W. M. SCOTT.

ELECTROPNEUMATIC SWITCH.

APPLICATION FILED JULY 22, 1910.

1,147,820. Patented July 27, 1915.

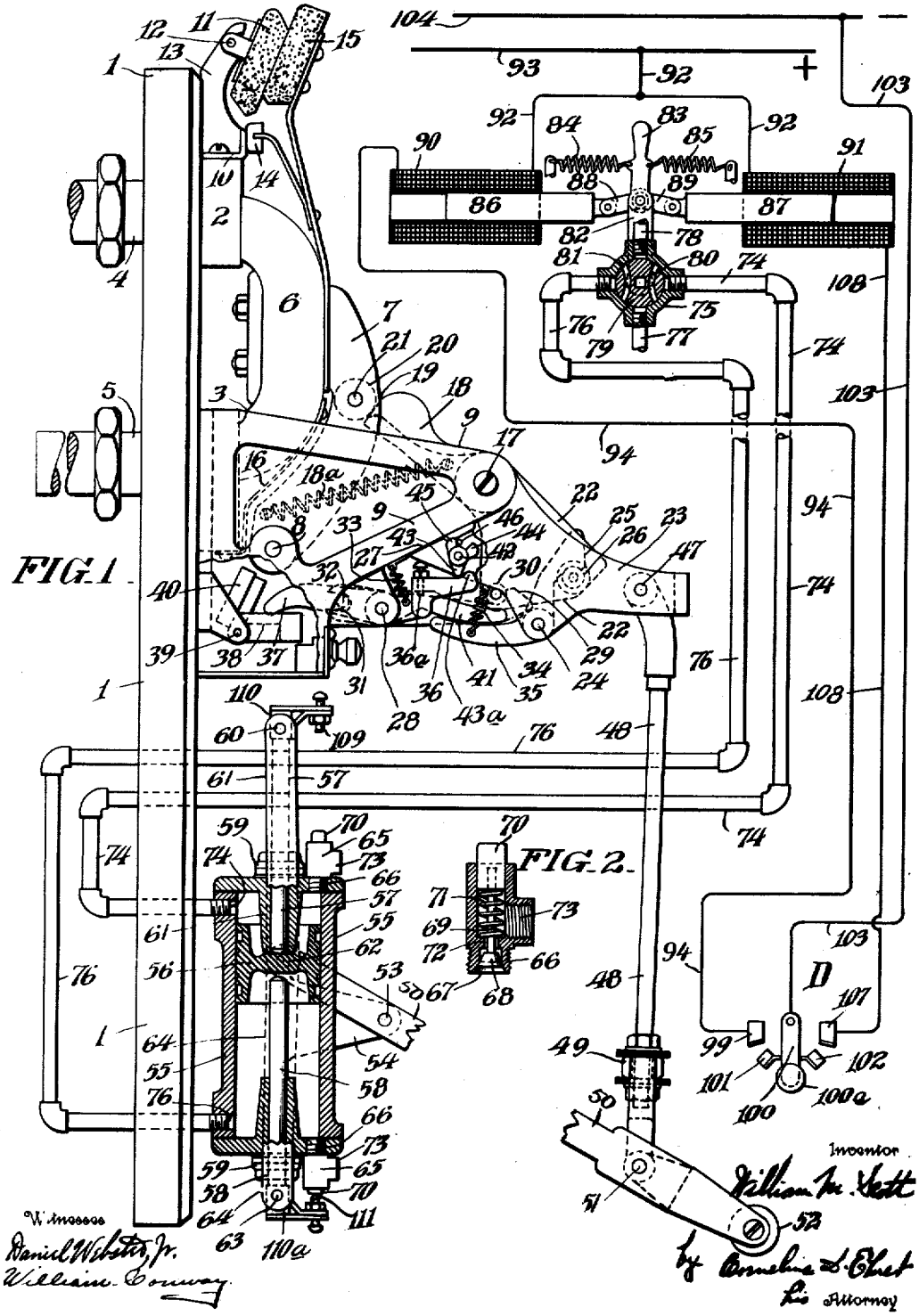


FIG. 1.

FIG. 2.

Witnesses
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UNITED STATES PATENT OFFICE.

WILLIAM M. SCOTT, OF PHILADELPHIA, PENNSYLVANIA.

ELECTROPNEUMATIC SWITCH.

1,147,820. Specification of Letters Patent. Patented July 27, 1915.

Application filed July 22, 1910. Serial No. 573,169.

To all whom it may concern:

Be it known that I, WILLIAM M. SCOTT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented a new and useful Electropneumatic Switch, of which the following is a specification.

My invention relates to electro-pneumatically controlled switches or circuit breakers adapted to control circuits carrying heavy electric currents, such as used in lighting, power, or other electric systems.

My invention resides in an electric switch or automatic circuit breaker which may be restored to normal position (for example, circuit closing position) by pneumatic power furnished by air or other suitable medium under pressure, operating upon a piston within a cylinder, suitable control means being provided.

My invention resides further in apparatus as described, in which the piston moves in one direction to restore a switch or circuit breaker to normal position, and which moves in the opposite direction to trip the switch or circuit breaker, a suitable control valve being provided which may be located at a point more or less remote from the switch or circuit breaker or which may be controlled by electric energy from a point more or less remote.

My invention resides in other features hereinafter described and claimed.

For an illustration of one of the forms my invention may take, reference is to be had to the accompanying drawing, in which:

Figure 1 is a side elevational view of a switch or circuit breaker with the pneumatic operating means shown in section, together with a diagram of electrical control circuits. Fig. 2 is a vertical sectional view through a valve.

Upon a base or switch-board 1, preferably of insulating material, such as slate or marble, are secured the main terminal blocks 2 and 3 of the switch or circuit breaker, the studs 4 and 5 electrically communicating, respectively, with the main terminal blocks 2 and 3 adapted to connect them in the circuit to be controlled. A movable contact member 6, representing a laminated bridging member, is adapted to engage and bridge the main terminals 2 and 3 to close the controlled circuit. The bridging member 6 is secured upon the arm 7 pivoted at 8 to the bracket or housing 9 secured upon the base 1.

Mounted upon and in electrical communication with the upper terminal block 2 are the intermediate metallic shunt contact 10 and the stationary shunt carbon contact 11 pivoted at 12 to the bracket 13. The movable intermediate shunt contact 14 and the movable shunt carbon contact 15 are carried upon the arm 7 and engage, respectively, the contacts 10 and 11, permanent electrical connection between the contacts 14 and 15 and the lower terminal block 3 being maintained by the flexible conductor 16.

Pivoted to the bracket or housing 9 at 17 is the operating lever or member 18 provided with the cam surface 19 adapted to engage the roller 20 pivoted to the arm 7 at 21. A tension spring 18^a is connected at its one end to the arm 7 and at its other end to the member 18. The operating member 18 has an extension outward beyond the pivot 17, as shown at 22. Pivoted at 17 independently of the arm or operating member 18 is the actuator member 23 having pivoted thereto at 24 the latch 25 adapted to engage the roller 26 pivoted upon the member 22. The actuator 23 is provided with a stop 27 adapted to engage the under side of the bracket or housing 9. Pivoted to the bracket or housing 9 at 28 is a second latch 29 adapted to engage the roller 30 pivoted upon the member 22, the rear end of the latch 29 having a jaw 31 loosely embracing the pin 32 upon the housing or bracket 9 for limiting the movement of the latch 29, the latch 29 being held with its outer end in upward position by a spring such as 33. A tension spring 34 is connected at its one end to the tail 35 of the latch 25 and at its other end to the member 23, urging the latch 25 in a direction to engage the roller 26. Independently pivoted at 28 is the tripping member 36 having the tail 37 extending into the path of travel of the member 38 pivoted at 39 and carrying the armature 40 of an electro-magnet whose energizing coil or winding may be connected in series in the same circuit with the main terminals 2 and 3, so as to trip the switch or circuit breaker upon overload, or any other electromagnetic means may be provided to trip the switch or circuit breaker upon the occur-

rence of any other predetermined electrical condition in the circuit including terminals 2 and 3 or in any other circuit.

In the path of the tripping member 36 is disposed the latch actuator 41, pivoted at 28, the members 36 and 41 having limited movement as in the case of latch 29. A spring 33 holds latch actuator up, and a similar spring holds up latch 29. The tail 35 of latch 25 is disposed in the path of travel of the actuator 41. Pivoted at 42 on the member 23 is the dog 43 whose pivotal movement on pin 42 is determined by the projections 44 and 45 embracing the pin 46, upon the member 23. Screws 36^a carried by member 36 engage latch 29 and latch actuator 41.

Pivoted to the member 23 at 47 is the rod 48 connected by a turn buckle or other adjusting means 49 to the lever 50, the rod 48 being pivoted to the lever 50 at 51, the lever 50 carrying an operator's handle 52. The lever 50 is pivoted at 53 upon the bracket 54 secured upon the cylinder 55 which, in turn, is mounted upon the base or switchboard 1. Within the cylinder 55 is a longitudinally movable piston 56 with which coöperates the rod 57 and the rod 58 passing through the glands or stuffing boxes 59. As shown, the piston 56 is not secured upon either of the rods 57 or 58, but actuates said rods by abutting against the same and pushing them, the rod 57 upwardly, and the rod 58 downwardly. By this construction any tendency of the piston to bind within the cylinder is avoided, such binding being more likely if the piston were secured upon the piston rod, and where the latter passes through such a long bearing as shown on the cylinder heads. Pivoted at 60 to the bar 110 connected with rod 57 are the downwardly extending links 61, one on either side of the cylinder 55, which are pivoted, in turn, at 62 to the inner end of the lever 50, the latter being in two parts one on either side of the cylinder 55. Similarly, the upwardly extending links 64 are pivoted at 63 to the bar 110^a connected with rod 58, one link 64 on either side of the cylinder 55; links 64 are, in turn, pivoted to the lever 50 at 62.

On each end of the cylinder 55 is provided a valve 65, shown in section and elevation in Fig. 2. The nipple portion 66 screws in through the wall of the cylinder 55 and is provided with the valve seat 67 with which engages the valve 68 carried upon the rod 69 carrying at its upper end the head or button 70, a spring 71 intervening between the head or button 70 and a wall or projection within the valve, the spring 71 holding the valve 68 against its seat 67. From beneath the valve seat 67 there is a passage 72 communicating with the outlet passage 73. With the clearance space above the piston 56 communicates a pipe 74 which communicates with the interior of the valve casing 75. Similarly, with the clearance beneath the piston 56 communicates the pipe 76 which also communicates with the interior of the valve casing 75. Similarly, the supply pipe 77 and the exhaust pipe 78 communicate with the interior of the valve casing 75. Within the casing 75 is the valve member 79 having the two passages or ports 80 and 81, the member 79 having attached thereto a lever 82 which carries an operator's handle 83. The springs 84 and 85 engage upon either side of the lever 83 and serve to hold the same in the central position shown. Solenoid cores or armatures 86 and 87 are connected, respectively, by pivoted links 88 and 89 to the lever 83. With the core or armature 86 is associated its energizing coil or winding 90 and with the core or armature 87 is associated its energizing coil or winding 91. The common terminals of windings 90 and 91 connect by conductor 92 with bus bar or other conductor 93 here shown, by way of example, as the positive conductor of a control network or circuit. The other terminal of the winding 90 connects by conductor 94 with contact 99 of the operator's switch D, which may be located at a more or less remote point. The switch D comprises the pivoted lever 100 normally held in the central position shown, by gravity or a spring, and carries the contacts 101 and 102 in electrical communication with each other and with the conductor 103, the latter connecting with the bus bar or conductor 104 of the same network or control circuit and shown, for example, as the negative conductor of such network or circuit. The contact 102 of the switch D is adapted to engage the contact 107 which communicates by conductor 108 with the remaining terminal of the coil or winding 91.

The valves 68 are provided for the purpose of determining with nicety the moment when the piston 56 shall cease to exert power through switch operating or controlling mechanism. It is desirable, to save the switch mechanism from undue strains and damage, that the power exerted thereon by the pneumatic means shall cease when such switch mechanism has attained a predetermined position. When the pneumatic device is moving the switch or circuit breaker mechanism to circuit closing position, it is desirable that the pneumatic power shall cease at the moment the parts shall have reached full circuit closing position and shall have become latched. And it is desirable that the pneumatic power cease immediately it has operated in opposite direction to cause the actuator 23 to become locked and just as it becomes locked to the member 22. These valves 68 determine with nicety these actions.

The operation is as follows: With the switch or circuit breaker in the circuit closing position as shown in Fig. 1, if an over-

load should occur in the circuit, or if any other predetermined electrical condition should obtain in its circuit, or in any other circuit in which the coil or winding causing the attraction of the armature 40 is connected, the armature 40 will be attracted and rotated in a counter-clockwise direction about its pivot 39 causing the member 38 to engage the under side of the tail 37 of the member 36 rotating the member 36 in a clockwise direction about its pivot 28, and causing screw 36[a] to depress the latch 29 in opposition to spring 33, thus disengaging the latch 29 from roller 30, whereupon the operating member 18 is free to rotate in a counter-clockwise direction about its pivot 17 due to the tension of the spring 18[a] and due to the outward force exerted by the bridging member 6. In the downward movement of the outer end of the tripping member 36, the second screw 36[a] depresses the latch actuator 41 in opposition to second spring 33, and 41 in turn depresses the tail 35 of the latch 25 in opposition to spring 34 thus releasing latch 25 from roller 26 and unlocking the member 22 from the member 23. The member 18 is then free to rotate about its pivot 17 independently of the member 23 and in so rotating the cam surface 19 is removed from the path of the roller 20 and the arm 7 carries outwardly with it the bridging contact 6 separating the same from the main terminals 2 and 3 to break the circuit. After the bridging contact 6 has left main terminals 2 and 3 the contact 14 leaves contact 10, and finally contact 15 leaves contact 11, the final arcing occurring at these carbon contacts. The continued outward movement of the arm 7 is accompanied by the complete rupture of the circuit, and in the circuit rupturing position the extension 22 on the member 18 is in elevated position. If, now, it be desired to close the circuit breaker again the operator at the valve 75 grasps the handle 83 and rotates the same in a clockwise direction until the port 80 is in communication with the supply pipe 77 and the pipe 74, and port 81 is in communication with pipes 76 and 78, whereupon pressure will be exerted through pipe 74 to the upper end of the cylinder 55 causing the downward travel of piston 56 (and exhaust of air from below piston 56 through pipes 76 and 78) and the counter-clockwise movement of the lever 50 about its pivot 53 with the consequent elevation of rod 48 and the counter-clockwise rotation of member 23 about its pivot 17. This upward movement continues until the latch 25 again engages the roller 26 locking the members 22 and 23 together. At this moment the lower end of the screw 109, carried by the member 110 connecting the links 61, engages the top of the button 70 of the upper valve 65, moving the valve 68 away from its seat 67 in opposition to spring 61, thereby allowing communication through the valve and the port 73 with the outer air, thus removing the pressure from the upper side of the piston 56 and robbing the piston of power to further raise the rod 48. Now, that the actuator 23 has become locked to the operating member 22, the operator moves the valve handle 83 in a counter-clockwise direction, so as to bring the port or passage 81 into communication with the supply pipe 77 and the pipe 76 and port 80 into communication with pipes 74 and 78, whereupon pressure will be exerted upon the under side of the piston 56 causing it to rise in the cylinder 55. This upward movement of the piston 56 causes a clockwise movement of the lever 50 about its pivot 53 and the simultaneous closing of the upper valve 65, the passage 80 now making connection between pipe 74 and exhaust pipe 78 allowing the air above the piston 56 to escape through exhaust pipe 78. As the lever 50 rotates in a clockwise direction about its pivot 53 the rod 48 pulls downwardly upon the actuator 23 causing the cam surface 19 to engage the roller 20 and force the arm 7 inwardly to bring the bridging member 6 into engagement with the main terminal blocks 2 and 3 to close the circuit, and when full circuit closing position has been reached the latch 29 engages roller 30 to lock the parts in circuit closing position. At this moment the upper end of the lower screw 111 engages the button 70 of the lower valve 65 to raise its valve 68 from its seat 67 to open the lower end of the cylinder 55 to the outer atmosphere, and the pressure on the under side of the piston 56 is reduced, robbing the piston of power to further move the parts. If, during the closing movement above described, the predetermined electrical condition obtains in response to which the switch or breaker has been tripped or ought to be tripped, the parts will not reach full circuit closing position because upon the attraction of the armature 40 the tail 35 of the latch 25 will engage the latch actuator 41 which is held in downward position and thereby disengage the latch 25 from roller 26 and allow the member 22 and the other parts of the switch or circuit breaker to fly to open circuit position. It is apparent, therefore, that the switch or circuit breaker shown is of the "non-closable" type.

If it should be desired to trip the switch or circuit breaker independently of any predetermined electrical condition, the operator at the valve 75 will rotate the handle 83 in a clockwise direction to connect pipe 74 with the supply pipe 77, whereupon pressure will be exerted above the piston 56 causing it to descend and raise the rod 48 and thereby start to rotate the actuator 23 in a counter-clockwise direction about pivot 17,

whereupon the dog 43 will ride upon the projection 43^a at the outer end of the tripping member 36 depressing the same and causing the latches 29 and 25 to disengage from their rollers 30 and 26, respectively, and allow the circuit breaker to fly to open circuit position.

If desired, the valve 75 may be controlled from the more or less distant operator's switch D. If the operator moves his lever 100 to bring contacts 102 and 107 into engagement current will flow from the positive conductor 93 through conductor 92, coil 91, conductor 108, contact 107, contact 102, lever 100, conductor 103, to the negative conductor 104, thereby energizing the winding 91 and causing the core 87 to move toward the right and rotate the valve so as to bring pipes 77 and 74 into communication with each other which will cause the tripping of the circuit breaker, as above described. Or upon moving contact 101 into engagement with contact 99 the coil 90 will be energized and the core 86 attracted toward the left to rotate the valve in a counter-clockwise direction to bring supply pipe 77 into communication with pipe 76 to the air beneath the piston 56 to cause a closure of the circuit breaker as above described.

What I claim is:

1. In combination, a movable contact member, an operating member therefor, an actuator, means for locking said actuator and operating member together, a fluid pressure device for moving said actuator to position to lock the same to said operating member, a valve for rendering said fluid pressure device inert when said actuator has been moved to said position, and means movable in definite relation with said actuator for actuating said valve.

2. In combination, a movable contact member, an operating member therefor, an actuator, means for locking said actuator and operating member together, a doubly acting fluid pressure device for moving said actuator in both directions, valves for rendering said fluid pressure device inert when said actuator has reached predetermined positions, and means movable in definite relation with said actuator for actuating said valves.

3. In combination, a movable contact member, an operating member therefor, an actuator, means for locking said actuator and operating member together, a fluid pressure device for moving said actuator to position to lock the same to said operating member, a valve for rendering said fluid pressure device inert when said actuator has been moved to said position, means movable in definite relation with said actuator for actuating said valve, a valve controlling the fluid supplied to said fluid pressure device.

4. In combination, a movable contact member, an operating member therefor, an actuator, means for locking said actuator and operating member together, a doubly acting fluid pressure device for moving said actuator in both directions, valves for rendering said fluid pressure device inert when said actuator has reached predetermined positions, means movable in definite relation with said actuator for actuating said valves, a valve controlling the movement of said fluid pressure device in both directions, a circuit controlling said last named valve, an operator's switch biased toward normal position controlling said circuit, and means returning said last named valve to position rendering said fluid pressure device inoperative when said operator's switch is in normal position.

5. The combination with a "non-closable" circuit breaker having an operating member and an independently movable actuator, of a single cylinder, a piston movable in opposite directions therein, a valve controlling the movements of said piston in both directions, an operative connection between said piston and said actuator, and means for rendering said piston inert when said actuator has been moved to position to engage said operating member.

6. The combination with a "non-closable" circuit breaker having an operating member and an independently movable actuator, of a single fluid pressure cylinder, a piston movable in opposite directions therein, a connection from said piston to said actuator, a valve controlling the movements of said piston, and a valve controlling said piston independently of said first mentioned valve and actuated after predetermined movement of said actuator.

In testimony whereof I have hereunto affixed my signature in the presence of the two subscribing witnesses.

WILLIAM M. SCOTT.

Witnesses:

ANNA E. STEINBOCK,

ELEANOR T. MCCALL.

Correction in Letters Patent No. 1,147,820.

It is hereby certified that in Letters Patent No. 1,147,820, granted July 27, 1915, upon the application of William M. Scott, of Philadelphia, Pennsylvania, for an improvement in "Electropneumatic Switches," an error appears in the printed specification requiring correction as follows: Page 4, line 64, claim 3, after the word "device" strike out the period and insert a comma and the words *a circuit controlling said last-named valve, an operator's switch biased toward normal position controlling said circuit, and means returning said last-named valve to normal position when said operator's switch is in normal position.;* and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 24th day of August, A. D., 1915.

[SEAL.]

J. T. NEWTON,

Acting Commissioner of Patents.