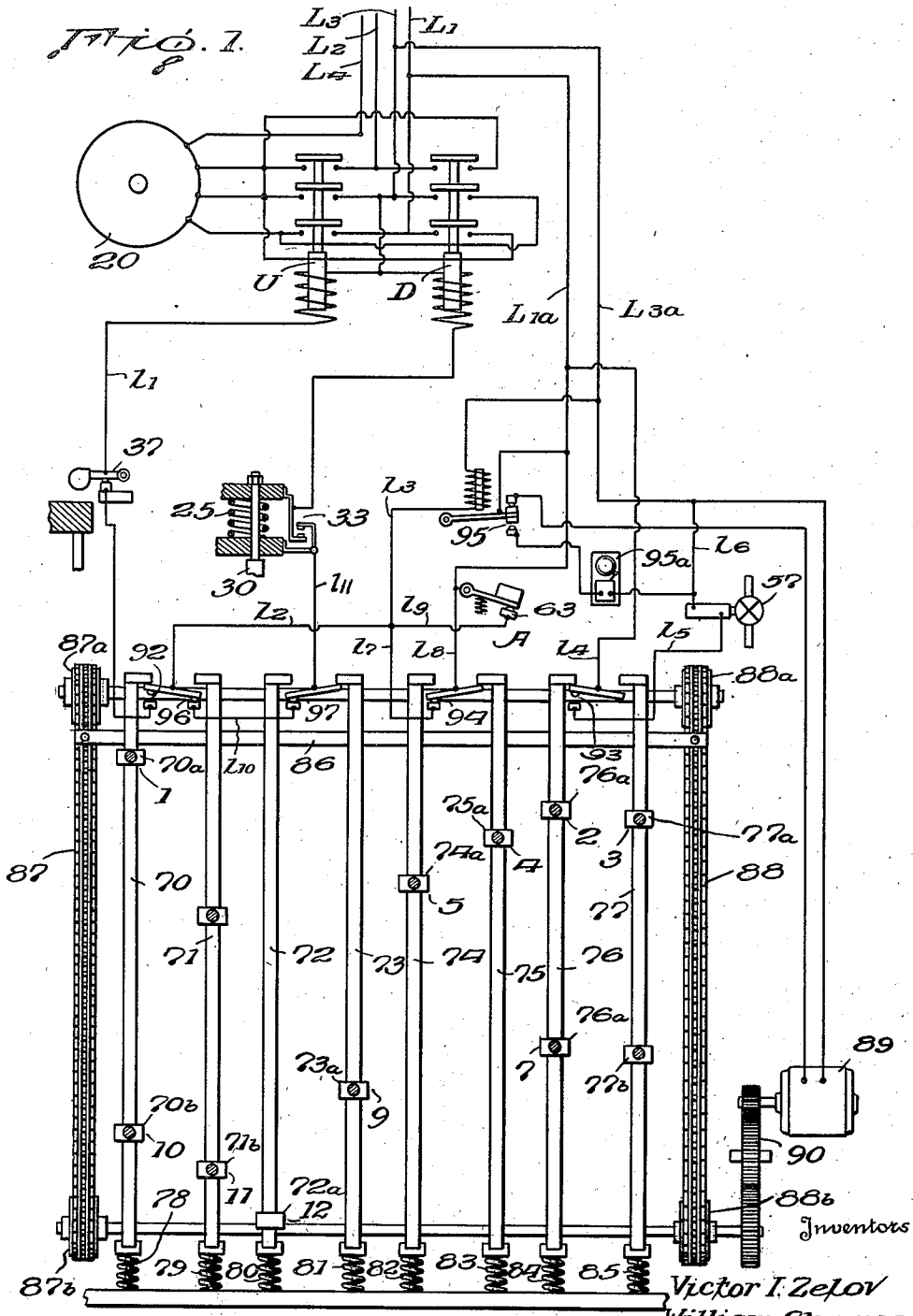
July 22, 1941. V. I. ZELOV ET AL 2,250,342

ELECTRIC CONTROLLER

Original Filed June 5, 1937 2 Sheets-Sheet 1

Fig. 1.



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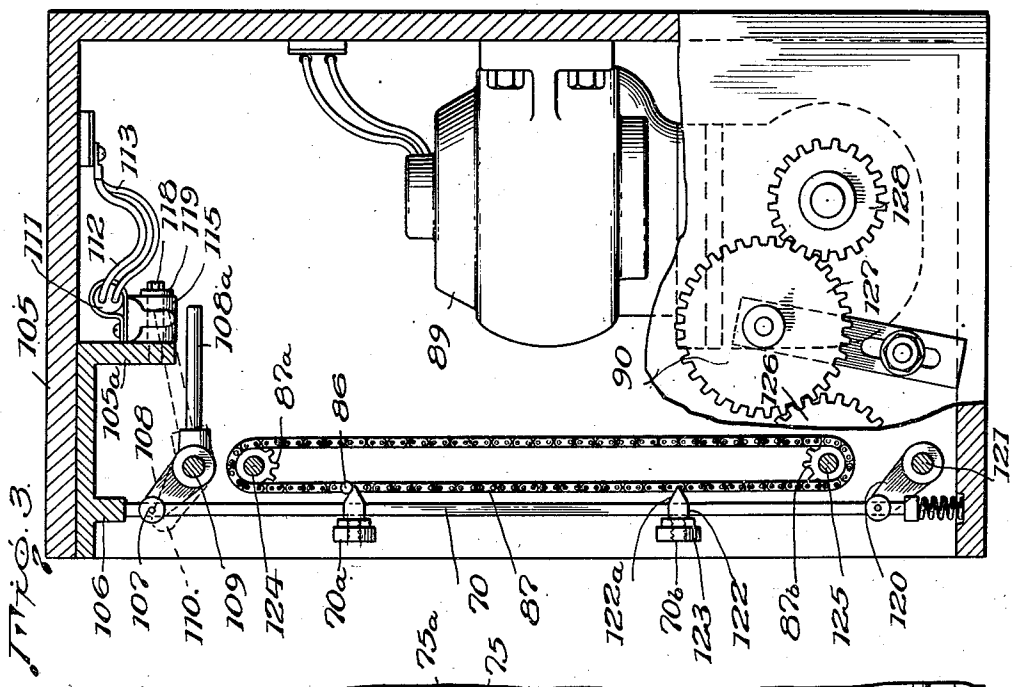


Fig. 3.

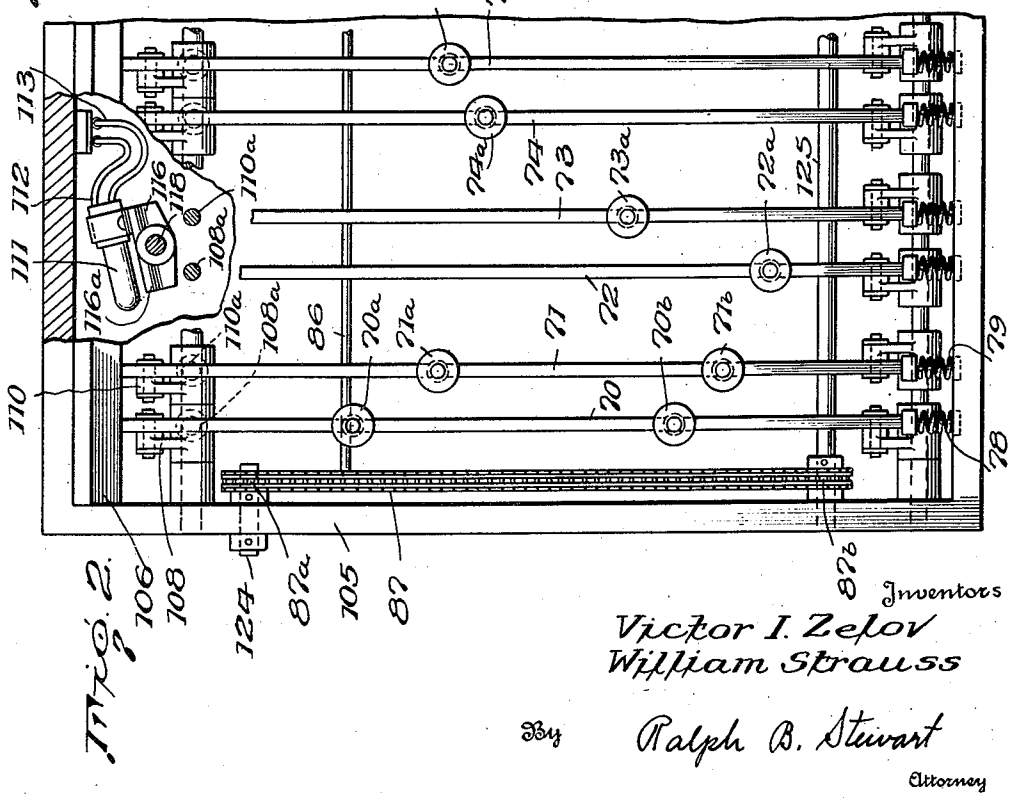


Fig. 2.

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ELECTRIC CONTROLLER

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Original application June 5, 1937, Serial No. 146,550, now Patent No. 2,242,189, dated May 13, 1941. Divided and this application December 27, 1939, Serial No. 311,222

14 Claims. (Cl. 200—32)

This invention relates to control devices and has for its chief object to evolve a device which is capable of controlling the operation of a plurality of electric switches in such a manner that they will be operated automatically in timed relation and in a predetermined sequence, the error or time lag being reduced to a very small fraction of the time cycle. It is a further object to evolve a device wherein adjustment may be readily effected when it is required to vary the sequence of operation or the period of time between any two or more operations.

According to the invention, an actuating member is provided which is adapted to move in a predetermined path and at a predetermined speed, said member being adapted to effect actuation of a plurality of linkages in a predetermined sequence which latter are in turn each adapted to effect opening or closing of a switch in order to make or break circuits.

In further accordance with the invention the device comprises a plurality of switches, a plurality of linkages, a pair of such linkages being associated with one or more switches, a plurality of dogs or the like associated with said linkages, a control rod and means for moving said rod at a predetermined rate to engage said dogs or the like on the linkages and thereby to open or close said switches.

This application is a division of our copending application Serial No. 146,550, filed June 5, 1937.

In order that the said invention may be clearly understood and readily carried into effect the same will now be more fully described with reference to the accompanying drawings, wherein:

Fig. 1 is a diagram illustrating the principle and manner of operation of our invention when employed to control the operation of a molding press;

Fig. 2 is a view in elevation, with certain parts broken away, showing the details of construction of one embodiment of our control device; and

Fig. 3 is a side view of the arrangement illustrated in Fig. 2 with certain parts broken away.

The drawings illustrate by way of example one embodiment of the device according to the invention which is adapted particularly for controlling the operation of an automatic molding press such as is described in the specification of our copending application Serial No. 146,550, filed June 5, 1937, now Patent No. 2,242,189, May 13, 1941.

Referring to Figs. 2 and 3, the control device illustrated therein is supported within or upon a frame or casing 105 which has an open side as shown to the left of Fig. 3. A number of switches 111 (four switches are employed in the illustrated embodiment and are represented by contacts 92—96, 97, 94, and 93 in Fig. 1) are mounted in the upper part of casing 105, each switch preferably being of the kind known as the mercury sealed vacuum type and each being carried by a holder 115 which is mounted on a fulcrum 118 extending from a support 105a carried by the frame 105. Each holder 115 may swivel or tilt about its fulcrum when engaged by a switch finger 110a and will remain in such tilted position under the action of a retaining member 119 until a second finger 108a engages and tilts the holder to its original position. Each switch 111 is connected in the customary manner to its proper circuit by means of flexible leads 112 and 113.

In the embodiment illustrated, the switch-actuating mechanism comprises a plurality of bars, 70 to 77, inclusive, two for each switch, and each being pivotally attached to a lever 108 at the top and a lever 120 at the bottom, a pair for each bar, and forming a linkage for the actuation of the switch. These levers are free to swivel on their respective shafts 109 and 121, which are attached to the side members of frame 105. Springs 78 to 85 yieldably urge bars 70 to 77 respectively against a stop 106 of frame 105 to limit their upward movements. Each lever 108 and 110 has an extension (switch finger) 108a, and 110a, respectively, suitable to contact abutments 116 and 116a, respectively, on switch holder 115 and by such action tilt holder 115 to a position which either opens or closes the circuit through switch 111. On bars 70 to 77 are placed one or more adjustable dogs 70a, 70b, 71a, 71b, etc., respectively, and the location of these dogs on the bars determine the point in the molding cycle at which a switch 111 opens or closes a circuit. The dogs may be made in any suitable manner as, for example, in the form of an arm 122 extending out from the bar and provided with a bevel 122a at one end, a suitable recess at the other end fitting over the bar and threads or the like engaging a nut or screw 123 for clamping and holding the dog at the desired position on the bar.

The dogs are actuated to move their respective linkage by one or more control rods 86, carried by endless belts or chains 87 and 88 engaging upper and lower pulleys or sprockets 87a, 87b, and 88a, 88b, respectively, mounted on shafts 124 and 125 which have their bearings in the side

members of frame 105. The sprocket 88b is driven from a motor 89, through a train of change gearing 90, comprising one or more interchangeable gears 126, 127 and 128, chosen so as to secure a suitable speed of travel for chains 87 and 88, which will result in a complete lap for control rod 86 around its track during each cycle regardless of whether the duration of the cycle is two, three, or more minutes or a fraction of a minute. If a time cycle of five and one-half (5½) minutes is desired, suitable gears are selected and mounted at 90 to cause the control-rod 86 to make one lap in that time. On one side of the lap it will be noticed that the control-rod 86 is merely idling, while on the other side it contacts one dog after another, thus opening and closing circuits in timed relation. The order of operation of the dogs is indicated in Fig. 7 by the underscored numerals *1* to *12*, inclusive.

The controller above described and illustrated is adapted particularly for application to an automatic molding press of the kind forming the subject of our co-pending application referred to above and in the description hereinafter it will be assumed that it is incorporated in such a press. A reversible motor 20, controlled by "up" relay U and "down" relay D is arranged for raising and lowering the upper platen of the press to open and close the mold. The lower platen is supported upon spring 25 by rod 30, and limit switch 33 is arranged to interrupt the motor circuit upon a predetermined compression of spring 25 by the upper platen. In case the control device does not stop the motor 20 at the proper time in its upward movement, limit switch 37 is provided in the circuit of relay U and arranged to be operated by the upward movement of the upper platen.

Assuming the end of the curing phase whose duration depends upon the idle travel back and up of the control-rod 86 from the last to the first of the dogs, the bar engages the dog 70a to close the contacts 92 of the control circuit for "up" relay U, the control circuit extending from line L_2 through relay U, limit switch 37, switch contacts 92 and 94 and back to line L_1 through line L_{1a}. Operation of relay U causes the motor 20 to turn in a direction to move the plunger 15 upwardly to open the mold.

After operating dog 70a, bar 86 next engages the dog 76a to close the contacts 93 of a circuit including the leads l_4, l_5, and l_6, resulting in opening of the valve 57 to provide the air blast for cleaning the mold and securing discharge therefrom of a molded article. The blast continues until rod 86 engages the dog 71a to open the controls 93.

The bar 86 next engages the dog 75a to open the switch 94, disconnecting the line side L_{1a}, through the leads l_8, l_7 and l_3, to the line side L_{2a}, the line side then remaining connected through the leads l_3, l_9 and the switch 63 which, as described in the specification of our co-pending application referred to above, is actuated by the weight of a finished article ejected from the mold. Unless, therebefore, the switch 63 is weighted closed by an article, as soon as the switch 94 is opened, the relay 95 is rendered ineffective and the circuit to the timing motor 89 is interrupted and a warning signal is given, if desired, and the machine stops. If switch 63, however, was closed, the rod 86 continues and engages the dog 74a to close the switch 94 again.

The bar 86 next engages the dog 71a to close the contacts 96 connecting lead l_2, through lead l_{10}, closed contacts 97 and lead l_{11}, through the limit switch 33 and relay D to operate the motor 20 to move the upper platen and the ram of the press downwardly.

The dog 76b is next actuated to close contact 93 of the circuit including leads l_4, l_5 and l_6 to open the air-blast valve 57 just after the punch enters the die cavity, for the purpose of removing any powder on top of the die. This circuit is opened again almost instantly by the action of dog 77b.

When it is desired to de-gas or "breathe" the mold, this is accomplished by placing a dog at 73a to open the circuit incuding leads l_{10}, l_{11} and limit switch 33 to stop motor 20 and thereby stop the downward motion of the ram, and then reverse the motor rotation to secure upward motion of the ram by action of dog 70b closing contact 92. The upward motion of the ram is stopped by operation of dog 71b. The upward motion is only continued for a very short time period, as may be seen from the relative positions of dogs 70b and 71b. It is preferable to limit the upward motion a distance just sufficient to relieve the pressure, and retain the punch at that position in the die cavity. The control-rod 86 actuates dog 71b at that point to open contact 92 and stop the motor 20. At the end of the desired breathing period, the control-rod 86 engages the dog 72a, closing contact 97 and thereby completing the circuit through limit switch 33 again for the final closing of the mold. The motion to close the mold is interrupted as recited above by limit switch 33. The mold remains closed during the time that bar 86 travels around pulleys 87b and 88b and back up to and around pulleys 87a and 88a. It will be appreciated from the above that by virtue of the control device according to the invention the various functions of the molding press will take place automatically and in timed relation.

Although the controlling device according to the invention has been described above with reference to its application to an automatic molding press of the type described in the specification of our co-pending application Serial No. 146,550, it will be appreciated that its application is not necessarily limited thereto since it may be employed in any case where it is desired to control the operation of a plurality of switches automatically in a predetermined sequence and in timed relation. It is obvious that the number of switches together with the actuating linkages therefor may be varied as desired to suit the requirements in any particular case, while in addition the number and setting of the dogs on the respective linkages may be varied as desired, it being possible readily by this means to vary the sequence and time relation as required.

In the preferred form of our invention, we use tilting switches of the mercury type, but other forms of switch may be employed, for example, a simple form of switch having pivoted blades such as represented in Fig. 1 may be used.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:

1. In combination, a switch, a reciprocating bar for actuating said switch, means for operating said bar comprising a control element movable along a closed path having a section thereof arranged parallel to said bar, and an abutment carried by said bar and extending into the path of travel of said control element, said abutment

being adjustable in position along the length of said bar.

2. A combination according to claim 1 including means for biasing said reciprocating bar for movement in a direction opposite to the direction of movement of said bar by said control element, and means operated by a predetermined movement of said bar for releasing the abutment from contact with said control element.

3. In combination, a switch, an actuator for said switch comprising a bar arranged for longitudinal reciprocation, means for biasing said bar in one direction, means for operating said bar in the opposite direction comprising a control element movable in a fixed path parallel to said bar, an abutment carried by said bar and extending into the path of travel of said control element, and means rendered operable by movement of said bar in the opposite direction for causing said bar to move away from the path of travel of said control element.

4. In combination, a switch, a pair of parallel bars arranged for longitudinal reciprocation, means for opening said switch by movement of one of said bars in one direction, means for closing said switch by movement of the other bar in the same direction, an operator for said bars comprising a control bar arranged transversely of said reciprocating bars, means for moving said control bar in a path parallel to said reciprocating bars, and adjustable abutments carried by said reciprocating bars and extending into the path of travel of said control bar.

5. A combination according to claim 4 in which the control bar is arranged to travel in a closed path, a portion of which is parallel to said reciprocating bars, and including means for causing said control bar to travel at a constant speed around said path in repeated cycles.

6. In an electric controller, the combination of a plurality of switch elements, a reciprocating bar associated with each switch element and arranged to actuate the associated switch, said bars being arranged in parallel relation in a common plane, means for operating said bars comprising a control bar arranged transversely of said reciprocating bars, means for causing said control bar to move in a direction parallel to said reciprocating bars, at least one abutment carried by each reciprocating bar and extending into the path of travel of said control bar, and means for mounting said abutments for adjustment in position along the length of said reciprocating bars whereby the sequence of operation of said switches may be varied.

7. An electric controller according to claim 6 in which the control bar is arranged to travel in a closed path, a portion of which is parallel to said reciprocating bars, and means for causing said control bar to travel at a constant speed around said path in repeated cycles.

8. In an electric controller, the combination of a control bar, means for moving said control bar in a closed path while maintaining said bar at right angles to its direction of movement, a plurality of electric switches having actuating members extending into the path of travel of said bar, and mounting means for said actuating members permitting adjustment in position of said members along the path of travel of said bar, whereby the sequence of operation of said switches by said bar may be varied.

9. A controller according to claim 8 in which the control bar is supported at opposite ends upon endless bands arranged in parallel relation and running over spaced pulleys or sprockets, and means for driving said endless bands at a constant speed.

10. In an electric controller, the combination of a rotary shaft, a pair of spaced wheels mounted on said shaft, a pair of parallel endless bands driven by said wheels, a control rod secured at opposite ends to said endless bands and arranged at right angles to the direction of movement of said bands, a plurality of switches adjacent the path of travel of said control rod, actuating means for each switch extending into the path of travel of said rod, said actuating means being spaced apart to be engaged by different linear sections of said rod, and means for mounting said actuating means for adjustment in position in the direction of movement of said rod.

11. A controller according to claim 10 in which the actuating means for each switch comprises a bar arranged parallel to the path of travel of said rod and connected to operate the switch by longitudinal movement thereof, and an abutment mounted upon said bar for adjustment along the length thereof and extending into the path of travel of said rod.

12. In an electric controller, the combination of a rotary shaft, a pair of spaced wheels mounted on said shaft, a pair of parallel endless bands driven by said wheels, a control rod secured at opposite ends to said endless bands and arranged at right angles to the direction of movement of said bands, a plurality of switches adjacent the path of travel of said control rod, a pair of actuating bars for each switch arranged parallel to each other and parallel to the path of movement of said rod, said bars being arranged for longitudinal reciprocation and including means for closing the switch upon reciprocation of one bar and for opening the switch upon reciprocation of the other bar of each pair, means for biasing said bars in a direction opposite to the direction of movement of said rod, and an abutment mounted on each bar and extending into the path of travel of said rod, said abutments being adjustable in position along the length of said bars whereby the sequence of operation of said switches may be varied.

13. A controller according to claim 12 wherein each of said actuating bars is mounted to be moved away from the path of travel of said bar, and to disengage said abutment from said rod upon a predetermined reciprocation of the bar.

14. A combination according to claim 4 wherein each of the reciprocating bars is mounted at opposite ends upon a pair of pivoted levers, said levers being positioned so that said bars move away from the path of travel of said control bar upon engagement of said control bar with said abutments.

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