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SAFETY CONTROL MECHANISM

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Fig. 1.

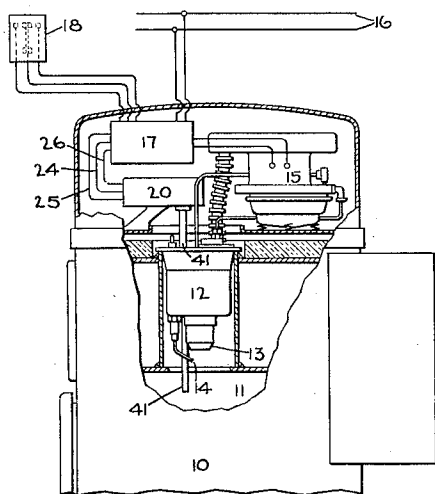


Fig. 2.

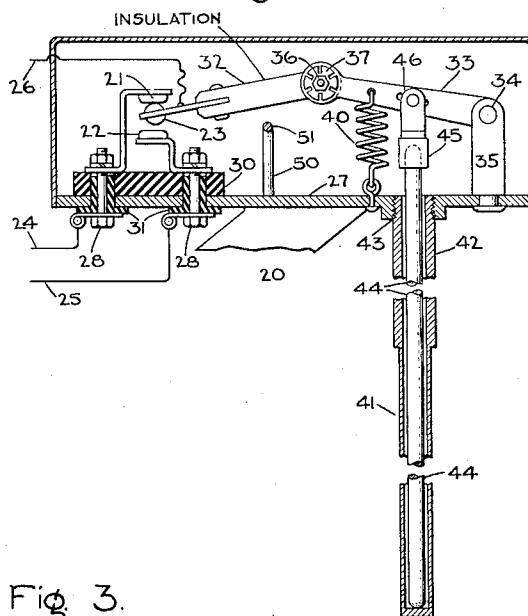


Fig. 3.

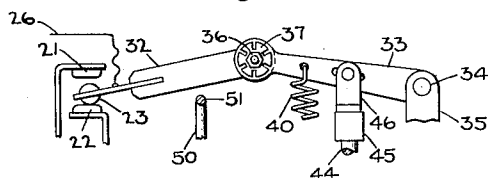
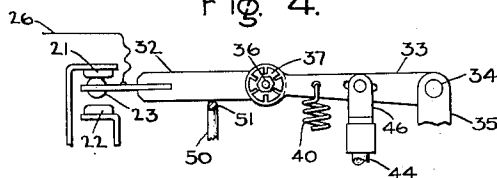


Fig. 4.



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## UNITED STATES PATENT OFFICE

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## SAFETY CONTROL MECHANISM

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Application February 8, 1935, Serial No. 5,623

18 Claims. (Cl. 200—137)

My invention relates to safety control mechanism and more particularly to improvements for insuring safety in the operation of thermal responsive electric circuit controlling mechanisms.

5 A principal object of the invention is the provision of improved safety mechanism for incorporation with a control device which is operated selectively between two control positions by an overrunning operating means, whereby overrunning of the operating means for any reason in excess of a predetermined amount after operation of the control device to one of the control positions is effective to produce reverse operation of the control device from such one control position to the other control position.

The ensuing description and accompanying drawing are directed to setting forth clearly the details of construction and operation and the advantages of one embodiment of my invention which is particularly adapted for incorporation in a thermal responsive control mechanism for electrically operated liquid fuel burner apparatus. However, it will be evident to one skilled in the art that the invention may assume different forms and is adapted for other applications and also that the particular embodiment herein described and illustrated is subject to modification to meet various conditions.

30 In control systems for liquid fuel burner apparatus it is common to employ switching means operable by a thermo-sensitive device responsive to flame conditions in the combustion chamber of the furnace, one function of such switching means being to establish proper circuit connections for starting the fuel burner apparatus when the thermo-sensitive device is cold and to establish different circuit connections after flame is obtained. In this way the switching means automatically prevents the starting of the fuel burner apparatus under improper and dangerous conditions so as to avoid any accumulation of liquid fuel or vapors in the combustion chamber of the furnace with the resultant possibility of dangerous explosions.

Such switching means are usually so adjusted and so connected to the thermo-sensitive device that a minimum of increase in temperature in the combustion chamber of the furnace due to initiation of flame effects operation of the switching means from its "starting position" to its "running position" and that the switching means thereafter is maintained in its running position notwithstanding continued functioning of the thermo-sensitive device due to continued increase

in temperature in the combustion chamber of the furnace.

An important object of my invention is the provision in a control mechanism of the type above outlined of improved safety means for effecting operation of the switching means from the "running position" to the "starting position" either upon mechanical failure of the thermo-sensitive device or upon operation of the thermo-sensitive device in excess of a predetermined limit due to an increase in temperature in the combustion chamber in excess of a predetermined safe degree.

More specifically an object of my invention is the provision of improved electric circuit controlling mechanism embodying a movable circuit controlling element operable from one limiting circuit controlling position to a second limiting circuit controlling position by movable response of a thermo-sensitive device due to an increase in temperature with means providing for the continuation of the movement of the thermo-sensitive device after the circuit controlling element has reached the second limiting circuit controlling position and with means for effecting reverse movement of the circuit controlling element from the second circuit controlling position to the first circuit controlling position either upon failure of the thermo-sensitive device or upon movement of the thermo-sensitive device past a predetermined limit due to an increase in temperature to a dangerous degree.

Other objects of my invention and the detailed manner in which my invention is carried out will be understood from the following description taken in conjunction with the accompanying drawing in which

Fig. 1 is a diagrammatic illustration of the manner of incorporating my invention in the circuit controlling mechanism of an electrically operated liquid fuel burner furnace,

Fig. 2 is a sectional elevation diagrammatically illustrating the details of construction of one embodiment of my invention, and

Figs. 3 and 4 diagrammatically illustrate steps in the operation of the mechanism illustrated in Fig. 2.

Referring to Fig. 1, numeral 10 designates a vertical type boiler furnace having a combustion chamber 11 in the top of which is an opening for the seating of a burner head unit 12 provided with an oil and air nozzle 13 and ignition electrodes 14. Oil, atomizing air and primary combustion air are supplied under proper pressure to the nozzle 13 by the combined blower compressor unit

15 which is energized from the electrical supply line 16 through the automatic control apparatus represented at 17. 18 designates a room thermostat for initiating operation of the control apparatus. For a detailed description of the operation of the various elements of the burner and control apparatus above referred to, reference should be had to the following copending applications: H. S. Woodruff, Serial No. 676,651, filed June 20, 1933, for the boiler furnace 10; W. O. Lum and J. Eaton, Serial No. 691,320, filed September 28, 1933, for the burner head 12; W. O. Lum, Serial No. 553,119, filed July 25, 1931, and Serial No. 737,063, filed July 26, 1934, for the blower compressor 15; John Eaton, Serial No. 735,103, filed July 14, 1934, for the control apparatus 17; and W. N. Mischler, Serial No. 715,631, filed March 15, 1934, for the room thermostat 18, all of which above enumerated applications are assigned to the assignee of the present invention. However, a sufficient description of the operation of the various elements of the burner and control apparatus above referred to will be given hereinafter for a proper understanding of the present invention. It is to be understood that it is not intended that the present invention be limited by the details of the specific apparatus herein illustrated.

Numeral 20 designates an embodiment of a thermal responsive control mechanism constructed in accordance with my invention and the details of which are shown in Fig. 2. Embodied in the control mechanism 20 are contact 21, hereinafter designated the "cold" contact, contact 22, hereinafter designated the "hot" contact, and contact element 23, which are connected by leads 24, 25 and 26, respectively, to be integral parts of control apparatus 17. Contacts 21 and 22 are fixedly mounted on supporting plate 27 by any suitable means such as bolts 28 and are insulated from each other and from the plate 27 by means of plate 30 and bushings 31 of insulating material. As will be seen from Fig. 2 the fixedly mounted contacts 21 and 22 are so constructed and arranged that they are supported in spaced apart relation to each other in a manner to limit the range of movement of the contact element 23 both in an upward and downward direction.

Contact element 23 is mounted upon movable control arm 32 which may be of insulation material. The end of the control arm 32 remote from the contact element 23 is mounted upon operating arm 33 by means of an over-running connection, and arm 33 is arranged to rotate in two directions about pivot 34 which is carried by stud 35 mounted on the supporting plate 27.

The over-running connection by which control arm 32 is mounted upon the free end of operating arm 33 is illustrated as comprising pivot pin 36, about which arm 32 may rotate with relation to arm 33, and resilient washers, one of which is shown at 37, which tend to press the ends of the two arms into frictional engagement with each other. The object of the pivotal frictional connection between the two arms is to constrain arm 32 to move as a unit with arm 33 so long as arm 32 is not impeded in its progress, as by either one of the motion limiting contacts 21 or 22, and after engagement of contact element 23 with either of the fixed contacts, to provide for relative movement of the arm 32 with respect to the arm 33 in order that arm 33 may continue to rotate in either direction about its pivot while contact element 23 is maintained in engagement

with one of the fixed contacts. It will be evident to one skilled in the art that various forms of over-running connections, other than the specific form illustrated, may be used, the object being to secure the unitary movement of one member in response to movement of another member until the one member or a part thereof is impeded in its progress by a motion limiting device and which connection thereafter affords relative movement between the two members.

In the illustrated embodiment of the invention, movement of the operating arm 33 in two directions is effected by means of biasing spring 40 and thermo-sensitive device 41. The biasing spring 40 is connected in any suitable manner between the operating arm 33 and the supporting plate 27 in such manner that it is under tension and the force thereof tends to influence movement of the operating arm 33 in a counterclockwise direction as viewed in the drawing.

Thermo-sensitive device 41 is so connected to the operating arm 33 that it normally opposes movement of the arm in the counterclockwise direction under the influence of the biasing spring 40. The thermo-sensitive device comprises an outer casing 42 which is made of nichrome and which is rigidly mounted in an opening in the supporting plate 27 by means of screw threaded connections 43, an inner quartz rod 44 and an extension rod 45, the last of which elements is connected to the operating arm 33 by means of a lost motion connection such as that diagrammatically illustrated at 46. The nichrome casing and the quartz rod have different coefficients of expansion which result in the movement of the quartz rod with respect to the plate 27, upon which the casing 42 is mounted, in response to temperature variations due to the conditions of combustion of the fuel. The lower end of the quartz rod 44 abuts against the inner lower end of the casing 42 and the upper end of the rod is accommodated by a seat provided at the lower end of the extension rod 45. The particular construction of the thermo-sensitive device 41 and the details of arrangement of the thermo-sensitive device and the operating arm 33 are not to be taken as imposing limitations upon my invention since it will be evident to one skilled in the art that various forms of thermo-sensitive devices are similarly suitable and various arrangements of the thermo-sensitive device and the operating arm 33 are possible to effect like desired results.

An additional motion limiting or tripping device is provided in the form of a stop 50 rigidly mounted upon supporting plate 27 and having a horizontal portion 51 arranged transverse to the control arm 32 and positioned to engage the control arm intermediate the contact element 23 and the pivotal frictional connection 36—37 upon movement of the control arm to a predetermined limit after engagement of the contact element 23 with the fixed contact 22.

In operation the control apparatus 17 is normally effective when the burner apparatus is not in operation, as described in detail in the previously referred to application of John Eaton, Serial No. 735,103, to establish starting connections for the burner apparatus preparatory to initiation of operation thereof. A call for heat by the thermostat 18 causes energization of control apparatus 17 to effect starting of the blower-compressor 15 and energization of the electrodes 14 whereby fuel and air are supplied to the nozzle 13 of the burner head 12 and ignited to produce

flame in the combustion chamber 11 of the furnace 10. During nonoperation of the burner apparatus when no flame is present within the combustion chamber, the nichrome casing 42 of the thermo-sensitive device 41 is in its contracted state causing the quartz rod 44 to force the operating arm 33 in a clockwise direction, as viewed in the drawing, in opposition to the force of the biasing spring 40, thus forcing the contact element 23 into engagement with fixed "cold" contact 21. Upon initiation of flame in the combustion chamber, the casing 42 expands and the force opposing the action of biasing spring 40 is thereby decreased in accordance with increase in the temperature of the burning fuel. Operating arm 33 is caused to rotate in the counterclockwise direction about the pivot 34 and control arm 32 moves as a unit therewith in the counterclockwise direction due to the constraint imposed by the friction producing washers 37 of the pivotal frictional connections 36-37. Control arm 32 continues to rotate in the counterclockwise direction as a unit with operating arm 33 until contact element 23 engages fixed "hot" contact 22 when further motion of the contact element 23 in the counterclockwise direction is prevented.

Movement of the contact element 23 away from engagement with fixed contact 21 (the "cold" contact) and into engagement with fixed contact 22 (the "hot" contact) causes disruption of the starting connections of control apparatus 17 and establishment of running connections for the fuel burner apparatus. It is, of course, desirable that this change of connections be made in a minimum of time after initiation of flame within the combustion chamber and hence the control mechanism is so adjusted that a minimum of expansion of the casing 42 of the thermo-sensitive device effects movement of the control element 23 from contact 21 to contact 22. Further expansion of the casing 42 due to continued rise in temperature within the combustion chamber continues to lessen the force opposing the action of biasing spring 40 and results in continuation of the rotation of the operating arm 33 in the counterclockwise direction. During this continued movement of the operating arm 33 the contact element 23 remains in engagement with the fixed contact 22 as shown in Fig. 3 and the control arm 32 is rotated in a substantially clockwise direction about the contact 22 as a pivot point until the control arm comes into engagement with the horizontal transverse arm 51 of the stop 50, the two arms 32 and 33 moving relative to each other throughout this continued movement of the arm 33.

The position of the stop 50-51 is so adjusted that it is engaged by the control arm 32 only upon rotation of the operating arm 33 past a predetermined limit due to increase of temperature within the combustion chamber to a dangerous degree. If the burner apparatus functions properly and such dangerous temperature conditions do not occur, the contact element 23 remains in engagement with the contact 22 until, upon satisfaction of the call for heat by the thermostat 18, the control apparatus 17 automatically functions to disrupt the running connections of the burner apparatus and to establish the starting connections as set forth in detail in the previously referred to Eaton application. Upon cessation of flame within the combustion chamber, the casing 42 of the thermo-sensitive device 41 immediately begins to contract and a minimum of movement

of the quartz rod 44 in opposition to the biasing spring 40 rotates the operating arm 33 in the clockwise direction, the control arm 32 moving as a unit therewith with the result that contact element 23 is moved from engagement with contact 22 into engagement with contact 21. Continued contraction of the casing 44 produces continued movement of the operating arm 33 in the clockwise direction which in turn produces movement of the control arm 32 is a substantially counterclockwise direction about the contact 21 as a pivot point while the contact element 23 is maintained in engagement with the contact 21. Thus it will be seen that the control mechanism is effective to transfer the contact element 23 from either of the fixed contacts to the other upon initiation of a relatively small change in temperature.

If, after establishment of combustion within the combustion chamber 11, the temperature thereof continues to rise to a dangerous degree after movement of the contact element 23 into engagement with the "hot" contact 22, the continued expansion of the casing 42 effects movement of the control arm 32 into engagement with the stop 50-51 as previously pointed out and as illustrated in Fig. 3. Further increase in temperature in excess of the predetermined safe degree causes such continued expansion of the casing 42 that operating arm 33 continues to move in a counterclockwise direction to effect movement of the control arm 32 in a substantially clockwise direction about the stop 50-51, thereby disengaging the contact element 23 from contact 22 and producing engagement thereof with "cold" contact 21 as shown in Fig. 4. As a result, the control apparatus 17 is energized in a manner to disrupt the running connections of the burner apparatus and establish the starting connections therefor, thus shutting down the burner apparatus either permanently or preparatory to recycling operations as determined by the characteristics of the particular control apparatus employed.

In addition to the safety operation of my improved control mechanism as just outlined, the mechanism also operates in a similar manner to prevent unsafe operation of the burner apparatus in case of mechanical failure of the very essential thermo-sensitive device 41. From an understanding of the operation of the control mechanism as previously set forth, it will be evident that upon failure of any part of the thermo-sensitive device, such for instance as the casing 42 or the quartz rod 44, or the extension rod 45, the force in opposition to the biasing spring 40 is removed and the operating arm 33 is rotated in a counterclockwise direction about pivot 34. If such mechanical failure occurs prior to initiation of combustion within the furnace, the control element 23 is rotated first into engagement with the contact 22, whereas if such failure occurs subsequent to initiation of combustion, the contact element 23 is already in engagement with the contact 22. Then upon failure of the thermo-sensitive device the operating arm 33 is rotated under the influence of the biasing spring 40 to effect engagement of the control arm 32 with the stop 50-51 which in turn effects movement of the contact element 23 from engagement with contact 22 into engagement with contact 21 where it is permanently held due to the force of the biasing spring 40 until proper repairs are made to the thermo-sensitive device.

From the foregoing discussion it will be seen

that my improved control mechanism not only provides an additional check upon the operation of the fuel burner apparatus but also provides a "fail-safe" mechanism whereby operation of the fuel burner apparatus is prevented in case of mechanical failure of the thermo-sensitive device or flame detector.

The embodiment of the invention illustrated and described herein has been selected for the purpose of clearly setting forth the principles involved. It will be apparent, however, that the invention is susceptible of being modified to suit the different conditions encountered in its use and of being adapted to other similar applications, and I therefore, aim to cover by the appended claims all the modifications within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a thermal responsive electric circuit controlling mechanism, the combination of means including a pair of relatively movable control members movable as a unit for opening and closing an electric circuit upon variation in temperature in opposite directions and having relative movement for maintaining said circuit closed during continuation of variation in temperature in one direction, and means controlling the relative movement between said control members for opening said circuit upon continuation of the variation in temperature in said one direction past a predetermined limit.

2. In a thermal responsive electric circuit controlling mechanism, the combination of means for closing a first electric circuit in response to variation in temperature in one direction and for opening said first circuit and closing a second electric circuit in response to variations in temperature in the opposite direction, means included in said first mentioned means for maintaining said second circuit closed upon continuation of the variation in temperature in said opposite direction, and means operative upon continuation of the variation in temperature in said opposite direction past a predetermined limit for opening said second circuit and closing said first circuit.

3. In a thermal responsive electric circuit controlling mechanism, the combination of means for closing a first circuit in response to temperature decrease and for closing a second circuit in response to temperature increase, means included in said first mentioned means for maintaining said second circuit closed during continuation of an increase in temperature after said second circuit is closed and means operative upon continuation of such increase in temperature past a predetermined limit for opening said second circuit and reclosing said first circuit.

4. A thermal responsive electric circuit controlling mechanism including a movable contact, operating means movable in accordance with temperature variation, means interconnecting said movable contact and said operating means for effecting movement of said movable contact as a unit with said operating means, means including a fixed contact for limiting the movement of said movable contact due to temperature variation in one direction, said operating means being movable in accordance with temperature variation in said one direction a distance in excess of that necessary to effect engagement of said contacts and said interconnecting means including means providing for relative movement between said operating means and said movable contact

upon continued movement of said operating means due to continued temperature variation in said one direction after engagement of said contacts, and means operable upon continuation of such temperature variation in said one direction past a predetermined limit for effecting disengagement of said contacts.

5. Electric circuit controlling mechanism including operating means movable in different directions, a movable contact, means interconnecting said operating means and said movable contact for effecting movement of said movable contact as a unit with said operating means, means including a fixed contact for limiting the movement of said movable contact in one direction, said operating means being movable in said one direction a distance in excess of that necessary to effect engagement of said contacts, and said interconnecting means including means providing for relative movement between said operating means and said movable contact upon continued movement of said operating means in said one direction after engagement of said contacts, and means operable upon continuation of the movement of said operating means in said one direction past a predetermined limit for effecting movement of said movable contact in the opposite direction out of engagement with said fixed contact.

6. Electric circuit controlling mechanism including operating means movable in two directions, a movable contact, means interconnecting said operating means and said movable contact for effecting movement of said movable contact as a unit with said operating means, means including a pair of fixed spaced apart contacts for limiting the movement of said movable contact in both directions, said operating means being movable in each direction a distance in excess of that necessary to effect engagement of said movable contacts with one of said fixed contacts and said interconnecting means including means providing for relative movement between said operating means and said movable contact upon continuation of the movement of said operating means after engagement of said movable contact with either of said fixed contacts, and means operable upon continuation of the movement of said operating means in one direction past a predetermined limit after engagement of said movable contact with one of said fixed contacts for effecting reverse movement of said movable contact out of engagement with said last mentioned one fixed contact and into engagement with the other of said fixed contacts.

7. In an electrical switching mechanism, the combination of a movable switch arm having a contact element mounted on one end thereof, means connected to said arm for moving said arm in two directions, means including a pair of fixed contacts for determining the range of movement of said element, means providing for continuation of the movement of the other end of said arm in both directions after said contact element engages one of said fixed contacts and means operative upon continuation of the movement of said other end of said arm in one of said directions past a predetermined limit for moving said contact element out of engagement with the one of said fixed contacts which limits the movement of said element in said one direction and into engagement with the other of said fixed contacts.

8. In a furnace having selectively operable fuel burner means for producing combustion therein and electrical energizing circuits for the fuel

burner means, means operable upon a decrease in temperature within the furnace for establishing a predetermined set of electrical connections and operable upon an increase in temperature within the furnace for establishing a second predetermined set of electrical connections, means included in said first mentioned means for maintaining said second set of connections upon continuation of the increase in temperature after said second set of connections is established, and means operable upon continuation of the increase in temperature past a predetermined limit for disrupting said second set of connections and re-establishing said first set of connections.

9. In a furnace having electrically operated fuel burner means for producing combustion therein and electrical energizing means including a fixed "cold" contact and a fixed "hot" contact therefor, a movable switch arm having a contact element mounted on one end thereof, operating means including a movably responsive thermosensitive device subjected to temperature variation within the furnace and connected for moving said arm in two directions in accordance with changes in temperature, means including said "cold" contact for limiting the movement of said contact element due to a decrease in temperature, means including said "hot" contact for limiting the movement of said contact element due to an increase in temperature, means providing for continuation of the movement of the other end of said arm remote from said contact element due to either further decrease or further increase in temperature after movement of said contact element into engagement with said "cold" contact or said "hot" contact respectively, and means operative upon continuation of the movement of said other end of said arm due to increase in temperature in excess of a predetermined limit for moving said contact element away from engagement with said "hot" contact and into engagement with said "cold" contact.

10. In a furnace having electrically operated fuel burner means and an electrical energizing circuit therefor, switching means including an arm pivotally mounted at one end with the other end free to move, a second arm pivotally and frictionally mounted on the free end of said first arm for unitary movement therewith, an electric contact element mounted on the free end of said second arm and connected in said circuit, a second electrical contact connected in said circuit and fixedly mounted in position to limit the movement of said contact element in one direction, biasing means connected to effect movement of said first arm in said one direction, means normally operative for opposing movement of said first arm in said one direction and for maintaining said contact element and said fixed contact in disengagement, said last mentioned means including a thermo-sensitive device subjected to the temperature within said furnace and cooperative with said biasing means upon a temperature increase for moving said first arm in said one direction to effect engagement of said contact element and said fixed contact, said pivotal frictional mounting serving to provide for continuing movement of said first arm in said one direction after said contact element engages said fixed contact, and an abutment positioned to engage said second arm intermediate said contact element and said pivotal frictional connection upon movement of said first arm in said one direction to a predetermined limit whereby movement of said first arm past said limit oper-

ates to rotate said second arm about said abutment and effects disengagement of said contact element and said fixed contact.

11. Electric circuit controlling mechanism including a movable contact, operating means connected to move said movable contact in two directions, means including a fixed contact for limiting the movement of said movable contact in one direction, biasing means connected to said operating means for moving the same in said one direction, other means connected to said operating means and variably operable for opposing said biasing means, said movable contact being operable into engagement with said fixed contact upon decrease in the opposing force of said other means, and means cooperating with said biasing means upon decrease of the opposing force of said other means in excess of a predetermined amount after engagement of said contacts for effecting disengagement of said contacts.

12. Electric circuit controlling mechanism including operating means movable in different directions, movable control means, a contact carried by said control means and movable therewith, means including a fixed contact for limiting the movement of the movable contact in one direction, means interconnecting said operating means and said control means for effecting movement of said control means as a unit with said operating means whereby movement of said operating means in said one direction effects movement of said movable contact into engagement with said fixed contact to energize an electric circuit, said operating means being movable in said one direction a distance in excess of that necessary to effect engagement of said contacts and said interconnecting means including means providing for relative movement between said operating means and said control means upon continued movement of said operating means in said one direction after engagement of said contacts, and means operable upon continuation of the movement of said operating means in said one direction past a predetermined limit after engagement of said contacts for effecting de-energization of said electric circuit.

13. A control mechanism including operating means movable in different directions, a movable member, a control element carried by said member, means for limiting the movement of said element in one direction, means interconnecting said operating means and said member for effecting movement of said member as a unit with said operating means whereby movement of said operating means in said one direction effects movement of said element into engagement with said movement limiting means, said operating means being movable in said one direction a distance in excess of that necessary to effect engagement of said element with said movement limiting means and said interconnecting means including means provided for relative movement between said operating means and said member upon continued movement of said operating means in said one direction after engagement of said element with said movement limiting means, and means operable upon continuation of the movement of said operating means in said one direction past a predetermined limit for effecting movement of said element in the opposite direction away from said movement limiting means.

14. A control mechanism including a movable control element, operating means connected to move said element in two directions, means for limiting the movement of said element in one

direction, biasing means connected to said operating means for moving the same in said one direction, other means connected to said operating means and variably operable for opposing  
5 said biasing means, said element being operable into engagement with said movement limiting means upon decrease in the opposing force of said other means, and means cooperating with  
10 said biasing means upon mechanical failure of said other means for effecting reverse movement of said element away from said movement limiting means.

15. A control mechanism including in combination a movable control member, operating  
15 means connected thereto for moving the same in two directions, means for limiting the movement of one end of said member in one direction, means cooperating with said last mentioned means for maintaining said one end of said member in the limited position thereof upon continuation of the movement of the other end of  
20 said member in said one direction, and means for effecting reverse movement of said one end of said arm away from said limited position upon  
25 continuation of the movement of said other end of said member in said one direction past a predetermined limit.

16. A control mechanism including in combination a movable control arm, operating means  
30 connected thereto for moving the same in two directions, means for limiting the movement of one end of said control arm in each direction, means providing for continuation of the movement of the other end of said control arm after  
35 said one end of said arm has reached one of said movement limiting means and means operative upon continuation of the movement of said other

end of said control arm in one of said directions past a predetermined limit for moving said one end of said control arm away from the one of said movement limiting means which limits the movement of said one end of said control arm in  
5 said one direction and into engagement with the other one of said movement limiting means.

17. A mechanism including in combination a movable member, means for moving said member in two directions, a second member having one  
10 end frictionally mounted on said first member for effecting movement of said second member as a unit with said first member and means cooperating with said first member upon movement of the same in one of said directions past  
15 a predetermined limit for effecting movement of the free end of said second member in the other of said directions.

18. A mechanism including in combination an arm pivotally mounted at one end, means for  
20 rotating said arm in opposite directions about the pivotal mounting, a second arm pivotally and frictionally mounted at one end upon the free end of said first arm for rotation therewith, means including a stop for limiting the movement in one direction of the free end of said  
25 second arm, and a second stop arranged to engage said second arm intermediate the free end thereof and the pivotal frictional mounting upon rotation of said first arm in said one direction  
30 to a predetermined limit, said second stop serving as a pivot about which said second arm is rotated by movement of said first arm past said limit and whereby said free end of said second arm is rotated in a direction substantially opposite to said one direction.  
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