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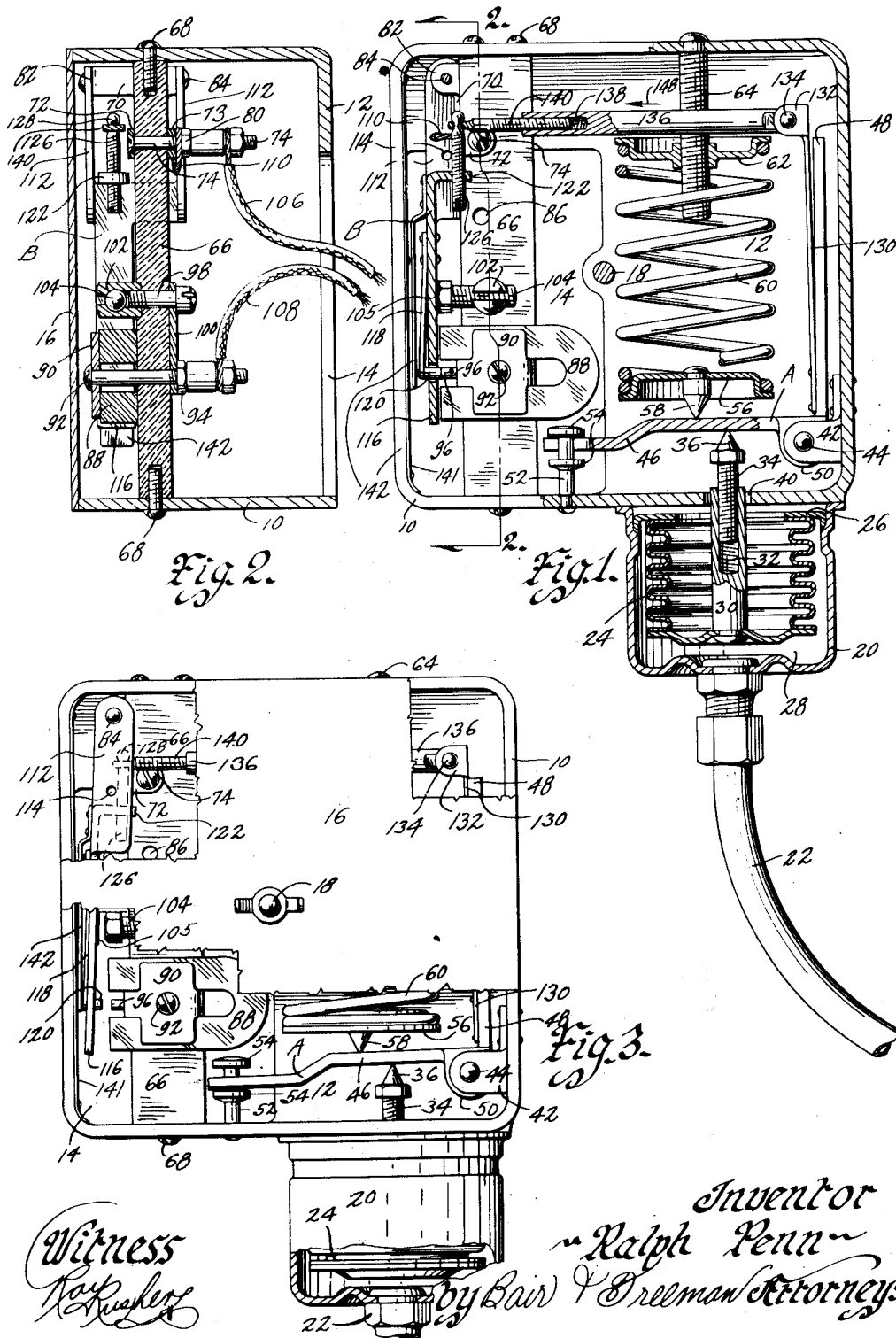
R. PENN

1,827,102

PRESSURE ACTUATED SWITCH

Filed May 21, 1927

2 Sheets-Sheet 1



Oct. 13, 1931.

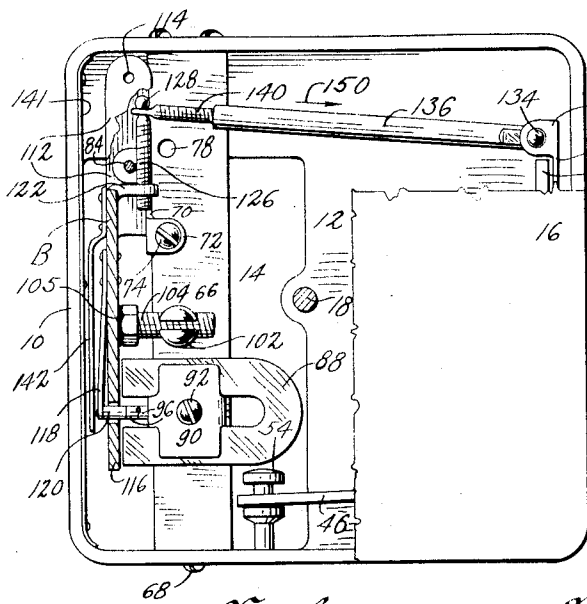
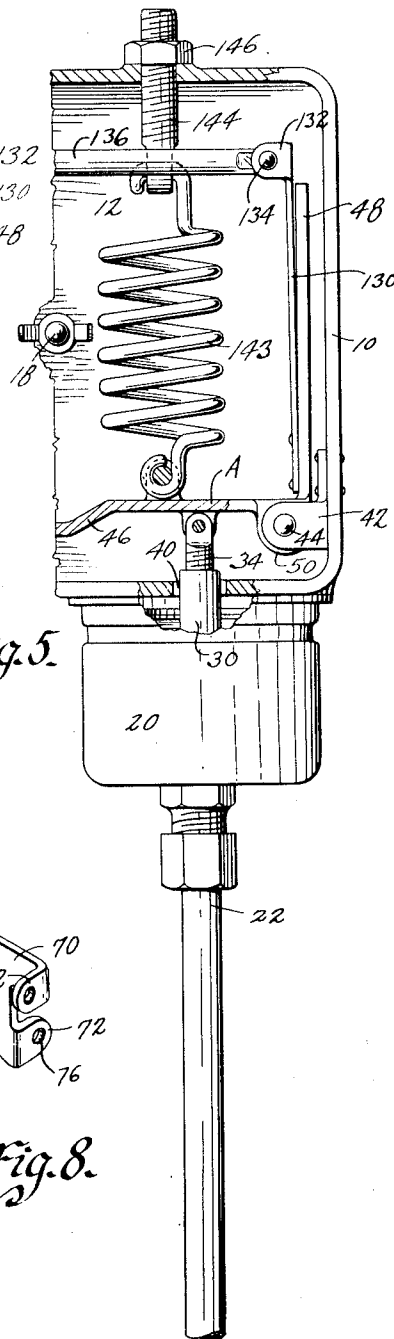
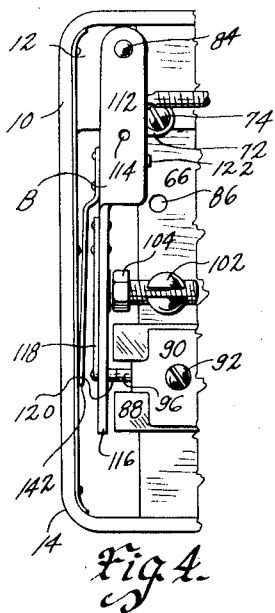
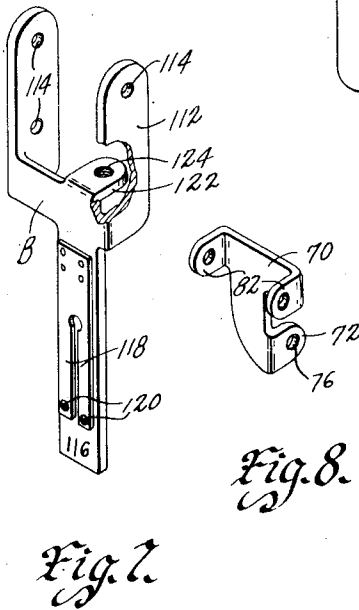
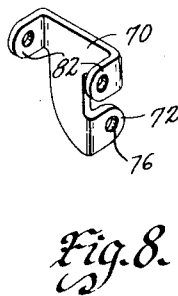
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1,827,102

PRESSURE ACTUATED SWITCH

Filed May 21, 1927

2 Sheets-Sheet 2



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PRESSURE ACTUATED SWITCH

Application filed May 21, 1927. Serial No. 193,316.

The object of my invention is to provide a pressure actuated switch for making and breaking an electric circuit employing in such switch a magnet and other parts so arranged
5 that the circuit may be made or broken with a positive snap action and thus eliminate any "lingering" effect, at the time the circuit is made or broken, the parts being simple, durable and comparatively inexpensive.

10 More particularly it is my object to provide a flexible actuating mechanism, so that the magnet is effective and does: first, accelerate the final movement of the armature when closing the circuit; and second, resist
15 the opening movement of the armature against the flexible actuating parts to a degree sufficient to cause the circuit to be finally broken by rapid snap action.

Still a further object is to provide a switch
20 actuated by either air or fluid pressure wherein an auxiliary contact member carried by an armature arm will retain the contact and keep the circuit closed until after the main
25 contact point has been broken and the armature carrying the movable main contact member and the movable auxiliary contact member is in rapid motion moving from the closed to the open position.

Still another object is to provide "an excess motion take-up" between the pressure operated lever of the switch and the movable
30 armature member wherein the contact is made without the danger of the lever moving too far and damaging the connecting
35 parts between the lever and armature member.

Still another object is to provide a magnet for functioning as a magnetic blow-out for all arcing that takes place either when closing
40 or opening the circuit, which arcing always occurs directly between the poles of the magnet.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various
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parts of my pressure actuated switch, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims, and illustrated in the accompanying drawings, in which:

Figure 1 is a plan view of my pressure actuated switch with parts shown in section to better illustrate the operation thereof.

Figure 2 is a vertical sectional view taken on the line 2—2 of Figure 1.

Figure 3 is a plan view of the switch with portions of the cover plate broken away and illustrating the contacts in opened position.

Figure 4 is a plan view illustrating the auxiliary contacts as in engagement with each other and the armature and main contact disengaged.

Figure 5 illustrates a slightly modified form of mechanism for actuating the switch.

Figure 6 is a plan view of the switch illustrating the operating parts in another position.

Figure 7 is a perspective view of the armature arm and

Figure 8 is a perspective view of the bracket upon which the armature arm is mounted.

In the accompanying drawings I have used the reference numeral 10 to indicate generally a shell or casing in which the switch mechanism and the actuating parts are mounted. The shell or casing 10 includes a back wall 12 having an open portion 14 adjacent the switch mechanism as will hereinafter be more fully set forth.

The front side of the shell 10 is entirely open and may be closed by a cover plate 16. The cover plate 16 is designed to be held in position by a bolt or the like 18 fixed to the back wall 12 of the shell 10 and extending through the cover plate 16.

A control casing 20 is secured to the shell 10 and has an inlet pipe 22 in communication therewith through which the air or fluids of

various kinds may pass into the control casing 20.

Within the control casing 20 is mounted an expansible and contractible bellows structure 24 at one end. The bellows structure 24 is mounted upon a plate 26 secured to the control casing 20 for providing an air or liquid tight chamber 28 around the bellows 24.

A pin or shaft 30 is connected to the bellows 24 at the other end and has a reciprocating movement when the bellows is expanded or contracted. The pin 30 is provided with a central screw threaded opening 32 for receiving an adjusting screw 34. The screw 34 has a pointed cap or head 36 thereon.

It will be understood that the bellows 24 is expanded or contracted by the pressure or vacuum to which the chamber 28 is subjected. This expansion and contraction imparts movement to the pin 30 and adjusting screw 34. The adjusting screw and pin project through an opening 40 formed in the shell 10 as clearly illustrated in Figures 1 and 5 of the drawings.

A bracket 42 is mounted upon one of the walls of the shell 10. A bell crank lever A is pivoted upon the bracket 42 by means of a pivot pin or the like 44. The bell crank lever A is formed with a substantially horizontal arm 46 and a substantially vertical arm 48. The arms 46 and 48 need not be horizontal or vertical and it is only for the purpose of clearly describing the operation of my device that I refer to them by such terms.

Upon the arm 46 of the bell crank lever A, I provide downturned ears or the like 50 through which the pivot pin 44 extends for properly mounting the entire bell crank lever A. The cap 36 of the adjusting screw 34, which is tapered so as to provide a sharp point, engages the underside of the arm 46.

Movement of the pin 30 of the bellows 24 will impart movement to the bell crank lever A. The bell crank lever A is moved in one direction at least by spring pressure which will hereinafter be more fully set forth.

In order to limit the movement of the bell crank lever A, I provide a limiting device 52 which has a pair of spaced flanges 54 thereon. The end of the arm 46 of the lever A is bifurcated and straddles the limiting device 52 between the two flanges 54.

Movement of the lever A is thus restricted or limited within the range afforded by the two flanges 54 of the element 52. Upon the arm 46 of the lever A is mounted a disc or spring holder 56 resting upon a pointed support 58.

A coil spring 60 tending to normally expand has one end resting against the disc 56 and its other end resting against a disc 62. The disc 62 is formed with a central screw threaded opening which receives an adjust-

ing screw 64. The adjusting screw 64 is mounted in the shell 10.

The tension applied upon the spring 60 may be varied by simply rotating the entire spring at which time the disc 62 will travel either upwardly or downwardly upon the adjusting screw 64. The tension upon the coil spring 60 may be varied and adjusted to meet the conditions under which the switch structure is arranged to be operated.

From the construction of the parts just described it will be seen that contraction of the bellows 24 will cause the pin 30 to move upwardly or against the bell crank lever A thus operating it in one direction and against the action of the spring 60.

When the bellows 24 expands, the spring 60 will force the lever A to follow the downward movement of the pin 30 and cause the pin 30 and the head 36 upon the adjusting screw 34 to remain in engagement with each other.

I will now describe the switch mechanism wherein the electric circuit may be made or broken and which is operated through movement of the bell crank lever A in either direction. An insulated plate or support 66 is positioned within the shell between two of the walls thereof and held in position by screws 68.

Upon the support 66 I provide an armature bracket 70 which has a finger 72 arranged to rest against the support 66. A binding post 74 extends through an opening 76 formed in the finger 72 and through an opening 78 formed in the support 66.

A nut 80 is mounted upon the post 74 and when tightened retains the bracket 70 upon the support 66. The bracket 70 is also formed with a pair of lugs 82 provided with central openings for receiving a pivot pin 84 upon which an armature arm B is pivotally supported as will be hereinafter more fully set forth.

Below the opening 78 in the support 66 I provide another opening 86 wherein the position of the bracket 70 may be changed relative to the support 66 upon which it is mounted.

The purpose of the two openings 78 and 86 for varying the position of the bracket 70 will be more fully described.

Upon the support 66 I mount a magnet 88 held in position by a retaining clip 90. A binding post 92 projects through the clip 90 and through the support 66 for holding the retaining clip 90 and magnet 88 in operative position. The magnet 88 as illustrated in the drawings is of the horseshoe type and may be adjusted or moved crosswise of the support 66. Other magnets may be used.

A nut 94 is positioned upon the post 92 and serves to retain the post 92 in operative position relative to the support 66. An auxiliary contact 96 is carried by the retaining clip 90

and is centrally located between the ends of the magnet 88 and may be said to be centrally located within the magnetic field of the magnet 88.

5 The contact 96 is what may be termed a "stationary auxiliary contact". The binding post 92 makes contact with the contact point 96 through the retaining clip 90. An auxiliary post 98 is mounted upon the support 66, and is connected to the post 92 by a metal bar 100.

10 A sleeve or the like 102 is carried by the post 98 and has an adjusting screw 104 mounted therein. The adjusting screw 104 may be termed a "fixed main contact". The position of the screw 104 may, however, be adjusted and when once adjusted remains stationary.

15 The supply lines or wires 106 and 108 lead to the binding posts 74 and 92 respectively. It will thus be seen that the wire 108 electrifies the post 92, the bar 100 and thereby the post 98 and the main contact 104. The auxiliary contact 96 is also electrified from the wire 108. The wire 106 electrifies the post 74 and by means of a short wire 110, the armature arm B.

20 The armature arm B comprises a pair of spaced arms 112 which are provided with a pair of spaced openings 114. The upper openings 114 are designed to receive the pivot pin 84 of the bracket 70. The armature arm B is thus pivotally supported upon the bracket 70 and relative to the support 66.

25 The armature arm B includes an elongated plate 116 having a movable leaf spring 118 carried thereby. The leaf spring 118 is bifurcated near its lower end and carries a pair of movable contact points 120. The contact points 120 are designed to register with similar contact points 96 carried by the retaining clip 90.

30 In the drawings I have illustrated two contact points 120 and in such case there is provided two contact points 96. The contact points 120 project through openings formed in the plate 116 of the armature arm B. The contact points 120 may be referred to as "auxiliary movable contacts". The contacts 120 are capable of movement relative to and independent of the armature arm B.

35 The contacts 120 and 96 are located between the poles of the magnet so that the magnet functions to blow out any arcing that occurs when the circuit is made or broken.

40 The fixed main contact 104 is arranged to coact or contact with a main movable contact 105 carried by the armature arm B. The contact made through the member 104 and the armature arm B may carry the main load of the circuit. In order to move the armature arm B through actuation of the lever A, it is necessary to provide a connection therebetween which I will now describe in detail.

45 Upon the armature arm B substantially between the arms 112, is an intumed lug 122

having a central threaded opening 124. The opening 124 receives a screw 126. The screw 126 is formed with a head 128 having a groove or contracted neck therebelow. The screw 126 is vertically adjustable relative to the armature arm upon which it is mounted.

70 The lug 122 is positioned upon one side of the support 66 and does not interfere therewith. Upon the lever A adjacent the pivot point thereof I mount a spring 130 preferably of the leaf type. The spring 130 extends upwardly adjacent the vertical arm 48 of the lever A and has its upper end terminating near the upper end of the arm 48. The spring 130 normally rests against the arm 48 and the two elements usually move together as a single construction.

75 The upper end of the spring 130 is provided with extensions 132 through which is extended a pivot pin or the like 134. A connecting link or rod 136 is received between the extensions 132 and is connected to the pivot pin 134. The free end of the link 136 is provided with a central screw threaded opening 138 which receives a screw threaded pin or connection 140.

80 The pin 140 has one end formed with an opening adapted to extend around the neck of the screw 126. The pin 140 and the screw 126 are swivelly connected together and at the same time, there is provided limited universal movement of the pin 140 relative to the screw 126.

85 The connection between the pin 140 and the screw 126 enables either of them to be adjusted within their bearings. The adjustment just referred to enables the distance between the screw 126 and the spring 130 to be varied depending upon the particular mode or range of operation to which the switch structure is to be subjected.

90 The purpose of providing the spring 130 in place of directly connecting the link 136 with the upper end of the arm 48, is one that adds materially to the successful operation of the entire switch structure. The spring 130 allows for excess operation of the lever A without effecting the armature arm B.

95 After the contact has been made, any further movement of the lever A causes it to leave the spring 130 as illustrated in Figure 1 of the drawings.

100 The limiting device 52 serves as a positive stop for the lever A. The desired position of the contact 104 and the armature arm B is such as to have them contact just as the lever is about to engage the upper flange 54 of the limiting device 52. It has been found very difficult to so construct the lever and armature arm as to have them engage the flange 54 and contact 104 at the very same time.

105 Any additional movement of the lever after the armature has contacted with the contact 104, is taken up by the spring 130 which allows the arm 48 of the lever A to move away

therefrom. Movement of the lever to break the contact operates against the spring 130 as though the parts were integral.

Upon the armature arm B, I provide a leaf spring 142 which serves as a shock absorber for the armature when it strikes the shell 10. Insulating material 141 is placed within the shell adjacent the leaf spring 142.

In Figure 5 of the drawings I have shown the bell crank lever A as being operated through vacuum and in such case, a spring 143 is provided which tends to contract and is connected at one end to the lever A and at its other end to a screw member 144 mounted in the shell 10.

A nut 146 is positioned upon the screw 144 and by rotation of the nut 146, I am able to adjust or change the tension of the spring 143. In Figure 1 of the drawings the link 136 is moved in the direction indicated by the arrow 148 for breaking the contact, while in Figure 6 of the drawings, the link 136 is moved in the opposite direction or in the direction indicated by the arrow 150 to break the contact.

When the armature arm is moved to break the circuit by the link 136 moving in the direction indicated by the arrow 148, it is necessary to have the pivot point of the armature arm above the upper end of the screw 126. When the armature arm is moved to break the circuit by moving the link 136 in the direction indicated by the arrow 150, then the pivotal connection of the armature arm is positioned below the upper end of the screw 126.

The positioning of the pivotal connection is governed by shifting the bracket 70 upon the support 66. The bracket 70 may be mounted upon the support 66 by using either of the openings 78 or 86. The position of the bracket 70 upon the support 66 determines whether the pivot rod or pin 84 engages with the upper pair of the openings 114 of the arms 112 or the lower pair of openings 114.

When the bracket 70 is shifted upon the support 66 with the pivot pin 84 engaging the lower pair of openings 114 of the arms 112 as illustrated in Figure 6 of the drawings, the leaf spring 130 is secured to the opposite side of the vertical arm 48 of the bell crank lever A.

It will be noted that in Figure 1 of the drawings, the leaf spring 130 is on one side of the arm 48 while in Figure 6, the same leaf spring 130 is on the other side of the same arm 48. In each case the position of the spring 130 relative to the arm 48 is such that the arm 48 moves with the spring 130 as a single structure when moving the armature B from the closed circuit position to the open circuit position.

Practical operation

The switch as shown in Figure 1 of the drawings, operates in the manner I will now

describe in detail. The switch is in position where the armature is in engagement with the contact 104 and the electric circuit is closed.

When the bellows 24 expands, it allows the circuit to be broken. The expanding bellows 24 allows the pin 30 to move downwardly or away from the bell crank lever A. The spring 60 retains the lever A and screw 34 in engagement while the pin 30 is being moved downwardly. Such movement forces the vertical arm 48 of the lever A to move the leaf spring 130.

This movement of the vertical arm 48 forces the link 136 in the direction indicated by the arrow 148. This movement swings the armature arm B upon its pivot in a direction away from the contact 104.

It will be noted that when the contact 104 is in engagement with the armature B, the spring 118 upon which the auxiliary contacts are carried, is positioned as sprung away from the plate 116 of the armature B. As the link 136 is moved in the direction indicated by the arrow 148, it first causes the armature B to break away from the contact 104 as illustrated in Figure 4 of the drawings. The auxiliary contacts 120 and 96 are still in engagement with each other.

The different positions of the armature and the leaf spring 118, is clearly shown in Figures 1 and 4 of the drawings. It will be remembered that the electric circuit, when the parts are in position as illustrated in Figure 4 of the drawings, will still be maintained through the auxiliary contacts 120 and 96.

The movement of the link 136 which is caused by a positive but flexible movement, compels or forces the armature B to move away from the magnet 88 and out of the effective magnetic field. Further movement of the link 136 in the direction indicated by the arrow 148 causes the auxiliary contacts 120 and 96 to be broken and the parts then assume the position illustrated in Figure 3 of the drawings.

The magnet 54 retards the armature arm from breaking away from the contact 104 until the flexible connections between the armature and operating lever have built up a force to overcome the magnetic influence and thereafter the built up force is released thus imparting to the armature arm a very rapid movement.

The armature arm when moving to open circuit position picks up and carries away the auxiliary contacts 120 from the contacts 96. The release of the built up forces in the flexible connections as just described accelerates the movement of the armature arm to open circuit position.

During such movement the magnet 88 tends to hold the armature B against the pressure of the spring 60, the force of which is being allowed to act on the horizontal arm

46 of the bell crank lever A. When the force exerted by the spring 60 overcomes the attraction of the magnet 88 for the armature B, the main circuit through the contact 104 and the armature B will be broken as clearly illustrated in Figure 4 of the drawings.

The armature B is now in a much weaker magnetic field and the forces of the spring 60 and the pressure within the control casing 20 will tend to equalize themselves which equalization does not occur until after the auxiliary contacts 96 and 120 have been separated. Incidentally these auxiliary contacts will be broken quickly due to the momentum acquired by the armature B after it has been moved out of the strongest portion of the magnetic field produced by the magnet 88 and due further to the fact that the forces of the spring 60 and the actuating pressure in the control casing 20 are not yet equalized.

Soon after the contacts 96 and 120 are separated, and before the equalization just mentioned takes place, the arm 46 has engaged the lower flange 54 of the stop member 52 and the armature arm B is held in the open circuit position illustrated in Figure 3 of the drawings. When moving from the position shown in Figure 4 of the drawings, to the open circuit position just mentioned, the spring 142 acts as a shock absorber for the arm B and tends to eliminate vibration.

The magnet 88 when the armature B is being moved to position where a circuit will be made, functions to draw or snap the armature arm B towards its ends and in turn the electric circuit is caused by engagement of the auxiliary contacts 96 and 120 and then the armature arm B with the contact 104.

The snap movement imparted to the armature arm B through the influence of the magnet 88 causes a positive engagement of the contacts 96 and 120 and of the contact 104 with the armature arm B. The leaf spring 130 takes care of the continued movement of the bell crank lever A after the circuit is made and allows the arm 46 of the lever to move to position engaging the lower flange 54 of the stop 52.

In Figure 6 of the drawings, the breaking of the circuit takes place by movement of the link 136 in the direction indicated by the arrow 150. The operation except for the direction of the movement, is exactly the same as that described in connection with Figure 1 of the drawings.

The armature arm B is first disengaged from the contact 104. The magnetic field of the magnet 88 influences the armature B in the same way as described in connection with Figure 1, thus disengaging the contacts 120 from the contacts 96.

The lever A may be actuated by either fluid or air pressure or vacuum operated or operated under any conditions that will give to it movement, thus in turn causing the arma-

ture arm to be actuated for making or breaking an electric circuit. The magnet itself, is adjustable as is the contact 104 and the screw 126. The adjustment of the screw 126 varies the distance between the pivot of the armature arm and the connection between the screw 126 and link 136.

Such adjustment varying the effect of the magnet as to point of operation of the armature arm B all of which makes for a switch that is capable of a wide range of application.

The switch is capable of accurate and fine adjustment thus providing a switch that is sensitive in that its cycle of operation may be predetermined and there is assurance of its operation.

Some changes may be made in the construction and arrangement of the parts of my device without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims, any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope.

I claim as my invention:

1. In an automatic controlling device, a power unit, a switch unit including an armature arm and an operative connection between said units including a lever adapted to be moved by the power unit and a connection between said lever and said armature arm, said connection when moving in one direction serving to rigidly connect the arm and lever together and when moving in the opposite direction allowing independent movement of the lever relative to said arm and means for varying the differential as to when said armature arm operates.

2. In an automatic controlling device, a power unit, a switch unit and an operative connection between said units including a lever adapted to be moved by the power unit and a connection between said lever and said switch unit for operating the latter upon movement of the former, a spring secured to one side of said lever and normally in contact herewith, said connection being connected with said spring whereby the lever positively pushes the connection in one direction and the spring pulls the connection in the other direction.

3. In an automatic controlling device, a power unit, a switch unit and an operative connection between said units including a member adapted to be moved by the power unit and a connection between said member and said switch unit for operating the latter upon movement of the former, a spring secured to one side of said member and normally in contact therewith, said connection being connected with said spring whereby the member positively pushes the connection in one direction but may leave the connection

under tension of said spring when moving in an opposite direction.

4. In an automatic controlling device, a power unit, a switch unit and an operative connection between said units including a lever adapted to be moved by the power unit and a connection between said lever and said switch unit for operating the latter upon movement of the former, a spring secured to one side of said lever and normally in contact therewith and an ear carried by the spring and connected with the connection.

Des Moines, Iowa, May 16, 1927.

RALPH PENN.

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