June 9, 1925. 1,541,343

H. W. GOFF

SWITCHING DEVICE

Filed Oct. 12, 1921

Fig. 1.

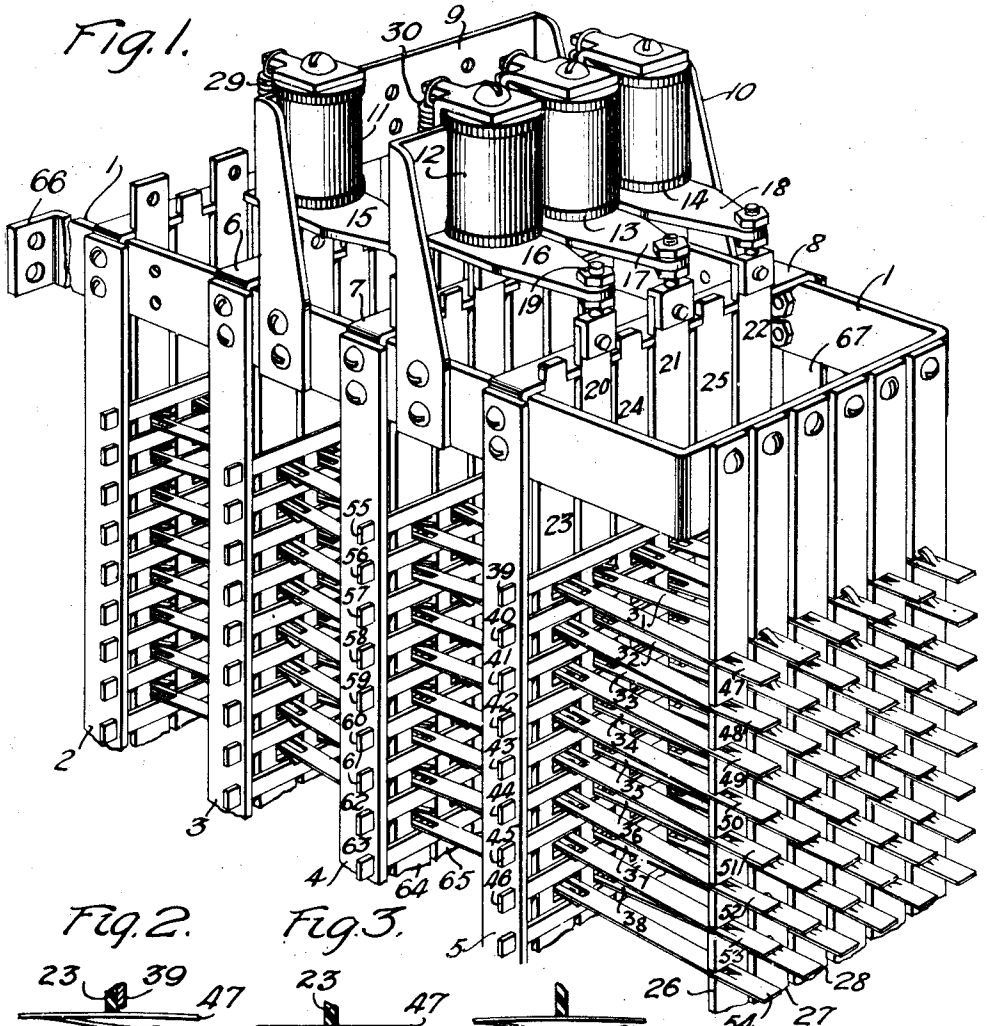


Fig. 2.

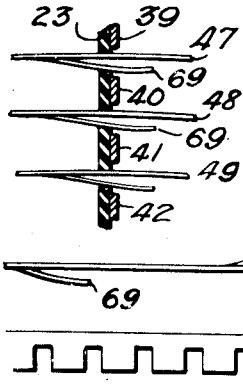
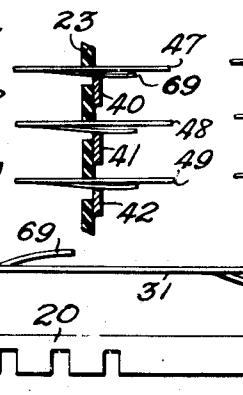


Fig. 3.



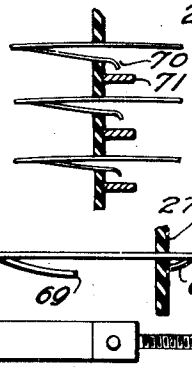


Fig. 4.

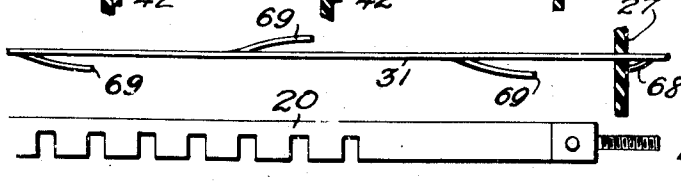


Fig. 5

Fig. 6.

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UNITED STATES PATENT OFFICE.

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SWITCHING DEVICE.

Application filed October 12, 1921. Serial No. 507,282.

To all whom it may concern:

Be it known that I, HAROLD W. GOFF, a citizen of the United States, residing at New York, in the county of New York, State of New York, have invented certain new and useful Improvements in Switching Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to switching and contact making apparatus and more particularly to devices of this general character in which cooperating contact elements are provided for establishing electrical circuits.

Among the various types of switching devices used for controlling electrical circuits by means of co-acting contact making elements are to be found many different methods of bringing these elements into physical engagement with each other. One of the essential requirements, regardless of what design the switch may be, is that the contacting surfaces shall be kept clean to insure good electrical connections. This result is secured without any difficulty in certain kinds of switches. For instance, selector switches, such as those employed in telephone systems, with brushes having a wide latitude of movement, are so arranged that the movable brushes wipe over the entire surface of their cooperating stationary terminals. By means of such rubbing action, the terminals and brushes are cleaned and always present to each other a well polished surface.

There are, however, other classes of electric contact making switches in which the principle of construction and operation differs radically from those mentioned. Included in these are the types of switching structures wherein the contacting elements are arranged to have a multiplicity of connecting points and to undergo only a slight amount of movement in making engagement with each other. The relative motion between the two elements is in the direction that will bring them into engagement by traversing the least distance and in the shortest time. Consequently, where this principle is employed. the tendency is to spare none of the relative movement between the contact elements for maintaining them in a polished condition. The rubbing action between the cooperating contacts in switching structures of this latter category is a feature that largely determines the practicability of the device.

Considering, therefore, an electrical switching mechanism in which the movable terminals are each arranged to have a plurality of points of contact with respective stationary terminals, it is the object of the present invention to provide for a relative movement between each movable terminal and its cooperating stationary terminal during the engagement.

A feature of the invention is a switching mechanism having a movable terminal member provided with a plurality of resilient contact elements, each arranged in cooperative relation to a corresponding stationary terminal, wherein movement of said member in the direction of a stationary terminal first causes engagement between the corresponding resilient element and stationary terminal, while further movement causes the resilient element to flex and thereby change its point of engagement with the stationary terminal.

A further feature relates to a switching device in which the movable terminal is provided with a plurality of resilient contact elements, each arranged for cooperation with respective stationary terminals, said movable terminal being arranged for movement in different directions for causing engagement between the different resilient elements and the stationary terminals, further movement thereof causing the resilient elements to flex and modify the point of engagement.

Such other features as are contemplated by the present invention will become obvious from a consideration of the description given hereinafter and also from the appended claims.

Referring to the drawing which forms part of this application, Fig. 1 is a perspective view of a portion of a multiple switching structure wherein the features of the invention above enumerated are incorporated.

Fig. 2 is a detail illustrating the normal relative position of the movable and stationary contact elements.

Fig. 3 is a detail showing the same elements depicted in Fig. 2, except that they are here illustrated when in the fully operated position. Fig. 4 shows a modific

form of stationary and movable contact elements.

Fig. 5 is a side view of one of the movable terminal strips showing the resilient contact elements.

Fig. 6 is a detail of one of the draw-bar members for operating the movable terminals.

Although shown as embodied in a certain type of electrical switching device, it should be understood that the invention is not so limited but may be applied to switching mechanisms of widely variable character. For the purpose of illustration, the novel method of obtaining a rubbing or sliding action between the contact elements of an electrical switching mechanism is incorporated in a multiple switching structure of the relay type, more particularly suited for use in telephone and signaling systems. In general, the plan on which these mechanisms are designed to operate has as one of its outstanding features a cooperation between the movable and stationary terminals which requires the least amount of displacement accomplished in the shortest possible time. The movable terminal members are usually controlled by some power device, such as an electromagnet, and arranged to be moved directly into physical contact with the stationary terminals. The engagement of the movable and stationary terminals may serve for any of the numerous purposes required in telephone or other systems, such for example, as the connection of subscribers' lines to trunks, the connection of one trunk to another, the connection of trunks to called subscribers' lines, etc.

Referring to Fig. 1 of the drawing, the switching structure here shown consists of a metallic frame 1 shaped in any desirable fashion and arranged to be attached to a supporting structure by passing bolts or screws through the holes shown in the angle portion 66. To the main frame 1 there are secured at properly spaced intervals a plurality of straps, such as 6, 7 and 8. Also attached to the main frame 1, in correspondingly spaced relation to one another, are the vertical supporting members 2, 3, 4, 5, etc. For each of the vertical supporting members 2, 3, 4 and 5, shown on the near side of the structure, there is a similar and oppositely positioned vertical member on the other side of the main frame 1. One of these vertical members 67, matching with the member 5, is partially visible. At the end of the frame 1, a plurality of vertical supporting straps 26, 27, 28, etc. are secured. The purpose of these will be explained hereinafter.

The terminal bank or contact making portion of the structure comprises a plurality of stationary terminal members running in one direction and a plurality of movable terminal members arranged in intersecting relation with the stationary members and whereby movement of the movable terminal members brings about an engagement with the stationary members. The movable terminal members may have a crossing point with any number of sets of stationary terminals and some power means, such as an electromagnet, is provided at each intersection for causing engagement between the movable terminals and the stationary terminals at the corresponding intersecting points. In this manner, a set of movable terminals, representing for example one or a plurality of incoming circuits, may be moved into contact with any one of a plurality of sets of stationary terminals by operating the proper electromagnet, said stationary terminals representing one of a plurality of outgoing circuits.

Turning again to the drawing, the set of stationary terminals 39, 40, 41, 42, 43, 44, 45 and 46 are shown as consisting of horizontal bars arranged in a vertical column and supported rigidly by the vertical members 5 and 67 at either side of the frame. A second set of stationary terminals 55, 56, 57, 58, 59, 60, 61, 62 and 63 are supported in position by the vertical member 4 and a similar member on the other side of the frame. In like manner the structure consists of any desired number of sets of stationary terminals, two more of which are shown in the drawing. In depth, there may be as many individual stationary terminals in a set as the circuit conditions for which the switch is intended require.

Cooperating with these sets of stationary terminals are a plurality of sets of vertical layers of movable terminal strips, six being shown in the drawings. The first of these layers comprises a plurality of flat conducting strips 47, 48, 49, 50, 51, 52, 53 and 54 made of any suitable resilient material. Each of these conducting strips is secured to the supporting member 26 at the end of the frame and passed between two corresponding adjacent stationary terminals at each stationary set throughout the structure. Considering the uppermost of the movable terminals 47, this one is seen to be anchored to the member 26 and from thence it passes between the stationary terminals 39 and 40 of the first set, between terminals 55 and 56 of the second set and so on between the two uppermost terminals at each succeeding set of stationary terminals. The next vertical movable terminal 48 in like fashion is anchored to the member 26 and passes between the next two adjacent terminals at each position along the switch. The same is true for all other movable terminals in the layer. Considering the second vertical layer of movable terminals, this one is seen to comprise the flexible strips 31, 32, 33, 34, 35, 36,

37 and 38 which are secured to the second vertical member 27 of the frame and pass between the adjacent stationary terminals in a manner corresponding to the disposition of the movable terminals of the first layer. Each succeeding vertical layer of movable terminals in the structure is disposed in like fashion. Before proceeding further to describe the operating features of the switch, an explanation will be given of the formation of the movable terminal strips.

Fig. 5 shows a side view of the terminal strip 31. This strip at its extreme end has a short portion 68 stamped therefrom which, when the strip 31 is passed into a receiving slot in the support member 27, engages the surface of the support member to prevent longitudinal movement of said strip 31 and to anchor the same in place. At points along the length of the strip 31, corresponding to the positions at which the stationary terminal sets occur in the structure, portions of said strip are punched through and shaped to form the resilient contact elements 69. Referring to Figs. 2 and 3, it will be seen that the resilient contact elements 69 of the movable terminal strips are so arranged with respect to the stationary terminals 39, 40, 41, etc. that when the movable terminal strips are depressed, the resilient elements make engagement with the stationary terminals.

In order to impart the necessary motion to the movable terminal strips, a draw-bar of insulating material is provided for each set of movable terminals at each point in the switch where this set intersects a set of stationary terminals. The draw-bars for the several vertical layers of movable terminals at the first set of stationary terminals in the switch are identified by the characters 23, 20, 24, 21, 25 and 22, respectively. At the next set of stationary terminals 55, 56, 57, etc. a similar set of draw-bars is provided for operating the movable strips into engagement with said stationary terminals. Likewise, for each succeeding set of stationary terminals there is provided a set of these draw-bar members. One of the draw-bars 20 is shown in detail in Fig. 6 and consists of a flat strip of insulating material having one side formed with a series of equally spaced notches. When the draw-bar 20 is assembled in its normal position in the structure, the notches register with the spaces between the adjacent stationary terminals 39, 40, 41, 42, 43, 44, 45 and 46 allowing the movable terminal strips to pass through the registering openings in such manner that the resilient contact elements 69 are out of engagement with the stationary terminals, as shown in Fig. 2. The same is true of the other draw-bars, namely, that when in their normal positions, the movable terminal strips pass through the registering openings with the resilient spring contacts free from engagement with the cooperating stationary terminals.

When it is desired to establish a connection between a set of movable and a set of stationary terminals, the draw-bar individual to the points of intersection is operated longitudinally by an electromagnet. To economize in space in the structure, at each set of stationary terminals the draw-bars are arranged to be moved in opposite directions for establishing contact. Considering the first stage in the structure, the draw-bars 23, 24 and 25 are designed to be moved downwardly, while the alternate draw-bars 20, 21 and 22 are arranged to be moved upwardly. The magnets for operating half of the draw-bars are located on the top of the structure, three of these magnets 12, 13 and 14 being shown, and the magnets for operating the other half of the draw-bars are similarly located at the bottom of the structure. Considering the magnet 12, for example, which serves to move the draw-bar 20, the armature 16 thereof is attached to the bar 20 by a suitable joint connection 19. When the magnet is energized, the armature 16 is attracted against the tension of a spring 30 and moves the draw-bar 20 upwardly in the guide member 8. The upward movement of the draw-bar 20 carries the movable terminal strips 31, 32, 33, 34, etc. first to a point where the resilient contact elements of these respective strips make engagement with the cooperating stationary terminals. Continued movement of the draw-bar causes the flexing of the resilient contact elements to provide a good electrical contact. When the electromagnet 12 is later deenergized at the time it is desired to disestablish the connection, the spring 30 retracts the armature and forces the draw-bar 20 downwardly in its guides, carrying the movable terminal strips back to their normal positions and disengaging the contact elements from the stationary terminals.

If the electromagnet actuating the draw-bar 23, which as mentioned is located at the opposite side of the structure, is energized, its armature causes the said draw-bar 23 to be moved downwardly. The first downward movement of the bar 23 carries the movable terminal strips 47, 48, 49, etc. to a point where their contact elements make engagement with the stationary terminals 40, 41, 42, etc., while continued movement thereof causes the resilient elements to flex insuring a firm contact as shown in Fig. 3. The deenergization of the electromagnet controlling bar 23 permits the bar to restore to its normal position under the influence of a retractile spring to disestablish the connection.

It is, of course, desirable that when a set of flexible contacts are carried into engage-

ment with a particular set of stationary terminals other contacts on the same terminal strip should be free from engagement with any other set of stationary terminals. The reason for this is that it is necessary in many cases that one circuit should never be connected to more than one other circuit simultaneously. Therefore, when, for example, the movable terminal strips 47, 48, 49, 50, etc., have their contacts in engagement with any particular set of stationary terminals 39, 40, 41, 42, etc., other contacts on the same strips should be free from contact with any other set of stationary terminals in the structure. Due to the fact that each movable terminal strip passes throughout the entire length of the structure and is operatively associated with all sets of stationary terminals, a considerable amount of flexibility is necessary for the movable terminal strip. This must be in order to enable the said movable strip to be displaced by any of the other electromagnets and draw-bars at the different sets of stationary terminals in the structure. The danger, therefore, arises that when a certain draw-bar is actuated to move the movable terminal strips at one point, this motion is likely to be felt at the adjacent set of stationary terminals sufficiently to cause engagement with said second set of stationary terminals. To avoid this undersirable likelihood, the construction of the switch is such that a flexible terminal strip is designed to be moved in one direction to make contact with the stationary terminal of one set and in the opposite direction to make contact with the corresponding stationary terminal at the next set and so on alternately throughout the different sets of stationary terminals. This end is acquired by punching the resilient contact elements 69 from opposite sides of the strip as shown in Fig. 5. Hence, at the first stage the draw-bar is moved in one direction, at the next stage in the opposite direction, at the third stage in the first direction, at the fourth stage in the second direction, and so on. Considering the effect of this arrangement, when for example, the draw-bar 23 is moved downwardly it carries the movable terminal strip 47 down against the stationary terminal 40 at the first set of stationary terminals. This downward movement of the strip 47 is felt at the second set of stationary terminals, but the movement being downward, the strip 47 only presses against the edge of the insulating draw-bar 64 and cannot be carried into contact with either of the adjacent stationary terminals 55 or 56.

Consideration will now be given of the action occurring between the contact elements and stationary terminals during the period of engagement, whereby a good electrical contact is insured. The normal position of the movable terminal strip and the operating draw-bar is shown in Fig. 2. The resilient contact 69 by means of its spring action rests against the lower edge of the notch in the draw-bar, while the other portion of the movable terminal rests against the upper edge of the notch in the draw-bar. The movable terminal 47, for example, when in its normal position is held by the draw-bar 23 out of physical contact with the stationary terminal 39 and the resilient contact 69 depending from the movable terminal 47 is held by the draw-bar out of contact with the adjacent stationary terminal 40. When the switch is operated and the draw-bar 23 moves downwardly, it first carries the resilient contact element 69 into engagement with the stationary terminal 40. The terminal 40, being immovable, arrests the downward movement of the element 69, so that the continued movement of the movable terminal 47 under the pressure of the draw-bar 23 causes said resilient element to flex to a relative position such as that shown in Fig. 3. Inasmuch as the movable element 47 is substantially fixed with regard to motion in a longitudinal direction and since the resilient element 69 is integrally secured by the terminal 47 against a similar lateral movement, said element undergoes a movement of rotation about its point of attachment as a result of the flexing action. As will be obvious, this causes the resilient element to rub or slide over the surface of the stationary terminal 40 in a direction to the right as viewed in the figure. This rubbing movement serves to polish the contacting surfaces whereby a clean electrical contact is secured.

Upon release of the draw-bar 23 and its restoration in the opposite direction by one of the springs such as spring 30, first the resilient element 69 becomes unflexed as pressure is withdrawn and in so doing undergoes relative or rubbing movement with respect to the stationary terminal 40 in the opposite direction. After the unflexing action is terminated during the upward movement of the draw-bar 23, the resilient element 69 disengages the stationary terminal 40 and the different parts resume their normal relative arrangement as shown in Fig. 2.

A modification of the contacting elements for securing the desired rubbing action between the engaging parts is shown in Fig. 4. Here the resilient element 70 is turned over at the contacting end sharply so that a chisel edge is presented to the flat surface of the stationary terminal 71, disclosed as shown. The action in this case is substantially the same except that the contacting edge of the element 70, being sharp has a more pronounced cutting or rubbing action

upon the surface of the stationary terminal.

What is claimed is:

1. In a switching device, a plurality of stationary terminals, a plurality of movable terminals each carrying a plurality of resilient contact elements arranged in cooperative relation respectively with said stationary terminals, means for moving a portion of a movable terminal to cause one of the contact elements thereon to move with a flexing action into engagement with a particular stationary terminal, the flexing action of the contact element causing a relative movement between such contact and said particular stationary terminal.

2. In a switching device, a plurality of stationary terminals, a plurality of movable terminals each carrying a plurality of resilient contact elements arranged in cooperative relation respectively with said stationary terminals, means for moving a particular portion of a movable terminal toward one of said stationary terminals to cause but one of the contact elements on said movable terminal to move with a flexing action into engagement with said one of said stationary terminals, the flexing action of said contact element causing a relative movement between such contact and said one of said stationary terminals.

3. In a switching device, a plurality of stationary terminals, a movable terminal member having a plurality of integral resilient contact elements punched therefrom and arranged in cooperative relation respectively with said stationary terminals, and means for moving one of said elements toward a stationary terminal with a flexing action, the flexing action of the resilient element causing a relative movement between such element and the stationary terminal.

4. In a switching device, a plurality of stationary terminals, a flat movable terminal strip having a plurality of integral resilient contact elements punched therefrom and projecting in cooperative relation respectively with said stationary terminals, and means for moving one of said elements with a flexing action into engagement with one of the stationary terminals, the flexing action of the resilient element causing a relative movement between such element and the stationary terminal.

5. In a switching device, a plurality of stationary terminals, a plurality of movable terminals each carrying resilient contact elements at different portions thereof, means for moving similar portions of different movable terminals to cause the corresponding contact elements to engage and disengage a plurality of different stationary terminals with a flexing action, the flexing action of the contact elements causing a relative movement between said elements and the stationary terminals.

6. In a switching device, a plurality of stationary terminals, a movable terminal having a plurality of resilient contact elements integral therewith and arranged in cooperative relation respectively with said stationary terminals, and means for moving any desired portion of the movable terminal in a plurality of directions with a flexing action of a resilient contact element, the flexing action of the resilient element causing it to move over the surface of said stationary terminal while in contact therewith.

7. In a switching device, a plurality of stationary terminals, a movable terminal having a plurality of resilient contact elements integral therewith and arranged in cooperative relation respectively with said stationary terminals, and means for moving different portions of the movable terminal in opposite directions with a flexing action of one of the resilient contact elements, the flexing action of the resilient element causing it to move over the surface of said stationary terminal while in contact therewith.

In witness whereof, I hereunto subscribe my name this 4th day of October, A. D. 1921.

HAROLD W. GOFF.