June 30, 1925. 1,543,825

H. F. DOBBIN

SWITCHING DEVICE

Filed Oct. 6, 1921

Fig. 1.

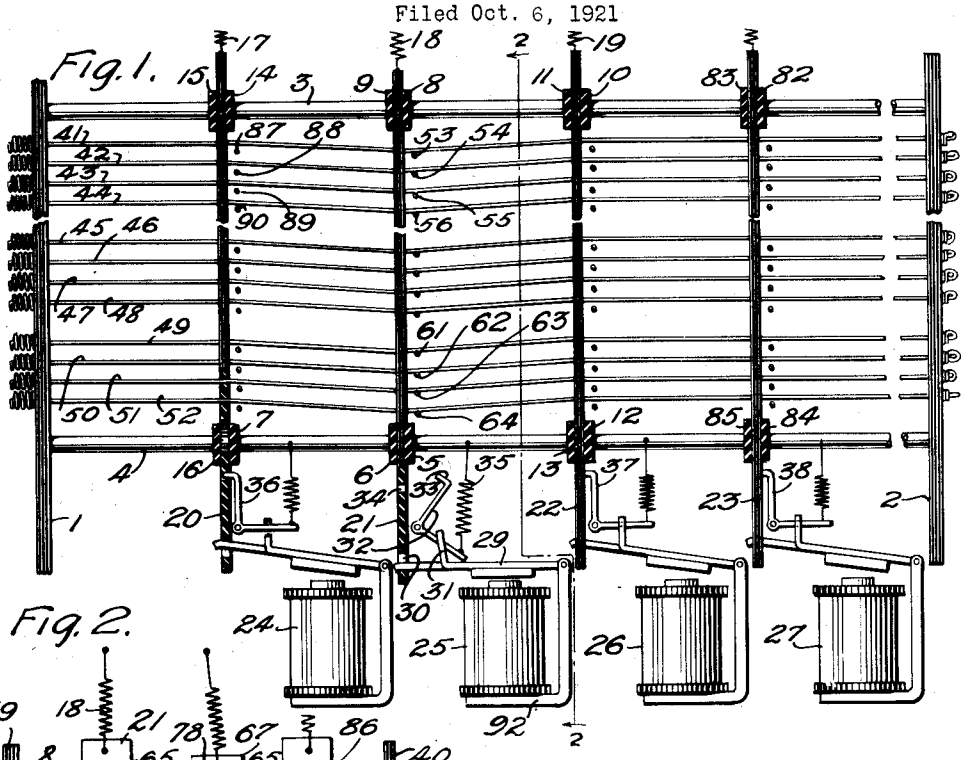


Fig. 2.

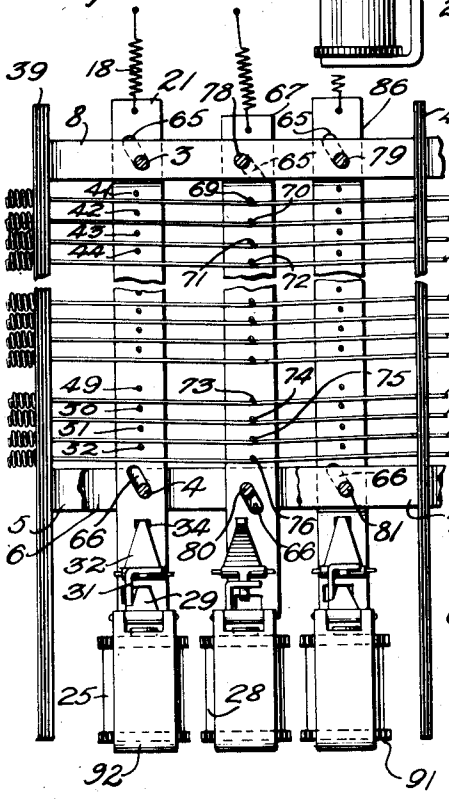
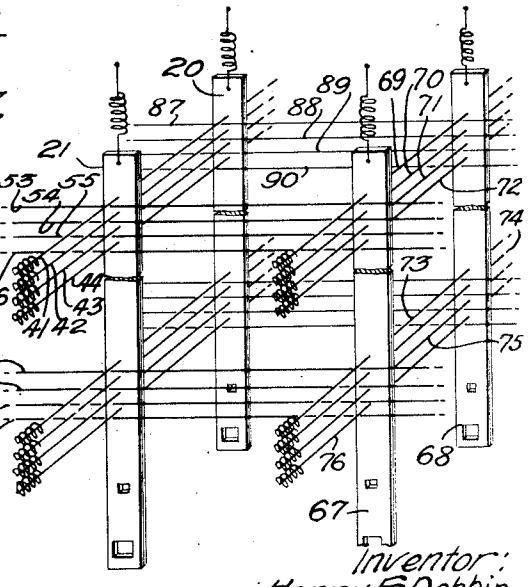


Fig. 3.



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UNITED STATES PATENT OFFICE.

HENRY F. DOBBIN, OF NEW YORK, N. Y., ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SWITCHING DEVICE.

Application filed October 6, 1921. Serial No. 505,715.

To all whom it may concern:

Be it known that I, HENRY F. DOBBIN, 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 apparatus used for the establishment of electric circuit connections and particularly to switching devices such as those employed in telephone systems where the cooperating terminal elements are arranged to close circuits at a multiplicity of points.

It is especially true in telephone systems, due to the requisite flexibility in the connection of circuits of one kind to circuits of another kind, that the requirement frequetly arises for an arrangement in which any one of a plurality of incoming lines or circuits, for example, may be connected to any one of a plurality of outgoing lines. Various types of switching devices have been employed for accomplishing this purpose. One form of switching apparatus is the ordinary selector having movable brushes for connecting the incoming circuit to any one of the outgoing circuits. The outgoing circuits, being multipled to several switches, are accessible by any of a plurality of incoming circuits. Another species of connecting device is the crossbar switch in which the incoming circuits are connected to metallic bars arranged in an intersecting relation to a plurality of other bars, each connected to an outgoing circuit. The incoming line bars each have contact making elements for each outgoing line bar arranged in cooperative relation to similar elements for said outgoing line bars. By operating any two bars the circuits represented are connected together.

In both of these types, which in their general classification embrace the majority of telephone switching devices, the same condition is true, namely, that the electrical connection between the conductors of the incoming circuit and the conductors of the outgoing circuit is made through the agency of intermediary elements, such as brushes, terminals, bars or other devices. These intermediary elements, which are often complicated in their movements and in their cooperation with each other, serve to electrically join the conductors whereby the incoming circuit is extended to the proper outgoing circuit.

With the foregoing facts in mind, it is one of the objects of the present invention to provide for the connection of incoming circuit conductors to outgoing circuit conductors in a simple and efficient manner without the use of complicated intermediate circuit making elements.

A feature of the invention relates to the provision of an electromagnetic switching mechanism in which a plurality of sets of movable conducting elements, representing respective incoming circuits, are each arranged in cooperative relation to a plurality of sets of passive conducting elements, representing respective outgoing circuits, and in which an electromagnet is provided at each point of cooperation between a set of movable elements and a set of passive elements, each of said magnets serving to move the corresponding movable element into contact with the corresponding passive element.

Another feature of the invention relates to the provision of a switching mechanism in which a plurality of movable bare wire conductors, each representing an incoming circuit, are each arranged in intersecting relation to each of a plurality of passive bare wire conductors, each representing an outgoing circuit, and in which magnets are provided, one at each point of intersection, each magnet serving to move the corresponding movable bare wire bodily into contact with the corresponding passive bare wire to interconnect the incoming and outgoing circuits represented.

For operating the movable wires or conductors into engagement with the passive wires or conductors, a plurality of magnets are utilized as above explained. Each magnet may be equipped with a movable bar or some similar operating member to which the movable conductors are attached. The magnet on energizing actuates the operating member to carry the movable conductors into contact with the passive conductors. Due to the freedom of movement allowed the movable conductors, there may be danger that the displacement of a movable conductor caused by one of the operating members would be sufficient to bring about an in-

advertent contact between such movable conductor and the passive conductor at one of the other points of intersection, particularly at the adjacent point.

Accordingly it is another object of the invention to insure against a double connection of a movable conducting element with the passive conducting elements by locking all operating members except the one in use.

Another feature of the invention is the provision of means for normally locking each movable element operating member against displacement and for unlocking any of such members upon the initial actuation of the corresponding magnet.

A still further feature relates to a means for controlling the motion of the operating members or bars in such manner that the movable contact elements governed by said members are caused to rub over the cooperating passive elements during contact engagement.

Another feature relates to an arrangement for attaching the contact elements to the supporting structure whereby the necessary resiliency is acquired.

These and other advantages of applicant's novel switching structure will become more clearly understood from the following detailed description and from the appended claims:

Referring to the drawing which constitutes a part of this application Fig. 1 is a side view, partly in section, of one embodiment of a switching device suitable for illustrating the invention.

Fig. 2 is an end view taken along the line 2—2 in Fig. 1 showing a part of the elements in section and others in plan.

Fig. 3 is a perspective view illustrating schematically the manner in which circuit connections are made by switching mechanism of this character.

In order to set forth the principles of this invention it has been chosen to illustrate the same as embodied in a switching device of the character in which bare wires are arranged in intersecting relation with one another to constitute the terminals. Electromagnets are provided at the intersecting points with suitable actuating devices for moving the wires into contact with one another and with mechanical locking arrangements for preventing interference and double connections. In its broader aspect, however, the said invention is applicable to a wide variety of switching mechanisms. The relative disposition of the conducting elements may be widely modified to suit the character of the structure, all of which variations come within the scope of the invention.

Considering Figs. 1 and 2, particularly, a description will now be given of the construction and operation of applicant's novel switching arrangement. The supporting structure of the switch mechanism consists of two opposite end plates 1 and 2 made preferably of some insulating material. These plates are spaced and held secure by means of a plurality of rods 3, 78, 79, etc., extending across the top of the switch. Similarly, at the bottom of the mechanism the end plates 1 and 2 are likewise held by a second set of spacing rods 4, 80, 81, etc. In the drawing only three rods at the top and three at the bottom are shown. However, there will be as many of these rods across the width of the mechanism as may be necessary to meet the capacity or other requirements.

In addition to the end plates 1 and 2 there are also provided two side plates 39 and 40 also of some insulating material. The side plates 39 and 40 extend in parallel relation to the spacing rods and may be of solid material or skeletonized, if desirable, and serve as supports for a plurality of cross members. At the top there are shown (Fig. 1) four sets of these cross members 82—83, 10—11, 8—9 and 14—15. At the bottom of the switch there are shown the four corresponding sets of cross members 84—85, 12—13, 5—6 and 7—16. Although not essential, these cross members, which are attached in any convenient manner to the side plates 39 and 40, may also be of insulating material.

The terminals of the switching mechanism consist of plain bare wires, some of which are passive or relatively stantionary, while others are bodily movable and are so arranged in cooperative relation to the passive wires that such movement carries them into physical contact therewith. Considering the passive terminals or conducting elements, as they may be called, Fig. 2 illustrates one set of these. Such set comprises twelve wires 53, 54, 55, 56–63, 64. They are passed through holes in the side plates as illustrated in Fig. 2 and are secured in any convenient method, being drawn to a considerable degree of tautness, yet slightly yielding when encountered by the conducting movable elements through the spring formation of their fixed ends as shown at the left in Fig. 2.

The movable conducting elements consist of a plurality of bare wires extending between the end plates 1 and 2 to which they are secured and disposed in intersecting relation at right angles to the several sets of passive contact elements. One set of movable elements is shown in Fig. 1 consisting of bare wires 41, 42, 43, 44–51, 52 placed in a vertical plane and secured to end plates 1 and 2 as illustrated. These movable elements are not drawn so taut as are the cooperating passive elements, but are permitted to participate in a considerable amount of displacement when actuated upon at any point throughout their length through the spring

formation of one of their fixed ends, as illustrated at the left in Fig. 1. Fig. 1 shows only four sets of passive contact elements, while Fig. 2 illustrates a structure having three sets of movable contact elements. Obviously, however, any suitable number of both movable and passive elements may be provided.

At each point of intersection or cooperation between a set of movable contact elements and a set of stationary elements there is provided an operating member shown in the form of a draw-bar for bodily moving the movable elements into physical contact with the stationary elements at that point. For the set of movable elements shown in Fig. 1 there are provided four such draw-bars 20, 21, 22 and 23, each located in proximity to the point of intersection of the successive sets of passive contact elements. Looking at Fig. 2, the draw-bar 21 is shown at the extreme left of the structure. To the right of this draw-bar there are shown two other similar members 67 and 86. The member 67 lies in the same plane with member 21 thereby serving the same set of stationary contact elements 53, 54, 55, etc., while the draw-bar 86 is located in some other plane such as the plane containing draw-bar 20, shown in side view in Fig. 1. These draw-bars are made of insulating material and are supported on the spacing rods extending between the end plates of the structure and are guided in their movement between the cross members which extend from one side plate 39 to the other side plate 40. Paying particular attention to the draw-bar 21, it will be noted that said bar is provided with two diagonally disposed elongated apertures 65 and 66. The rods 3 and 4 which support the draw-bar 21 pass through the apertures 65 and 66 respectively. At the top a retractile spring 18 attached to the end of the draw-bar normally holds said bar in its extreme upper position with the lower ends of the elongated apertures 65 and 66 resting against the rods 3 and 4 which limit the upward movement of the bar. The draw-bar 21 in Fig. 2 is shown to be in its normal position.

Each draw-bar is punched or drilled with a series of holes through which the movable contact wires 41, 42, 43, 44, etc., pass. After passing through each draw-bar, each of the said movable wires then crosses a corresponding cooperating passive wire, being separated thereform by a substantial distance when the draw-bar is in its normal position. By operating one of the draw-bars the set of movable contact elements is displaced bodily and moved into physical contact with the cooperating passive contact elements. In Fig. 1 the draw-bar 21 is illustrated in its operated position, drawn downwardly against the tension of spring 18 carrying the movable conductors into contact with the stationary conductors 53, 54, 55, etc.

The electromagnets are employed for imparting the necessary motion to the draw-bars. There is one magnet for each bar, magnets 24, 25, 26, 27, 28, and 91 being assigned respectively to draw-bars 20, 21, 22, 23, 67 and 86. These magnets and their attachments to the respective draw-bars are all the same so that a description of one will serve as an explanation for the rest. Referring to magnet 25 allotted to the draw-bar 21, this magnet is suitably mounted on a support 92 to which the armature 29 is pivoted. The extreme opposite end of the armature 29 projects through a hole 30 in the lower end of the draw-bar 21. To some stationary part of the structure there is pivoted a bell crank lever 32, one arm of which is overturned as shown at 33 to form a finger which normally rests in a hole 34 in the depending portion of the draw-bar 21. To the other arm of the lever 32 a retractile spring 36 is attached, the opposite end of which spring is secured to the stationary rod 4. The armature 29 of the magnet 25 carries an upturned portion 31, the end of which extends across over the top of one arm of the bell crank lever. This arrangement is clearly shown in Fig. 2. Normally the retractile spring 35 draws the lever 32 upwardly about its pivot so that the projecting finger 33 enters the hole 34 in the draw-bar 21. The draw-bar 21 being also moved upwardly to its extreme position as shown in Fig. 2 by the spring 18 carries the armature 29 upwardly to its extreme position whereby the upturned portion 31 moves away from the bell crank lever 32, permitting the same to enter the hole 34. The normal position of these elements is shown in connection with the magnet 24, for example, which is deenergized, the bell crank lever 36 having its projecting finger extending into the hole in the draw-bar 20. Also the draw-bars 22 and 23 are shown in their normal positions with the magnets 26 and 27 deenergized and the levers 37 and 38 engaging the holes in the respective draw-bars. The function of the levers 36, 32, 37 and 38 is to mechanically lock the corresponding draw-bars against downward movement. The reason for locking the draw-bars at all times except when one is taken for use will be explained in connection with a description of the manner in which the switching mechanism is operated to effect the interconnection of an incoming and an outgoing circuit.

Assume that the structure is in its normal position, all draw-bars being at their extreme upward positions. By some suitable circuit arrangement the magnet 25 is selected and energized. The selection of this magnet determines that the particular circuit to be established necessitates the con-

nection of the movable contact elements 41, 42, 43, etc., with the passive set of contact elements 53, 54, 55, etc. The energization of magnet 25 causes the same to attract its armature 29. The first downward motion of the armature 29 carries the same from the top of the slot 30 to the bottom thereof, it being observed that the slot is considerably deeper than the thickness of the armature. Consequently, this first motion of the armature 29 takes place without any effect whatever upon the draw-bar 29. This downward movement of the armature 29, however, does cause the upturned member 31 to engage the bell crank lever 32, rotating it about its pivot against the tension of spring 35. The rotation of the lever 32 withdraws the projecting finger 33 from the hole 34 whereby the draw-bar 21 is unlocked. Continued movement of the armature 29 toward the pole piece of the magnet causes the tip end of said armature to engage the bottom of the hole 30 and to draw the bar 21 downwardly against the spring 18. The downward movement of the bar 21 bodily carries the movable conductors 41, 42, 43, etc., into physical contact with the cooperating passive conductors 53, 54, 55, etc., thus establishing the desired connection. So long as the connection is required the magnet 25 is maintained energized and when the time arrives that such connection is no longer needed the circuit of the magnet is opened and the armature 29 is withdrawn by the action of springs 18 and 35, the bell crank lever 32 again locking the draw-bar in position.

It will be noted that the movable conductors 41, 42, 43, 44, etc. pass on the same side of, namely, above, all sets of stationary intersecting conductors. If the draw-bars were free to move, only being restrained by the tension of the retractile springs, there would be danger of double connections due to the movement imparted from one draw-bar to another. That is to say, if the draw-bar 20 were only held by means of its spring 17 and the draw-bar 21 were moved downwardly by its operating magnet, the displacement of the movable conductors would probably urge in the draw-bar 20 against the tension of spring 17 to a position where the movable conductors might engage the stationary conductors 87, 88, 89, 90, etc. For this reason the draw-bars are all locked mechanically as has been explained and remain locked until their individual magnets are operated. With the adjacent draw-bars 20 and 22 firmly locked in position, the displacement of the movable conductors by the operating draw-bar 21 cannot bring them into engagement with the passive conductors at either of the positions represented by the said adjacent draw-bars.

Consideration will next be given to another feature of the invention by means of which a sliding or rubbing action is attained between the coacting sets of stationary and movable conductors, the purpose being to maintain clean electrical contacts. Regarding Fig. 2, especially, this feature is attained by means of the diagonal apertures 65 and 66 hereinbefore mentioned. Whenever a draw-bar is moved downwardly by its operating magnet, the diagonal apertures coact with the stationary supporting rods in such manner that the draw-bar is displaced laterally during its downward movement. A substantial portion of this lateral displacement may take place following the engagement of the movable conductors with the stationary conductors. In other words, the first movement of the draw-bar carries the movable conductors into contact with the stationary conductors, while the greater part of the movement which follows causes the movable conductors to rub sideways over the stationary conductors due to the lateral action of the draw-bar. Conversely, upon release of the draw-bar the first effect is lateral motion in the opposite direction, rubbing the conductors over each other until the latter part of the return stroke, at which time the said conductors are disengaged.

In Fig. 3, a diagrammatic illustration is given of two sets of movable conducting elements and two sets of passive conducting elements and the draw-bars located at the points of intersection for effecting connection. The movable conductors 41, 42, 43, etc. of the first set are shown in intersecting relation with one set of passive conductors 53, 54, 55, 56–63, 64 and in intersecting relation with a second set of passive conductors 87, 88, 89, etc. The draw-bar 21 is located at the point of intersection between the movable conductors and the first set of passive conductors, while the draw-bar 20 is provided at the point of intersection between the movable conductors and the second set of passive conductors. Also, there is shown in this figure a second set of movable conductors 69, 70, 71, 72–75, 76, arranged in cooperating intersecting relation with said two sets of passive conductors. The draw-bar 67 located at the point of intersection serves to move the movable conductors into contact with the first set of passive conductors 53, 54, 55, etc. The draw-bar 68 serves to move the movable conductors 69, 70, 71, 72, etc. into engagement with the second set of passive conductors 87, 88, 89, etc. This principle of having a set of movable conducting elements arranged in cooperative relation with a plurality of sets of passive conducting elements and of having the passive conducting elements serve a plurality of sets of such movable conducting elements may be carried as far as desirable, the number of points of coopera-

tion depending upon the nature of the circuit conditions for which the switch is required.

As shown in these figures a single set of movable and a single set of corresponding passive conductors comprise twelve individual conductors in number. These are shown as subdivided into groups of four which might indicate that each group of four represented a separate circuit such as an incoming line or an incoming trunk, while the cooperating group of four conductors might represent a corresponding outgoing line or trunk. Obviously, the subdivision of the conductors of a set is entirely arbitrary and depends only upon the conditions to be met.

What is claimed is:

1. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements, each movable element having a separate point of cooperation with each of said passive elements, and a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of any one of said magnets serving to move the corresponding movable element into contact with the corresponding passive element.

2. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements, each movable element having a separate point of cooperation with each of said passive elements, and a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of any one of said magnets serving to move bodily the corresponding movable element into contact with the corresponding passive element.

3. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements supported at either end, each movable element having a point of cooperation with each of said passive elements, and a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of one of said magnets serving to displace the corresponding movable element laterally, carrying it into contact with the corresponding passive element.

4. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements arranged under tension, each movable element having a point of cooperation with each of said passive elements, and a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of one of said magnets serving to move the corresponding movable element against its tension into contact with the corresponding passive element.

5. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements, each supported at a plurality of points, each movable element having a point of cooperation with each of said passive elements, and a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of one of said magnets serving to move the corresponding movable element between two of said supporting points into contact with the corresponding passive element.

6. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements arranged under tension, each movable element having a point of cooperation with each of said passive elements, a plurality of magnets, one for each point of cooperation between the movable and passive elements, the operation of one of said magnets serving to move the corresponding movable element into contact with the corresponding passive element, and means assisted by the tension of said movable element for moving the same out of contact with the passive element.

7. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements, each movable element having a point of cooperation with each of said passive elements, a plurality of operating members, one for each point of cooperation between the movable and passive elements, said movable elements being attached to the operating members, and a plurality of magnets, one for each operating member, the operation of one of said magnets serving to actuate its operating member to move the corresponding movable element into contact with the corresponding passive element.

8. In a switching device, a plurality of passive conducting elements, a plurality of movable conducting elements, each movable element having a point of cooperation with each of said passive elements, a plurality of slidable drawbars, one for each point of cooperation between the movable and passive elements, and a plurality of magnets, one for each drawbar, the operation of one of said magnets serving to actuate the drawbar longitudinally to move the corresponding movable element into contact with the corresponding passive element.

9. In a switching device, a plurality of passive bare wire conductors, a plurality of movable bare wire conductors, each movable wire having a point of cooperation with each of said passive wires, and a plurality of magnets, one for each point of cooperation between the movable and passive wires, the operation of one of said magnets serving to move the corresponding movable wire into contact with the corresponding passive wire.

10. In a switching device, a plurality of sets of passive bare wire conductors, a plu-

rality of sets of movable bare wire conductors, each set of movable wires having a point of cooperation with each of said sets of passive wires, and a plurality of magnets, one for each point of cooperation, the operation of one of said magnets serving to move the corresponding set of movable wires into contact with the corresponding set of passive wires.

11. In a switching device, a plurality of passive bare wire conductors, a plurality of movable bare wire conductors, each movable conductor having a point of proximity with each of said passive wires, and a plurality of magnets, one for each point of proximity, the operation of one of said magnets serving to move the corresponding movable wire into contact with the corresponding passive wire.

12. In a switching device, a plurality of passive bare wire conductors, a plurality of movable bare wire conductors, each movable wire having a point of intersection with each of said passive wires, and a plurality of magnets one for each point of intersection, the operation of any one of said magnets serving to move the corresponding movable wire into contact with the corresponding passive wire.

13. In a switching device, a plurality of passive conducting elements, a movable conducting element having a point of cooperation with each of the passive elements, a plurality of operating members, one for each point of cooperation, a plurality of magnets, one for each operating member, each magnet serving to actuate its operating member to move the movable element into contact with the corresponding passive element, and means for locking said operating members in normal position.

14. In a switching device, a plurality of passive conducting elements, a movable conducting element having a point of cooperation with each of the passive elements, a plurality of operating members, one for each point of cooperation, a plurality of magnets, one for each operating member, each magnet serving to actuate its operating member to move the movable element into contact with the corresponding passive element, means for locking said operating members, and means controlled by each magnet for unlocking its operating member.

15. In a switching device, a plurality of passive conducting elements, a movable conducting element having a point of cooperation with each of the passive elements, a plurality of operating members, one for each point of cooperation, means for locking each member in a normal position, and a plurality of magnets, one for each operating member, each magnet serving to unlock its operating member and then to actuate said member to move the movable element into contact with the corresponding passive element.

16. In a switching device, a frame, a passive conducting element, an operating bar supported by said frame, a movable conducting element supported by said bar and arranged for cooperation with the passive element, means for actuating the bar longitudinally for moving the movable element into contact with the passive element, and means for moving said bar laterally to cause the movable element to rub over the passive element while in contact therewith.

17. In a switching device, a frame, a passive conducting element, an operating member supported by said frame, a movable conducting element supported by said member and arranged for cooperation with the passive element, an electromagnet for actuating the operating member in the direction of its length for moving the movable element into contact with the passive element, and means acting upon said member during its lengthwise movement for displacing it laterally to cause the movable element to rub over the passive element while in contact therewith.

18. In a switching device, a passive conducting element, an operating bar having diagonal slots therein, supporting members passing through said slots, a movable conducting element supported by said bar and arranged for cooperation with the passive element, and means for actuating said bar longitudinally for moving the movable element into contact with the passive element, said supporting members acting upon said diagonal slots during such movement to displace said bar laterally to cause the movable element to rub over the passive element while in contact therewith.

19. In a switching device, a frame, a plurality of conducting elements arranged in contact making relation with each other, one end of each conducting element being fashioned to form a resilient member which cooperates with the frame to resiliently secure said element therein, and electromagnetic means to move one of the elements into contact with another.

20. In a switching device, a frame, a plurality of wires arranged in contact making relation with each other, each wire having one of its ends fashioned to form a spiral spring which cooperates with the frame to resiliently attach such wire thereto, and electromagnetic means to move one of the wires into engagement with another.

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

HENRY F. DOBBIN.