

Nov. 16, 1937.

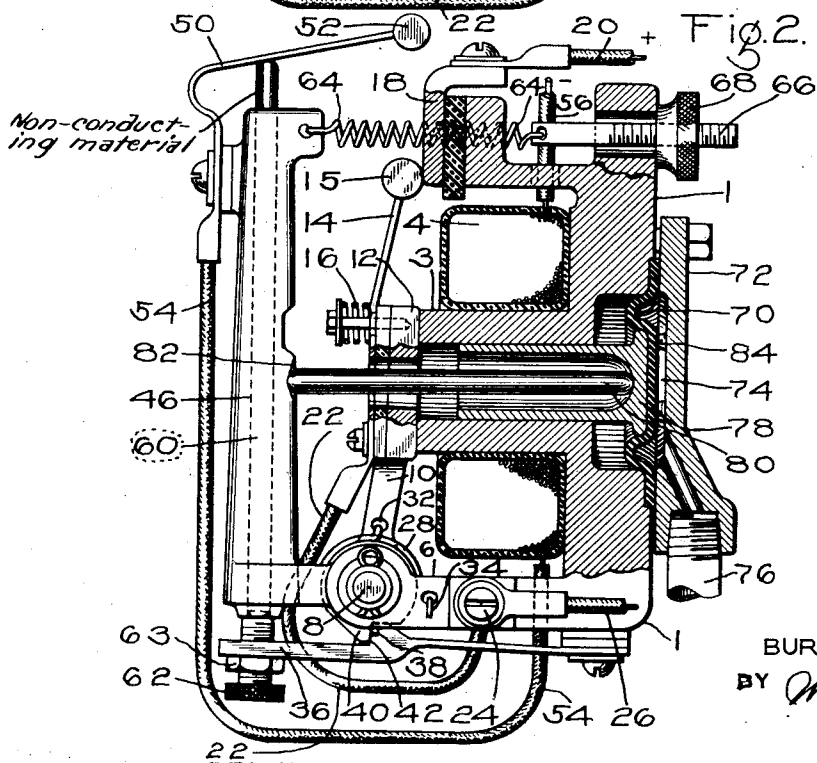
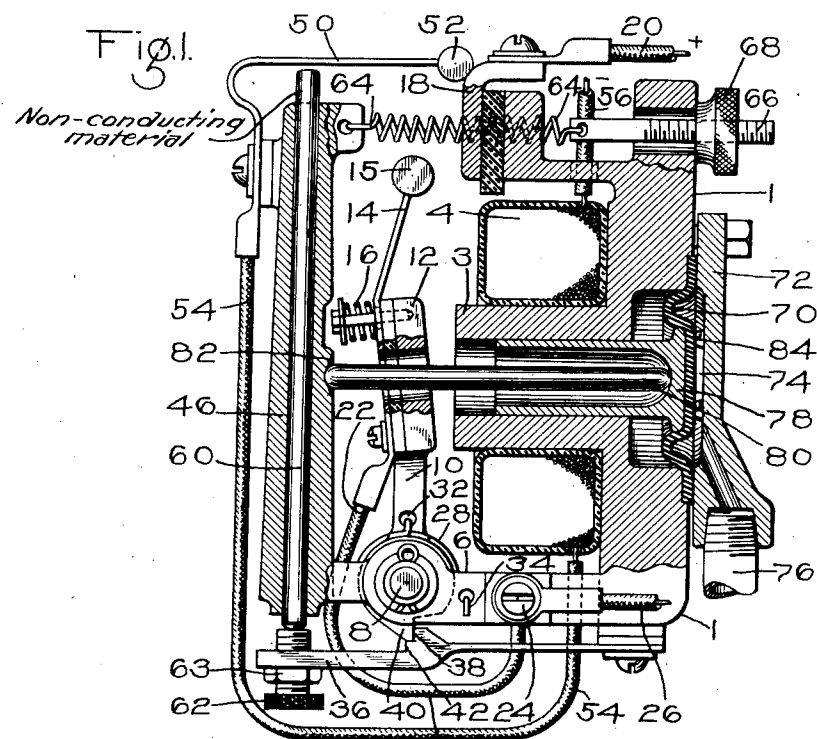
B. S. AIKMAN

2,099,416

COMPRESSOR GOVERNOR

Filed May 15, 1936

2 Sheets-Sheet 1



INVENTOR
BURTON S. AIKMAN
BY *Wm. M. Cady*
ATTORNEY

Nov. 16, 1937.

B. S. AIKMAN

2,099,416

COMPRESSOR GOVERNOR

Filed May 15, 1936

2 Sheets-Sheet 2

Fig. 3.

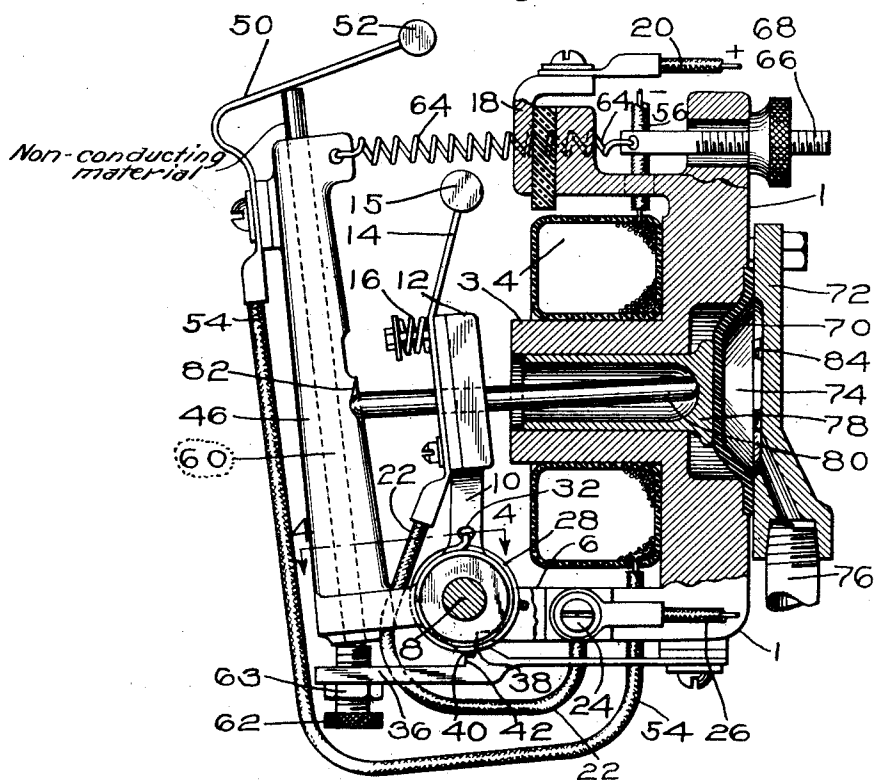
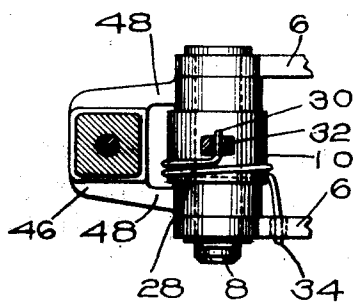


Fig. 4.



INVENTOR
BURTON S. AIKMAN
BY *Wm. H. Coady*
ATTORNEY

UNITED STATES PATENT OFFICE

2,099,416

COMPRESSOR GOVERNOR

Burton S. Aikman, Wilkinsburg, Pa., assignor to
The Westinghouse Air Brake Company, Wil-
merding, Pa., a corporation of Pennsylvania

Application May 15, 1936, Serial No. 79,937

18 Claims. (Cl. 200—83)

This invention relates to switches of the type adapted to be operated in response to variations in the pressure of the fluid supplied thereto.

It is an object of this invention to provide a switch of this type which is operative in response to relatively small variations in the pressure of the fluid supplied thereto.

A further object of the invention is to provide a switch of this type, which incorporates means to adjustably vary the pressure to which it is adapted to respond to interrupt or to complete the circuit controlled thereby.

Another object of this invention is to provide a switch of this type and in which the force operative to maintain the switch contacts in engagement is not affected by changes in the adjustment of the switch.

A further object of this invention is to provide an improved fluid pressure switch.

Other objects of the invention and features of novelty will be apparent from the following description taken in connection with the accompanying drawings in which,

Fig. 1 is a view, largely in section, of a switch provided by my invention,

Fig. 2 is a view similar to Fig. 1, but showing the parts of the switch in a different operating relationship than they are shown in Fig. 1,

Fig. 3 is a view similar to Figs. 1 and 2, but showing the parts of the switch in a still different operating relationship, and

Fig. 4 is a sectional view taken substantially along the line 4—4 of Fig. 3.

Referring to the drawings, the switch therein illustrated comprises a body or frame indicated generally by the reference numeral 1. This body is preferably formed of magnetic material, such as cast iron, and has formed integral therewith a hollow, substantially tubular core portion 3 on which is mounted a winding 4.

The body or frame 1 has formed thereon spaced arms 6, as is best shown in Fig. 4 of the drawings, which carry a pin 8 on which is mounted a switch lever 10 which may be formed of any suitable material, and which has adjacent the end thereof an armature portion 12 formed of magnetic material. The armature portion 12 is adapted to be attracted to the end of the core 3 by the flux field created in the region of the end of the core on energization of the winding 4.

The switch lever 10 has secured thereto, but insulated therefrom, a contact 14 having a substantially spherical end portion 15 carried by a resilient arm which is yieldingly pressed against a face of the lever 10 by means of a spring 16,

The spherical end portion 15 of the contact 14 is adapted at certain times, as will hereinafter more fully appear, to engage a stationary contact 18 which is secured to, but insulated from, a portion of the body or frame 1. The stationary contact 18 is connected by way of a wire 20 with one terminal of a source of electric current.

The contact 14 carried by the switch lever 10 is connected by way of a wire 22 with a terminal post 24 mounted on, but insulated from, the body or frame 1. The terminal post 24 is connected by way of a wire 26 with one terminal of the apparatus to be controlled, which may be the driving motor for a fluid compressor. The other terminal of this motor or other apparatus is connected to the other terminal of the source of electric current, that is, to the terminal other than the one to which the wire 20 is connected.

The switch lever 10 has associated therewith a torsional spring 28, one end 30 of which extends through an opening 32 through the switch lever 10, while the other end 34 extends through an opening in one of the arms 6 of the body or frame 1, as is best shown in Fig. 4 of the drawings. The spring 28 operates to yieldingly urge the switch lever 10 in a counterclockwise direction, as viewed in the drawings, so as to move the armature 12 away from the end of the core 3, and to move the spherical end portion 15 of the contact 14 away from the stationary contact 18.

The switch provided by this invention includes means for controlling movement of the switch lever 10. As shown in the drawings this means comprises a latch lever 36 which has one end thereof rigidly secured to the body or frame 1. The latch lever 36 has a shoulder 38 formed thereon, and adapted to be engaged by a projection 40 on the lower end of the switch lever 10 to limit movement of the switch lever 10 in a counterclockwise direction by the spring 28.

The latch lever 36 is formed of resilient material and is arranged on the body or frame 1 so that the free end of the lever is urged upwardly with considerable force. When the projection 40 on the switch lever 10 is in engagement with the shoulder 38, the lower end of the projection 40 is engaged by the face of the latch lever 36 and prevents further upward movement of the free end of the lever 36.

The latch lever 36 has, in addition, a shoulder indicated at 42 formed thereon, and which at certain times, as will hereinafter more fully appear, is adapted to be engaged by the projection 40 on the switch lever 10 to limit movement of the switch lever 10 by the spring 28.

The switch provided by this invention also includes means for controlling the supply of current to the winding 4 and for controlling operation to the latch lever 36. As shown in the drawings this means comprises a lever 46 having spaced arms 48 formed integral therewith, as is best shown in Fig. 4 of the drawings, and these arms are pivotally secured on the pin 8 which is carried by the spaced arms 6 of the frame or body 1.

The lever 46 has secured adjacent the upper end thereof, but insulated therefrom, a contact 50 comprising a substantially spherical end portion 52 which is mounted on the end of a resilient portion of the contact 50. The spherical end portion 52 is adapted to engage the stationary contact 18.

The contact 50 is connected by way of a wire 54 with one terminal of the winding 4, while the other terminal of the winding 4 is connected by way of a wire 56 to the terminal of the source of electric current opposite from the terminal to which the wire 20 is connected.

The lever 46 has a bore extending therethrough and a rod 60, which is formed of a suitable non-conducting material, such as fiber or moulded plastic composition, is positioned in this bore. The rod 60 is slidable in the bore in the lever 46 and is somewhat longer than this lever. The lower end of the rod 60 is engaged by an adjusting screw 62 which is adjustably secured in the end of the latch lever 36, while the upper end of the rod 60 is adapted to engage the contact 50. The adjusting screw is locked in the adjusted position by means of a lock nut 63.

The upper end of the lever 46 has secured thereto one end of a spring 64 and the other end of this spring secured in an eye in a threaded member 66 which is adjustably secured relative to the body or frame 1 by means of a knurled nut 68. The nut 68 is adjusted so as to subject the spring 64 to substantial tension, thereby urging the lever 46 to move in a clockwise direction about the pin 8 and moving the spherical end portion 52 of the contact 50 into engagement with the stationary contact 18.

The switch provided by this invention also includes means responsive to the pressure of the fluid in a chamber for effecting movement of the lever 46. As shown in the drawings this means comprises a movable abutment in the form of a diaphragm 70, which has its periphery clamped between the body or frame 1 and a cover 72. The diaphragm 70 is subject on one side to the pressure of the fluid in a chamber 74 which is connected by way of a passage and pipe 76 with the source of fluid under pressure to which the switch is intended to respond to interrupt or complete the circuit controlled thereby.

The diaphragm 70 is engaged on the other side by a plunger 78 which is slidable in a bore in the core 3. The plunger 78 is provided with a hollow stem which terminates in a curved end portion which is engaged by one end of a push rod 80 which projects through an opening in the armature 12 of the switch lever 10, and which has its other end extending into a recess indicated at 82 in the face of the lever 46.

The cover 72 has stops 84 formed thereon which are adapted to be engaged by a face of the diaphragm 74 to limit movement of the diaphragm 70 to right, as viewed in the drawings, and thereby limit movement of the plunger 78, the push rod 80, and the lever 46 in this direction by the spring 64.

The switch is shown in Fig. 1 of the drawings in the position which it assumes when the pressure of the fluid in the chamber 74 is below the value at which the switch is intended to respond to complete the circuit controlled thereby, with lever 10 in the open position, and with the supply of current to the switch cut off.

The switch is shown with the switch lever 10 held in the open position by the torsional spring 28, and movement of the switch lever 10 is limited by engagement of the projection 40 with the shoulder 38 on the latch lever 36, while upward movement of the free end of the latch lever 36 is prevented by engagement of the upper face of the latch lever with the projection 40 on the switch lever 10.

The adjusting screw 62 carried by the free end of the latch lever 36 is maintained away from the lower face of the lever 46, and the rod 60 may slide downwardly in the bore in the lever 46 away from the contact 50. At this time the lever 46 is urged in a clockwise direction by the spring 64 to the position in which its movement is limited by the engagement of the diaphragm 70 with the stops 84 on the cover 72.

In this position of the lever 46 the spherical end portion 52 of the contact 50 may engage the stationary contact 18, and as the rod 60 is in its lower position, the contact 50 is moved by the inherent resiliency of the material of which it is constructed to the position in which it is shown in Fig. 1 of the drawings, in which the spherical end portion 52 engages the stationary contact 18.

If at this time the line switch, which controls the supply of current to the switch provided by this invention is closed, a circuit will be established through the winding 4. This circuit will be by way of the wire 20 which is connected to one terminal of the source of electric current, the stationary contact 18, the spherical end portion 52 and the contact 50, the wire 54 to one terminal of the winding 4, and through this winding to the wire 56 which is connected to the other terminal of the source of electric current.

On the completion of the circuit through the winding 4 a strong flux field will be created in the region adjacent the end of the core 3 and the armature 12 of the switch lever 10 will be attracted to the core 3. The force exerted by the flux field created adjacent the core 3 is sufficient to move the switch lever 10 against the torsional spring 28 with the result that the armature 12 is moved from the position in which it is shown in Fig. 1 of the drawings into engagement with the end of the core 3, which is the position in which it is shown in Fig. 2 of the drawings.

On this movement of the switch lever 10, the projection 40 on the lower end of the switch lever moves away from the projection 38 on the latch lever 36 far enough that the face of the projection 40 is located to the left of the shoulder 42 on the latch lever 36.

When the projection 40 on the switch lever 10 is moved to this position the free end of the latch lever 36 is moved upwardly due to the inherent resiliency of the material of which the latch lever is constructed.

On this movement of the free end of the latch lever 36, the adjusting screw 62 moves the rod 60 upwardly in the bore in the member 46. The force exerted by the latch lever 36 upon the rod 60 exceeds the opposing force exerted on this rod by the contact 50, and the upper end of the rod 60 will engage the contact 50 and move it so that the spherical end portion 52 is moved away from the

stationary contact 18, thereby interrupting the circuit through the winding 4.

The free end of the latch lever 36 will continue to move upwardly until the end of the adjusting screw 62 engages the lower face of the lever 46, while the shoulder 42 on the latch lever 36 will be moved into the path of movement of the projection 40 on the switch lever 10 so as to prevent movement of switch lever 10 by the torsional spring 28 when the circuit through the winding 4 is interrupted.

When the switch lever 10 is moved from the position in which it is shown in Fig. 1 of the drawings by the magnetic flux produced adjacent the core 3 to the position in which it is shown in Fig. 2 of the drawings, the spherical end portion 15 on the contact 14 is pressed into engagement to the stationary contact 18 and is firmly held in engagement therewith by the inherent resiliency of the material of which the contact 14 is constructed and by the spring 16.

On movement of the spherical end portion 15 of the contact 14 into engagement with the stationary contact 18 a circuit is established through the motor or other apparatus which is controlled by this switch. This circuit includes the wire 20, which is connected to one terminal of the source of electric current, the stationary contact 18, the contact 14, the wire 22 to the terminal post 24 and thence by way of the wire 26 to one terminal of the motor. The other terminal of the motor is connected to the other terminal of the source of electric current.

The switch is now substantially in the position in which it is shown in Fig. 2 of the drawings. In this position the spherical end portion 52 of the contact 50 is out of engagement with the stationary contact 18, being held away from this contact by the rod 60 which is forced upwardly by the latch lever 36.

In addition, in this position of the switch, the switch lever 10 is in the position in which the spherical end portion 15 of the contact 14 is in engagement with the stationary contact 18 so as to complete the circuit to the motor or other apparatus to be controlled, while movement of the switch lever 10 by the torsional spring 28 is prevented by engagement of the projection 40 with the shoulder 42 on the latch lever 36.

At this time the adjusting screw 62 engages the lower face of the lever 46 and exerts a force on this lever supplementing that of spring 64 and tending to move the lever 46 in a clockwise direction about the pin 8.

On the supply of electric current to the motor or other apparatus controlled by the switch, the compressor or device driven by this motor or other apparatus is operated to supply fluid under pressure to the reservoir to which the pipe 76 is connected, and as the pressure in this reservoir builds up there will be an increase in the pressure of the fluid in the chamber 74 on the face of the diaphragm 70.

On an increase in the pressure of the fluid in the chamber 74 there will be an increase in the force exerted on the diaphragm 70, and this force will be transmitted through the plunger 78 and the push rod 80 to the lever 46 and will tend to move this lever against the opposing force of the spring 64 and the latch lever 36.

As the pressure of the fluid in the chamber 74 builds up the diaphragm 70 will be moved to the left, as viewed in the drawings, and this movement will be transmitted to the lever 46 to move this lever in a counterclockwise direction. On

this movement of the lever 46, the lower end of the lever 46 will press against the adjusting screw 62 and move the free end of the latch lever 36 downwardly so that the shoulder 42 is moved away from the projection 40.

When the pressure of the fluid in the chamber 74 has increased to a predetermined relatively high value the movement of the diaphragm 70 will be sufficient to move the lever 46 far enough to move the latch lever 36 downwardly so that the shoulder 42 is moved out of the path of movement of the projection 40 on the switch lever 10.

When the shoulder 42 is moved out of the path of movement of the projection 40 the switch lever 10 is no longer held by the shoulder 42 and the torsional spring 28 will move the switch lever 10 in a counterclockwise direction about the pin 8, thereby moving the spherical end portion 15 of the contact 14 away from the stationary contact 18, thus interrupting the circuit to the motor or other apparatus controlled by the switch. The switch lever 10 will be moved by the torsional spring 28 until the projection 40 thereon engages the shoulder 38 on the latch lever 36. The switch is now substantially in the position in which it is shown in Fig. 3 of the drawings.

On this movement of the lever 46 by the fluid under pressure in the chamber 74 on the face of the diaphragm 70, the spherical end portion 52 of the contact 50 is moved away from the stationary contact 18 so that it is no longer able to engage the stationary contact, as is clearly shown in Fig. 3 of the drawings.

As the circuit to the motor or other apparatus controlled by this switch is interrupted, the device driven thereby will not operate to supply fluid under pressure to the reservoir from which fluid is supplied by way of the pipe 76 to the chamber 74. There will, therefore, be no further increase in the pressure of the fluid in the chamber 74.

On a subsequent reduction in the pressure of the fluid in the reservoir into which fluid is compressed by the device controlled by this switch, there will be a similar reduction in the pressure of the fluid in the chamber 74 on the face of the diaphragm 70, and a corresponding reduction in the force exerted by this fluid through the diaphragm 70, the plunger 78, and push rod 80 upon the lever 46 in opposition to the spring 64.

As a result of the reduction in the force exerted by the fluid under pressure in the chamber 74, the lever 46 will be moved in a clockwise direction by the spring 64, thereby moving the lower end of the lever 46 away from the adjusting screw 62. At this time the free end of the latch lever 36, which carries the adjusting screw 62, is prevented from moving upwardly by engagement of the upper face of the latch lever with the projection 40 on the switch lever 10.

As the free end of the latch lever 36 is prevented from moving upwardly at this time, the adjusting screw 62 will be spaced from the lower end of the lever 46 after movement of the lever 46 in a clockwise direction from the position in which it is shown in Fig. 3 of the drawings, and the latch lever 36 will thereafter not exert any force upon the lever 46.

During this movement of the lower end of the lever 46 away from the adjusting screw 62, the lower end of the rod 60 will be maintained in engagement with the adjusting screw 62 by the contact 50 which yieldingly presses upon the upper end of the rod 60.

As the lever 46 continues to move in clockwise

direction about the pin 8 the distance between the lower end of the lever 46 and the adjusting screw 62 will increase and the rod 60 will be moved further downwardly in the bore in the lever 46, while the contact 50 will move towards the free end of the lever 46.

When the pressure of the fluid in the chamber 74 falls to a relatively low value the lever 46 will be moved by the spring 64 substantially to the position in which the lever is shown in Fig. 1 of the drawings. However, before the lever 46 will be moved to this position, the pressure of the fluid in the chamber 74 must fall to a somewhat lower value than was required to effect movement of a lever 46 away from the position in which it is shown in Fig. 1 of the drawings, as movement of the lever 46 away from this position is opposed by the spring 64 and by the latch lever 36, while movement of the lever 46 towards the position in which it is shown in Fig. 1 of the drawings is effected solely by the spring 64 without the aid of the latch lever 36.

When the lever 46 has moved substantially to the position in which it is shown in Fig. 1 of the drawings, the spherical end portion 52 of the contact 50 engages the stationary contact 18 so as to complete the circuit from the stationary contact 18 through the winding 4. When the circuit through the winding 4 is completed this winding is energized and a magnetic flux field is created in the region adjacent the end of the core 3 and the armature 12 of the switch lever 10 is again moved towards the end of the core 3 against the opposing force of the torsional spring 28.

On this movement of the switch lever 10 the projection 40 is moved away from the shoulder 38 and is moved to a position to permit the free end of the latch lever 36 to move upwardly so that the shoulder 42 is now in the path of movement of the projection 40.

On upward movement of the free end of the latch lever 36 the adjusting screw 62 presses against the lower end of the rod 60 and moves it upwardly in the bore in the lever 46 so that the upper end of the rod 60 engages the contact 50 and moves the spherical end portion 52 of the contact 50 away from the stationary contact 18, thereby interrupting the circuit through the winding 4.

The free end of the latch lever 36 continues to move upwardly until the adjusting screw 62 engages the lower end of the lever 46. The adjusting screw 62 will thereafter press against the lever 46 and exert a force on this lever supplementing the spring 64 and opposing movement of the lever 46 by the fluid under pressure in the chamber 74.

On the interruption in the supply of current to the winding 4 the flux field adjacent the end of the core 3 diminishes, but the spring 28 is unable to move the switch lever 10 away from the core 3 as the projection 40 engages the shoulder 42 on the latch lever 36.

In this position of the switch lever 10 the spherical end portion 15 of the contact 14 engages the stationary contact 18 to complete a circuit to the motor or other apparatus controlled by the switch and the device driven thereby is operated to compress fluid into the reservoir with which the pipe 76 communicates.

On an increase in the pressure of the fluid in this reservoir there will be a similar increase in the pressure of the fluid in the chamber 74 on the face of the diaphragm 70 and a correspond-

ing increase in the force exerted through the plunger 78 and the push rod 80 on the lever 46.

At this time movement of the lever 46 is opposed by the spring 64 and also by the latch lever 36 acting through the adjusting screw 62 which engages the lower end of the lever 46. As a result the lever 46 will not be moved until there has been a substantial increase in the pressure of the fluid in the chamber 74, and thereafter on a further increase in the pressure of the fluid in the chamber 74, the lever 46 will be moved in a counterclockwise direction and will move the free end of the latch lever 36 downwardly until the shoulder 42 is moved out of the path of movement of the projection 40 on the switch lever 10 so as to permit the switch lever 10 to be moved to the open position by the torsional spring 28 associated therewith, thereby interrupting the circuit to the motor or other apparatus controlled by the switch.

The switch provided by this invention incorporates means by which the pressures to which the switch will respond to effect opening and closing of the circuit controlled thereby may be adjustably varied. This means comprises the knurled nut 68 which operates through the threaded member 66 to control the tension on the spring 64.

If the nut 68 is turned in one direction the tension on the spring 64 is increased, thereby increasing the force exerted by this spring on the lever 46 and producing a corresponding increase in the value to which the pressure of the fluid in the chamber 74 must fall before the lever 46 will be moved to the position to complete the circuit through the winding 4 and thereby complete the circuit controlled by this switch. In addition, there will be a similar increase in the pressure to which the fluid in the chamber 74 must increase before the lever 46 will be moved to a position to release the latch lever 36 and permit the switch lever 10 to be moved by the torsional spring 28 to move the spherical portion 15 of the contact 14 out of engagement with the stationary contact 18 and thereby interrupt the circuit to the motor or other apparatus controlled by the switch.

If the knurled nut 68 is turned in the other direction the tension on the spring 64 is decreased, thereby decreasing the force exerted by this spring on the lever 46 and producing a corresponding decrease in the value to which the pressure of the fluid in the chamber 74 must fall before the lever 46 will be moved to the position to complete the circuit through the winding 4 and thereby complete the circuit controlled by the switch.

Likewise there will be a similar decrease in the pressure to which the fluid in the chamber 74 must build up before the lever 46 will be moved to a position to release the latch lever 36 and permit the switch lever 10 to be moved by the torsional spring 28 to a position to interrupt the circuit to the motor or other apparatus controlled by this switch.

The switch provided by this invention also incorporates means by which the difference in the pressures at which it operates to interrupt the circuit controlled thereby and the pressure at which it operates to complete the circuit may be adjustably varied. This means comprises the adjusting screw 62 which is carried by the latch lever 36. If this screw is turned in one direction the distance the free end of the latch lever may move before the end of the adjusting screw 62

engages the lower end of the lever 46 will be reduced, and hence the portion of the shoulder 42 on the latch lever 36 which extends into the path of movement of the projection 40 on the switch lever 10 will be reduced.

The distance which the free end of the latch lever 36 must be moved before the shoulder 42 is moved out of the path of movement of the projection 40 to release the switch lever 10 and permit it to be moved by the torsional spring 28 to a position to interrupt the circuit controlled thereby will be correspondingly reduced, therefore, and there will be a similar reduction in the pressure to which the fluid under pressure in the chamber 74 on the face of the diaphragm 70 must build up before the lever 46 will be moved far enough to move the free end of the latch lever this distance.

Similarly, if the adjusting screw 62 is turned in the opposite direction the distance which the free end of the latch lever 36 may move before the end of the adjusting screw 62 engages the lower end of the lever 46 will be increased and the portion of the shoulder 42 on the latch lever 36 which extends into the path of the projection 40 on the switch lever 10 will be correspondingly increased. Likewise the distance which the free end of the latch lever 36 must be moved before the shoulder 42 is moved out of the path of movement of the projection 40 to release the switch lever 10 and permit it to be moved by the torsional spring 28 to a position to interrupt the circuit controlled thereby will be increased, and there must be a similar increase in the pressure of the fluid in the chamber 74 before the lever 46 will be moved this distance.

It will be seen, however, that changes in the adjustment of either of the adjusting means incorporated in this switch do not affect in any way the pressure with which the spherical end portion 15 on the contact 14 is pressed into engagement with the stationary contact 18. This pressure remains the same and is determined by the inherent resiliency of the material of which the contact 14 is constructed, together with the force exerted by the spring 16, and these are proportioned so as to insure that the spherical end portion 15 of the contact 14 will firmly engage the stationary contact 18 to make good electrical connection with this contact.

It will be seen also that movement of the switch lever 10 between its switch open and switch closed positions occurs very rapidly so as to reduce arcing between the movable and stationary contacts and thereby reduce to a minimum the damage which occurs to these contacts.

While one embodiment of the improved switch provided by this invention has been illustrated and described in detail, it should be understood that the invention is not limited to these details of construction, and that numerous changes and modifications may be made without departing from the scope of the following claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. In a switch device, in combination, a switch movable between an open position and a closed position, yielding means urging the switch to one of said positions, electro-responsive means for moving the switch against the yielding means, latch means for preventing movement of the switch by the yielding means, biasing means, said switch device having a chamber adapted to con-

tain fluid under pressure, and means subject to the opposing pressures of the fluid in said chamber and of said biasing means for controlling said latch means and for also controlling the supply of current to the electro-responsive means.

2. In a switch device, in combination, a switch movable between an open position and a closed position, yielding means urging the switch to one of said positions, electro-responsive means for moving the switch against the yielding means, latch means movable between a release position and a latching position, the latch means being operative in the release position to permit movement of the switch between its positions by the yielding means and in the latching position to prevent movement of the switch by the yielding means, biasing means, said switch device having a chamber adapted to contain fluid under pressure, and movable abutment means subject to the opposing pressures of the biasing means and of the fluid in said chamber for moving the latch means from the latching position to the release position.

3. In a switch device, in combination, a switch movable between an open position and a closed position, yielding means urging the switch to one of its positions, electro-responsive means for moving the switch against the yielding means, latch means movable between a release position and a latching position, the latch means being operative in the release position to permit movement of the switch between its positions by the yielding means and in the latching position to prevent movement of the switch by the yielding means, biasing means, said switch device having a chamber adapted to contain fluid under pressure, and movable abutment means subject to the opposing pressures of the biasing means and of the fluid in said chamber for moving the latch means from the latching position to the release position and for controlling the supply of current to the electro-responsive means.

4. In a switch device, in combination, a switch movable between an open position and a closed position, yielding means urging the switch to one of its positions, electro-responsive means for moving the switch against the yielding means, latch means movable between a release position and a latching position, the latch means being operative in the release position to permit movement of the switch between its positions by the yielding means and in the latching position to prevent movement of the switch by the yielding means, a member movable between spaced positions and controlling the latch means and the supply of current to the electro-responsive means, biasing means urging said member to one of said positions, said switch device having a chamber adapted to contain fluid under pressure, and a movable abutment subject to and operated on an increase of the pressure of the fluid in said chamber for moving the member to other of said positions.

5. In a switch device, in combination, a switch movable between an open position and a closed position, yielding means urging the switch to one of its positions, electro-responsive means for moving the switch against the yielding means, latch means movable between a release position and a latching position, the latch means being operative in the release position to permit movement of the switch between its positions by the yielding means and in the latching position to prevent movement of the switch by the yielding means, a member movable between the spaced po-

sitions, said member controlling the latch means and being operative on movement to one of its positions to move the latch means to the release position and on movement to the other of its positions to permit the latch means to move to the latching position, biasing means urging said member to one of said spaced positions, said switch device having a chamber adapted to contain fluid under pressure, and movable abutment means subject to and operated on an increase in the pressure of the fluid in said chamber for moving the member to the other of the said spaced positions.

6. In a switch device, in combination, a switch movable between an open position and a closed position, biasing means associated with the switch and urging the switch to one of said positions, electro-responsive means for moving the switch against the biasing means, latch means movable between a release position and a latching position and operative in the latching position to prevent movement of the switch from one of said positions, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, a member subject to the opposing pressures of the fluid in said chamber and of said yielding resistance means for moving the latch means from one of its positions to the other of its positions, and means controlled by said member and by said latch means for controlling the supply of current to the electro-responsive means.

7. In a switch device, in combination, a switch movable between an open position and a closed position, biasing means associated with the switch and urging the switch to one of said positions, electro-responsive means for moving the switch against the biasing means, latch means movable between a release position and a latching position and operative in the latching position to prevent movement of the switch from one of the said positions to the other of said positions, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, and a member subject to the opposing pressures of the fluid in said chamber and of said yielding resistance means for moving the latch means from the latching position to the release position, the switch being operative to control movement of the latch means from the release position to the latching position.

8. In a switch device, in combination, a switch movable between an open position and a closed position, biasing means associated with the switch and urging the switch to one of said positions, electro-responsive means for moving the switch against the biasing means, latch means movable between a release position and a latching position and operative in the latching position to prevent movement of the switch from one of the said positions to the other of the said positions, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, a member subject to the opposing pressures of the fluid in said chamber and of said yielding resistance means for moving the latch means from the latching position to a release position, the switch being operative to control movement of the latch means from the release position to the latching position, and means controlled by said member and by the latch means for controlling the supply of current to the electro-responsive means.

9. In combination, a switch movable between an open position and a closed position, biasing

means associated with the switch and urging the switch to the open position, electro-responsive means operative on the supply of current thereto to move the switch against the biasing means to the closed position, latch means associated with the switch and operative on movement of the switch to the closed position to prevent movement of the switch from said position, and means controlled by the latch means for controlling the supply of current to the electro-responsive means.

10. In combination, a switch movable between an open position and a closed position, biasing means associated with the switch and urging the switch to the open position, electro-responsive means operative on the supply of current thereto to move the switch against the biasing means to the closed position, latch means associated with the switch and operative on movement of the switch to the closed position to move to a latching position to prevent movement of the switch from the closed position, and means operative on movement of the latch means to the latching position to interrupt the supply of current to the electro-responsive means.

11. In a switch device, in combination, a switch movable between an open position and a closed position, biasing means associated with the switch and urging the switch to the open position, electro-responsive means operative of the supply of current thereto for moving the switch to the closed position, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, and a member subject to the opposing pressures of the fluid in said chamber and of the yielding resistance means and controlling the supply of current to said electro-responsive means.

12. In a switch device, in combination, a switch movable between an open position and a closed position, yielding resistance means associated with the switch and urging the switch to the open position, electro-responsive means operative on the supply of current thereto for moving the switch to the closed position, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, a member movable between spaced positions and controlling the supply of current to said electro-responsive means, said member being subject to the opposing pressures of the yielding resistance means and of the fluid in said chamber, and other yielding resistance means controlled by the switch for opposing movement of said movable member from one of its positions to the other of its positions.

13. In a switch device, in combination, a switch movable between an open position and a closed position, electro-responsive means operative on the supply of current thereto to move the switch to the closed position, latch means movable between a release position and a latching position and operative on movement to the latching position to prevent movement of the switch from the closed position, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, a movable member subject to the opposing pressure of the yielding resistance means and of the fluid in said chamber for moving said latch means from the latching position to the release position, and biasing means operating through the latch means and opposing movement of the movable member to move the latch means from the latching position to the release position, the switch being operable

on movement of the latch means to the release position to render the biasing means inoperative to exert force on said movable member.

14. In a switch device, in combination, a switch movable between an open position and a closed position, electro-responsive means for controlling movement of the switch, latch means movable between a release position and a latching position and operative in said latching position to permit movement of the switch from one of said positions to the other of said positions and to prevent movement of the switch in the other direction, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, and means subject to the opposing pressures of the yielding resistance means and of the fluid in said chamber for controlling the supply of current to the electro-responsive means and for controlling operation of the latch means.

15. In a switch device, in combination, a switch movable between an open position and a closed position, latch means movable between a release position and a latching position and being operative in the latching position to permit movement of the switch from one of the said positions to the other of the said positions and to prevent movement of the switch in the other direction, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, and means subject to the opposing pressures of the fluid in said chamber and of the yielding resistance means for controlling operation of the latch means.

16. In a switch device, in combination, a switch movable between an open position and a closed position, latch means movable between a release position and a latching position and being operative in the latching position to permit movement of the switch from one of the said positions to the other of the said positions and to prevent movement of the switch in the other direction, yielding resistance means, said switch device having a chamber adapted to contain fluid under

pressure, and means subject to the opposing pressures of the yielding resistance means and of the fluid in said chamber for moving the latch means from the latching position to the release position.

17. In a switch device, in combination, a switch movable between an open position and a closed position, latch means movable between a release position and a latching position and being operative in the latching position to permit movement of the switch from one of the said positions to the other of the said positions and to prevent movement of the switch in the other direction, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, means subject to the opposing pressures of the yielding resistance means and of the fluid in said chamber for moving the latch means from the latching position to the release position, and means associated with the switch and controlling movement of the latch means from the release position to the latching position.

18. In a switch device, in combination, a switch movable between an open position and a closed position, latch means movable between a release position and a latching position and being operative in the latching position to permit movement of the switch from one of the said positions to the other of the said positions and to prevent movement of the switch in the other direction, yielding resistance means, said switch device having a chamber adapted to contain fluid under pressure, a member subject to the opposing pressures of the yielding resistance means and of the fluid in said chamber for moving the latch means from its latching position to the release position, biasing means associated with the latch means and opposing movement of the latch means by said member, and means operative on movement of the switch to one of its positions to prevent said biasing means from exerting force on said member.

BURTON S. AIKMAN.