Sept. 4, 1962 E. A. KATHE 3,052,778

ELECTRIC SWITCH

Filed Oct. 24, 1955 2 Sheets-Sheet 1

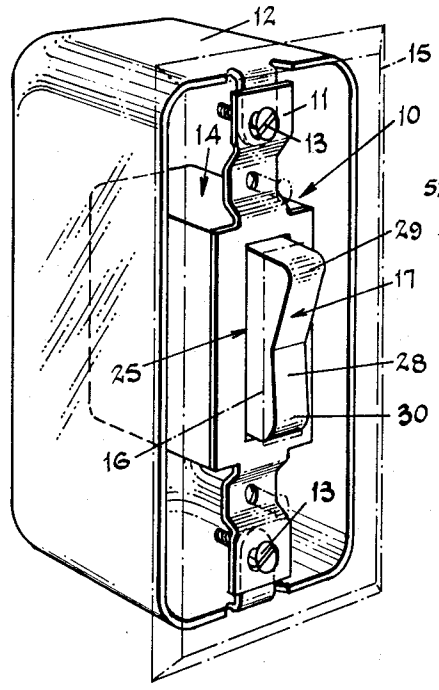


Fig. 1

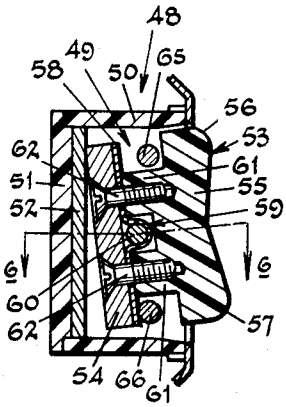


Fig. 5

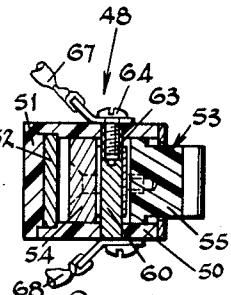


Fig. 6

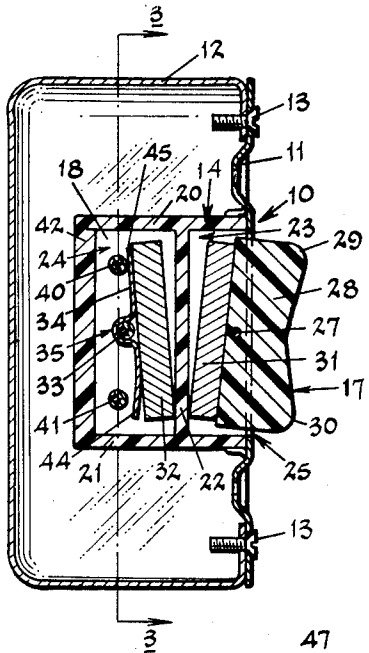


Fig. 2

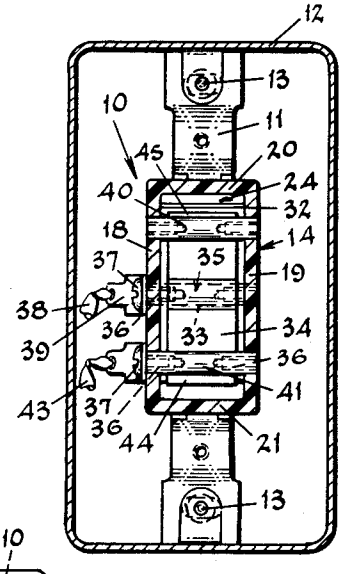


Fig. 3

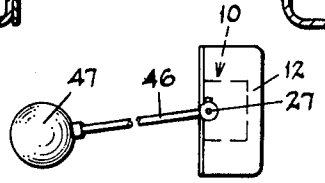


Fig. 4

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ELECTRIC SWITCH

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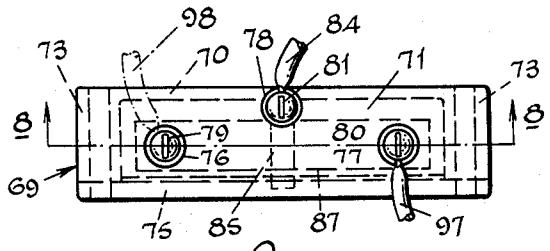


Fig. 7

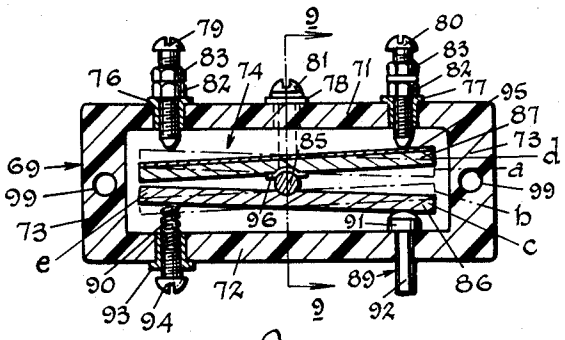


Fig. 8

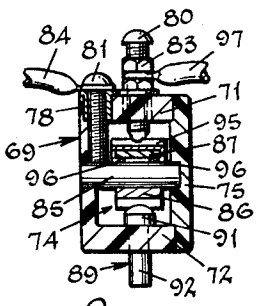


Fig. 9

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3,052,778

ELECTRIC SWITCH

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6 Claims. (Cl. 200—87)

This invention relates broadly to switch devices for controlling electric circuits. More particularly, it has to do with an improved form of switch wherein the related movements of associated members are carried out by means of magnetic attraction to open or close a circuit therethrough.

In contrast to most switch devices presently employed, switches containing the embodiments of my invention are constructed of fewer and more rugged component parts. Heretofore many switches, conventionally known as "snap" or "toggle" switches, have utilized relatively light metal parts that are caused to abruptly engage and disengage each other in the making or breaking of an electric circuit. This, over a period of time, weakens or produces complete breakage of at least the movable switch part or damage of the switch entirely.

In many instances, it has also been found practically impossible to construct a switch having sturdy parts that will conform to usual safety requirements, especially when the switch is also intended to be used to control circuits in highly dangerous atmospheres. As will be fully set forth during the course of the following description, switch constructions, containing the novel features of my invention, are practically indestructible by reason of the simplicity of operation and, in a preferred construction, will be usable in and under any conditions of service.

The principal object of my invention therefore is to provide an electric switch which is constructed to operate in the making and breaking of a circuit in a simple and efficient manner.

Another object of the invention is to provide an electric switch wherein the operable parts may be actively moved without relatively frictional wear-producing engagement therebetween, such motion being conducive to arcing of an electric current as the said parts separate.

Another object of the invention is to provide in a switch of the above character an hermetically sealed relation of the circuit-closing parts from the actuator parts whereby the making and breaking of an electric circuit may be carried out in the presence of an explosive or otherwise dangerous atmosphere.

Another object of the invention is to provide in a switch of the above character a manually operable member and a circuit controlling member, said members being insulatingly sealed from one another and means being carried by each of the said members for producing relative movement therebetween by the use of magnetic influences.

Another object of the invention is to provide an operable switch member carrying a permanently magnetized element and a circuit controlling member carrying a permanently magnetized element, the said magnetized elements being arranged with respect to one another to produce instantaneous movement of the circuit controlling member from one position to another upon actuation of the operable switch member.

A further object of the invention is to provide means in a switch for the control of an electric circuit for moving a circuit controlling member between circuit open and circuit closed positions by magnetic attraction of the said member from an external and separated source of operation.

A further object of the invention is to provide an operable switch member adapted to make and break an electric circuit therethrough which is fixedly maintainable in a

circuit making or breaking position without the use of mechanical force or leverage.

A still further object of the invention is to provide a switch for the control of an electric circuit embodying means for predeterminedly adjusting the limits of motion of a circuit controlling member when such motion is effected by magnetic attraction to vary the responsiveness of the said circuit controlling member between the open circuit position and closed circuit position.

A still further object of the invention is to provide an electric switch for the control of an electric circuit which is of simple yet rugged construction and which is adapted to remain in service for exceedingly longer periods of time than has heretofore been found possible.

Other objects and advantages of the invention will become more apparent during the course of the following description, when read in connection with the accompanying drawings.

In the drawings, wherein like numerals are employed to designate like parts throughout the same:

FIG. 1 is a perspective view of an electrical control switch constructed in accordance with the invention;

FIG. 2 is a longitudinal vertical section through the switch;

FIG. 3 is a transverse vertical section of the switch taken on line **3**—**3** of FIG. 2;

FIG. 4 is a side elevation of the switch when it is adapted for automatic operation;

FIG. 5 is a vertical cross-sectional view of a modified form of electric switch;

FIG. 6 is a horizontal section view of the switch of FIG. 5 and as taken on line **6**—**6** in that figure;

FIG. 7 is a plan view of a second modified form of switch;

FIG. 8 is a horizontal section view of the switch of FIG. 7 as taken on line **8**—**8**; and

FIG. 9 is a transverse vertical section of the switch taken on line **9**—**9** of FIG. 8.

The known forces of magnetism are herein utilized to produce the relative movement of two separate elements and for the fixed positioning of one element with reference to another when one or an actuating element is acted upon either manually or otherwise. The capacity of certain metals to attract one another when magnetized may be employed in accordance with the elementary knowledge that like poles repel and unlike poles attract. Thus I have found that even though one of the magnetized elements is maintained in spaced relation to another like element yet the so-called north pole of one will cause the so-called south pole of the other to produce motion of one element upon the actuation of the other. In a like manner, one magnetized element will produce a magnetic attraction to an element as to be somewhat fixedly engaged therewith unless separated by an externally applied force.

Referring now to FIG. 1 there is shown a switch, constructed in accordance with a preferred embodiment of my invention and generally designated by the numeral **10**. As mounted in a conventional arrangement, the switch **10** has associated therewith a positioning plate or strap **11** by which it is supported in a well-known form of outlet box **12** by means of screws **13**. When so supported, the body **14** of the switch **10** is normally concealed behind an escutcheon or cover plate **15** (shown in broken line); the plate **15** being mounted relative to the switch **10** and box **12** by means of suitable screws threaded into the plate **11**. Conventionally also, the plate **15** has a centrally disposed aperture **16** through which the actuator member **17** of the switch **10** is projected.

As shown more in detail in FIGS. 2 and 3, the body **14** of switch **10** is formed of a suitably moldable material such as a thermo-setting plastic or like material which

possesses diamagnetic characteristics. This body has oppositely disposed side walls 18 and 19, a top wall 20 and bottom wall 21 with a medially disposed, transverse wall or barrier 22 integrally formed with the other walls. The body is thus generally divided into two separate cavities or chambers 23 and 24. The strap 11 may be affixed to the outer surface of the walls 20 and 21 of the body in any conventional manner, the strap having a rectangularly shaped opening 25 registering with the open end of chamber 23.

The manually-operable member 17 for the switch 10 is located within the chamber 23 so that the outwardly directed surface will be disposed to project through the opening 25 of strap 11, and when the switch and outlet box have been installed, also the aperture 16 of the cover plate 15. More particularly, the member 17 is pivotally mounted on a shaft 27, the ends of which are supported in the side walls 18 and 19 associated with the chamber 23. The switch member 17 may thus be disposed in an angular position so that it can typically be engaged at one exposed corner or the other to cause its pivotal movement about the axis of shaft 27. As herein provided, the manually engageable section 28 of the member 17 is formed of a suitable plastic of any desired color that is shaped to afford distinguishable contacting corner portions 29 and 30. The outer section 28 on its inner surface carries a block 31 of paramagnetic material such as iron or steel which constitutes the switch operating member. The block 31 is accordingly magnetized before its securement on the section 28 to provide, in the well-known manner, a polarized element having a "north pole" and "south pole" to which will be attracted the opposite poles of a like paramagnetic member.

Since it is my intention to provide a switch that is usable under any condition without regard to dangerously explosive gases or like circumstances, the block 31 that is swung in one direction or the other by manipulation of the member 17 generally is spaced from a component magnetized part by the barrier 22. The magnetic force exerted between the block 31 and the similarly constructed block 32 is thus directed through the barrier 22 to cause a responsive motion between the blocks.

The magnetic block 32 is carried on a rod 33 which is supported at its ends in the side walls 18 and 19 of chamber 24. For this purpose, a strip 34 of non-ferrous metal such as copper is fixedly secured to the rear surface of the block 32 and has a centrally disposed bight portion 35 that encircles the rod 33. This rod may constitute one contact of the switch 10 and have its ends drilled and tapped as at 36 to receive a screw 37 to secure the end of a wire thereagainst. If desired, the wire 38 may have an attaching clip 39 soldered to the end thereof although connection of the wire to the end of rod 33 can be as conveniently served in any simpler way. Arranged within the chamber 24 are also two rods 40 and 41 that are secured at their ends in the side walls 18 and 19. The rods 40 and 41 are adapted to complete the circuit through the switch and, similarly to the rod 33, are drilled and tapped to receive a wire attaching screw 37.

The rods 40 and 41 are vertically spaced above and below the rod 33 and, though disposed in a vertical plane with respect to one another are offset from the plane through the axis of rod 33. This will permit angular movements of the block 32 with reference to the axis of rod 33 to move the ends of the strip 34 alternately into contact with one or the other of rods 40 or 41. In the assemblage of the block into the chamber 24, the same is positioned therein to receive the rod 33 through bight portion 35 after which the rods 40 and 41 are inserted through their mounting holes in the walls 18 and 19. The chamber 24 is now sealingly closed by a plate 42 of a material similar to the body 14 so that by the use of a suitable solvent or cement, the plate 42 will more or less hermetically seal the chamber. This will seal the functioning or circuit making and breaking portions of the switch 10 from the entry or presence of spark influencing atmospheres.

As shown in the drawing, the switch 10 may be employed as a "two" pole or "three" pole switch. In other words, the switch can be employed to control one electric circuit upon the motion of the switch parts to one position or the other, or two circuits on which event, one circuit will be closed while the other circuit is opened upon any related motion of the said parts. More particularly as illustrated in FIGS. 2 and 3, the rod 33 is electrically connected to the wire 38 and the rod 41 is similarly connected to wire 43. As with the position of block 32 in FIG. 2, the circuit between wires 38 and 43 will be open.

Now, when the corner of the manually-operable member 17 is urged inwardly, said member will be caused to pivot on shaft 27 and angularly swing the associated block 31 so that by its magnetic attraction the block will cause the block 32 to swing on the rod 33 to a position opposite to that shown. The end 44 of strip 34 will now be carried into surface contact with the rod 41 to effect a circuit from wire 38 to wire 43. Since the chamber 24 is hermetically sealed and, more especially, since there can be no flexing of the switch parts, their separation is effected without any distortion and/or snap action and there will be no arcing of the circuit at the instant of separation. Accordingly, even in the presence of dangerous gases, the making or breaking of the circuit will be carried out without danger.

On the other hand, in the event that two circuits are to be controlled the rod 40 will be connected to a third wire by a screw 37. Now with the switch parts arranged as shown in FIG. 2, a circuit will be completed while the end 45 of strip 34 is engaged with rod 40 and a second circuit will be open at rod 41.

Referring now to FIG. 4, the sealed condition of the actuated parts of the switch 10 will be seen as well adapted to operation in response to the fluctuating level of liquids. For this purpose, the box 12 is mounted on the wall of a suitable container (not shown). The shaft 27 is modified to extend outwardly of the box so as to have mounted thereon one end of a lever 46. The lever 46 is equipped with a bulb 47 at its outer end; the bulb being adapted to float on the surface of a liquid and rise or fall therewith as the level changes. As here employed, the switch can be utilized to advantage in the controlling of electrically operable valves which will operate to maintain the supply of a liquid at a desired or necessary level.

Referring now to FIGS. 5 and 6, a modified form of switch is illustrated and which, according to a second embodiment of my invention, is adapted to hold a circuit in the open or closed condition upon the magnetic engagement of a paramagnetic member with a fixed member of similar material that may or may not be magnetized. This type of switch is more particularly designed for conventional household uses and without specific attention being directed to the presence of gaseous atmospheres that may explode during the creation of an electrical arcing or "spark." Thus the switch generally designated by the numeral 48 is contained within a chamber 49 formed by the open-end box 50. Arranged against the rear wall 51 of the box 50 is a plate 52 of suitable ferrous material. The manually-operable member 53 is adapted to be restrained in either of two positions to which it is pivotally swung by the attraction of a block 54 toward the plate 52.

More particularly, the member 53 comprises the block 54 which is of a paramagnetic material and a manually engageable block 55 of plastic or like insulation material. Preferably the outer surface of block 55 is suitably shaped, as was the block 28 of the member 17, to provide distinguishing corner areas 56 and 57. According to this construction, the manually-operable member 53 carries a metal strip 58 of copper or like material that is interposed between the blocks 54 and 55 thereof. The strip 58 is formed in its medial portion with a bight section 59 within

which is received a rod 60 which constitutes the pintle or shaft on which the member 53 is bodily supported. For this purpose, the block 55 on its rearward surface is formed with two lugs 61 which are spaced from the horizontal axis of the block. Each lug is tapped to receive a screw 62 that is passed through suitable holes in the block 54 and strip 58. Since the strip 58 constitutes the movable contact part of the switch, the rod 60 is tapped as at 63, in FIG. 6, to receive a wire connecting screw 64.

Suitably spaced above the lugs 61 of the block 55 are rods 65 and 66 that are fixedly mounted at their opposite ends in the side walls of the box 50. The rods 65 and 66 are tapped in one or both of their ends to receive wire connecting screws 64.

As shown in FIG. 5, a closed circuit is presently completed from the wire 67 attached to rod 60, the strip 58, the rod 66 and wire 68 similarly attached thereto. Obviously upon engagement of the block 55 at the corner 57 thereof, the member 53 will be swung on rod 60 until the opposite corner of block 54 is carried into contact with the plate 52. Now by the magnetic affinity of the magnetized block for the fixed metal plate, the member 53 will be restrained in a position angularly opposed from that shown in the drawing. At this time, the strip 58 will be disassociated from the rod 66, will be in engagement with the rod 65 and the circuit between wires 67 and 68 will be open.

Should it be desirable to employ the switch 48 to control two electric circuits or, to open a first circuit and then close a second circuit, by securing a wire to one end of rod 65, a second circuit will thus be completed when the manually-operable member 53 is pivotally swung as above described. Conversely if the member 53 is then engaged at the corner area 56, the strip will be moved to open the second circuit at rod 65 and then close the first circuit at rod 66 as the strip 58 resumes the position shown in FIG. 5.

Referring now particularly to FIGS. 7 to 9, inclusive, it will be seen that the heretofore disclosed embodiments of my invention may be modified for use in switch constructions that are adapted to produce a temporary "on" and "off" condition in the circuit or circuits of substantially automatically operating mechanisms. Such types of switches may thus control, in an instantaneous manner, the sequentially occurring phases of machines without intervention of manual attention or assistance.

As shown in these figures, the further modified form of the invention is provided in the form of a precision switch that is contained within a suitable receptacle or box 69. The box 69 is preferably molded from a thermosetting plastic or like material which has diamagnetic characteristics.

This box 69 has a rear wall 70, top wall 71, bottom wall 72 and end walls 73. The chamber 74 thus formed within the box may be closed by a plate 75 of like plastic material that is secured thereagainst in any suitable manner as by screws or the like. And anchored in the wall 71 are internally threaded sleeves 76, 77 and 78 that can be suitably disposed in the said walls at the time the box per se is molded.

As seen in FIG. 7, the sleeves 76 and 78 in wall 71 are arranged to provide for use of the switch for either two and three pole operation. For this purpose, the two sleeves 76 and 77 are located in longitudinal alignment while the third sleeve 78 is positioned midway therebetween and adjacent the rear wall 70. Terminal screws 79 and 80 are accordingly threaded into the aligned sleeves 76 and 77 while a screw 81 is similarly located in the remaining sleeve 78. The screws 79 and 80 are each equipped with a pair of nuts 82 and 83; one (82) serving to lock the screw in a desired position and the other (83) for securing a wire in electrical connection thereto.

The screw 81 is adapted to secure one wire 84 to complete a circuit and also operate as a set-screw for a shaft 85. The shaft 85 is carried at its ends in suitable openings or sockets provided in the rear wall 70 and the plate 75 and is located substantially medially between the top and bottom walls 71 and 72 as well as the end walls 73. The shaft 85 serves as a fulcrum for a pair of bars 86 and 87, as shown in FIG. 8. Each bar 86 and 87 is formed of paramagnetic material such as iron or steel and likewise each is provided in its central area with an arcuate groove 88 for properly aligned bearing with the shaft 85.

As herein shown, the bar 86 is positioned beneath the shaft 85 and is caused to rock about the same by means of an actuating plunger 89 located near one end of the bar and against the bias of a coil spring 90. The plunger 89, of suitable insulation material, has an enlarged head portion 91 located in the chamber 74 and a stem 92 slidably mounted in an opening in lower wall 72 while the spring 90 is loosely supported in a threaded sleeve 93 in said wall and is adjustably urged to contact the bar 86 by a screw 94 threaded into the lower or outer end of the sleeve. The bar 86 is thus supported to "teeter" or rock in one direction and about the shaft 85 upon inward thrusting movement of the plunger 89 or by the spring 90 in the opposite direction.

Magnetic attraction of the bar 86 for the bar 87 causes said bar 87 to rock on shaft 85 from a rest position when it contacts the end of screw 80 as shown in FIG. 8 to a position indicated at *a* in broken line. This is produced by an inward thrust of the plunger 89 and as it urges the proximate end of bar 86 to the position indicated in broken line at *b*.

In order to carry a circuit between the screws 80 and 81 (as shown), the wire 84 is connected at screw 81 and thereby to shaft 85. The bar 87 is provided with an upwardly disposed sheath 95 of non-ferrous metal such as copper, said sheath having centrally disposed tabs 96 in bearing relation on the shaft. Also, the screw 80 has a wire 97 attached thereto so that when the bar 87 is angularly disposed to maintain the sheath 95 in engagement with the end of screw 80, a circuit will be closed between line wires 84 and 97.

Since the proximity of the magnetically attracted ends of bars 86 and 87 can precisely determine the rapidity with which the switch operates, the screws 79, 80 and 94 are adapted to be movably positioned so as to adjust the limits of rocking motion of the bar 87 in one instance and, by the compression of spring 89 as determined by the screw 94, the rocking motion of bar 86 in the other. Also the contacting ends of screws 79 and 80 may be spherically finished to afford satisfactory and accurate points of engagement with the respective end surfaces of the sheath 95 on bar 87.

Should it be desirable to open a circuit between screws 80 and 81 or wires 84 and 97, and simultaneously close a second circuit between screws 79 and 81, a wire 98, shown in broken line, can be connected to screw 79.

For mounting the box 69, suitable holes 99 may be formed in the end walls 73 and the box thereby located for easy and convenient actuation of the plunger 89 by a moving element of a machine part. When the plunger is so engaged, even temporarily, and urged inwardly, the force of the spring 90 is overcome and the bar 86 is rocked so that its end *c* is moved toward the end *d* of bar 87. This enables the magnetic force therebetween to rock bar 87 and disengage the sheath 95 from screw 80 and into engagement with screw 79. This, as above described, will open a circuit between lines 84 and 97. However, when the force on plunger 89 is removed as by separation of an actuator machine part therefrom, the spring 90 automatically urges bar 86 to rock on shaft 85 and, as its end *e* moves toward the adjacent end of bar 87, the increased magnetic force attracts the said bar to rock the same until engagement is again effected between the sheath 95 and screw 80.

It is believed that the general operation of this modified form of switch can be easily comprehended; however, it is to be noted that this operation can be precisely deter-

mined by the adjustable setting or positioning of the screws 79 and 80. Thus, upon loosening of the lock-nut 82, the screw 80 can be moved inwardly to accelerate the opening of the circuit between screws 80 and 81 since the inclination of the bar 87 will accordingly be varied to move the spaced-apart ends of bars 86 and 87 closer together and from the full-line position shown in FIG. 8. Should the screw 80 be moved outwardly, the spacing between the ends of the bars then in close proximity will be shortened and likewise the magnetic force between the opposite ends *c* and *d* will be diminished. This will delay opening of the said circuit.

Adjusted modification of the position of the screw 79 may also be inversely employed to alter the responsiveness of the bar 87 to the magnetic attraction of the bar 86. This, of course, will also affect the open and closed condition of a second circuit in the event that the switch is used in a three pole arrangement.

Accordingly, when the plunger 89 is moved inwardly, the head portion 91 is operated to rock the adjoining end of the bar 86 upwardly and thereby increase the magnetic attraction of said bar to the bar 87. This will remove the sheath 95 from the screw 80 and open the circuit between line wires 84 and 97. The extent of rocking motion afforded to the bar 87 is of course limited by the position of the end of screw 79.

In the event the return motion of the bar 86 is to be regulated in a slower or more rapid manner, the screw 94 can be moved outwardly or inwardly of the threaded sleeve 93 to vary the compression characteristics of the spring 90.

It is to be understood that the forms of the invention herewith shown and described are to be taken as illustrative embodiments only of the same, and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. An electric switching device having a receptacle box, a switch actuating member pivotally mounted in the box and having manually engageable surfaces outwardly directed therefrom, a switch operating member disposed in the box adjacent the closed end thereof, means pivotally supporting the switch operating member and adapted to serve as one terminal of an electric circuit, a second terminal mounted in the box in radial relation to the switch supporting means, and means associated with the switch actuating member for magnetically holding the same in circuit open or circuit closed position.

2. An electric switch device having a receptacle box, the receptacle box having an open end and a closed end, a switch actuating member pivotally mounted in the box and having manually engageable surfaces outwardly directed therefrom, a switch operating member disposed in the box adjacent the closed end thereof, means for pivotally supporting the switch operating member and adapted to serve as one terminal of an electric circuit, a second terminal mounted in the box in radial relation to the shaft, a magnetic member affixed to the switch actuating member, a magnetic member affixed to the switch operating member, and barrier means associated with the box for enclosing the second-named magnetic member in a sealed chamber while allowing a magnetic force to be carried from the first to the second-named magnetic member.

3. An electric switch device having a receptacle box, a manually operable switch member, means for pivotally supporting the switch member and adapted to serve as one side of an electric circuit, a second terminal mounted in the box adapted to serve as a second side of an electric circuit, a magnetic block affixed to the switch member, and means adjacent the closed end of the box and engageable by the magnetic block to hold the said switch member in either the circuit open or closed positions.

4. An electric switch device, comprising a plurality of spaced terminals, a pivotally mounted non-magnetic contact member adapted to connect selected terminals with one another, a magnetic member carried by the contact member and movable therewith relative to one of said terminals, and a magnetic operating member for moving said first magnetic member to bring the contact member into selective contact with another of said terminals and to maintain said contact member in a selected open circuit or a closed circuit position.

5. An electric switch device having a receptacle box, a plurality of terminals radially spaced apart and insulated from one another in a wall of said receptacle box, a non-magnetic contact member pivotally carried by one of the terminals and adapted to connect selected terminals with one another, a magnetic member carried by said contact member and movable therewith, and a magnetic operating member for attractively moving said first magnetic member to bring the contact member into selective contact with another of said terminals and to maintain said contact member in a selected open circuit or a closed circuit position.

6. An electric switching device, comprising a plurality of terminals spaced apart and insulated from one another, contact means formed of a non-magnetic material movable from an open circuit position to a closed circuit position with respect to said terminals, a movable base formed of a magnetic permeable material to which said contact means is secured, magnetic means mounted adjacent said movable base for moving said base and contact means carried thereby to open and closed circuit positions with respect to said terminals, actuating means mounted independently of said magnetic means for moving the same, and means for urging said magnetic means toward said actuating means.

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