To all whom it may concern:

Be it known that I, BENJAMIN S. McCLELLAN, a citizen of the United States, residing in Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electric Switches and Actuating Mechanism Therefor, of which the following is a specification.

This invention relates to that class of electric switches and actuating mechanism therefor which are adapted to be operated automatically to open position, or to position to open or break an electric circuit, or to be operated manually, so as to open or close an electric switch, as desired.

The principal object of the invention is to provide a simple, economical and efficient electric switch and actuating mechanism therefor.

Other and further objects of the invention will appear from the following description and claims and from an inspection of the accompanying drawings, which are made a part hereof.

The invention consists in the features, combinations and details of construction herein described and claimed.

In the accompanying drawings,

1. Fig. 1 is a view in vertical section of an electric switch and actuating mechanism constructed in accordance with my invention and improvements, showing in side elevation the switch or pivoted arms and contact members of a switch and the actuating levers and spring mechanism for operating the pivoted arm members or switch proper;

2. Fig. 2, a view in transverse vertical section taken on line 2—2 of Figure 1, looking in the direction of the arrow, and showing the actuating spring and lever mechanism in elevation and the fluid pressure operated plungers or piston and diaphragm, and the casing and fluid chamber in central vertical section; and

3. Fig. 3, a detail view in front elevation of the pivoted switch member and contact members of the switch shown in Fig. 1, as they would appear taken on line 3 of said figure, with a condenser and compressor of a refrigerating system shown diagrammatically.

In constructing an electrical switch and actuating mechanism therefor, in accordance with my invention and improvements, I provide a supporting member or frame comprising a base 1, and an upright frame member 2, adapted to support the assembled members of the device in operative position; and an enclosing casing 3, having a removable cover or front wall 4, is mounted in position to enclose all or any desired parts of the mechanism.

Mounted upon the upright frame member or supporting member 2, and in position to be enclosed by the casing or box 3, is a switch which is, by preference, in the form of a knife-switch and comprises a back-plate or insulating block 5 formed of compressed fiber, hard rubber, porcelain or similar strong insulating material, and secured to the support 2 by means of screws 6, or other suitable means. Metallic contact members 7, comprising a spring finger 8, the projecting extremities of which are spaced apart and adapted to receive the corresponding pivoted arm member 9 of the switch between said spring finger portions, are mounted upon the insulating block or back-plate 5, to which they are secured by means of screws 10, or any desired suitable securing means. The pivoted arm members 9 are pivotedly secured to the insulating block or back-plate 5 by means of supporting brackets 11, having projecting arms 12 spaced apart and adapted to receive the lower or pivoted end portions of the corresponding switch members or arms 9 therebetween. Pivots 13 are inserted through suitable perforations in the projecting forked arms 12 and transversely through the end portion of the arm 9 located between said projecting forked arms. (See Fig. 3.)

A connecting bar 14 of compressed fiber, hard rubber, or similar insulating material is connected at its opposite ends with the respective outer or swinging ends of the pivoted arms 9 by means of screws 15, or in any desired ordinary and well known manner, and forms a connection between the upper or swinging ends of said arms. A depending yoke or bracket 19, is secured to the horizontal operating or insulating bar 14 by means of screws 17 and nuts 18, adapted to engage the base portions of said bracket and securely hold the bracket in rigid relation to the insulating bar.
The depending bracket 19 is provided with an opening 20 between the opposite side portions 21 thereof; and an operating plunger 22, having a longitudinally elongated slot 23, is mounted in position to extend through the insulating plate 5 and the opening 20 in the depending bracket 19, and has its slotted end portion operatively connected with the bracket 19 by means of a pin 24, which extends transversely through the elongated slot 23 and has its opposite ends secured to the side portions 21 of said bracket by means of cotter pins 25 or other similar or desired suitable means. (See Figs. 1 and 3.)

The opposite end or rearward portion of the operating plunger 22 is pivotally connected with the upper extremity of a forked lever or yoke 26, which comprises a pair of forked arms 27 pivotally connected at their lower ends with upright supporting side frame members 28 by means of pivot pins 29. (See Figs. 1 and 2.)

The arms 27 of the yoke or forked lever 26 are spaced apart and provided with a transverse pin 30 fixed to the upper portion thereof, extending through the perforated rear end of said plunger 22. (See Figs. 1 and 2.)

The forked lever or yoke 26 is so mounted that its lower forked end portions 27 are pivotally supported by the pivots 29 below the level of the plunger 22 and on opposite sides of the plunger, and, by preference, substantially midway between the opposite extremities of the path of movement of the pivotally connected end of the plunger 22; or of the pin or point of pivotal connection between said members 22 and 26.

An actuating spring 31, which is, by preference, in the form of a helical tension spring, is secured at its lower end by means of a securing pin 32 to a suitable support, such as the upright side frame members 28. (See Figs. 1 and 2.) The opposite or upper end of the spring 31 is secured to, or operatively connected with, the upper portion of the double armed lever or yoke 26 by suitable securing means such as a transverse pin 33, which, by preference, extends from one to the other of the forked arm or lever portions 27, and has its opposite ends secured to said forked arm portions in such position that the upper connected portion of the spring 31 and said connecting pin 33 are adapted to move to and fro above the level of the axis formed by the pivot pins 29, and from one side to the other of the transverse vertical plane in which the pin 32 and the centers of the pins 29, or axial center of the lever 26, are located.

The plunger 22, the forked lever or yoke 26, and the pivoted switch members comprising metallic arms 2, and the connecting bar 14, are thus adapted to be moved to and from an upright position by the action of the spring 31 and the actuating mechanism hereinafter described. Said parts are shown in circuit closing position in full lines in Fig. 1, and are shown in open or circuit breaking position in broken lines in said figure.

A bell crank lever 34, comprising an upward extending relatively long lever arm 35, and a relatively short lever arm 36, is pivotally mounted in a suitable support, such as the side frame members 28 of the supporting frame, already described, by means of a transverse pin 37, which extends through a perforation in the transverse hub portion 38 of said bell crank lever, and has its opposite ends secured to said side frame members or supporting frame portions 28. (See Fig. 2.) The upwardly extending lever arm 35 has a forked end portion 39, pivotally connected with a forked connecting link or yoke 40, by means of a pivot pin 41, which extends through suitable perforations in said link and lever arm. The opposite extremity of the link 40 comprises forked arms 42, which are spaced apart, as shown in Fig. 2, and which extend between and are loosely connected with the forked arms 27 of the doubled armed lever or yoke 26, already described. (See Figs. 1 and 2.)

These forked arm portions 42 are each provided with a longitudinally elongated slot 43, and each of the forked arms 27 of the lever or link member 26 is provided with a pin or bolt 44 fixed thereto and extending transversely through the adjacent elongated slot 43 of the corresponding forked arm 42 and in sliding engagement therewith. (See Figs. 1 and 2.)

The lower or relatively short arm 36 of the bell crank lever 34 has forked portions 45 between which extends an upright reciprocating operating plunger 46, the upper end of which is slidable mounted in a suitable bearing 47, and the lower extremity of which extends into a diaphragm chamber or piston chamber 48 in a casing comprising an upper casing member 49 and a lower casing member 50. Said casing members 49 and 50 are rigidly secured together and are provided with a fluid or water containing chamber or passage 51 having an inlet opening 52 adapted to communicate with a source of fluid or water supply, and an outlet passage 53 leading from said chamber. A flexible or movable waterproof diaphragm or partition member 54 forms a partition between the fluid containing chamber 51 and the upper plunger or piston containing chamber or space 48, already described. The lower extremity of the plunger 46 is fixed to a circular plunger-head or piston member 55, which is slidable mounted in, and in sliding engagement with, the inner or cylindrical peripheral walls of the chamber 48, and above or on the opposite side of the diaphragm 54 from the water or fluid containing chamber 51. An upper collar or sleeve 120
portion 56, of smaller diameter than the plunger-head 55, projects upward beyond the relatively large cylindrical portion of said plunger-head or piston and is in sliding engagement with and encircled by the inner peripheral walls of a cylindrical upper chamber portion 57, in which is mounted a compressible helical spring 58. The lower end of this spring engages the collar or sleeve portion 56 of the plunger-head or piston 55, and the upper extremity of said spring is in engagement with the inner face of a threaded cap or nut 59 which is in threaded engagement with and closes the opening in the upper casing member 49, already described. The tension of the spring 58 is regulated or increased and decreased as desired by turning the cap 59 in the required direction. The spring thus adjusted is adapted to operate the plunger downward when the pressure in chamber 51 is reduced to or below a predetermined point. The plunger or stem 46 is provided with lateral bosses or annular peripheral collars 61 and 62, fixed thereto and spaced apart so as to admit the circular forked arm portions 45 of the lever arm 36 between said collar portions and in position to extend on opposite sides of the plunger 46. The upward movement of the plunger will thus cause the forked arm 36 of the bell crank lever 34 to move upward therewith from a position in which said lever arm is shown in dotted lines to the position in which the same is shown in full lines in Fig. 1. It follows as a matter of course that the movement of the plunger 46 with its plunger-head or piston 55, from the position shown in full lines in Fig. 1, to the position shown in broken lines in said figure, will cause a corresponding downward movement of the forked bell crank lever arm 36 from the position in which it is shown in full lines in Fig. 1 to the position in which it is shown in broken lines in said figure. This will cause a corresponding movement of the upwardly extending bell crank lever arm 35 and forked link 40 from the position in which said members are shown in full lines in Fig. 1 to the position in which the same are shown in broken lines in said figure, or in other words, to a position which will cause the spring 31, already described, to move the lever 26, plunger 22 and switch member 9 to open or circuit breaking position, as shown in broken lines in Fig. 1.

Stops or shoulders 63 upon the side frame members 28, having inclined contact or stopping surface portions located at the forward extremity of the path of movement of the corresponding forked lever arms 27, are adapted to limit the forward movement of the forked lever 26, and plunger 22, and similar stops or shoulders 64 which are inclined upwardly and located at the opposite extremity of the path of movement of the arms 27 of the forked lever 26, are adapted to limit the movement of said lever in the direction of its movement in closing the circuit, or in the operation of moving the metallic switch members 9 to circuit closing position, as shown in full lines in Fig. 1.

The pivoted or movable metallic switch members 9 and the contacts 7 are connected with or embraced within an electric circuit in which is included an electric motor to be driven, and a suitable source of electric supply. The metallic brackets 11 which are in contact with the pivoted extremities of the switch members 9, are connected with electric conductors or wires 65 and 66 in any desirable ordinary or suitable manner, as by means of a metallic binding post 67, binding screws 68, fuse 71, metallic connecting part 72, and metallic fuse supports 69 and 70 for each of said wires. Electric conductors or wires 73 and 74 are connected with the opposite terminals or parts of an electric motor 77, and with the respective contacts or metallic switch members 7.

A binding post or metallic base 75, and a binding screw 76 for each contact member 7, serves to connect each of said contact members with the corresponding wire leading to the electric motor 77, which may be of any ordinary, well-known or desired type.

The switch and switch actuating plunger and spring and switch mechanism herein described and shown in the drawings are particularly well adapted to be used in connection with, and to form a part of a refrigerating plant or apparatus.

In Fig. 2 is shown diagrammatically and in a much smaller scale than the switch and switch actuating plunger, a household refrigerating system, comprising a condenser 81, having a cooling coil 82 therein surrounded by a condensing chamber or space adapted to contain ammonia gas and liquid ammonia or similar refrigerating agent in process of being condensed and cooled. The receiving end of said coil is connected with the water supply pipe 78 and the discharge end communicates with the pipe 83 leading to the interior or water containing space of a water jacket 84, which surrounds the compression or piston chamber of a compressor 84. A pipe 85 leads from said water-containing space or water-jacket of the compressor and communicates with the inlet passage 52 and with the interior of the chamber 51. Cooling water from the condenser and from the water jacket of the compressor is thus adapted to pass through chamber 51 while under pressure sufficient to operate the diaphragm 54 and plunger 46 and thereby cause the electric switch arms 9 to be moved.
into and held in contact with the spring fingers of contact members 7, or in circuit closing and operative position. The water is thus adapted to pass first through the pipes and water-containing spaces of the condenser and compressor and then through chamber 51, and in contact with diaphragm 54 and out through the discharge pipe 56 leading from the chamber 51 and adapted to empty into a suitable receptacle, such, for instance, as a sewer. A suitable valve,—not shown—may be provided for restricting or opening and closing the outlet passage formed by the pipe 86, so that sufficient pressure may be maintained in chamber 51, or the passage may be of such area that when open the desired pressure will be produced.

The compressor 84 has a driving wheel or belt pulley 89 fixed to the piston-driving crank shaft 90 provided with a driving belt 91 mounted on said driving pulley and adapted to be operatively connected with and driven by the electric motor 77. The stopping and starting of said motor being controlled by the switch and switch actuating mechanism as herein described. The condenser 81 has a supply pipe 87 which communicates with the condensing chamber or ammonia-containing space which surrounds the water-containing cooling coil 82 of the condenser; and the receiving end of said pipe is adapted to communicate with the outlet of the compression or piston chamber of the compressor. An outlet pipe 88 leads from said condensing chamber or ammonia-containing space of the condenser 81 and is adapted to communicate with an expansion coil or coils of the refrigerating system, and the pressure-fluid-containing space of an automatic pressure-controlled expansion valve not shown—and which expansion coil and valve may be of any desired or ordinary and well known form. A return pipe 88' forms the inlet to the compression chamber and is adapted to be connected with the discharge end of the expansion coil.

A two-way cock 79, which may be of any desired ordinary or well known construction, and having an operating handle or lever 80, is mounted in position to open or close the water supply passage leading through the pipe 78, the condenser, the compressor and the pipe 83 to the chamber 51. Water under pressure may thus be admitted to said chamber 51, and in contact with the diaphragm, by moving the lever in one direction, to open the inlet passage through pipe 78. To shut off the water and discontinue or remove the fluid pressure upon the diaphragm and plunger, the lever is moved in the opposite direction, or into position to close the inlet passage.

It will be readily understood by those skilled in the art that any break in the water main or in the water supply conduit leading to the chamber 51, or any stoppage of the supply of water to the chamber 51, whether such supply is stopped by operating the cock 79, or by some accidental or unforeseen cause, will result in the removal or absence of pressure in the chamber 51 against the diaphragm 54 or the head of the plunger 46. The plunger 46 will, as a result, be automatically operated by the spring 58, so as to open the switch and break the electric circuit, thereby causing the motor and mechanism driven thereby to stop. The removal of fluid pressure from the chamber 51 and diaphragm 54 will cause the bell crank lever 34, spring 31, lever 26 and plunger 22, and the metallic switch members 9, to be moved from the position in which said parts are shown in full lines in Fig. 1, or circuit closing position, to the position in which said members are shown in broken lines in said figures, circuit-breaking or open position, by turning the cock 79 to open position, so as to admit water, or liquid, to chamber 51, under sufficient pressure to operate the plunger 46 against the pressure of the spring 58, the spring 31 and the lever and plunger mechanism operated by, or operatively connected with, said spring, and also the metallic switch members 9, will be actuated or moved from open to circuit closing position, in which position said parts are shown in full lines in Fig. 1.

In the operations of throwing the switch from circuit closing position to open or circuit-breaking position, and from circuit-breaking or open position, to circuit closing or operative position it is very important that means be provided for preventing the possibility of the switch members 9 stopping intermediate their completely open or the completely closed position, thereby preventing the possibility of making an imperfect or incomplete contact or electrical connection between the switch members 9 and the contacts 7. The plunger 22 is therefore provided with a longitudinal elongated slot 23 in sliding engagement with which the pin 24 is mounted, as already described, and the arms 42 of the forked link 40 are provided with the elongated slots 43, in sliding engagement with which the corresponding pins 44 are mounted. (See Fig. 1.) The desired lost motion or independent movement of the plunger 22, with respect to the switch members 9 and of the bell crank 34 and link 40 with respect to the plunger 22 and forked lever 26, is thus provided; and the desired relatively extended, or independent longitudinal movement of the plunger 22 in either direction with respect to the switch members 9, and with respect to the upwardly extending arm 35 of the bell crank 34 and the link 40, is thus obtained.
With the parts constructed, arranged and adapted to operate as above described, the plunger 46 and diaphragm 54 are only required to make a very short movement, either upward or downward, as compared with the more extended movement of the plunger 22, in order to enable the spring 31 to complete the movement of the plunger 22 in either direction, said movement being begun and partly completed by the positive action of the plunger 46 and the upwardly extending arm 35 of the bell crank lever 34 and its forked link 40.

The operation of the plunger 46 and the bell crank 34 and of the link 40 from the position in which said parts are shown in full lines in Fig. 1 to the open or circuit breaking position in which they are shown in broken lines in said figure, or in the opposite direction from circuit breaking to circuit closing position, will bring the pin 33 or point of connection between the spring 31, lever 26 and plunger 22 in the like or corresponding direction through and slightly beyond the transverse plane in which the axial center of the lever 26 and the centers of the pivot pins 29 and pin 32 are located, so that the completion or continuation of the movement of the plunger 22 and switch members 9 in the proper direction will be produced by the action of the spring 31.

By the construction and arrangement of parts as above described, so that the plunger casing and chamber 51 are connected with the outlet passage from the compressor water-jacket instead of the water supply pipe leading to the refrigerating system, the diaphragm 54 and switch actuating plunger 46, are adapted to be operated by the pressure of the cooling water of the refrigerating system after, instead of before, such water has passed through the water-containing passages and spaces of the refrigerating system. Any stoppage, clogging or interruption of the flow of water through any of the water-containing passages or spaces of the refrigerating apparatus will, therefore, at once cause a reduction of pressure in chamber 51 and thus cause the switch to be automatically actuated so as to open the electric circuit which operates the motor, thereby causing the motor and the compressor driven thereby to stop. Such excessive and dangerously high pressure as would result from permitting the compressor to continue in operation after the stopping of the flow of cooling water or liquid is thus prevented, and the danger of breaking of conduits and of the escape of ammonia gas is reduced to a minimum. The water is permitted to pass freely through chamber 51 to the discharge pipe 86 and the chamber 51 is kept free from obstructions, and any obstructions in the water-containing passages of the refrigerating system, such as the compressor water-jacket, or the water-containing coil of the condenser are, by this arrangement, on the receiving side of the chamber 51, and not on the discharge side thereof where such obstructions would not cause, but might prevent the stopping of the motor.

I claim:
1. In a machine of the class described, the combination of a metallic contact member, a movable switch arm adapted to be moved into and out of engagement with said metallic contact member, insulated supporting means for supporting said metallic contact member and movable switch arm, means for connecting said contact member and movable switch arm with an electric circuit, a reciprocating switch-arm-operating plunger bar having slidably engaged slot and pivot pin connection with said movable switch arm, and adapted to have a limited movement independently of the latter, spring mechanism operatively connected with said switch-arm-operating plunger bar and adapted to actuate the same and thereby the movable switch arm in opposite directions alternately, a main actuating lever operatively connected with and adapted to have a limited movement independently of said spring-actuated switch-arm-operating plunger bar, and acting to move the latter in opposite directions alternately against the tension of the spring mechanism, and a piston operatively connected with said lever and acting to operate the same in opposite directions alternately.
2. In a mechanism of the class described, the combination of a metallic contact member, a pivoted metallic switch arm adapted to be moved into and out of contact with said contact member, insulated supporting means for supporting said metallic contact member and pivoted metallic switch arm, means for connecting said contact member and pivoted switch arm with an electric circuit, a reciprocating switch-arm-operating plunger bar having slidably engaged slot and pivot pin connection with said movable switch arm and adapted to have limited independent movement with respect to the latter, an actuating lever mounted on a suitable support and adapted to be operatively connected with said reciprocating switch-arm-operating plunger bar for operating the latter in opposite directions alternately, connecting link and lever mechanism interposed between and having articulate connection with said actuating lever and said reciprocating switch-arm-operating plunger bar and adapted to permit a limited independent movement of said lever with respect to said reciprocating switch-arm-operating plunger bar, spring mechanism operatively connected with the reciprocating switch-arm-operating
mechanism and adapted to operate the same and thereby the movable switch arm in opposite directions alternately, and means for automatically actuating said lever against the tension of said spring mechanism in opposite directions alternately.

3. In a mechanism of the class described, the combination of a metallic contact member, a pivoted metallic switch member adapted to be moved into and out of contact with said contact member, insulating means in engagement with said contact member and pivoted switch member, means for connecting said contact member and pivoted switch member with opposite terminals of an electric circuit, a reciprocating member having a transverse longitudinally elongated slot through a portion thereof, a lever pivotally mounted in a suitable support and having a swinging end portion adapted to be connected with said slotted reciprocating member, pins extending through opposite end portions of said slotted reciprocating member and connected with said lever and said pivoted switch member respectively, one of said pins being mounted in position to extend through and in sliding engagement with said elongated slot, a tension spring having one end connected with said pivoted lever and having its opposite end secured to a suitable stationary support, said spring being adapted to actuate said lever in opposite directions successively, a link pivotally connected with said pivoted lever and provided with a pivot-engaging elongated slot acting to permit a limited movement of said link independently of said spring-actuated lever, and means for operating said link pivotally mounted in a suitable support, means for pivotally connecting one arm of said bell crank lever with said link, and means for operating said bell crank independently of said spring-actuated mechanism in opposite directions successively against the tension of said spring.

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Witnesses:

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