

Oct. 14, 1947.

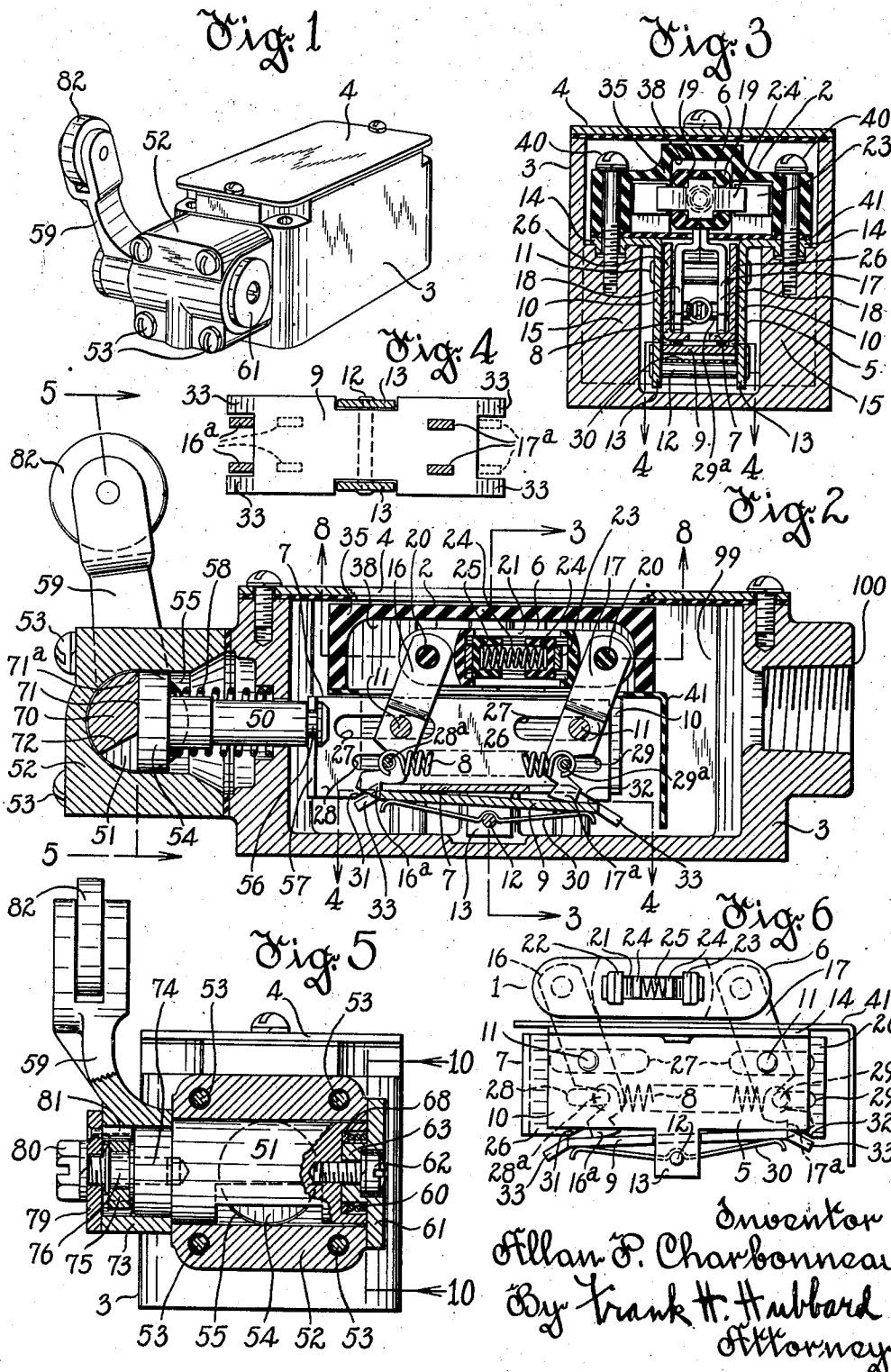
A. P. CHARBONNEAU

2,428,832

CIRCUIT CONTROLLING DEVICE

Filed June 7, 1943

3 Sheets-Sheet 1



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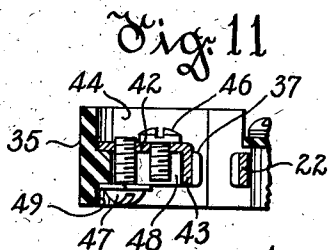
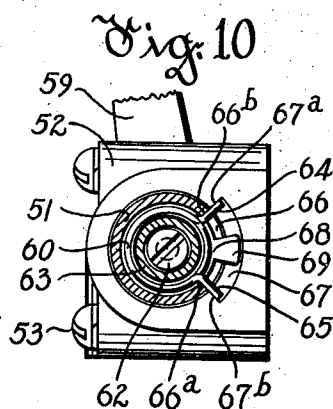
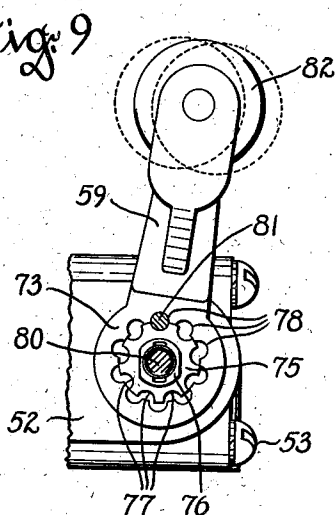
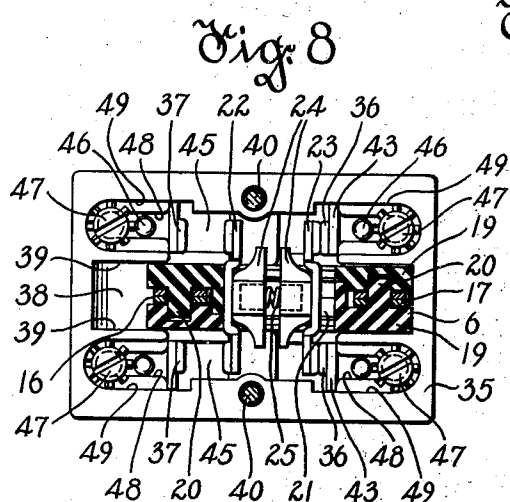
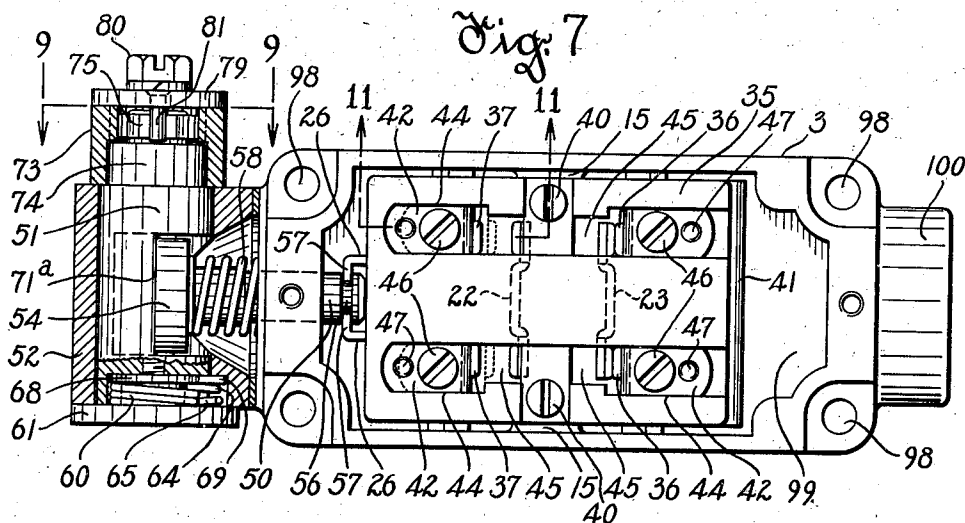
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3 Sheets-Sheet 3

Fig. 12

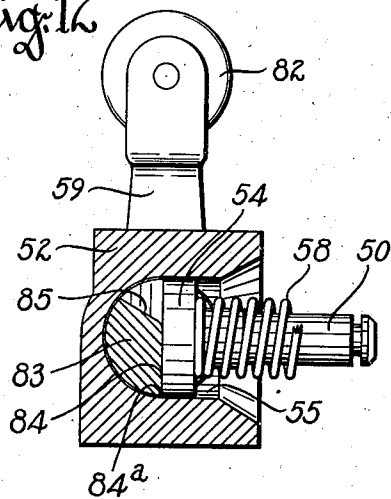


Fig. 13

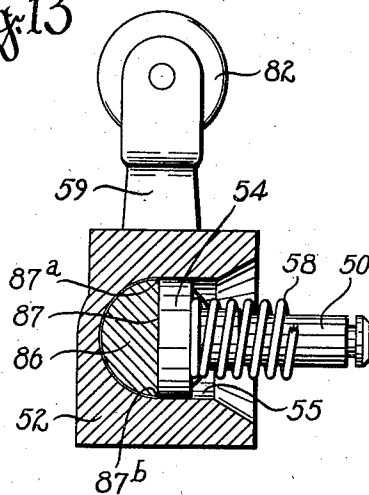


Fig. 14

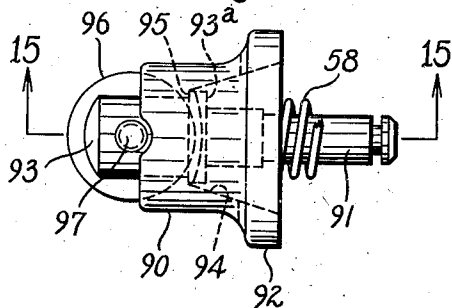
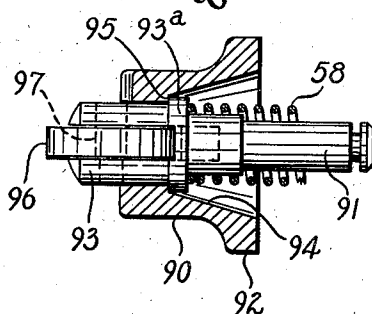


Fig. 15



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UNITED STATES PATENT OFFICE

2,428,832

CIRCUIT CONTROLLING DEVICE

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Application June 7, 1943, Serial No. 489,887

10 Claims. (Cl. 200-70)

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This invention relates to circuit controlling devices, and more particularly to limit switches of the snap action type.

The invention has among its objects to provide an improved snap action limit switch which is exceedingly simple, compact and rugged in construction, positive and reliable in operation, and which is adapted to a variety of uses, as for example in connection with controllers for cranes, hoists and machine tools of various types.

Another object is to provide an improved snap action limit switch which is constructed largely of sheet metal stampings and molded insulating parts capable of being readily manufactured and assembled at low cost.

Another object is to provide an improved limit switch having normally open and normally closed contacts which are readily adjustable to provide for closure of the normally open contacts either before or after opening of the normally closed contacts.

Another object is to provide an enclosed limit switch unit which without change in its construction may be equipped with operating heads of different types for lever or push rod operation thereof.

Another object is to provide a limit switch having an improved lever operating mechanism which is readily adjustable to render the switch adaptable for use in a wide variety of control applications.

Various other objects and advantages of the invention will hereinafter appear.

The accompanying drawings illustrate certain embodiments of the invention which will now be described, it being understood that various modifications may be made in the embodiments illustrated without departing from the spirit and scope of the appended claims.

In the drawings,

Figure 1 is a perspective view of a lever operated limit switch embodying the invention;

Fig. 2 is a longitudinal sectional view of the limit switch shown in Fig. 1;

Figs. 3, 4 and 5 are sectional views on lines 3-3, 4-4 and 5-5, respectively of Fig. 2;

Fig. 6 is a side elevational view of the movable contact assembly of the switch shown in Fig. 2;

Fig. 7 is a plan view of the limit switch shown in Fig. 2, with the cover plate removed and the operating head shown in section;

Figs. 8 and 9 are sectional views on lines 8-8 and 9-9, respectively, of Figs. 2 and 7;

Fig. 10 is a sectional view on line 10-10 of Fig. 5;

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Fig. 11 is a fragmentary sectional view on line 11-11 of Fig. 7;

Figs. 12 and 13 are sectional views, and Fig. 14 is a side elevational view of different types of operating heads for the switch shown in Fig. 2, and Fig. 15 is a sectional view on line 15-15 of Fig. 14.

Referring to the drawings, the same illustrate a snap action limit switch comprising a movable contact assembly 1 and a stationary contact assembly 2, both of which are mounted within an elongated rectangular casing 3 having a removable top cover plate 4. As hereinafter set forth, different types of operating heads are provided for effecting operation of the switch, said operating heads being interchangeable and being adapted for mounting in various angular positions upon the front end of casing 3.

More specifically, the movable contact assembly 1 includes a stationary frame 5 which carries a contact element 6, a reciprocable operating member 7 and a snap operating mechanism including a coil spring 8 and a latch member 9. Frame 5 comprises a pair of elongated rectangular side plates 10-10 of like form which are secured together in spaced relation by pins 11-11 fixed within openings adjacent opposite ends of said plates and also by a pin 12 located midway between said former pins and fixed within openings in projections 13-13 formed on the underside of said plates. As shown in Fig. 3, the side plates 10-10 are provided with outwardly extending right angle top projections 14-14 for securement to lugs 15-15 formed on the interior of casing 3.

Contact carrying element 6 is carried by a pair of vertically disposed inverted Y-shaped levers 16 and 17 which are arranged in parallel relation, and are rotatably supported intermediate their ends upon the pins 11 associated with frame 1. Each of the levers 16 and 17 comprises a pair of stamped sheet metal arms 18 of like form which are arranged in opposed relation, as shown in Fig. 3. Contact carrying element 6 is arranged above frame 5 and is pivotally supported at opposite ends upon the upper ends of levers 16 and 17. Said contact carrying element comprises two molded insulating sections 19-19 of like form arranged in opposed relation on opposite sides of the levers 16 and 17. Insulating sections 19 are formed to interfit as shown in Fig. 8, each being provided with a pivot projection 20 which extends through an opening in the upper end of one of the levers 16 or 17 into a recess formed in the other insulating section. Insulating sections 19

are also formed to provide an elongated slot 21 for receiving a pair of horizontally disposed bridging contacts 22 and 23. Said bridging contacts are yieldingly supported intermediate their ends and held in assembled position within slot 20 by a pair of insulating keepers 24 which are slidably supported within said slot and are biased apart by a spring 25.

Operating member 7 comprises a U-shaped sheet metal stamping having elongated rectangular side arms 26—26 which are slidably supported between the side plates 10—10 of frame 5 and are provided with elongated horizontally disposed slots 27 for receiving the pins 11 associated with said frame. The side arms 26 of operating member 7 are also provided with horizontally disposed slots 28 and 29 which are located below the slots 27. Pins 28^a and 29^a are supported at opposite ends within the slots 28 and 29, respectively, and as shown in Fig. 2 pin 28^a is located to the left of lever 16, and pin 29^a is located to the right of lever 17. The arms 18 of levers 16 and 17 are provided with V-shaped notches for receiving the pins 28^a and 29^a and said pins are connected by a tensioned coil spring 8 which is located between the arms 18 of said levers.

Latch member 9 comprises an elongated rectangular plate which is supported intermediate its ends by the projections 13 on frame 5. As shown in Fig. 4, latch member 9 is notched on opposite sides to receive projections 13 and as shown in Fig. 2 the same is biased upwardly by a bow spring 30 which bears against the underside of said latch member and is supported intermediate its ends upon the pin 12 associated with frame 5. The left hand end of latch member 9 cooperates with stop projections 16^a formed on the lower ends of the arms 18 of lever 16 and the right hand end of said latch member cooperates with stop projections 17^a formed on the lower ends of the arms 18 of lever 17. Latch member 9 is actuated by opposed inclined cam surfaces 31 and 32 formed on the underside of each of the side arms 26 of operating member 7 and as shown in Figs. 2 and 4 said latch member has inclined projections 33 formed on opposite ends thereof to be engaged by said cam surfaces.

The operation of the aforedescribed movable contact assembly will now be more fully described. As hereinafter set forth operating member 7 is normally held in the position shown in Fig. 2 and with the same in this position the left hand end of latch member 9 is held by the spring 30 in engagement with the stop projections 16^a on lever 16. Lever 16 is thus locked against counterclockwise rotation upon its associated pin 11 to prevent movement of contact element 6 toward the left out of the extreme position shown in Fig. 2. Upon initial movement of operating member 7 toward the right out of the position shown in Fig. 2 pin 29^a is engaged by the left hand end of slot 29 and is moved to the right with respect to lever 17. Spring 8 is thus tensioned and tends to rotate lever 16 in a counterclockwise direction, such movement being prevented by latch member 9. Upon continued movement of operating member 7 toward the right into the position shown in Fig. 6 the cam surfaces 31 thereof engage the inclined projections 33 on the left hand end of latch member 9 to move said latch member out of engagement with stop projections 16^a on lever 16. Spring 8 then acts to rotate lever 16 in a counterclockwise direction for snap movement of contact carrying element 6 from the extreme position shown in

Fig. 2 into the extreme position shown in Fig. 6. Upon movement of contact carrying element 6 into the extreme position shown in Fig. 6 the stop projections 17^a on lever 17 are engaged by the right hand end of latch member 9. Lever 17 is thus locked against clockwise rotation to maintain contact carrying element 6 in the extreme position shown in Fig. 6.

Upon initial movement of operating member 7 from the position shown in Fig. 6 toward the position shown in Fig. 2 pin 28^a is engaged by the right hand end of slot 28 and is moved toward the left with respect to lever 16. Spring 8 is thus tensioned and tends to rotate lever 17 in a clockwise direction, such movement being prevented by latch member 9. Upon continued movement of operating member 7 toward the left the cam surfaces 32 thereof engage the inclined projections 33 on the right hand end of latch member 9 to move said latch member out of engagement with the stop projections 17^a on lever 17. Spring 8 then acts to rotate lever 17 in a clockwise direction for snap movement of contact carrying element 6 from the extreme position shown in Fig. 6 into the extreme position shown in Fig. 2. Upon return of contact carrying element 6 into the extreme position shown in Fig. 2 the left hand end of latch member 9 reengages the stop projections 16^a on lever 16 to lock said element in such position.

The stationary contact assembly 2 comprises a flat molded insulating base 35 of rectangular shape having a pair of stationary contacts 36—36 mounted upon one end thereof which are normally engaged by bridging contact 23 and a pair of stationary contacts 37—37 mounted upon the opposite end thereof to be engaged by bridging contact 22 upon movement of contact carrying element 6 into the extreme position shown in Fig. 6. Insulating base 35 has a recess 38 formed on the underside thereof for receiving contact carrying element 6 and its associated bridging contacts 22 and 23, and as shown in Fig. 8 said recess is formed to provide guide surfaces 39 which engage said contact-carrying element on opposite sides to hold the insulating sections 19 thereof in assembled position upon the upper end of levers 16 and 17. Insulating base 35 and the projections 14 on frame 5 are provided with aligned openings for receiving screws 40 which thread into the lugs 15 to hold the movable contact assembly 1 and stationary contact assembly 2 in assembled position within casing 3. As shown in Fig. 2, a sheet of insulating material 41 is interposed between frame 5 and insulating base 35, said sheet being slotted to receive the upper ends of levers 16 and 17.

Stationary contacts 36 and 37 are of like form, each comprising a sheet metal stamping which is L-shaped to provide a terminal portion 42 and a contact portion 43. The upper face of insulating base 35 is provided with recesses 44 for receiving the terminal portions 42 of said stationary contacts and the contact portions 43 of said stationary contacts extend downwardly through openings 45 in said base into the path of bridging contacts 22 and 23. The terminal portion 42 of each stationary contact is provided with a binding screw 46 and is secured to base 35 by a screw 47. As shown in Figs. 8 and 11 insulating base 35 is provided with slot openings 48 for receiving the screws 47 and the under side of said base is provided with recesses 49 for receiving the heads of said screws. The slot openings 48 permit adjustment of the pairs of stationary contacts 36 and

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37 for variation of the distance therebetween. With contacts 36 and 37 spaced as shown in Fig. 8, bridging contact 23 disengages its cooperating stationary contacts 36 prior to movement of bridging contact 22 into engagement with its cooperating stationary contacts 37. However, if desired, the pairs of stationary contacts 36 and 37 may be adjusted to decrease the distance therebetween so that bridging contact 22 engages its cooperating stationary contacts 37 prior to movement of bridging contact 23 out of engagement with its cooperating stationary contacts 36.

As hereinbefore stated, different types of operating heads are provided for controlling the switch, said operating heads being interchangeable and being adapted for mounting in any one of several angular positions upon the front end of casing 3. Figs. 2, 5 and 7 of the drawings illustrate an operating head of the lever type including a reciprocable push rod 50, a rotatable cam shaft 51 for operating said rod and a supporting block 52 for said parts which is rectangular in shape and is secured to the front end of casing 3 by screws 53.

Push rod 50 is slidably supported within an opening in the front wall of casing 3 and has an enlarged circular head 54 formed on the front end thereof which is guided and supported within a bore 55 in supporting block 52. The rear end of push rod 50 is provided with a groove 56 and the side arms 26 of switch operating member 7 are provided with inwardly bent portions 57 (Fig. 7) which engage within said groove to operatively connect said switch operating member to said push rod. Push rod 50 is biased to move forwardly by a coil spring 58 which is held under compression between head 54 and the front wall of casing 3.

Cam shaft 51 is disposed at right angles to push rod 50 and is rotatably supported within a bored opening in block 52. As shown in Fig. 5, cam shaft 51 has an operating lever 59 adjustably secured to the left hand end thereof and the right hand end of said cam shaft has a spring 60 associated therewith for normally holding the same in the angular position shown in Fig. 2. Spring 60 is of coil form and is held in assembled position within an opening in the right hand end of cam shaft 51 by a washer 61. Washer 61 is secured to cam shaft 51 by a screw 62 and has a circular projection 63 formed on the inner face thereof which extends through the opening in spring 60. As shown in Fig. 10, spring 60 is provided with straight radial extremities 64 and 65 and cam shaft 51 and block 52 are recessed as shown at 66 and 67 to receive the extremities of said spring. Spring 60 is tensioned so that the extremities 64 and 65 thereof are biased to move apart and said spring extremities cooperate with faces 66^a and 66^b of recess 66, and with faces 67^a and 67^b of recess 67 to bias cam shaft 51 and its associated operating lever 59 against rotation in opposite directions out of the intermediate position shown in Fig. 2.

Rotation of cam shaft 51 in opposite directions out of the position shown in Fig. 2 is limited by a stamped sheet metal washer 68. Washer 68 is rotatably supported upon projection 63 of washer 61 and is provided with a radial tongue 69 which extends into the recesses 66 and 67. As is apparent from Fig. 10, clockwise rotation of cam shaft 51 is limited by engagement of tongue 69 with faces 66^a and 67^b of recesses 66 and 67, and counterclockwise rotation thereof is limited by en-

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gagement of said tongue with the faces 66^b and 67^a of said recesses.

Cam shaft 51 is recessed as shown in Fig. 2 to provide a cam portion 70 for engaging the front face of push rod head 54. The face of cam portion 70 is V-shaped to provide surfaces 71 and 72, the former surface being radially disposed with respect to the axis of cam shaft 51 for normal engagement with the upper half of push rod head 54. When operating lever 59 is operated in a clockwise direction out of the normal position shown in Fig. 2 the upper edge 71^a of surface 71 engages the face of push rod head 54 to move push rod 50 inwardly for operation of the switch mechanism from the normal position shown in Fig. 2 into the position shown in Fig. 6. Upon release of operating lever 59 the same is returned to normal position under the action of spring 60 and push rod 50 is moved forwardly by spring 58 to return the switch mechanism to the normal position shown in Fig. 2. The surface 72 of cam portion 70 permits counterclockwise by-pass rotation of lever 59 and cam shaft 51 out of the normal position shown in Fig. 2 without movement of the switch mechanism out of normal position.

As shown in Fig. 5, lever 59 is provided with a hub 73 which is bored to receive a portion 74 of reduced diameter on cam shaft 51 and to also receive a lock washer 75 which is fixed to a pin extension 76 on the left hand end of said shaft. As shown in Fig. 9, lock washer 75 has nine semi-circular notches 77 formed on the periphery thereof which are spaced 40 degrees apart and the portion of hub 73 which overlaps said washer has ten equally spaced semi-circular notches 78 formed on the interior thereof which are spaced 36 degrees apart. Lever 59 is held in assembled position upon cam shaft 51 by a washer 79 which is secured to said shaft by a screw 80. Washer 79 has a pin 81 fixed to the inner face thereof and as shown in Fig. 9 said pin is adapted to engage within a circular space formed by a selected notch 77 in washer 75, and a selected notch 78 in hub 73 to lock lever 59 against rotation with respect to said shaft. With nine equally spaced notches 77 in lock washer 75 and ten equally spaced notches on the interior of hub 73 provision is made for locking lever 59 to cam shaft 51 by means of pin 81 in any one of ninety angular positions which are spaced 4 degrees apart. As shown in Fig. 5, lever 59 is offset to clear casing 3 and has a roller 82 mounted upon the free end thereof.

As hereinbefore stated, supporting block 52 is secured to casing 3 by screws 53 and as shown in Fig. 5 said screws extend through corner openings in said block which are equally spaced with respect to each other and with respect to the axis of push rod 50. Block 52 may thus be secured to casing 3 in any one of four equally spaced angular positions for location of the operating lever 59 either above or below casing 3 or on either side thereof.

The operating head shown in Fig. 12 is similar to the operating head shown in Figs. 2 and 5 except that the cam shaft is modified to provide a cam portion 83 which is V-shaped to provide surfaces 84 and 85. Surface 84 is radially disposed with respect to the axis of shaft 51 for normal engagement with the lower half of push rod head 54. Upon counterclockwise rotation of lever 59 out of normal position the edge 84^a of surface 84 engages the front face of head 54 to move push rod 50 inwardly for operation of the switch out

of normal position. The surface 85 permits clockwise by-pass rotation of lever 59 out of normal intermediate position without movement of the switch mechanism out of normal position.

The operating head shown in Fig. 13 is also similar to the operating head shown in Figs. 2 and 5 except that the cam shaft is provided with a cam portion 86 having a diametrically disposed face 87 which normally engages the front face of push rod head 54. The edges 87^a and 87^b of surface 87 respectively engage push rod head 54 upon clockwise and counterclockwise rotation of lever 59 out of normal position to effect operation of the switch mechanism out of normal position.

Figs. 14 and 15 illustrate an operating head of the push type which may also be used in connection with the switch. The operating head shown in these figures is provided with a supporting block 90 and a push rod 91. Block 90 is cylindrical in form and has a square flange 92 formed on the rear end thereof for securement to casing 3 by screws which are located as shown in Fig. 5. Push rod 91 is similar to push rod 50 except that the front end thereof is provided with an enlarged cylindrical head 93 having a flange projection 93^a formed on the rear end thereof to be engaged by the spring 58. Block 90 is bored to receive head 93 and is recessed as shown at 94 to receive flange 93^a and to also provide shoulder 95 for engaging said flange to limit forward movement of the push rod under the action of spring 58. Head 93 and block 90 are slotted to receive a roller 96 which is secured to said head by a pin 97. Push rod 91 is normally held in the position shown in Figs. 14 and 15 by spring 58 and is movable inwardly from such position by means of roller 96 to move the switch mechanism out of normal position.

As shown in Fig. 7, casing 3 is provided with corner mounting holes 98 which are located outside of the switch compartment. As shown in Figs. 2 and 7, casing 3 extends rearwardly beyond the switch mechanism to provide a wiring space 99 and the rear wall of said casing is provided with a threaded conduit receiving lug 100. Insulating sheet 41 extends downwardly over the rear end of the movable contact assembly 1 to prevent contact between the parts of said assembly with the wiring contained in the space 99.

What I claim as new and desire to secure by Letters Patent is:

1. In a circuit controlling device, in combination, a contact element movable in opposite directions between extreme circuit controlling positions, a pair of pivoted operating levers therefor, a latch for locking one of said levers upon movement of said contact element into one extreme circuit controlling position and for locking the other of said levers upon movement of said contact element into its other extreme circuit controlling position, an operating member movable in opposite directions between given extreme positions and acting during movement into one extreme position to trip said latch out of engagement with one of said levers and during movement into its other extreme position to trip said latch out of engagement with the other of said levers, and a spring operating connection between said operating member and said levers for effecting snap movement of said contact element between its extreme circuit controlling positions upon tripping of said latch.

2. In a circuit controlling device, in combination, a horizontally disposed contact element movable in opposite directions between given ex-

treme circuit controlling positions, a pair of vertically disposed pivoted levers supporting said element and movable in parallel relation to operate the same, a latch extending between said levers and acting to lock one of said levers upon movement of said contact element into one extreme circuit controlling position and to lock the other of said levers upon movement of said contact element into its opposite extreme circuit controlling position, a horizontally disposed operating member movable in opposite directions between given extreme positions and acting during movement into one extreme position to trip said latch out of engagement with one of said levers and during movement into its opposite extreme position to trip said latch out of engagement with the other of said levers, and a single spring operating connection between said operating member and said levers for effecting snap movement of said contact element between its extreme circuit controlling positions upon tripping of said latch.

3. In a control switch, in combination, a stationary frame, a pair of vertically disposed parallel levers each pivotally supported intermediate its ends upon said frame, a contact carrying element located above said frame and pivotally connected at opposite ends to the upper ends of said levers for movement by said levers in opposite directions between given circuit controlling positions, a latch member carried by said frame and operating to lock one of said levers upon movement of said contact element into one extreme circuit controlling position and to lock the other of said levers upon movement of said contact element into its other extreme circuit controlling position, an operating member movable in opposite directions between given extreme positions and having cam surfaces thereon acting during movement into one extreme position to trip said latch out of engagement with one of said levers and during movement into its other extreme position to trip said latch out of engagement with the other of said levers, a spring operatively connected to said levers at points below the pivots thereof, and means operatively connecting said spring to said operating member to provide for snap movement of said contact element between its extreme circuit controlling positions upon tripping of said latch.

4. The combination with a stationary frame, a reciprocable contact carrier and a snap operating mechanism therefor carried by said frame, said contact carrier being located above said frame and having bridging contacts yieldingly mounted thereon, an insulating base superimposed upon said frame and having its under side recessed to receive said contact carrier and its associated contacts, and a plurality of stationary contacts mounted upon said base to be engaged by said bridging contacts, said stationary contacts extending upwardly through openings in said base and each having a terminal portion upon the upper end thereof which is secured to the upper face of said base.

5. The combination with a stationary frame, a reciprocable contact element and a snap operating mechanism therefor carried by said frame, said contact element including a horizontally disposed elongated insulating support having a pair of horizontally disposed bridging contacts mounted thereon, an insulating base superimposed upon said frame and having its under side recessed to receive said contact carrier and its associated bridging contacts and a plurality of stationary

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contacts mounted upon said base to be engaged by said bridging contacts, said stationary contacts extending upwardly through openings in said base and each having a right angle terminal portion upon the upper end thereof for securement to the upper face of said base and securing means associated with the terminal portions of said contacts permitting adjustment of said contacts with respect to their associated bridging contacts.

6. In a control device, in combination, an enclosing casing, a control switch mounted within said casing and an operating head for said switch detachably mounted upon the exterior of said casing and having an axially movable push rod associated therewith extending through an opening in said casing and connected to said control switch to operate the same, said operating head being attachable to said casing in various angular positions with respect thereto.

7. The combination with a control switch and an enclosing casing therefor, of a reciprocable push rod operatively connected to said switch and extending outwardly through an opening in said casing, and an operating head for said push rod detachably mounted upon the exterior of said casing, said operating head including a supporting member attachable to said wall in any one of a plurality of angular positions, and a cam operating shaft rotatably mounted within an opening in said member and disposed at right angles to said push rod for engagement with the outer end thereof.

8. The combination with a control switch and an enclosing casing therefor, of a reciprocable push rod operatively connected to said switch and extending outwardly through an opening in said casing, an operating head associated with said push rod detachably mounted upon the exterior of said casing, said operating head including a supporting member attachable to said casing in any one of a plurality of angular positions, a cam operating shaft rotatably mounted upon said supporting member and disposed at right angles to said push rod for engagement with the outer end thereof, and an operating lever located to one side of said supporting member and adjustably secured to said operating shaft to permit variation of the angular position thereof with respect to said shaft.

9. The combination with a control switch hav-

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ing a reciprocable operating element, an enclosing casing therefor, a reciprocable push rod extending through an opening in said casing and having its inner end detachably secured to said switch operating element, a biasing spring associated with the outer end of said push rod for normally maintaining said switch in a given position and an operating head for said push rod detachably mounted upon the exterior of said casing, said operating head including a rotatable cam shaft disposed at right angles to said push rod for engagement with the outer end thereof, and a supporting member for said cam shaft attachable to said casing in any one of a plurality of equally spaced angular positions.

10. In combination, a control switch, an enclosing casing therefor, a reciprocable push rod operatively connected to said switch and extending outwardly through an opening in said casing, and an operating head for said push rod attachable to said casing in any one of a plurality of equally spaced angular positions, said operating head including a cam operating shaft disposed at right angles to said push rod for engagement with the outer end thereof, an operating lever having a bored hub portion for receiving said shaft, said hub portion having a plurality of equally spaced notches formed on the interior thereof and said shaft having a different number of equally spaced notches formed on the periphery thereof, and means for holding said lever in assembled position upon said shaft, said means including a pin insertable into the space formed by selected registering notches in said hub portion and said operating element to lock said operating lever in selected angular positions upon said shaft.

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