Dec. 29, 1931. C. E. IVES 1,838,944

SWITCH

Filed Nov. 28, 1927

Fig. 1

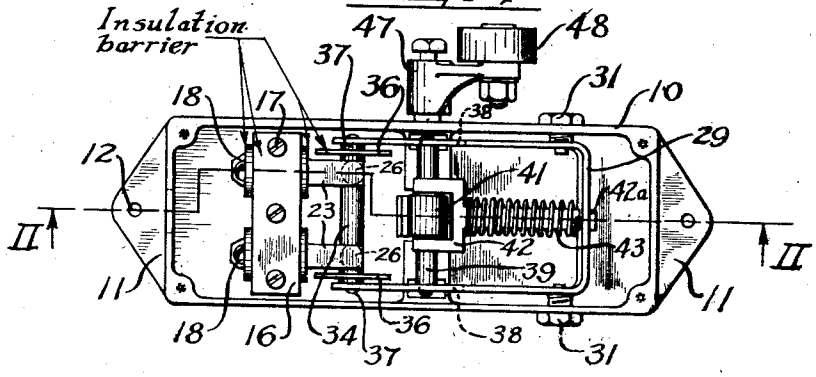


Fig. 2

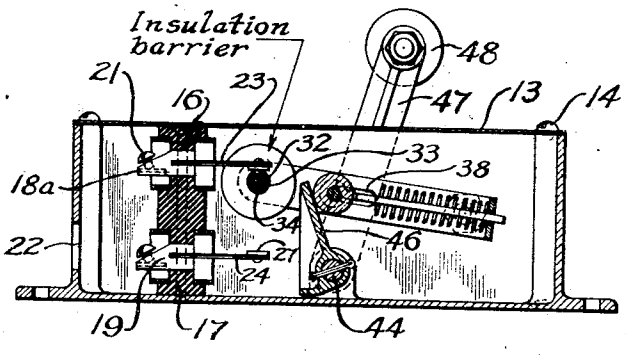


Fig. 3

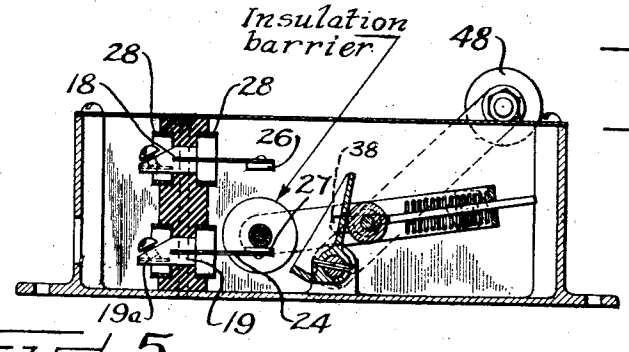


Fig. 4

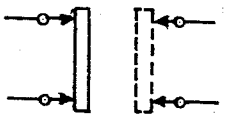
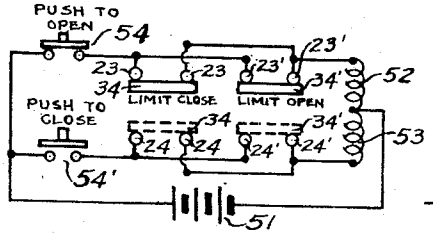


Fig. 5



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UNITED STATES PATENT OFFICE

CLIFFORD E. IVES, OF CHICAGO, ILLINOIS

SWITCH

Application filed November 26, 1927. Serial No. 233,104.

My invention relates in general to electrical switches.

It relates more in particular to a so called limit switch which has as its principal function, limiting the travel of such mechanisms as hoists, elevators, electrically controlled gate-valves, electrically controlled vault or other doors and the like.

One of the principal difficulties in designing a switch of this type is the obtaining of a sturdy, simple, construction which at the same time will pass the rigid tests required by the fire insurance underwriters. Since these switches are generally in out of the way positions, as for instance, between partitions and the like, they cannot readily be subjected to the same daily inspections and tests which are possible when dealing with mechanisms which are at all times in plain view.

As an example of the purely structural features which must be incorporated in such a switch, it might be noted that where 440 volt current is employed (and this is a standard industrial current for power machinery) there must be at least a half inch gap from a pole to ground through the air; where the path to the ground is across the surface of a dielectric, this must be increased to one inch. Between contacts of opposite polarity with no intervening dielectric but a straight air path, the space must be one inch; and where a dielectric intervenes the space between these parts having opposite polarity must be a minimum of two inches.

A switch conforming to these requirements and structurally of sufficiently sturdy design to stand up under daily use, is in existence but this switch is quite expensive and is objectionable for this reason. It is not as simple in its operation as can be desired and leaves somthing to be wished for in the matter of ruggedness and positive action.

One of the difficulties in constructing limit switches is that they serve to regulate the movement of relatively large slow moving objects, such as vault doors for example. The usual type of small snap switch would be inefficient for this purpose because the size of the object and manner of use requires sturdiness, and the incident slow movement is not suited to the function and method of operation of such switches. The standard snap movements of these switches are also ineffectual, even if an attempt were made to simply construct them on a larger scale.

With these premises in mind, it is apparent that the principal object of my invention is the production of an improved limit type of switch.

Another object is the production of a limit switch of sturdy design.

Another object is the production of a limit switch of relatively low initial cost and economical from the standpoint of up-keep.

Another object is the provision of a cheap electrical switch conforming to the present specifications of the underwriter's laboratories.

Another object is to produce a cheap limit switch of sturdy construction, and adapted to be operated by a slow moving object.

In carrying out the invention, a rectangular housing is provided toward one end of which two pairs of spring type electrical contacts are imbedded in a suitable dielectric. At the opposite end of the housing, a U-shaped switch arm is pivoted midway between the planes of the two pairs of contacts. At the end of the switch arm adjacent the contacts a bridging member is provided to interconnect either of the pairs of contacts depending upon whether the switch arm is above or below its pivot point. A suitable mechanism is provided operated by a lever on the outside of the housing, this mechanism including a spring so that as the contact arm is moved it will have an over center lever snap action causing it to snap from a point above its pivot to a point below the same or vice versa, and thus snap out of

contact with one pair of terminals and into contact with the other pair. The specific arrangement of parts is of considerable importance and will be apparent from the following description taken with the accompanying drawings, wherein

Fig. 1 is a plan view of the switch with the housing cover removed;

Fig. 2 is a sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a sectional view similar to that shown in Fig. 2 but with the parts in a different position;

Fig. 4 shows schematically the manner in which the terminals are interconnected by the switch bar, and

Fig. 5 shows a circuit illustrative of the manner in which the switch may be used.

Referring now to the drawings wherein like reference characters are employed to designate similar members throughout the several views, the switch includes a housing 10 in which the major portion thereof is adapted to be contained, this housing having ears 11 provided with screw holes 12 for securing the switch on a suitable support. The switch might be mounted of course horizontally, vertically, or in any other position depending upon the specific manner in which it is used. A cover 13 is adapted to enclose the housing and is secured thereto by means of screws 14.

Toward one end of the housing, a dielectric block 16 is secured to the bottom thereof by machine screws 17—17, this block being connected only to the bottom of the housing and spaced from the sides thereof as shown. Within the block are secured terminal lugs 18—18 and 19—19 having at one end thereof conductor receiving slots 18*a* and 19*a* respectively, screws 21—21 being provided in each instance to secure the conductor to the terminal block. Adjacent these positions, the end of the housing is provided with an opening 22 through which a cable (not shown) is adapted to extend, its separate conductors being fanned out on the inside of the housing for connection to the proper terminal lugs.

The terminal lugs 18—18 and 19—19 have secured thereto in clamping relation or in any other suitable manner, spring contacts 23—23 and 24—24, respectively, to which are secured contact points 26—26 and 27—27, respectively. These contact points may be formed integral with the springs, in which case they would simply comprise thickened portions thereof, or they may be fastened in any other way. It is obvious of course, that contact may be formed with the springs directly if it were considered desirable.

The terminal lugs are firmly imbedded in the insulating block 16 but on each side thereof the block has a cut away portion of circular cross section in which short tubular inserts 28—28 of dielectric material are placed to act as an insulation barrier and assist in adhering to the underwriters' specifications described above.

Toward the opposite end of the housing, a U-shaped switch arm 29 is secured on pivots 31—31 which are in the form of screws threaded into the side of the housing and with their heads extending on the outside thereof. Narrowed portions of the shank engage in suitably provided apertures in the closed end of the switch arm.

At the open end of the switch arm, a rod 32 is secured and surrounded by an insulating tube 33 surmounted by a cross bar 34 for interconnecting the switch terminals carried by the block 16. The contact bar 34 is of tubular cross section and has on each side thereof, an insulation barrier in the form of dielectric washers 36, these washers extending to the insulating tube 33 and having at the sides thereof, opposite the cross bar, spacers 37—37. It is apparent that the free end of the switch arm may by a suitable mechanism be forced upwardly or downwardly to interconnect either of the two pairs of terminals. Mechanism is provided for operating the switch arm to have this effect, with the inclusion of snap means resulting in a quick making and breaking of contact to prevent any possibility of arcing.

At two opposite points on the switch arm intermediate the ends thereof, slots 38—38 are provided into which extend the narrowed ends of a rod 39 which carries at its midpoint, a roller 41 free to revolve thereon and secured in place by the arms of a bifurcated guide 42 which is pinned to the rod 39 and has the end of its shank 42*a* extending through a slot in the bow portion of the switch arm 29. Intermediate the bifurcations and the bow end of the switch arm, compression spring 43 is mounted upon the shank of the bifurcated guide member.

Near the bottom of the housing, an operating shaft 44 is provided having at its midpoint a roller engaging rocking arm 46 and on its end on the outside of the housing, an operating lever 47 to the unconnected end of which, is secured a roller 48. The roller is adapted to be engaged by any moving object to move the lever 47, and the movement of the lever operates to move the roller engaging rocking arm 46 as well. This arm is adapted to incline either to the left as shown in Fig. 2, or to the right as shown in Fig. 3. The spring 43 being under-compression, the roller at all times tends to ride on the incline or cam surface so as to move the switch arm about its pivots either upwardly or downwardly. It does this by building up a compression in the spring until the rocking arm reaches a "dead center" position at which time contact is still maintained between the cross bar and terminals, the switch arm being

maintained in position by the tension of the spring, or just before it trips, by its own inertia.

As soon as the inclination of the rocking arm is slightly beyond that from which it is changing, however, the roller, impelled by the spring, starts to ride down the oppositely inclined surface. When this action takes place, it occurs with a snap, the roller in its movement of course carrying with it the entire mechanism of which it is a part, namely the entire switch arm assembly. This movement results in the quick breaking of the contact between the cross bar and one pair of terminals and a correspondingly quick snap engagement being effected between the cross bar and the other pair of terminals.

As an instance of the manner in which a switch of this type may be used, reference may be had to Fig. 5 showing a simplified circuit in which a pair of such switches may be incorporated. The same reference characters are employed as near as possible, as those used in the description of the apparatus itself. In this circuit, a source of power 51 is employed to drive suitable apparatus (not shown), put in motion by a solenoid controlled by coils 52 and 53. There are many ways in which this arrangement is carried out. As for example, on a door opening device, one solenoid may set the door opening mechanism in operation to open the door, while the other solenoid may function to cause the mechanism to move in an opposite direction to move the door to a closed position. The circuit will be described in connection with this arrangement.

Assume that the door is closed, then switch 54 may be pressed to establish a circuit through the terminals 23—23 and 23′—23′ of the two switches indicated by the terms "limit close" and "limit open". This energizes the solenoid 52 and operates the mechanism for opening the door. As the door starts to open, the "limit close" switch is actuated because the lever 47 which has been held by the closed door, is released. The switch bar 34 then shifts to the position indicated by the dotted lines. The door continues to open, the circuit being established through the "limit open" switch until it reaches substantially the desired end of its travel. Here its actuating arm is engaged by the door to move the cross bar 34′ and so open the circuit and stop the movement of the door.

The door is now open and the circuit is in the position shown with the switch bars contacting with the opposite pairs of terminals, their position being shown in dotted lines. Assume that it is now desired to close the door, the switch 54′ is closed. This establishes a circuit through the terminals 24—24 and 24′—24′ of the limit switches and energizes the solenoid 53. As the door begins to close, however, the cross bar 34′ is moved out of engagement with the terminals 24′ and the circuit is then through the other limit switch. When, however, the door approaches the final closed position, the lever 47 is moved by the door engaging the roller 48 and the circuit including the solenoid 53 is broken. This stops the movement of the door closing mechanism and leaves the circuit as shown in full lines, ready for the button 54 to be pushed to again open the door. Thence the operation is repeated each time the door must be either opened or closed.

There are many other manners in which a switch of this type may be used but it is not necessary to refer to them. The switch accomplishes everything that complicated, very expensive switches were required to do in the past, and in addition it is sturdy, positive in its action, and effects a quick throw. Mechanically, electrically and structurally it is an improvement over the prior art and passes the tests required by the fire underwriters.

Although specific details of one embodiment of the invention have been described to make the invention clear to those skilled in the art, it is obvious that I need not restrict myself to this particular form and the invention is limited only by the scope of the appended claims.

What I claim as new and desire to secure by United States Letters Patent is:

1. In a limit switch, a housing, two pairs of electrical contacts disposed at one end of the housing, a switch arm pivoted at a point midway of the planes of the two pairs of contacts, a cross bar carried by the switch arm and adapted to interconnect either pair of contacts, a guide reciprocable with respect to the arm, a spring for normally holding the guide in a position toward the contacts, a roller on the guide, a rocking operating arm in contact with the roller, and means projecting from and operable outside of the housing for inclining the operating arm in either direction to move the switch arm quickly from one position to another to snap the cross bar out of engagement with one pair of contacts and into engagement with the other pair.

2. The switch defined in claim 1 wherein said guide is T-shaped, with two of its legs extending into longitudinal slots in the switch arm, with the other leg thereof extending through and axially reciprocable in the pivoted end of said arm.

3. The switch defined in claim 1 wherein said guide is T-shaped and is secured on the switch arm in longitudinally reciprocable relation, the spring being mounted on one of the legs of the T, and compressed by having its ends engaging a portion of the switch arm and the other legs of the T respectively.

4. In a limit switch, a housing, an insulating block at one end of the housing, a plurality of contacts secured in the block, a U-

shaped switch arm pivoted at its bow end to the housing, a cross bar secured across the open end of the switch arm and insulated therefrom, a T-shaped guide assembly having two of its legs extending into slots in the sides of the switch arm and its remaining leg extending through a slot in the bow end of said switch arm, a roller mounted on said guide, spring means normally forcing said guide and said roller in the direction toward the contacts, an operating shaft in the bottom of the housing, a rocker arm pivoted to the shaft and engaging said roller, and an operating lever on the outside of the housing and secured to said shaft for changing the angle of inclination of said rocker arm to move said switch arm with an over center snap action about its pivots and so snap said cross bar out of engagement with one pair of contacts and into engagement with the other.

5. The combination defined in claim 4 wherein the means of insulating said cross bar from the switch arm includes a pair of relatively large dielectric washers forming an insulation barrier between said bar and other conducting portions of the switch.

6. A switch as defined in claim 4 wherein said spring is mounted on the longitudinal leg of said T member with its two ends abutting the bow portion of said switch arm and the cross piece of said T respectively.

7. A switch as defined in claim 4 wherein the roller engages said rocker arm always at the same side of said operating shaft, so that the switch arm will remain in one position without holding the operating lever, but when said operating lever is released the switch arm impelled by said spring returns to its normal position.

8. In a limit switch, a housing, an insulating block secured at one end of the housing, two pairs of terminal lugs secured in said block with terminal connecting means projecting into the smaller end of the housing, said housing provided with an opening adjacent said terminal lugs for leading a conductor therethrough, contacts of resilient material secured to said lugs and projecting from the insulating block to the large end of the housing, a U-shaped switch arm pivoted to the housing at a point midway between the planes of the contacts, a cross bar secured across the open end of the switch arm and adapted to engage the terminals to interconnect either pair thereof, a T-shaped guide reciprocable on said switch bar, a spring normally holding said T toward the terminals, a rocker arm interposed between said T and said terminals, and means partly on the outside of the housing for moving said rocker arm to cause the T-shaped guide to ride on the inclined face of the rocker arm to move said switch arm and disconnect one pair of terminals and connect the other pair with a snap motion.

9. In a limit switch, a housing, an insulating block secured at one end of the housing, two pairs of terminal lugs secured in said block with terminal connecting means projecting into the smaller end of the housing, said housing provided with an opening adjacent said terminal lugs for leading a conductor therethrough, contacts of resilient material secured to said lugs and projecting from the insulating block to the large end of the housing, a U-shaped switch arm pivoted to the housing at a point midway between the planes of the contacts, a cross bar secured across the open end of the switch arm and adapted to engage the terminals to interconnect either pair thereof, a T-shaped guide reciprocable on said switch bar, a roller secured on said guide, a spring mounted on one leg of said T with its ends engaging the closed end of the U-shaped switch arm, and the cross piece of the T, respectively, said roller being in line with the end of said spring, a rocker arm engaging said roller and disposed between said roller and said cross bar, a shaft supporting said rocker arm and extending to the outside of the housing, and an operating lever mounted on the projecting end of the shaft for moving said rocker arm to cause the roller driven by the spring to be moved on the inclined surface of said rocker arm to snap said switch arm in either direction.

10. The switch defined in claim 9 wherein said roller engages said rocker arm at all times on the same side of the rocker arm shaft, so that when said operating lever is disengaged the switch arm assembly will be returned to normal position by said spring.

11. A limit switch for controlling the movement of relatively slow moving objects, said switch including an over center snap mechanism, a single compression spring operating said mechanism, and a roller arm adapted to be engaged by the object to control the over center snap mechanism to snap the switch in one direction and means, including said spring for returning the mechanism and roller arm to normal position when said object is moved in the opposite direction, the roller arm being returned gradually, and the over center snap mechanism moved with a snap action when the arm has been moved through a portion of its distance.

12. In a limit switch, a pair of fixed, spaced contacts, a switch arm carrying a contact movable with respect to said fixed contacts and pivoted at its opposite end, a roller carried by said arm, a spring for urging said roller radially from the pivot point of said arm, an operating arm pivoted at one end and engaging the roller whereby the spring urges said operating arm always in the same direction, and means for actuating said operating arm against the pressure of the spring.

13. In a limit switch, a movable contact member, a switch arm supporting said contact member at one end, and being pivotally mounted at the other end, a roller carried by said switch arm, an operating arm pivoted at one end, a spring for urging the roller against the operating arm, said spring urging the operating arm always in one direction, and means moving the operating arm against the force of the spring.

In witness whereof I hereunto subscribe my name this 24th day of October, 1927.

CLIFFORD E. IVES.