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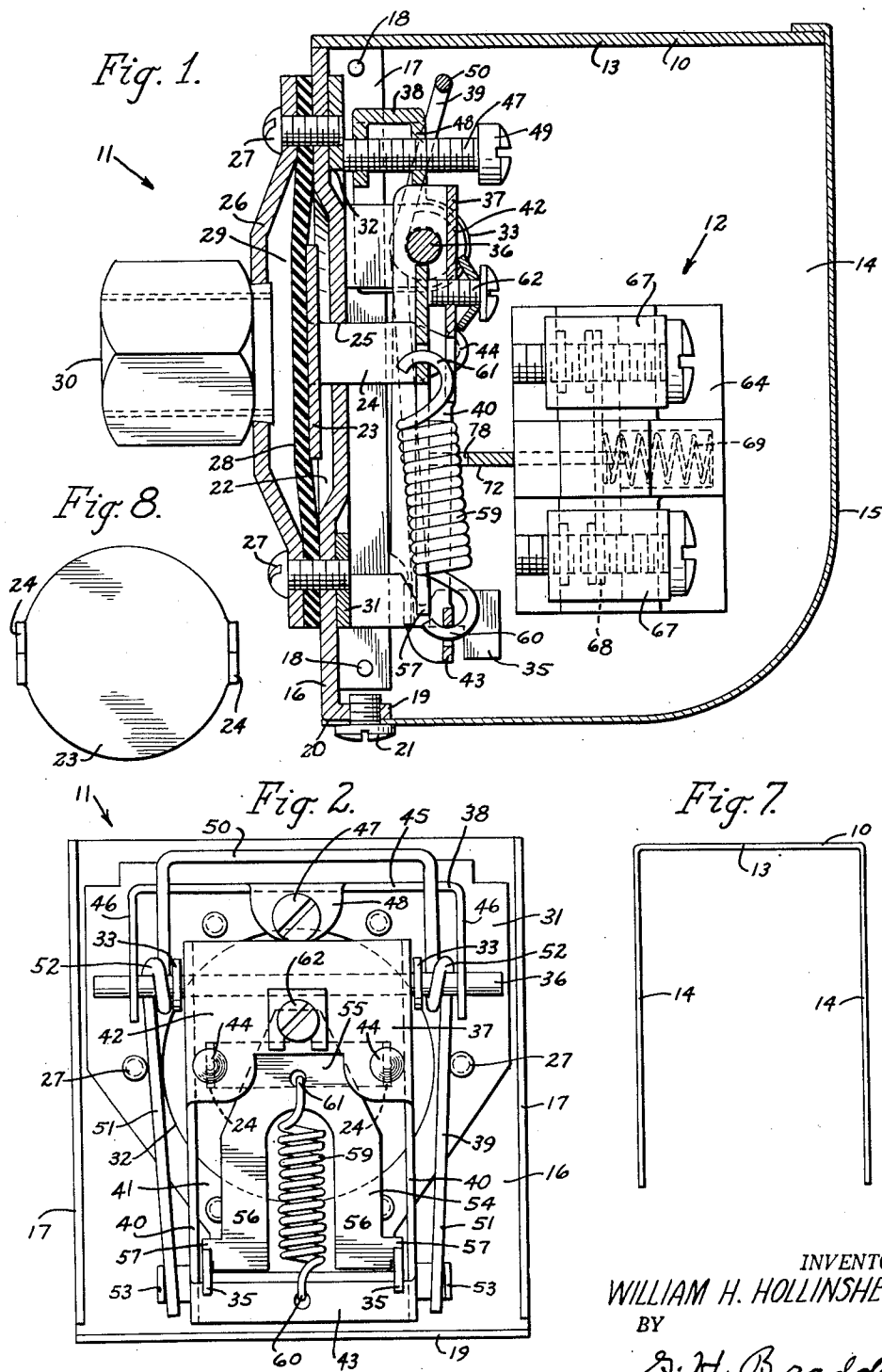
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2,658,397

CONTROL SWITCH

Filed July 28, 1950

2 Sheets-Sheet 1



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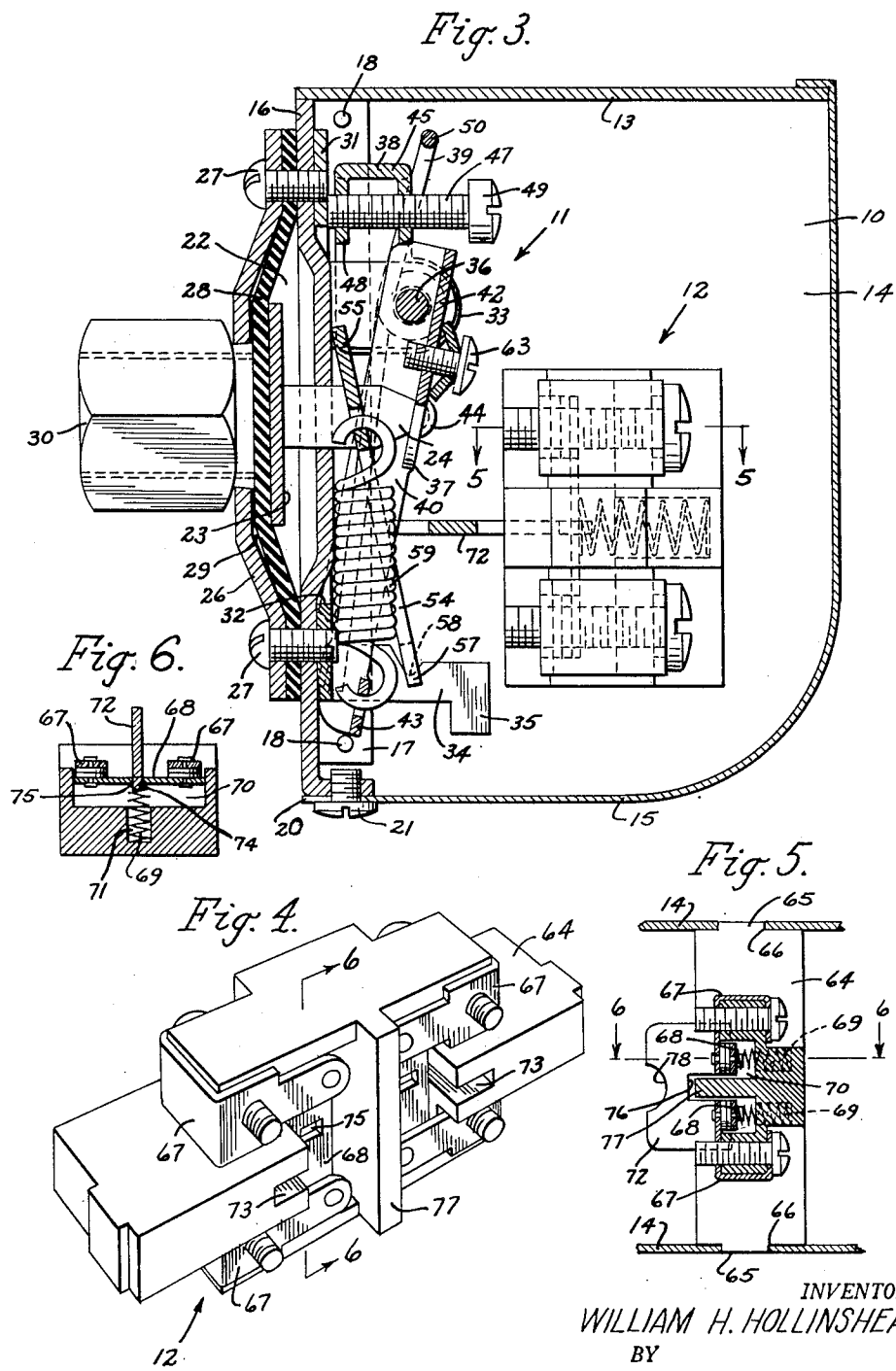
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CONTROL SWITCH

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8 Claims. (Cl. 74-100)

1

The invention herein presents a control switch, actuable to closed condition in response to decrease in fluid pressure and to open condition in response to increase in fluid pressure, useful for many purposes, but devised to be especially useful in the control of electrical circuits including motors for actuating pumps employed to build up pressure in fluid pressure systems.

The object of the invention is to provide a pressure controlled switch wherein will be incorporated various novel and improved features and characteristics of construction.

In the accompanying drawings forming a part of this specification,

Fig. 1 is a central sectional view of a control switch made according to the invention as when in open condition;

Fig. 2 is an elevational view, on a reduced scale, of a first unit of the control switch removed from the remainder thereof, as said first unit would appear from the right in Fig. 1;

Fig. 3 is a view corresponding generally with the disclosure of Fig. 1, but showing the control switch in closed condition;

Fig. 4 is a perspective view of a second unit of the control switch removed from the remainder thereof;

Fig. 5 is a sectional view, on a reduced scale, taken on line 5-5 in Fig. 3;

Fig. 6 is a sectional view, taken on line 6-6 in Fig. 4, or as on line 6-6 in Fig. 5;

Fig. 7 is an elevational view, on a reduced scale, of a frame of the control switch as it would appear from the right in Figs. 1 and 3; and

Fig. 8 is an elevational view of a disc shape element of the control switch.

With respect to the drawings and the numerals of reference thereon, 10 denotes a frame, 11 represents a first unit and 12 indicates a second unit of a control switch incorporating features and characteristics of the invention.

The frame 10 consists of a rectilinear member including an end wall 13 and opposite, spaced, parallel side walls 14, 14 perpendicular to said end wall 13. A removable cover 15 encloses an open side of the frame 10 adjacent the end wall 13 and an open end of said frame opposite said end wall, and an open side of said frame adjacent its end wall and opposite the portion of the cover adjacent said end wall is enclosed by a flat plate 16 constituted as a part of the first unit 11 of the control switch.

The flat plate 16 includes inwardly turned flanges 17 at its opposite sides which receive screws 18 rigidly attaching said flat plate to the

2

frame 10, and also includes an inwardly turned flange 19 at its end opposite the end wall 13 of said frame. The removable cover 15 includes inwardly turned flanges fitted over the adjacent edges of the end and side walls of the frame, and a marginal edge portion of said removable cover, at its end opposite the frame end wall, is fitted over the inwardly turned flange 19 and includes a slot 20 which removably receives a screw 21 in said inwardly turned flange 19 for detachably securing the removable cover on said frame.

An intermediate portion of the flat plate 16 is shaped inwardly to provide an annular concavity 22 in the outer side of said flat plate, and a disc shape element 23 in said concavity includes spaced, parallel actuator lugs 24 which are in right angular relation to the body of said disc shape element and extend through an elongated slot 25 in a portion of said flat plate 16 bounding the concavity 22. As disclosed, the spaced actuator lugs 24 are in a plane spaced from and parallel with the end wall 13 of the frame 10.

A cap member 26, at the outer side of the flat plate 16 and its annular concavity 22, is secured up against said flat plate by a series of screw bolts 27 which also secure a flexible diaphragm 28, of rubber as disclosed, across said annular concavity and a central hollowed-out portion of said cap member in such manner as to provide a chamber 29, bounded by the cap member and said flexible diaphragm, disposed at the outer side of and in alinement with the annular concavity 22. An inlet, from a source (not shown) of fluid under pressure, to the chamber 29 is indicated 30, and except for said inlet said chamber is closed.

A support member of the first unit 11 of the control switch consists of a flat piece 31 of metal with annular opening 32, spaced bearing lugs 33 struck up from said flat piece 31 at locations contiguous with said annular opening, and spaced flange portions 34, struck up from the flat piece at locations contiguous with marginal portions thereof, providing stops 35 in spaced relation to said flat piece and in a plane spaced from and parallel with the plane in which the bearing lugs 33 are situated. The flat piece 31 of the support member is secured up against an inner surface of the flat plate 16, with the bounding surface of the annular opening 32 in spaced, surrounding relation to the actuator lugs 24 and surrounding relation to the inwardly shaped portion of the flat plate, by the screw bolts 27 which secure the cap member 26, the flexible diaphragm 28 and the flat plate to each other, and when said support member is in assembled position, the bearing lugs

33, the stops 35 and the actuator lugs 24, respectively, are in spaced, parallel relation and substantially in a single plane.

A transverse pivot pin 36, extending between the bearing lugs 33 and having its opposite end portions mounted therein, rotatably supports a first actuator lever 37, situated between said bearing lugs, an adjuster lever 38, situated exteriorly of the bearing lugs, and a tension spring 39, situated exteriorly of said bearing lugs and interiorly of said adjuster lever.

The first actuator lever 37 is constituted as a flat element, having flanges 40 upon the opposite side edges thereof and in perpendicular relation thereto, cut away to provide a clearance opening 41 at an intermediate portion thereof, an actuator and adjuster piece 42 at one end thereof and an actuator piece 43 at the opposite end thereof. The transverse pivot pin 36 is mounted in portions of the flanges 40 which are adjacent an end of the actuator and adjuster piece 42 opposite the actuator piece 43, and said actuator and adjuster piece 42 includes spaced indentations 44, in its surface adjacent the flat piece 31 of the support member and in spaced relation to the transverse pivot pin 36 at the side thereof adjacent said actuator piece 43, which receive the free end portions of the actuator lugs 24 upon the disc shape element 23. Stated differently, in practical operation of the control switch, the free ends of said actuator lugs 24 are engaged against the bounding surfaces of the indentations 44.

The adjuster lever 38 is of U-shape. It includes a base 45, in adjacent relation to the flat piece 31 of the support member at a location spaced from the bearing lugs 33 at the side thereof opposite the actuator lugs 24 and the stop 35, and legs 46 rotatably mounted on the transverse pivot pin 36. A first adjuster screw 47, in spaced, parallel ears 48 integral with the base 45 of the adjuster lever 38, has its free end engaged against the adjacent surface of the flat piece 31 of the support member and includes an accessible head 49 through the instrumentality of which said first adjuster screw can be readily and easily turned thus to swingingly adjust said lever 38 toward or away from said flat piece 31.

The construction and arrangement are such that when the first actuator lever 37 is assembled with the transverse pivot pin 36, the actuator piece 43 is situated at the side of the flange portions 34 opposite the bearing lugs 33 and inwardly of the stops 35 adjacent the flat piece 31 of the support member, to engage said stops 35 in response to swinging movement of said actuator piece away from said flat piece. Stated otherwise, the first actuator lever 37 is mounted for swinging movement toward and away from the flat piece 31 of the support member, and the stops 35 limit the extent to which said first actuator lever can be swung away from said flat piece, by reason of engagement of the actuator piece 43 with said stops. Also, portions of the flanges 40 of the first actuator lever 37 which are adjacent said actuator piece 43 are disposed exteriorly of the flange portions 34 and the stops 35 of the support member when said first actuator lever is assembled with said transverse pivot pin.

The tension spring 39 consists of a length of wire of U-shape including a base 50 and spaced, parallel arms 51. Each arm 51 includes a curl or loop 52 intermediate its ends which is rotatably supported upon the transverse pivot pin 36. Portions of said arms 51 adjacent the base 50 are engaged against the adjacent edge of the base 45 of

the adjuster lever 38, and free end portions of the arms 51, at the side of said transverse pivot pin 36 opposite the bases 45 and 50, are seated against surfaces of ears 53, extending externally from portions of the flanges 40 of the first actuator lever 37 adjacent the opposite ends of the actuator piece 43, which are opposite the flat piece 31 of the support member. The construction and arrangement are such that the tension spring 39 normally resiliently urges portions of the flanges 40 of the first actuator lever 37 which are adjacent said actuator piece 43 into engaged relation with the adjacent surface of the flat piece 31 of the support member. The tension under which said first actuator lever 37 is urged toward and against said flat piece of said support member is adjustable in response to manipulation of the first adjuster screw 47. With turning of said first adjuster screw in direction to cause the base 45 of the adjuster lever 38 to be moved away from the flat piece 31, the tension of the spring 39 against the ears 53 will be increased, and vice versa.

A second actuator lever of the first unit 11 of the control switch is denoted 54. Said second actuator lever consists of a U-piece of flat metal including a more or less tapered base 55 and spaced legs 56. Outer edges of end portions of the legs 56 spaced from the base 55 integrally support exteriorly extending trunnions 57 situated in and rotatably seated against the bounding surfaces of grooves 58 in marginal edges of the flange portions 34 upon the flat piece 31 of the support member which are at the side of said flange portions adjacent the transverse pivot pin 36, and a tension coil spring 59, disposed in a space between the legs 56, has one of its ends secured, as at 60, to a central portion of the actuator piece 43 and its other end secured, as at 61, to a central portion of the tapered base 55, thus to retain the trunnions 57 in seated position against the bounding surfaces of the grooves 58.

The construction and arrangement are such that the tension coil spring 59 retains the end portion of the tapered base 55 of the second actuator lever 54 spaced from the trunnions 57 in engaged relation with an adjacent surface of the inwardly shaped portion of the flat plate 16, as in Fig. 3 of the drawings, when the first actuator lever 37 is retained in normal position, dictated by the tension spring 39. The construction and arrangement also are such that said second actuator lever 54 will be swung away from said flat plate 16, from left to right in said Fig. 3, with a snap action in response to swinging movement of said first actuator lever away from the flat piece 31 of the support member, also toward the right in Fig. 3, to extent sufficient to situate the actuator piece 43 outwardly with respect to the axis of the second actuator lever to cause the tension coil spring 59 to be swung outwardly beyond dead center position for said second actuator lever. That is, when the parts are in normal position, said actuator piece 43 is situated at the inner side of said second actuator lever axis to cause said tension coil spring to be at the inner side of dead center position for the second actuator lever thus to cause it to be retained in an inward position, and with outward swinging movement of the actuator piece 43 it becomes situated at the outer side of the second actuator lever axis to cause the tension coil spring to be at the outer side of dead center position for said second actuator lever thus to cause it to be swung to and retained in an outward position.

5

A stop for limiting the extent to which the second actuator lever 54 can be swung by the tension coil spring 59 away from the flat plate 16 is constituted as a second adjuster screw 62 in the actuator and adjuster piece 42 of the first actuator lever 37 adapted to be engaged, as disclosed in Fig. 1 of the drawings, by the tapered base 55 of said second actuator lever. A head 63 of the second adjuster screw 62 is conveniently accessible in order that adjustment of the extent to which the second actuator lever 54 is capable of swinging away from the support member can be readily and easily accomplished.

An insulating block 64 of the second unit 12 of the control switch is suitably and conveniently rigidly supported upon and between the side walls 14 of the frame 10, as by rectilinear protuberances 65 upon opposite ends of said insulating block inserted in rectilinear openings 66 in said side walls, to be situated in spaced, adjacent relation to the first unit 11 at the side thereof opposite the inlet 30.

Spaced apart, fixed contact elements 67 upon the insulating block 64 are adapted to receive lead wires (not shown) of an electrical circuit including a motor, as for operating a pump for building up pressure in a fluid pressure system. As disclosed, there are two sets of fixed contact elements 67. Each of separate movable contact elements, for bridging the contact element 67 of each set of fixed contact elements, is represented 68, and a compression coil spring 69, of considerably less strength than the tension coil spring 59, normally urges each movable contact element 68 into engagement with a pair of fixed contact elements 67. The movable contact elements 68 are situated in concavities 70 of the insulating block 64, interiorly of the fixed contact elements 67 and in facing, spaced, parallel relation to the flat plate 16 of the first unit 11, and the compression coil springs 69 are disposed in said concavities 70 interiorly of said movable contact elements. As disclosed, each compression coil spring 69 has one of its end portions seated in a pocket 71 contiguous with a corresponding concavity 70 and its opposite end engaged against a central portion of the adjacent surface of a corresponding movable contact element 68, thus to resiliently urge the movable contact elements into engaged relation with the fixed contact elements 67. The construction and arrangement will be such that when the movable contact elements 68 bridge the two sets of fixed contact elements 67 the circuit including said fixed contact elements will be closed, and when said movable contact elements are disengaged from the fixed contact elements said circuit will be broken.

An actuator 72, for causing the movable contact elements 68 to be removed or separated from the fixed contact elements 67, consists of a flat strip of insulating material slidably disposed in spaced slots 73, at the opposite sides of the concavities 70 and in contiguous relation to said movable contact elements 68, and having spaced protuberances 74 upon its interior end situated in perforations 75 through central portions of the different movable contact elements. A central part of the interior end portion of the actuator 72 is cut away, as at 76, to be clear of a projection 77 upon the insulating block 64 between its concavities 70, and a central part of the exterior end of said actuator 72 is provided with a partial circular clearance opening 78.

The construction and arrangement are such that when the parts of the first unit 11 of the

6

control switch are in their normal position, as in Figs. 3 of the drawings, with the first actuator lever 37 retained by the tension spring 39 against the flat piece 31 of the support member and the second actuator lever 54 retained by the tension coil spring 59 against the inwardly shaped portion of the flat plate 16, said second actuator lever is in clearing relation to the adjacent end of the actuator 72 thus to permit the compression coil springs 69 to retain the movable contact elements 68 in engaged relation with the fixed contact elements 67. In said Fig. 3, all of the operative parts of the control switch are disclosed as when pressure in the chamber 29, and hence in the system, is below an intended pressure, thus to cause an electric motor in circuit with said fixed and movable contact elements to be operative to actuate a pump adapted to cause pressure to be built up in said system and chamber.

The flexible diaphragm 28 will be forced from its position as in Fig. 3 toward its position as in Fig. 1 in response to build up of pressure in the system, and hence in the chamber 29, thus to cause the first actuator lever 37 to be swung from its position as in said Fig. 3 toward its position as in said Fig. 1, through the instrumentality of the disc shape element 23 and against force exerted by the tension spring 39, and upon the swinging of said first actuator lever 37 away from the flat piece 31 of the support member, toward the second unit 12 of the control switch, to extent sufficient to situate the actuator piece 43 outwardly with respect to the axis of the second actuator lever 54 to cause the tension coil spring 59 to be swung outwardly beyond dead center position for said second actuator lever, the latter will be swung with a snap action, from its position as in Fig. 3 to its position as in Fig. 1, against the stop or second adjuster screw 62. The construction and arrangement will be such that the spaced legs 56 of the second actuator lever 54 will strikingly engage the adjacent end of the actuator 72, while the tension coil spring 59 enters the clearance opening 78, thus to cause the movable contact elements 68 to be forcibly removed from the fixed contact elements 67, during snap action movement of said second actuator lever from its position as in Fig. 3 to its position as in Fig. 1, and as long as pressure of fluid in the chamber 29, and hence in the system, remains sufficiently high to retain the first actuator lever 37 in position situating the second actuator lever 54 at the outer side of its dead center position, said second actuator lever will retain said fixed and movable contact elements in disengaged relation. Upon decrease of pressure of fluid in the system, and hence in the chamber 29, to a value sufficiently low to permit the tension spring 39 to actuate the first actuator lever 37 to situate the second actuator lever 54 at the inner side of its dead center position, said second actuator lever will be swung with a snap action from its position as in Fig. 1 back to its position as in Fig. 3, thus to cause the fixed and movable contact elements to become engaged.

It will be apparent that the pressure of fluid in the chamber 29, and hence in the system, necessary to actuate the operating elements of the control switch to cause building up of pressure of fluid to cease will be proportional to the tension of the spring 39. With increase in tension of said spring, the pressure of fluid required to cause the fixed and movable contact elements 67 and 68 to be disengaged will be increased, and

vice versa. The tension of the spring 39 operative upon the first actuator lever 37 to resiliently urge it in direction toward the flat piece 31 of the support member is capable of being nicely adjusted merely by turning adjustment of the first adjuster screw 47, thus to adjust the lever 38 away from said flat piece to cause the tension of the spring 39 to be increased and toward the flat piece to cause the tension of said spring 39 to be decreased. The first adjuster screw 47 is in practice an instrumentality for initially accomplishing sensitive adjustment of the control switch rendering it capable of shutting off fluid pressure building up power when the pressure of fluid in a fluid pressure system has reached any high value which may be predetermined.

With return movement of the first actuator lever 37 from its position as in Fig. 1 toward its position as in Fig. 3, in response to decrease of pressure in the chamber 29, and hence in the system, the base 55 of the second actuator lever 54 obviously will be swung in direction to correspond, through the instrumentality of the stop or second adjuster screw 62 which is at this time engaged with said base 55, concurrently with the swinging of the actuator piece 43 of said first actuator lever to and past dead center position for said second actuator lever. It will be apparent that when said stop or second adjuster screw 62 is situated in the actuator and adjuster piece 42 of the first actuator lever 37 to permit outward throw of said second actuator lever beyond its dead center position to be relatively great, the return movement of said first actuator lever 37 required to cause the second actuator lever 54 to be swung inwardly toward the flat plate 16 beyond its dead center position necessarily will have to be through a longer arc than when the outward throw of the second actuator lever is comparatively less. Stated otherwise, when the second adjuster screw 62 is situated in the actuator and adjuster piece 42 of the first actuator lever 37 to arrest movement of the second actuator lever 54 at the end of a longer outward throw beyond dead center position, the return movement of said first actuator lever required to move said second actuator lever inwardly beyond its dead center position necessarily will have to be greater in extent than when said second adjuster screw 62 is situated in said actuator and adjuster piece 42 to arrest movement of the second actuator lever at the end of shorter outward throw. Inasmuch as the arc of return movement of the first actuator lever 37 is a function of, or proportional to, pressure existent in the system and chamber 29, the second actuator lever 54 obviously will be operated to release the movable contact elements 68 so they can engage the fixed contact elements, by reason of force exerted by the compression coil springs 69, in response to lower pressure in said chamber 29 when the second adjuster screw 62 is set in a retracted position, so that the free end of said second adjuster screw is closer to the actuator and adjuster piece 42, than when set in an advanced position, so that the free end of the second adjuster screw is farther from said actuator and adjuster piece. The second adjuster screw 54 is in practice an instrumentality for initially accomplishing sensitive adjustment of the control switch rendering it capable of turning on fluid pressure building up power when the pressure of fluid in a fluid pressure system has reached any low value which may be predetermined.

What is claimed is:

1. In a control switch, a support, a flexible diaphragm mounted on said support to be subjected to fluid under pressure, a first actuator lever, means rotatably mounting said first actuator lever on said support for swinging movement, first tension means constituted as a rotatably supported length of resilient material engaged with said first actuator lever urging the first actuator lever toward the flexible diaphragm, means for accomplishing rotatable adjustment of said length of resilient material thus to adjust the tension under which the first tension means is capable of urging the first actuator lever toward said flexible diaphragm, a device between and engaged with said flexible diaphragm and said first actuator lever operable in response to increase of fluid pressure upon the flexible diaphragm to swing the first actuator lever in direction away from said flexible diaphragm against force of the first tension means, said first tension means being adapted to swing said first actuator lever and device in direction toward said flexible diaphragm in response to decrease in fluid pressure upon the flexible diaphragm, a second actuator lever, means rotatably mounting said second actuator lever on said support at a location adjacent a portion of the first actuator lever spaced from its mounting means for swinging movement toward and away from the flexible diaphragm and to extend in overlying relation to said first actuator lever toward the mounting means therefor, second tension means connecting a portion of said second actuator lever spaced from its mounting means with a portion of said first actuator lever spaced from its mounting means and disposed at the side of the location where said second tension means is connected with the second actuator lever opposite the mounting means for said first actuator lever for causing said second actuator lever to be swung away from said flexible diaphragm in response to movement of the location where said second tension means is connected to said first actuator lever in direction away from said flexible diaphragm to extent causing the second tension means to become situated at the side of dead center position for the second actuator lever opposite said flexible diaphragm and to be swung toward said flexible diaphragm in response to movement of said location where said second tension means is connected to the first actuator lever in direction toward the flexible diaphragm to extent causing said second tension means to become situated at the side of dead center position for the second actuator lever adjacent the flexible diaphragm, and stop means for limiting the extent of swinging movement of said second actuator lever in either direction.

2. The combination as specified in claim 1, wherein said means for accomplishing rotatable adjustment of said length of resilient material includes an accessible rotatably adjustable element.

3. In a control switch, a support, a flexible diaphragm mounted on said support to be subjected to fluid under pressure, a first actuator lever, means rotatably mounting said first actuator lever on said support for swinging movement, first tension means urging the first actuator lever toward the flexible diaphragm, a device between and engaged with said flexible diaphragm and said first actuator lever operable in response to increase of fluid pressure upon the flexible diaphragm to swing the first actuator lever in direction away from said flexible diaphragm

4. In a control switch, a support, a flexible diaphragm mounted on said support to be subjected to fluid under pressure, a first actuator lever, means rotatably mounting said first actuator lever on said support for swinging movement, first tension means urging the first actuator lever toward the flexible diaphragm, a device between and engaged with said flexible diaphragm and said first actuator lever operable in response to increase of fluid pressure upon the flexible diaphragm to swing the first actuator lever in direction away from said flexible diaphragm against force of the first tension means, said first tension means being adapted to swing said first actuator lever and device in direction toward said flexible diaphragm in response to decrease in fluid pressure upon the flexible diaphragm, a second actuator lever, means rotatably mounting said second actuator lever on said support at a location adjacent a portion of the first actuator lever spaced from its mounting means for swinging movement toward and away from the flexible diaphragm and to extend in overlying relation to said first actuator lever toward the mounting means therefor, second tension means connecting a portion of said second actuator lever spaced from its mounting means with a portion of said first actuator lever spaced from its mounting means and disposed at the side of the location where said second tension means is connected with the second actuator lever opposite the mounting means for said first actuator lever for causing said sec-

25 5. In a control switch, a support, a flexible diaphragm mounted on said support to be subjected to fluid under pressure, a first actuator lever, means rotatably mounting said first actuator lever on said support for swinging movement, 30 first tension means urging the first actuator lever toward the flexible diaphragm, a device between and engaged with said flexible diaphragm and said first actuator lever operable in response to increase of fluid pressure upon the flexible diaphragm to swing the first actuator lever in direction 35 away from said flexible diaphragm against force of the first tension means, said first tension means being adapted to swing said first actuator lever and device in direction toward said flexible diaphragm in response to decrease in fluid pressure upon the flexible diaphragm, a second actuator lever, means rotatably mounting said second actuator lever on said support at a location adjacent a portion of the first actuator lever spaced 40 from its mounting means for swinging movement toward and away from the flexible diaphragm and to extend in overlying relation to said first actuator lever toward the mounting means therefore, second tension means connecting a portion of said second actuator lever spaced from its 45 mounting means with a portion of said first actuator lever spaced from its mounting means and disposed at the side of the location where said second tension means is connected with the second actuator lever opposite the mounting means 50 for said first actuator lever for causing said second actuator lever to be swung away from said flexible diaphragm in response to movement of the location where said second tension means is connected to said first actuator lever in direction away from said flexible diaphragm to extent causing the second tension means to become situated at the side of dead center position for the second actuator lever opposite said flexible diaphragm and to be swung toward said flexible diaphragm in response to movement of said location 60 where said second tension means is connected to the first actuator lever in direction toward the flexible diaphragm to extent causing said second tension means to become situated at the side of dead center position for the second actuator lever adjacent the flexible diaphragm, and stop means for limiting the extent of swinging movement of said second actuator lever in either direction, the 65 stop means for limiting the extent of swinging

11

movement of the second actuator lever away from the flexible diaphragm being constituted as an accessible element rotatably adjustable in the first actuator lever for movement toward and away from said second actuator lever.

6. The combination as specified in claim 3, and means for adjusting the tension under which said first tension means is capable of urging said first actuator lever toward said flexible diaphragm.

7. The combination as specified in claim 4 wherein said first tension means is constituted as a rotatably supported length of resilient material engaged with said first actuator lever, and means for accomplishing rotatable adjustment of said length of resilient material thus to adjust the tension under which the first tension means is capable of urging said first actuator lever toward said flexible diaphragm.

8. The combination as specified in claim 5 wherein said first tension means is constituted

12

as a rotatably supported length of resilient material engaged with said first actuator lever, and means for accomplishing rotatable adjustment of said length of resilient material thus to adjust the tension under which the first tension means is capable of urging the first actuator lever toward said diaphragm, said last mentioned means including an accessible rotatably adjustable element as a part thereof.

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