April 27, 1937. O. F. CARLSON 2,078,441

LIMIT SWITCH

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Fig. 1.

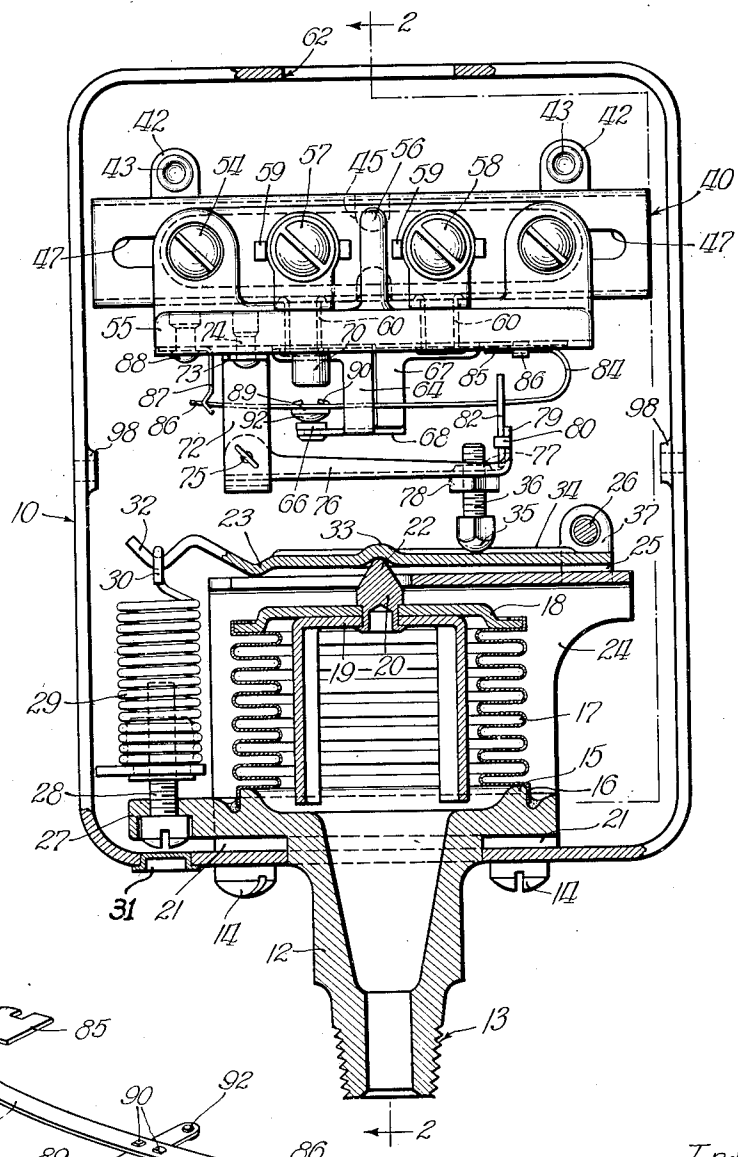


Fig. 6.

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Fig. 2.

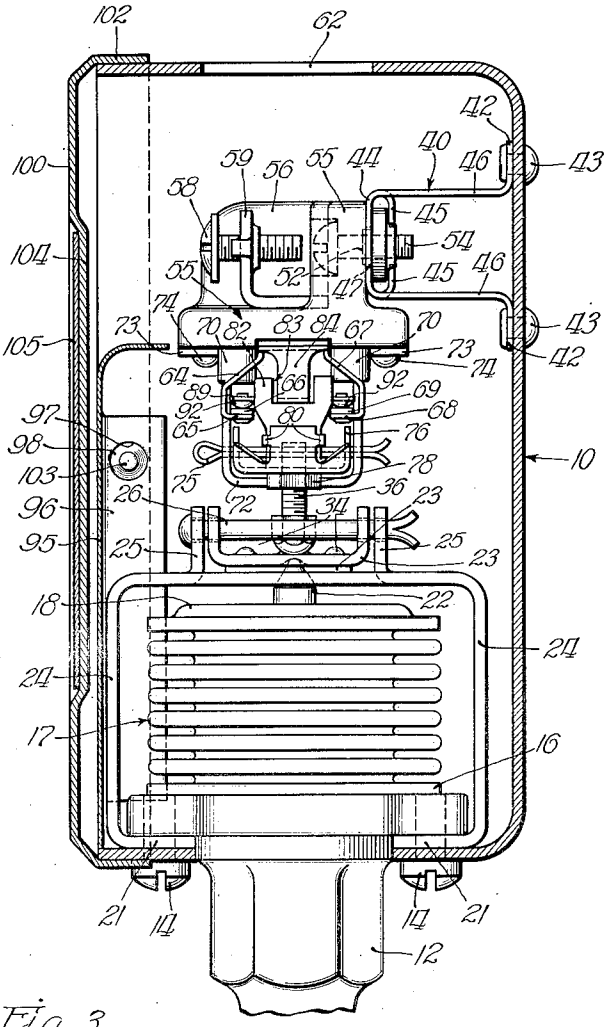


Fig. 3.

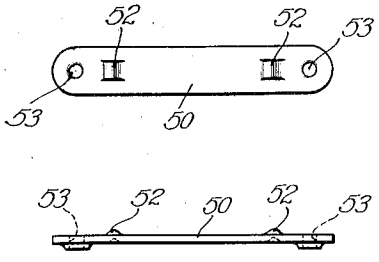
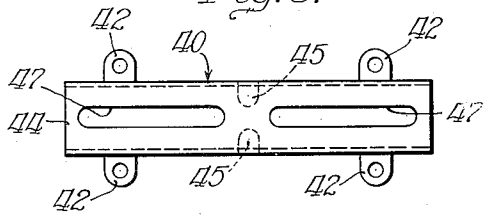


Fig. 4.

Fig. 5.



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UNITED STATES PATENT OFFICE

2,078,441

LIMIT SWITCH

Oscar F. Carlson, Chicago, Ill., assignor to Oscar F. Carlson Company, Chicago, Ill., a corporation of Illinois

Application November 16, 1935, Serial No. 50,131

15 Claims. (Cl. 200—83)

This invention relates to limit switches, and more particularly is directed to limit switches for use in connection with oil burners and similar oil utilizing devices employing a storage tank for feeding oil to the burner equipment. However, the switch can be employed as a limit control for any type of fluid storage tank or pressure system in which operation of the switch in response to changes in a pressure responsive element is desired.

In my copending application, Serial No. 5,893, filed February 11, 1935, of which the present application is a continuation in part, I disclose a control switch of this type for indicating the lowering of level in an oil supply tank for a burner or the like. The present invention is directed more particularly to a switch structure responsive to variations in pressure and capable of controlling a circuit or circuits in accordance with any desired pressure setting of a source of pressure to which the switch is connected.

One of the primary objects of the present invention is to provide a pressure limit switch in which the circuit controlling member is positively snapped from pressure engagement with its contacts out of engagement therewith, independently of the rate of expansion or contraction of the pressure responsive member.

Another object of the present invention is to provide a switch actuating member in which rate of movement can be varied as desired with respect to a predetermined rate of movement of a pressure responsive element.

Another object of the present invention is to provide a motion transmitting lever pivoted at one end, having an adjustable tensioning means on the opposite end, with a pressure responsive member engaging one side of the lever intermediate its ends, and a switch actuating lever having adjustable engagement with the opposite side of said lever, whereby the movement of the lever constitutes a differential between the spring tension and the pressure within the pressure responsive member, and is transmitted proportionately to the switch operating lever, depending upon the point of engagement of the latter with the motion transmitting lever.

Still another object of the present invention is to provide a slidable contact carriage which may be moved into selected positions with respect to the switch operating mechanism to produce different rates of operation of the switch per unit operating movement of the operating mechanism.

Another feature of the present invention is the provision of a compact, simplified limit switch which is capable of many calibrations for effecting actuation of the switch at any desired pressures.

Still another feature of the present construction is that the majority of the operating parts may be formed of metal stampings or the like, and may be quickly and readily assembled into position with a minimum of adjustment and labor.

A still further object of the present invention is the provision of a pressure responsive switch employing a leaf spring contact carrying member maintained slightly arched under longitudinal compression, actuation of the member being produced by exertion of force upon the spring normal to its longitudinal surface. This produces an endwise component of stress, increasing the normal longitudinal compression on the spring, and thereby producing abrupt lateral flexing of the spring intermediate its ends in the direction over center away from the force. One or more stationary contacts may be engaged by the spring, and provide abutments restraining its flexing movement, whereby a positive pressure contact is provided between the spring member and the contacts engaged thereby.

Another advantage secured by the present invention is the provision of an insulating base member securing the contacts, the leaf spring contact and the external terminal lugs in position, which can be removed from the switch as a unit for inspection, repair, or replacement.

Other objects and advantages of the present invention will appear more fully from the following detailed description, which, taken in connection with the accompanying drawings, will disclose to those skilled in the art the particular construction and operation of a preferred form of my present invention.

In the drawings:

Figure 1 is a vertical sectional view through a control limit switch of the present design;

Figure 2 is an end sectional view, taken substantially on line 2—2 of Figure 1;

Figures 3 and 4 are front and top views, respectively, of the switch clamping plate;

Figure 5 is a front elevational view of the switch mounting bracket for carrying the switch assembly; and

Figure 6 is a perspective view of the leaf spring contacting member.

Referring now in detail to the drawings, I provide a generally rectangular box-like housing 10 having an enlarged opening at its lower end adapted to receive the extending portion of a fitting 12 which at its lower end is threaded,

as indicated at 13, for connection to any suitable pressure supply line or the like. The fitting is mounted within the inner surface of the base of the housing 10 by means of a plurality of screw members 14, and upon its inner surface is provided with an annular shoulder portion 15 receiving the end 16 of a hollow flexible sylphon bellows member 17, which is sealed or otherwise suitably secured about the shoulder 15 to have pressure tight engagement therewith.

The upper end of the bellows 17 is provided with a closure plate 18, to which the upper end flange of the bellows is sealed, the plate 18 carrying a depending reenforcing member 19 secured thereto by means of the rivet member 20, which is provided with a conical head portion 22 adapted to engage a pivoted lever 23 mounted upon the U-shaped bracket 24. The bracket 24 is provided with inturned ends 21 clamped beneath the lower flange portion of the fitting 12 by the screws 14, and includes a central slotted portion in the upper horizontal surface thereof. The bracket at one end is provided with the upstruck ear members 25 forming a support for the pivot pin 26 upon which the lever 23 is pivoted.

The fitting 12 is provided with a laterally extending lug portion 27 which is adapted to receive the screw member 28 therein, this member serving as a suitable support for the lower end of a compression spring member 29, which at its upper end is provided with the hooked portion 30 engaging over the crimped end 32 of the lever 23, thereby biasing the lever 23 in a counterclockwise direction about the pivot pin 26. A suitable knock-out cap 31 provides access to the head end of screw 28 to provide for adjustment of the spring tension.

The lever 23, at the point of engagement with the conical head portion 22 of the rivet member 20, is provided with an upstruck portion 33 serving as a bearing seat for the conical head of the member 20. Extending longitudinally of the lever 23 are a pair of spaced rib members 34, which serve as stiffening means for the lever 23. The surface of the lever between the ribs 34 is adapted to receive the head portion 35 of the actuating bolt 36. The lever 23 is provided with upstruck ears 37 which have pivotal engagement about the pin 26 between the ears 25 of the bracket 24, as clearly shown in Figure 2.

Considering now the switch operating mechanism of the construction, I provide a switch mounting bracket 40, shown in more detail in Figure 5, having a plurality of normally extending ear portions 42 apertured to receive suitable rivet members 43 for securing the same to the rear wall of the housing 10. The bracket 40 comprises a substantially planar vertically extending portion 44, having the inturned tab portions 45 bent inwardly and rearwardly between the oppositely disposed horizontally extending arms 46 which space the channel portion 44 outwardly away from the rear wall of the housing 10. The front face of the bracket member 40 is provided with a pair of spaced slots 47 extending longitudinally thereof, and disposed upon opposite sides of the tab members 45.

Mounted within the channel portion of the bracket 40 is a sliding carrier member disclosed more in detail in Figures 3 and 4. This member comprises a metal strip 50 having a longitudinal extent less than the extent of the bracket member 40, the strip being provided with upstruck bosses 52 adapted to have engagement within the slots 47 for guiding the member 50 for longitudinal sliding movement within the bracket. The carrier member 50 is also provided with a pair of threaded openings 53 disposed adjacent the outer ends thereof, which openings are aligned with the slots 47 and are adapted to receive suitable screw members 54 which pass through and secure an insulating housing member or terminal block 55 to the carrier member 50 for conjoint sliding movement therewith.

The member 55 is provided with a central normally extending rib portion 56 forming an insulating separation for the two terminal screws 57 and 58, these terminal screws passing through suitable terminal lugs 59 which are riveted, as by means of the rivets 60, to the normally extending base portion of the housing member 55. A suitable opening 62 is formed in the upper surface of the housing and serves as a means for passing an armored cable or the like thereinto to connect suitable conductors to the terminal screws 57 and 58.

The terminal screw 57, through the lug 59 and the corresponding rivet 60, is connected to a contract carrying bracket 64, which bracket is provided with a horizontally extending portion 65 carrying a contact 66 disposed beneath the base portion of the housing and within the peripheral limits thereof. The contact 66 is somewhat resilient due to this type of mounting. Similarly the terminal screw 58, through its lug 59 and rivet 60, is electrically connected with a bracket member 67 having the horizontally extending portion 68 carrying the contact 69. These two contacts are in the same horizontal plane, and are disposed in laterally spaced positions beneath the base of the housing 55. Preferably formed integral with the housing 55 and projecting downwardly from the base thereof are a pair of abutment stop members 70 which have their end faces lying in the same horizontal plane, and which are spaced directly above each of the contacts 66 and 69.

It will be noted that the rivets 60 serve to support the terminal lugs in position upon the upper portion of the housing 55, and at the same time serve to support the brackets 64 and 67 in position projecting from the lower portion of the housing.

A suitable U-shaped bracket member 72 having outwardly extending ear portions 73 riveted, as indicated at 74, to the base of the housing, provides a depending hanger for receiving the pivot pin 75 engaging one end of the actuating lever 76 for pivotal movement thereabout. The actuating lever 76 is provided with longitudinally extending web portions providing stiffness for the member, and adjacent its outer end is provided with a suitable tapped opening 77 receiving the threaded portion of the screw member 36, this member 36 being locked in any desired adjusted position with respect to the lever 76 by means of the lock nut 78.

At its outer free end, the lever 76 is provided with an upturned end portion 79, having a pair of normally extending ears 80 adapted to secure the insulating actuating plate 82 thereto. This plate 82 is provided with a recessed end forming a slot 83 adapted to receive the longitudinally extending portion of a leaf spring member 84 shown in more detail in Figure 6.

The spring member 84 is provided with a reversely curved thickened flat end portion 85 adapted to be anchored to the bottom face of the housing 55 by suitable lugs 86 formed integral with the bracket 67. The spring mem-

ber 84 is thus U-shaped and has the extending leg thereof disposed between the two brackets 64 and 67. Adjacent the opposite end of the terminal block the member 84 has a projecting tip portion passing through the supporting bracket 72 and having an extending end 86 engaged within a suitable slot formed in a resilient normally extending supporting member 87, which member is riveted to the base of the housing 55 by means of the rivet 88. The member 87 provides for longitudinal compression of the spring 84, serving to arch the same over center in opposite directions and maintaining the same under compression to provide for flexing thereof upon movement imparted thereto by the fork member 82. In its normal position the spring is arched outwardly away from the terminal block 55.

Intermediate its ends the spring member is provided with a laterally extending bridging member 89 which is clamped thereto as indicated at 90 and which, at its ends, is provided with contact portions 92 adapted to have pressure engagement with the contacts 66 and 69 when the spring is in the normal position shown in Figure 1. This provides for bridging engagement between the contacts 66 and 69 to complete a circuit between the terminal screws 57 and 58.

In its opposite flexed position, the spring member 84 is moved over center to arch upwardly toward the terminal block, as viewed in Figure 1, whereupon the ends of the bridging member 89 move into abutting engagement with the faces of the stop members 70, thereby retaining the spring in position against further movement and limiting its movement to an extent such that it tends to snap back into its normal position of contact engagement. There is some longitudinal movement of the spring as it moves over center, accommodated by the resilient support 87, whereby the contact portions 92 have wiping pressure engagement with contacts 66 and 69.

In the operation of the limit switch thus far described, pressure from any suitable pressure supply source is admitted through the fitting 12 into the interior of the bellows 17. Increase of pressure results in expansion of the bellows, moving the conical head 22 of the rivet member 20 upwardly. This results in pivoting of the lever 23 about the pin 26, against the pressure of spring 29, and results in clockwise movement of this lever upwardly under the influence of the pressure within the bellows. The head end 35 of the screw 36 is thus raised in position, imparting a counter-clockwise movement to the lever 76, whereby the insulating actuating member 82, which engages the lateral surface of the spring member in a direction normal to its longitudinal extent, causes a flexing of the spring member at the point of engagement. Due to the fact that the spring is restrained to some extent against longitudinal expansion by means of the support member 87, the longitudinal compression of the spring is increased, and the spring snaps over center into abutting engagement with the stop members 70, breaking the circuit between the contacts 66 and 69.

The spring will remain in this position until the pressure within the bellows 17 decreases, whereupon, due to the resilience of the spring, the spring will force the lever 76 downwardly, the head end 35 of the screw 36 following the movement of the lever 23 downwardly under collapse of the bellows, and the spring will then snap back over center into outwardly arched position and the contacts 92 will be forced into positive wiping pressure engagement with the contacts 66 and 69, reclosing the circuit through the terminal screws 57 and 58.

Due to the sliding movement of the member 50 within the bracket 40, it is apparent that by loosening the screws 54 which clamp this member in fixed position by clamping engagement between the housing 55 and the face of the bracket member, the carrying member 50 may be moved longitudinally within the slots 47 to move the entire contact assembly either to the right or left, as viewed in Figure 1. This results in corresponding longitudinal movement of the head end 35 of the screw member 36 with respect to the upper surface of the lever 23, and thereby provides for a differential ratio of movement being imparted to the lever 76, depending upon the point at which the head end 35 engages the lever 23. Thus, with the carriage moved to the extreme right-hand position, a considerably greater expansion of the bellows 17 will be necessary in order to effect actuation of the switch, since the unit movement of the lever 76 per unit movement of the lever 23 is decreased. Correspondingly, if the switch contact carriage is moved to the extreme left-hand position, the movement of the bellows will produce a much greater unit movement of the lever 76 to produce a quicker actuation of the contact spring, due to the fact that the unit movement of the lever 76 is increased with respect to the unit movement of the lever 23.

The adjustment of the tension on spring 29, which restrains the movement of the lever 23 ,is produced by the screw member 28, and preferably this tension is adjusted at the factory, although of course it may be adjusted at the point of installation to provide a predetermined unit movement of the bellows per unit increase in pressure. This loading of the bellows by the spring tension restrains the unit movement of lever 23 per unit increase of pressure in the bellows and also serves to bring lever 23 downwardly simultaneously with the collapse of the bellows, whereby spring 84 can snap over center to drop lever 76 into engagement with lever 23.

It will thus be apparent that I have provided a limit switch in which the unit movement of the operating mechanism can be varied with respect to the unit movement of the actuating mechanism, whereby the switch may be made to respond at various differentials of pressure, depending upon the point at which breaking and making of the circuit is desired.

As shown in Figure 2, I preferably provide a closure plate 95 which has, along its vertically extending edges, inwardly turned flanges 96 provided with suitable openings 97 adapted to be snapped over the bosses 98 formed on the interior surface of the side walls of the housing 10. This provides a protecting shield for the switch contact structure and the bellows operating mechanism, and protects the same from accidental injury or the like. A suitable closure plate or cover for the housing is indicated at 100 and is provided with a peripheral flange portion 102 fitting over the defining edge portion of the face of the housing 10. Suitable screws passing through the threaded openings 103 in the bosses 98 are adapted to secure the closure plate 100 in position over the face of the housing 10. The closure plate 100 may be provided with a central

recessed portion 104 adapted to receive a name plate 105, or similar identifying insignia.

It is therefore believed apparent that I have provided a pressure limit switch in which the controlling member positively snaps into and out of contacting engagement, and in which the rate of operation of the switch mechanism may be varied per unit rate of operation of the actuating mechanism. In addition, the present construction is formed in the major part of metal stampings or the like, and may be readily assembled and installed with a minimum of time and labor.

Having described my invention in accordance with the statutes, what I claim as new and desire to secure by Letters Patent is:

1. A control switch comprising a housing, a pressure responsive element therein, means for introducing fluid under pressure into the interior of said element, a pair of spaced contacts, a contactor normally bridging between said contacts, means comprising a pair of spaced levers extending parallel to each other and to said contactor and pivoted at opposite ends, one of said levers being actuated by said element to actuate the other of said levers in the opposite direction for snapping said contactor out of engagement with said contacts, said contactor having limited longitudinal movement to provide a wiping action across said contacts upon disengagement therefrom, and means for varying the amount of movement imparted by said one lever to said other lever upon unit movement of said one lever.

2. A control switch comprising a pressure responsive element, a leaf spring normally maintained in longitudinal compression and arched toward said element, a contact engaged by said spring in its normal position, an insulated support for said spring, and means actuated by expansion of said element for moving said spring laterally out of normally arched position to snap said spring over center into oppositely arched position, and means on said support for limiting over center movement of said spring whereby upon contraction of said element said spring snaps back into normal position, and means for varying the rate of movement of said snapping means with respect to the rate of expansion of said element.

3. A control switch comprising a leaf spring having a U-shaped end, insulating means anchoring one leg of said end, the opposite leg being extended, means resiliently abutting against the end of the extended leg whereby said leg is normally arched outwardly away from said anchored leg, a pair of contacts on one side of said leg and normally bridged by said spring, means for applying a force to said extended leg intermediate its ends and normal to the surface thereof for snapping said leg over center into oppositely arched position, and means on said anchoring means limiting snap movement of said leg whereby said leg tends to return to normally arched position.

4. A control switch comprising a housing, an insulating terminal member carried thereby, terminal lugs carried by said member, a pair of laterally spaced contacts carried by said lugs within said housing, a leaf spring normally arched into engagement with said contacts, means including a lever movable substantially normal to said spring, a second lever carried by said terminal member and having abutting engagement with said first lever, means carried by said second lever for snapping said spring over center out of contacting engagement, and means for shifting said terminal member in said housing to vary the point of abutting engagement between said levers.

5. In a control switch, a leaf spring member maintained in longitudinal compression and normally arched into circuit closing position, a lever pivoted adjacent one end of said spring and having abutting engagement therewith adjacent the opposite end thereof, a pressure responsive element, a second lever parallel to said first lever and pivoted at its opposite end, said second lever being movable in response to movement of said element, means for transmitting movement of said second lever to said first lever for snapping said spring over center out of circuit closing position, and means for shifting one of said levers longitudinally with respect to the other of said levers for varying the movement imparted to said first lever by said second lever per unit movement of said element.

6. In a control switch, an insulating terminal member, a leaf spring carried thereby and maintained in longitudinal compression, a contact normally engaged by an intermediate portion of said spring, and actuating means for snapping said spring over center out of contact engagement comprising a pressure responsive element, a lever pivoted at one side thereof and movable in response to movement of said pressure responsive element, means carried by said terminal member for transmitting movement of said lever to said spring, and means for varying the unit movement transmitted to said spring per unit movement of said element.

7. In a control switch having a leaf spring contactor maintained under longitudinal compression and normally flexed into arched contact engaging position, actuating means for moving said contactor into oppositely flexed position comprising a pressure responsive bellows, a lever pivoted at one end and extending over said bellows in abutting engagement therewith, spring means engaging the opposite end of said lever for restraining movement of said lever upon expansion of said bellows, a second pivoted lever for transmitting movement of said first lever to said contactor, and means for varying the increment of movement of said second lever per increment of movement of said first lever.

8. Actuating means for a leaf spring contactor type switch in which the spring is normally arched into contact engagement, comprising a pressure responsive element, means for restraining expansion of said element under increase in pressure, pivotally mounted motion transmitting means between said element and said spring for applying a force normal to the longitudinal arch of said spring to snap said spring over center out of contact engagement, and means for varying the rate of transmission of motion through said motion transmitting means.

9. In combination, a housing, a supporting bracket secured therein, a slide carried by said bracket and having longitudinal movement therein, a terminal block, means securing said block to said slide and adapted to clamp said slide in selected positions, a pair of contacts carried by said block, a leaf spring contactor normally arched into engagement with said contacts, actuating means including a pressure responsive bellows and motion transmitting means operated thereby for snapping said contactor over center out of contact engagement, and abutments on said block for limiting snap move-

ment of said contactor whereby said contactor tends to return to normally arched position.

10. In combination, a housing, a supporting bracket secured therein, a slide carried by said bracket and having longitudinal movement therein, a terminal block, means securing said block to said slide and adapted to clamp said slide in selected positions, a pair of contacts carried by said block, a leaf spring contactor normally arched into engagement with said contacts, actuating means including a pressure responsive bellows and motion transmitting means operated thereby for snapping said contactor over center out of contact engagement, said motion transmitting means including a pivoted lever carried by said block whereby upon longitudinal movement of said slide the ratio of movement between said bellows and said lever is varied.

11. In combination, a housing, a supporting bracket secured therein, a slide carried by said bracket and having longitudinal movement therein, a terminal block, means securing said block to said slide and adapted to clamp said slide in selected positions, a pair of contacts carried by said block, a leaf spring contactor normally arched into engagement with said contacts, actuating means carried by said housing including a pressure responsive bellows and a lever movable in accordance with movement of said bellows, and a pivoted lever carried by said block and engageable with said first lever for transmitting movement of said bellows to said contactor to snap said contactor out of contact engagement, longitudinal adjustment of said slide varying the transmission of movement to said second lever per unit movement of said bellows.

12. The combination with a pair of contacts and a pressure responsive element for opening and closing the circuit therebetween, of a leaf spring contactor anchored at one end and having resilient means at the opposite end thereof for maintaining said contactor in longitudinal compression and normally arched over center in one direction, a contact bridging member carried by said contactor intermediate its ends and normally engaged with said contacts, means responsive to expansion of said element for exerting a force on said contactor normal to its longitudinal extent to snap said contactor over center, and means in said force exerting means for varying the ratio between movement of said element and movement of said contactor.

13. A control switch including a pair of contacts, contactor means normally bridging said contacts, a pressure responsive element, a lever pivoted at one side of said element and extending over said element to the opposite side thereof, spring means engaging the free end of said lever and urging said lever downwardly on said element, means on said element for rotating said lever upwardly against said spring means, a second lever pivoted above said free end of said first lever and having point contact adjacent its free end with the surface of said first lever, means on said second lever for moving said contactor means out of contact engagement, and means for shifting said second lever longitudinally to vary the point contact engagement between said levers.

14. In combination, a supporting member, a switch carrier having adjustable sliding engagement therewith, a pressure responsive element movable normal to said carrier, a pair of parallelly extending levers, one pivoted at one end on one side of said element and the other pivoted at its opposite end to said carrier on the opposite side of said element, a contactor carried by said carrier and extending substantially parallel to said levers, and means for transmitting motion of said element through said levers to said contactor, said carrier being adjustable to vary the ratio of movement transmitted to said contactor through said levers per unit movement of said element.

15. A switch housing having a slide support fixed therein, a switch carrier on said support including a resilient contactor and a pivoted lever, said lever extending parallel to said contactor and having abutting engagement therewith at its free end, a second lever extending parallel to said first lever and spaced therefrom, said second lever being pivotally mounted adjacent the free end of said first lever, means providing abutting engagement therebetween intermediate the ends of said levers, and means for shifting said carrier on said support to vary the point of engagement of said first lever with respect to the second lever for modifying the transmission of movement from said second lever to said first lever.

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