July 18, 1933. G. A. RITCHIE 1,919,039

SWITCHING DEVICE

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FIG. 1

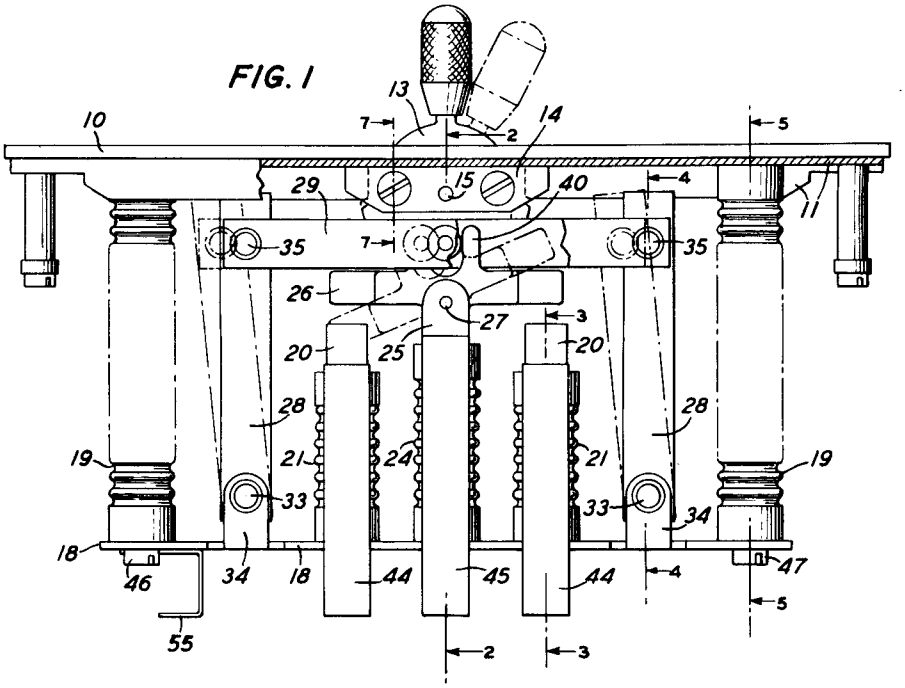

FIG. 2

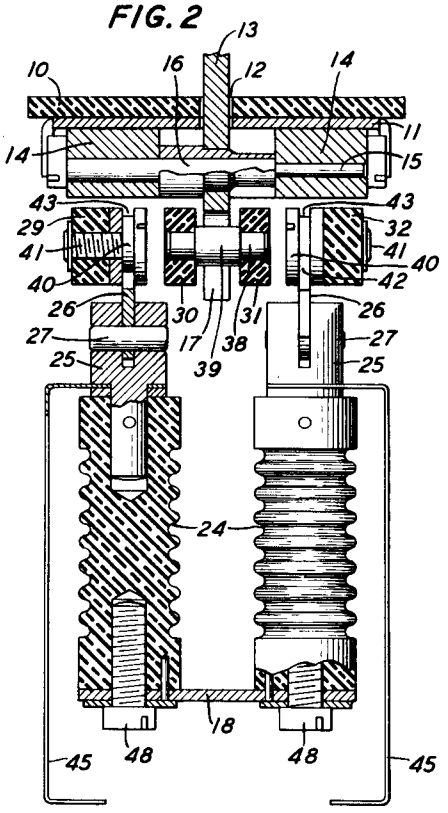

FIG. 3

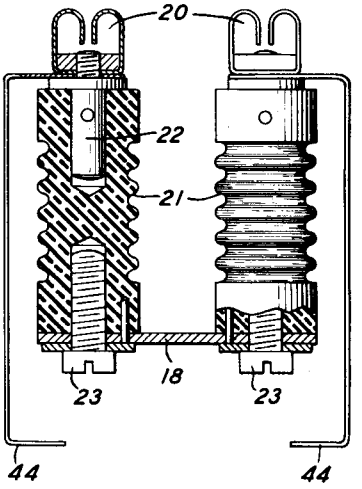

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FIG. 4

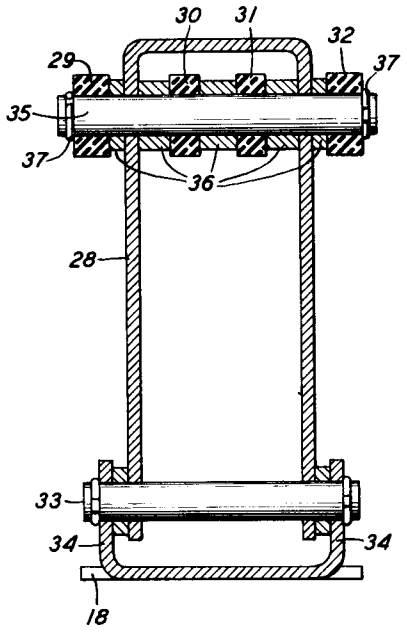


FIG. 5

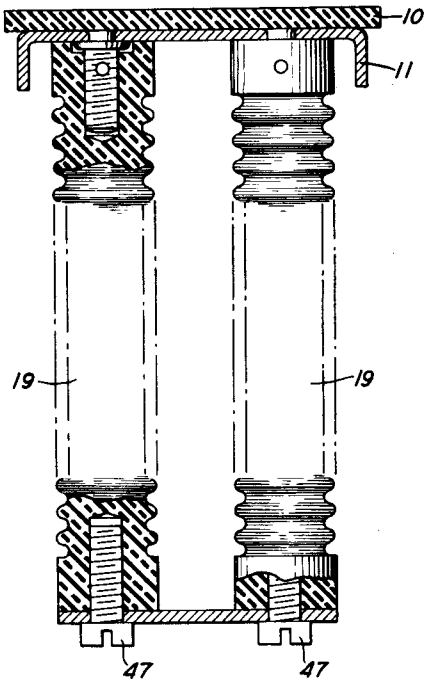


FIG. 6

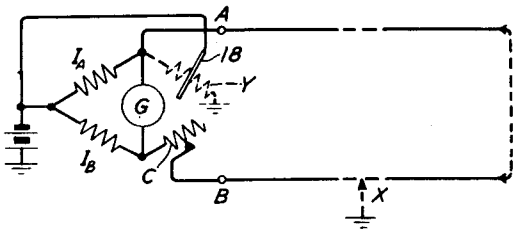
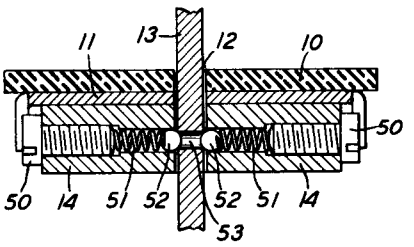


FIG. 7



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UNITED STATES PATENT OFFICE

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SWITCHING DEVICE

Application filed April 5, 1932. Serial No. 603,344.

This invention relates to circuit makers and breakers and particularly to highly insulated switches employed in controlling testing circuits.

In order to determine whether or not electric circuits in general, and telephone circuits particularly, are operating at a maximum efficiency and to locate and rectify unstandard conditions which may exist and which tend to interfere with the efficient operation of equipment associated with the circuits, it is necessary that the circuits be subjected to periodic tests. One of the chief sources of trouble in telephone systems is current leakage in telephone cable circuits which, if allowed to persist, would seriously impair the transmission characteristics of the circuits. It requires constant vigilance to guard against the growth of such a condition.

In locating current leaks in telephone cables various testing circuits are in general use. To insure accuracy in the tests made with such circuits it is essential that the apparatus employed be of such a design as to offer no low resistance current paths, so that the measurements made will not be affected by the equipment employed in making the tests.

It is the object of this invention to insure against leakage currents in apparatus employed in locating current leaks in telephone cables.

This object is attained in accordance with a feature of the invention by the provision of a circuit controlling switch which is highly insulated, durable, compact and simple in construction and which is quickly and conveniently operated.

In switches of the character herein disclosed, it is necessary that a current leakage guard be employed and the contact members be located at a relatively great distance from the guard in order to insure adequate resistance to current leaks. It is also essential that the contacts be sufficiently segregated to prevent leaks therebetween. The purpose of the guard is to permit by-passing some of the leakage which may occur along the surface of the insulators employed in the switch structure.

The switch contemplated by this invention embodies a pantograph operating mechanism interposed between the operating lever and the movable or active contact carrying parts and so proportioned relatively to the movable parts as to insure the necessary movement of the latter and maintain sufficient resistance throughout the switch structure as to reduce to a minimum the possibility of current leakage between the various elements of the switch.

The invention will be readily understood from the following detailed description made with reference to the accompanying drawings in which:

Fig. 1 is a front elevation of a switch embodying the features of this invention;

Fig. 2 is a section taken along the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a section taken along the line 3—3 of Fig. 1 looking in the direction of the arrows;

Fig. 4 is a section taken along the line 4—4 of Fig. 1 looking in the direction of the arrows;

Fig. 5 is a section taken along the line 5—5 of Fig. 1 looking in the direction of the arrows;

Fig. 6 shows schematically, a Wheatstone bridge testing circuit of which the switch shown in Figs. 1 to 5 inclusive, and 7, forms a part when the bridge is employed in testing a telephone toll line; and

Fig. 7 is a section taken along the line 7—7 of Fig. 1 looking in the direction of the arrows.

Like numerals throughout the several figures indicate similar parts.

The switch mounting plate is made up of a phenol fibre plate 10 superimposed on a metal plate 11 and secured thereto by means of screws or in any other suitable manner. The members 10 and 11 are centrally apertured to provide a slot 12 through which an operating lever 13 extends. Secured to the under side of plate 11 are two brass mounting brackets 14 which are centrally bridged by a pin 15 upon which the lever 13 is adapted to pivot, the lever being secured to the rivet

member 16 which is provided with a central bore which serves as a housing for the mid-portion of pin 15. The lower portion of the lever 13 is bifurcated to provide a slot generally indicated by the numeral 17, the purpose of which will hereinafter appear.

Interposed between the horizontal member 18 of a metallic guard and the metal plate 11 are four petti-coated insulating supporting members 19, there being two at either extremity of the switch.

The stationary or passive contact members 20 of the switch are mounted on petti-coated insulating members 21 by means of screws 22. The insulators 21 are rigidly secured to the guard member 18 by means of screws 23. Two sets of contact members 20 are provided, one on either side of the pair of petti-coated insulators 24 which, like insulators 21, are secured to the guard member 18 by means of screws 25. The insulators 24 are centrally located on the guard member 18 and are midway of the two pairs of contact carrying insulators 21 as shown in Fig. 1.

The centrally disposed insulators 24 are each provided with a centrally projecting push-fitting bifurcated bolt 25, each of which supports a pivotal contact rocker arm or knife blade 26. The knife blade 26 is centrally positioned on the bolt 25 and is pivotally supported in the slot effected by the bifurcated end of the bolt on a pin 27.

Interposed between the operating lever 13 and the movable or active contact member 26 is a pantograph operating mechanism which acts as a medium through which the movement of the lever 13 is communicated to the contact member or rocker arm 26.

The pantograph mechanism consists of two inverted U-shaped elements 28 which, with member 18 and pins 35 constitute the guard, one located near each end of the member 18, and insulating cross bars 29, 30, 31 and 32. The two U-shaped members 28 are pivotally supported on pins 33 each of which is carried by a pair of oppositely disposed upturned lugs or ears 34 which are integral portions of the guard member 18.

The insulating bars or members 29, 30, 31 and 32 are joined at their ends and supported by the guard pins 35 which pass through each leg of the U-shaped guard members 28 as clearly seen in Fig. 4. Metallic washers 36 are interposed between adjacent insulating rods and between the insulating rods and the vertical legs of the U-shaped member 28. The pins 35, insulating bars 29, 30, 31 and 32 and the washers 36 are so assembled as to permit the insulating bars to pivot on the pins 35 when the U-shaped members are actuated, as will appear from a later description. A small circular groove is provided at each end of the pins 35 which accommodate the circular springs 37. These springs prevent the pins 35 from working out of position.

It will be noted by reference to Fig. 2 that the four insulating members are not joined together at their centers. The insulators 30 and 31 are joined by means of a pin 38 upon which is loosely mounted a collar 39 which fits into the slot 17 effected by the bifurcated end of lever 13.

Each knife blade 26 is provided with two vertically extending ears 40 which cooperate to form a centrally located slot. At the midpoint of the insulating bars 29 and 32 there is provided a screw 41 provided with a head 42 having an annular groove 43 into which the two ears 40 freely fit. By virtue of the engagement of the ears 40 with the groove 43 of screw head 42, any movement of the insulating bars 29 and 32 is imparted to the knife blade 26.

To facilitate the making of external circuit connections with the contact members 20 and 25, spring members 44 and 45 are provided. A spring terminal 46 is also provided for the guard member 18 and is secured thereto by means of a screw 46 which with corresponding screws 47 serve to secure the guard member 18 to the insulators 19 which are interposed between the guard member 18 and the metal frame member 11.

Having described the construction of the switch embodying the features of this invention, its operation will now be explained.

Normally, the switch assumes a position shown by the full lines of Fig. 1 with the knife blade 26 in a horizontal position and disengaged from either set of stationary contacts 20. Assuming it is desirable to effect a circuit connection between the spring terminals 45 and the left hand terminals 44, the lever 13 is thrown to the right to the position indicated by the broken or dash lines in Fig. 1.

The lever 13 pivots about the pin 15 whereupon the pin 38 and insulating bars 30 and 31 experience a lateral movement to the left due to the fact that the pin 38 and its associated collar 39 are confined within the slot 17 effected by the bifurcated end of lever 13. The insulating bars 30 and 31 being loosely or rotatably secured to the insulating bars 29 and 32 respectively, at both ends and with the U-shaped guard members 28 by means of guard pins 35, the bars 29 and 32 move simultaneously with, and in the same direction as the bars 30 and 31, the guard members 28 moving angularly to the left about their respective pivot pins 33.

The screws 41 being rigidly secured to their respective insulating rods 29 and 32 move to the left therewith and in so doing cause the knife blades 26 to pivot about the pins 27 by virtue of the engagement of the depressed annular portion of the screw heads 42 with the ears 40. The left hand end of knife blade 26 is accordingly forced down into engagement with the left hand contact springs 20 so that

the terminal springs 44 and 45 are electrically connected by way of the contact springs 20, left hand portion of knife blade 26 and springs 25.

The methods of returning the switch to normal and of effecting a connection between terminal springs 45 and the right hand terminal springs 44 are obvious.

Fig. 7 discloses the method employed by applicant in centering the lever 13 in its normal position. The brass mounting brackets 14 are each provided with a cylindrical bore, the outer portion of which is of a greater diameter than the inner portion and is tapped to receive the screw 50. The inner portion of each bore houses a small coil spring 51 and a small steel ball 52. The lever 13 is provided with a small cylindrical bore 53 of smaller diameter than that of the steel balls 52 and is so located on the lever 13 that when the latter is in its normal position the axes of the lever bore 53 and the two bores in the mounting brackets 14 are in alignment. In normal position of the lever, therefore, the spring 14 forces its respective ball into the end of the lever bore 53 tending to maintain the lever in this position.

Referring to Fig. 6, there is disclosed a simple Wheatstone bridge circuit which is generally employed in testing telephone toll lines and with which the switch just described finds particular application. This circuit has been shown for the purpose of describing the use of a guard in the switch structure.

The circuit shown to the right of terminals A, B represents a telephone toll line and the ground X indicates the location of an unstandard condition on this line. Assuming the apparatus associated with the Wheatstone bridge is impervious to current leaks, which is the ideal condition, the currents I_A and I_B would be equal, and by adjusting the movable arm C, a balance, as indicated by the galvanometer G, may be obtained. Then, by a series of computations well known in Wheatstone bridge circuits, the exact location of the current leak X may be obtained. Should the equipment be poorly insulated and unguarded, a leak to ground shown at Y might occur. It is obvious that the current I_A will be increased by the current flow through Y to ground. This causes an unbalance in the circuit and in order to restore the balance, the movable arm C would have to be adjusted until the galvanometer G showed a zero reading. This causes an inaccurate location of the leak X to be computed, rendering the test wholly unreliable. However, when the equipment is guarded by the shield 18, the leakage current instead of finding a ready path to ground, is rendered ineffective in producing any appreciable effect on the galvanometer reading. The path through the insulating elements of the switch which is purposely designed to present a high resistance, generally in the neighborhood of ten thousand megohms, is now connected in parallel with the arm of the Wheatstone bridge through which the current I_A is flowing. For practical purposes the resistance of this arm is designed to be five thousand ohms so that the result of paralleling a five thousand ohm resistance with a resistance of ten thousand megohms produces a negligible effect on the current I_A so that the galvanometer reading is not affected and a true location of the leak X may be calculated.

It is apparent from the construction of applicant's switch that current leakage is reduced to a minimum. It is to be especially noted that the operating lever 13 and its associated insulating bars 30 and 31 are not connected directly to knife blades 26 for effecting the actuation thereof as such a construction would provide a relatively short path from the spring contacts 25 to the operating lever, when normal, or from either of the contacts 20 to the lever when actuated should the lever become accidentally grounded. The path of such a leakage current to an accidentally grounded lever includes one-half of the insulating bar 29, a relatively long path and one of very high resistance.

The utility of applicant's specially devised guard arrangement is clearly shown in Fig. 4. The guard consists primarily of the horizontal plate 18, its associated integral ears 34, U-shaped members 28 and the pins 35. Each of these elements is at guard potential, so that the pins 35 introduce such a potential at the ends of the horizontal rods 29 to 32 inclusive, and therefore between the actuating lever 13 and the knife blade contacts 26. The potential is applied to the guard by way of the terminal 55.

Other structural details which increase the insulating characteristics of the switch are evident from the foregoing description.

What is claimed is:

1. In a switching mechanism, a stationary contact, a movable contact member, an operating lever for effecting the engagement of said movable contact member with said stationary contact, and a pantograph mechanism interposed between said movable contact member and said operating lever for transmitting the movement of said operating lever to said movable contact member, said pantograph mechanism comprising a pair of pivotally movable end members and a plurality of insulating bars pivotally secured thereto, said operating lever being associated with one of said bars at its mid-point and said movable contact member being associated with another of said bars at its mid-point.

2. In a switching mechanism, a stationary contact, a movable contact member, an operating lever for effecting the engagement of

said movable contact member with said stationary contact, insulating rods interposed between said movable contact member and said operating lever for transmitting the movement of said operating lever to said movable contact member, and a current conducting guard pivotally supporting said insulating rods.

3. In a switching mechanism, a stationary contact, a pivotally movable contact, an insulating bar having its mid-point in operative engagement with said movable contact, a second insulating bar having an end mechanically coupled with an end of said first insulating bar and an operating lever in operative engagement with the mid-point of said second insulating bar for moving both said bars linearly as a unit to cause said movable contact to pivotally move into engagement with said stationary contact.

4. In a switching mechanism, a mounting plate, a pair of brackets secured to said mounting plate, a pin bridging said brackets, an operating lever pivotally mounted on said pin and protruding from said mounting plate, a guard, a plurality of elongated insulators interposed between said mounting plate and said guard and secured thereto, a plurality of insulating members carried by said guard each supporting a stationary contact member, said insulating members being interposed between said mounting plate and said guard, a pair of vertically extending supports pivotally mounted on said guard, one on either side of said plurality of insulating members, a plurality of insulating bars supported between said supports in superposed relation to said stationary contacts and adapted to move horizontally upon the pivotal movement of said supports, a knife blade pivotally mounted on one of said insulating members and provided with a pair of centrally located ears, a pin joining certain of said insulating bars and normally engaged by said ears, a pin joining other of said insulating bars and normally resting in a slot in said lever whereby the movement of said lever is transmitted to said knife blade, to effect engagement between said knife blade and said stationary contacts through the medium of said insulating bars.

5. In a switching mechanism, a stationary contact, a movable contact member, an operating lever, an insulating bar associated with said operating lever and actuated thereby, a second insulating bar associated with said movable contact member, and a guard, said insulating rods being secured together at their ends through the medium of a pin forming a portion of said guard whereby the movement of said operating lever is transmitted to said movable contact member to effect an engagement between said movable contact member and said stationary contact.

6. In a switching mechanism a stationary contact, a movable contact, an operating lever, means for transmitting the movement of said lever to said movable contact to effect engagement between said movable and stationary contacts, said means comprising two insulating members joined at their ends by a metallic pin, and a current conducting guard conductively associated with said pin whereby guard potential is introduced between said operating lever and said contact members.

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