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1,650,889

L. DE FLOREZ
SYSTEM OF REGULATION

Filed Nov. 16, 1925

2 Sheets-Sheet 2

Fig. 2,

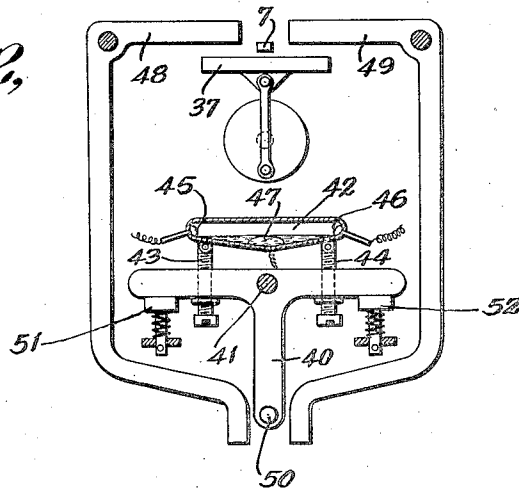


Fig. 3,

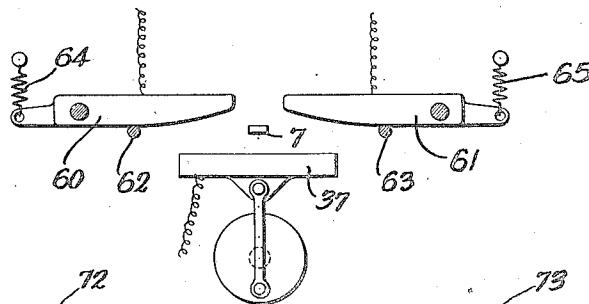
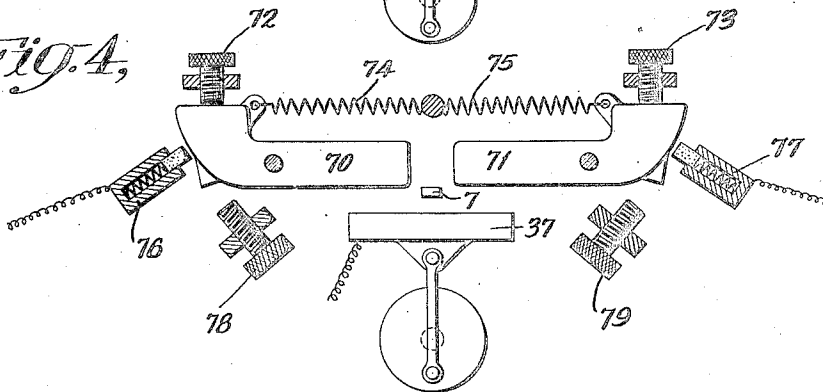


Fig. 4,



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UNITED STATES PATENT OFFICE.

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SYSTEM OF REGULATION.

Application filed November 16, 1925. Serial No. 69,373.

This invention relates to apparatus for the automatic control of a condition such as temperature, pressure, rate of flow, etc., which it is desired to maintain substantially at a predetermined value; the invention further relates particularly to apparatus comprising an improved contacting device adapted to control a circuit for varying periods of time, responsive to changes from a predetermined value in the condition under control.

In general my invention comprises means to reflect changes in the condition, the value of which is to be controlled, a contacting device adapted under certain conditions to be actuated by cooperation with said means, and apparatus energized upon the closing of the contacting device to effect corrections in the value of the condition to maintain it at the desired value.

For a more complete disclosure of my invention reference should be had to the following specification and drawings in which,

Figure 1 represents a diagrammatic showing of my control system;

Figure 2 indicates a modified form of contacting device as distinguished from the preferred form shown in Figure 1;

Figures 3 and 4 show further modifications of the contacting device.

The invention is shown as applied to the control of the temperature in a furnace or the like, but is not thus limited, inasmuch as it may be employed to control the value of any condition, such as temperature, pressure, rate of flow, etc., with equal facility and accuracy.

In Figure 1, the pyrometer or thermocouple 1 is shown protruding into a portion of a furnace 2, the temperature of which is to be regulated. The pyrometer is connected by wires 3 and 4, to a galvanometer, shown diagrammatically by coils 5 and 6, the needle 7, the standard cell 8, and the adjustable resistance 9, as customary in the art. Switch members 10 and 11 are pivotally mounted within the range of movement of the galvanometer needle 7, but in a plane slightly above the plane in which the needle normally moves. The switch members are provided with adjustable stops 12 and 13 against which they are normally held by springs 14 and 15. Upon the switch members 10 and 11 are mounted mercury contact-

ing tubes 16 and 17, the respective positions of which may be adjusted by the screws 18 and 19. The terminals 20, 21 and 22, 23 are provided for the tubes 16 and 17 and are adapted to be bridged by a movement of the mercury in the tubes 16 and 17 upon a change in the angular position of the switch members 10 and 11. These terminals are connected by the wires 24, 25 and 26, 27 respectively to solenoids 28 and 29, which are energized by the batteries or other suitable source of current 30 and 31, upon the closing of their respective circuits.

For the purpose of describing the invention, the system is illustrated in connection with the control of the amount of liquid or gaseous fuel used for the heating of the furnace 2, and whose temperature, in turn, is to be controlled. The fuel is delivered to the control apparatus preferably at a uniform pressure through the pipe 32. The main supply of fuel then passes through the valve 33 and into the pipe 34 which leads to a burner (not shown), for heating the furnace 2. Auxiliary supplies of fuel are controlled by the valves 35 and 36, the former being normally open and the latter being normally closed. These valves are controlled by the solenoids 28 and 29 and have a constant and not a variable opening so that fuel may be supplied at a definite fixed rate while open or subtracted at the same rate while closed.

Referring again to the contacting mechanism, there is provided below the galvanometer needle 7 a chopper 37, operated continuously by any suitable mechanism illustrated diagrammatically at 38 to periodically cause the chopper to be brought into contact with the needle 7, which in turn strikes the under side of one of the members 10 or 11, deflecting the same. This, of course, does not occur if the needle 7 is in the position between the members 10 and 11 corresponding to the normal or predetermined temperature, at which times no corrections are necessary.

The method of operation of the system is as follows: Assuming the temperature or other condition to have become lower than the predetermined or normal value, the galvanometer needle will reflect this change by moving under the member 11 and when the chopper 37 is next raised by the mechanism

38, the needle 7 will strike the member 11 and will deflect it an amount corresponding to the extent of the change of the needle from its normal position. The mercury in tube 17 will flow to bridge the contacts 22 and 23, thus closing the circuit and energizing the solenoid 29. This will operate to raise the valve 36 from its seat and will permit additional fuel to flow to the pipe 34 and to the burner under the furnace 2, tending to return the temperature to normal. In like manner an increase in the temperature will operate the valve 35 to decrease the amount of fuel. The galvanometer needle 7 in each instance merely selects the side upon which the correction is to be applied and determines the extent of the movement of the members 10 or 11 and it is obvious that the further the needle is from the normal position the greater will be the deflection of the pivoted members 10 or 11 and the correction applied will be of corresponding duration.

It will be observed that my invention provides an efficient and readily adjustable means for making contacts, in cooperation with a galvanometer needle or other indicating device, which are proportional in periods of time to the extent of the departure of a condition from normal as reflected by the galvanometer needle. The invention further may be employed in conjunction with the inventions disclosed in my copending applications, Serial Nos. 579,603, filed August 4, 1922; 688,406, filed January 24, 1924; 9359, filed February 14, 1925, and 9360, filed February 14, 1925, and constitutes an improvement upon the means for effecting the varying periods of contact in proportion to the position of the galvanometer needle as disclosed in those applications. It is to be understood, however, that this invention is not limited to the control of temperature, but as heretofore pointed out, may be employed for the control of any similar condition.

Furthermore the invention is not limited to a galvanometer as the means for reflecting the changes in the condition, since any suitable indicating means may be used in its stead, such as a Bourdon tube or a diaphragm device for indicating small changes in pressures or other well known mechanical devices. However, a galvanometer is preferred wherever applicable because of its sensitivity and ease of standardization.

In Figure 2 a modified form of contacting mechanism is shown, in which a single switch member 40 is pivoted at 41 and upon which the single mercury contact tube 42 is adjustably mounted by means of the screws 43 and 44. The tube 42 is provided with contacts 45 and 46, either of which may be bridged by the mercury with central contact 47. Bell cranks 48 and 49 are positioned above but in proximity to the galvanometer

needle 7 and chopper 37 and, when displaced by the movement of the galvanometer needle 7 and the chopper 37, will strike a pin 50, located on the lower end of the switch member 40, thus imparting the corresponding movement of the bell crank to the switch member. Spring stops 51 and 52 serve to limit the movement of the member 40 and to return it to normal position.

A further modification of the contacting device is shown in Figure 3. Pivoted switch members 60 and 61 are held against stops 62 and 63 by the springs 64 and 65. In this case direct contact is made between the chopper 37, serving as one terminal, and the switch members 60 and 61, serving as the other terminals. It will be observed that the galvanometer needle 7 acts as a conductor to complete the circuit between the chopper 37 and the switch member 60 or 61 and that a varying period of contact is obtained dependent upon the deflection of the galvanometer needle 7 because of the upwardly curved contacting surfaces of the switch members 60 and 61 near their inner ends.

In Figure 4 the pivoted switch members 70 and 71 are held against adjustable stops 72 and 73 by the springs 74 and 75. Contacts are made by the member 70 or 71 with the brushes 76 or 77 when the chopper 37 raises the needle 7 into engagement with one of the members 70 or 71 and at the same time the circuit is completed through the chopper 37, needle 7, member 70 or 71 and brush 76 or 77. Adjustable stops 78 and 79 provide a lower limit to the movement of the switch members 70 and 71. As in the case of the modification shown in Figure 3, the chopper 37 serves as a common terminal for the electrical circuit. The periods of contact will vary in accordance with variations in the temperature for, as in Figures 1 and 2, the further the needle 7 departs from normal the greater will be the deflection of the switch member and the period of contact will be correspondingly longer.

What I claim is:

1. In a system for the regulation of a condition, means to reflect changes from a predetermined value in the condition comprising a galvanometer, the needle of which moves in response to such changes, a switch member adapted to contact with the galvanometer needle for a period of time dependent upon the extent of the movement of the needle from a predetermined position representing the said predetermined value of the condition to effect the control of an electrical circuit, means adapted to periodically effect the contacting of the needle with the switch member, and means actuated during the period of circuit control for applying corrections to the value of the condition whereby the condition tends to be maintained substantially at the predetermined value.

2. In a system for the regulation of a condition, means to reflect changes from a predetermined value in the condition comprising a galvanometer, the needle of which
 5 moves in response to such changes, a pivoted switch member adapted to contact with the galvanometer needle for a period of time depending upon the extent of the movement of the needle from a predetermined position
 10 representing the said predetermined value of the condition, to effect the control of an electrical circuit, and adapted to return to normal position after each such contacting, means to periodically effect the contacting
 15 of the switch member with the needle, and means actuated during the period of circuit control for applying corrections to the value of the condition whereby the condition tends to be maintained substantially at the pre-
 20 determined value.

3. In a system for the regulation of a condition, a pivoted member having mounted thereon a mercury contacting switch adapted to effect the control of an electrical
 25 circuit upon the movement of said member from a predetermined normal position, means to effect such movement proportionately in response to changes from a predetermined value in the condition, means to return said member to its normal position
 30 after each such movement, an electrical circuit comprising said switch and controlled thereby, and means actuated during the period of circuit control for applying corrections to the value of the condition whereby the condition tends to be maintained substantially
 35 at the predetermined value.

4. In a system for the regulation of a condition, a pivoted member having mounted
 40 thereon a mercury contacting switch adapted to effect the control of an electrical circuit upon the movement of said member from a predetermined normal position, means to periodically effect such movement, the extent of which varies proportionately to the extent of the changes from a predetermined value in the condition, means to return said member to its normal position
 45 after each such movement, an electrical circuit comprising said switch and controlled thereby, and means actuated during the period of circuit control for applying corrections to the value of the condition where-

by the condition tends to be maintained substantially at the predetermined value.

5. In a system for the regulation of a condition, a pair of oppositely disposed pivoted members, each having mounted thereon a mercury contacting switch adapted to be actuated by the movement of the member,
 60 two electrical circuits, each comprising one of said switches and separately controlled thereby, means to selectively effect a movement of one of the pivoted members in response to changes from a predetermined value
 65 in the condition to actuate the corresponding mercury contacting switch for a period of time dependent upon the extent of the departure of the value of the condition from a predetermined value, means to return the members to normal position after each such movement, and means actuated during the period of circuit control for applying corrections to the value of the condition, whereby the condition tends to be maintained sub-
 75 stantially at the predetermined value.

6. In a system for the regulation of a condition, means to reflect changes from a predetermined value in the condition comprising a galvanometer, the needle of which
 80 moves in response to such changes, a pair of oppositely disposed pivoted members positioned in proximity to the normal plane of movement of the galvanometer needle, a mercury contacting switch mounted on each member and adapted to be actuated by the movement thereof, two electrical circuits,
 85 each comprising one of said switches and separately controlled thereby, means to periodically move said galvanometer needle out of its normal plane of movement to selectively strike one of said members and to actuate the corresponding switch for a period
 90 of time dependent upon the extent of the departure of the value of the condition from the predetermined value, means to return the members to normal position after each such movement, and means actuated during the period of circuit control for applying corrections to the value of the condition, where-
 95 by the condition tends to be maintained substantially at the predetermined value.

In witness whereof I have hereunto set my hand this 4th day of November, 1925.

LUIS DE FLOREZ.