

**Sept. 17, 1940.**

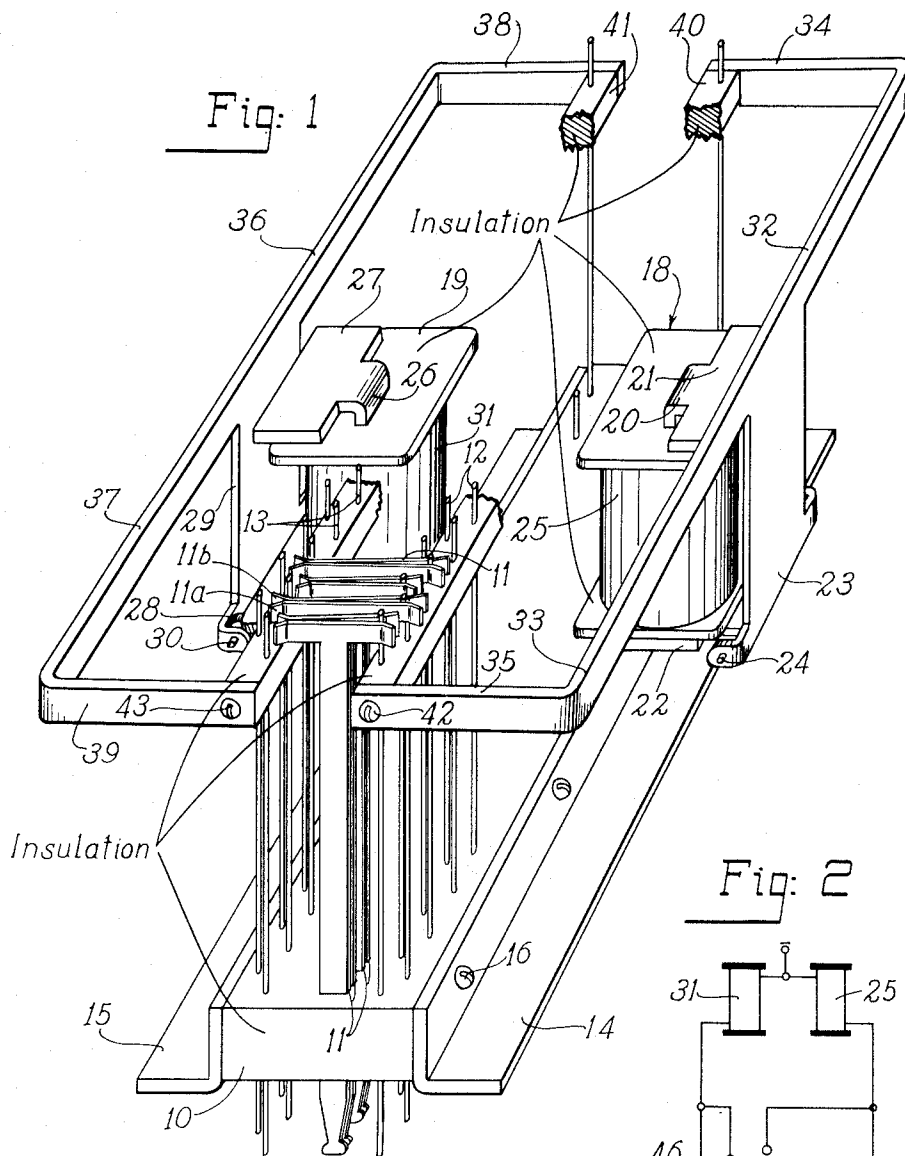
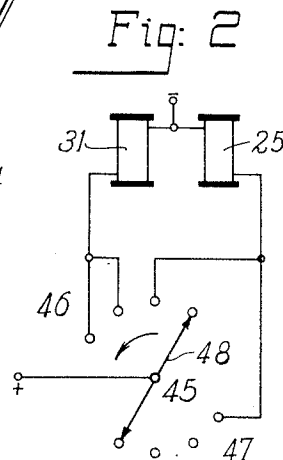
C. E. LOMAX ET AL

**2,214,907**

## SWITCHING APPARATUS

Filed Dec. 30, 1938

2 Sheets-Sheet 1



INVENTORS  
Clarence E. Lomax and  
George T. Martin  
 BY *Davis, Lindsey, Smith & Shotts*  
 ATTORNEYS

Sept. 17, 1940.

C. E. LOMAX ET AL

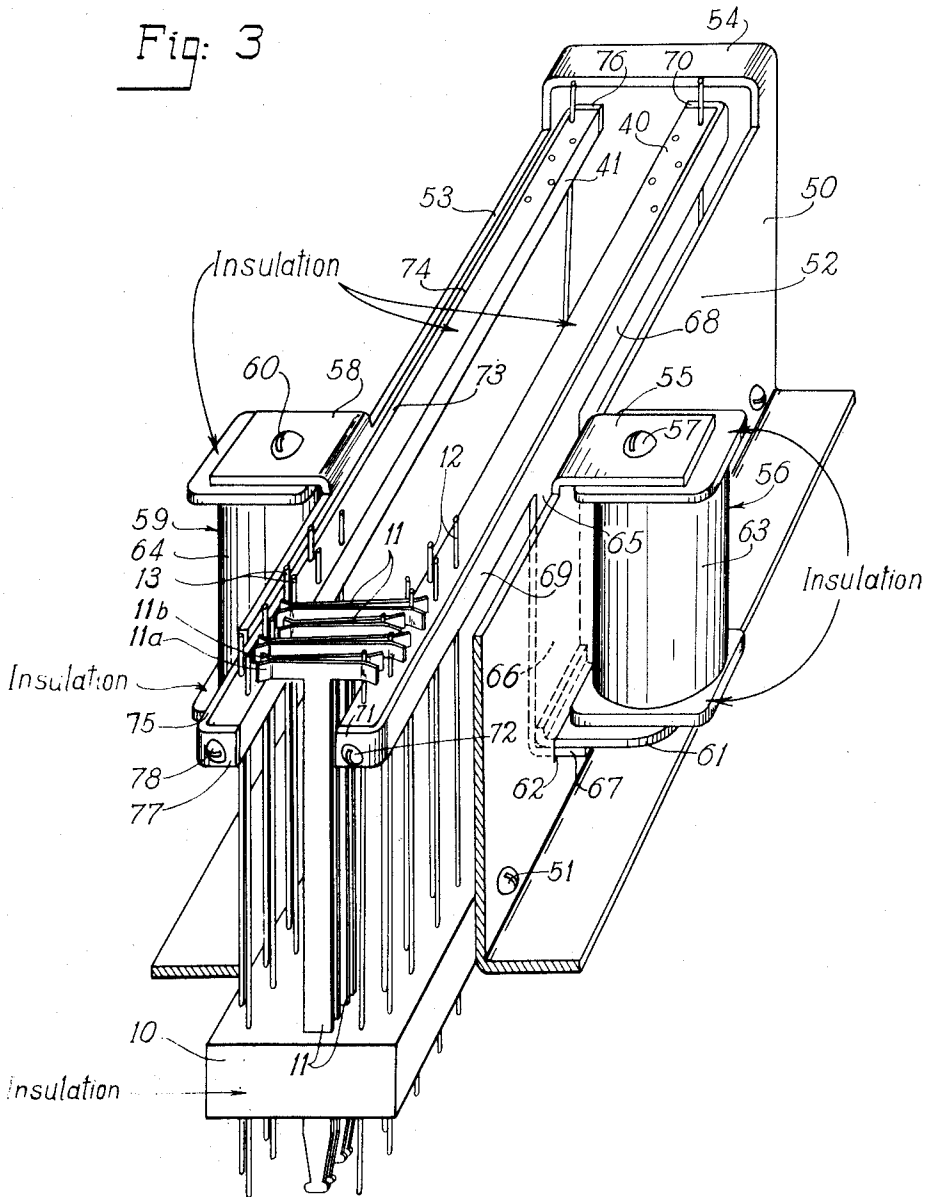
2,214,907

SWITCHING APPARATUS

Filed Dec. 30, 1938

2 Sheets-Sheet 2

Fig. 3



INVENTORS  
Clarence E. Lomax and  
George T. Martin  
BY  
Davis, Lindsey, Smith & Shonta  
ATTORNEYS

## UNITED STATES PATENT OFFICE

2,214,907

## SWITCHING APPARATUS

Clarence E. Lomax, Oak Park, and George T. Martin, Chicago, Ill., assignors to Associated Electric Laboratories, Inc., Chicago, Ill., a corporation of Delaware

Application December 30, 1938, Serial No. 248,546

7 Claims. (Cl. 179—27.54)

The present invention relates to switching apparatus and more particularly to improvements in switching apparatus suitable for use in automatic telephone exchanges.

In a telephone system one of the major items of cost, in regard to the construction and installation of any automatic telephone exchange, is that of connecting the large number of groups of lines to the many switches and the construction of the multiples between the switches. Usually this construction work is done manually, the conductors in a particular portion of the multiple and the conductors in a particular group of the lines being soldered to the respective terminals of a corresponding group of the switches. This item of cost may be materially reduced by minimizing the number of terminals included in each switch provided the number of groups of lines and the number of lines in each group to which the switch has access is not reduced rendering it necessary to employ a larger number of switches in the system.

It is an object of the present invention to provide improved switching apparatus having access to a predetermined number of groups of lines, each group of lines including a predetermined number of lines, which switching apparatus is so constructed and arranged that a minimum number of terminals are required therein in order to terminate the respective lines in the respective groups of lines.

Another object of the invention is to provide improved switching apparatus having access to a number of groups of lines and selectively operative to connect together selectively corresponding lines in two of the groups of lines, and to connect together simultaneously corresponding lines in each of the number of groups of lines.

In the improved switching apparatus there may be incorporated different forms of switching unit, two forms being illustrated and described in detail hereinafter. In each form of the switching unit there are provided a set of stationary contacts arranged in a longitudinally extending row and first and second sets of movable contacts arranged in two longitudinally extending and substantially parallel rows disposed on opposite sides of the set of stationary contacts. More particularly, the set of stationary contacts comprises a number of individual stationary contacts, each being of substantially T-shape and having a stem portion and a head portion providing two wiper portions; and each of the sets of movable conductors comprises a number of individual conductors, each having a flexible shank por-

tion and a contact portion. The contact portions of corresponding conductors in each of the sets of conductors are arranged in spaced relation with the respective wiper portions of corresponding stationary contacts in the set of stationary contacts. Also, there is provided a longitudinally extending insulating plate for mounting the stems of the stationary contacts in the set of stationary contacts at points remote from the head portions thereof and for mounting the shank portions of the conductors in each of the sets of conductors at points remote from the contact portions thereof. Furthermore, two insulating bars are individually associated with the respective conductors in the respective sets of conductors and motor means comprising two electromagnetic devices individually associated with the insulating bars are provided which are selectively operative to move selectively and simultaneously the insulating bars in a lateral direction. When the insulating bar individually associated with the first set of conductors is moved laterally, the shank portions of the conductors in this set of conductors are flexed laterally, thereby to cause the contact portions thereof to engage the associated wiper portions of the respective stationary contacts in the set of stationary contacts; and when the insulating bar individually associated with the second set of conductors is moved laterally, the shank portions of the conductors in this set of conductors are flexed laterally, thereby to cause the corresponding contact portions thereof to engage the associated wiper portions of the respective stationary contacts in the set of stationary contacts. Also, a circuit network is provided for the purpose of selectively controlling the energization of the electromagnetic devices in the motor means.

The respective stationary contacts in the set of stationary contacts are adapted to terminate the respective conductors of a first group of lines; the respective conductors in the first set of conductors are adapted to terminate the respective conductors of a second group of lines; and the respective conductors in the second set of conductors are adapted to terminate the respective conductors of a third group of lines. By selectively controlling the energization of the two electromagnetic devices, the respective lines in the second and third groups of lines may be selectively connected to the respective lines in the first group of lines; and by controlling the energization of the two electromagnetic devices to obtain simultaneous energization thereof, the respective lines in both the second and third groups

of lines may be simultaneously connected to the respective lines in the first group of lines. Accordingly, the improved switching apparatus utilizing the switching unit described has the effective switching capacity of conventional switching apparatus utilizing two separate and distinct switching units of conventional construction; yet, the switching unit described includes a number of terminals only fifty per cent greater than the number of terminals included in one conventional switching unit. Hence, the improved switching apparatus effects a net saving in the number of terminals required in the switches of the telephone system of twenty-five per cent, thereby reducing the number of soldered connections required in the system by a like amount.

In the first form of the switching unit, the electromagnetic devices individually associated with the insulating bars are arranged closely adjacent the respective sets of conductors and disposed on opposite sides of the switching unit; and in the second form of the switching unit, side members are provided which partially enclose the sets of conductors and respectively carry the electromagnetic devices on the outer walls thereof on opposite sides of the switching unit.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the following specification taken in connection with the accompanying drawings, in which Figure 1 is a perspective view of a switching unit constructed and arranged in accordance with the present invention; Fig. 2 is a diagrammatic illustration of a circuit arrangement for controlling the energization of the electromagnetic devices included in the switching unit shown in Fig. 1; and Fig. 3 is a perspective view of a modified form of the switching unit.

Referring now to Fig. 1 of the drawings, the switching unit there shown comprises a rectangular supporting plate 10 formed of insulating material, such as "Bakelite", carrying a centrally disposed and longitudinally extending row of upstanding wiper sets 11, constituting a set of stationary contacts, and two longitudinally extending rows of upstanding conductors 12 and 13 respectively arranged on opposite sides of the set of wiper sets 11 and constituting first and second sets of movable conductors. Each of the wiper sets 11 comprises complementary and substantially T-shaped wipers 11a and 11b formed of flexible conducting material and arranged in engaging side-by-side relationship, the heads of the wipers being disposed in spaced relationship with respect to the supporting plate 10, and the stems of the wipers being embedded in the supporting plate 10 and extending therethrough to provide a terminal on the outer ends of the stems of the wipers 11a and 11b comprising the wiper sets 11. These terminals provided on the wiper sets 11, comprising the set of stationary contacts, are adapted to terminate the respective conductors of a group of lines. Also, the outer ends of the heads of the wipers 11a and 11b of each wiper set 11 are flared outwardly in opposite directions in order to provide guiding grooves disposed therebetween adjacent the opposite ends of the head of the wiper set, which guiding grooves are adapted to receive adjacent contact portions of two of the conductors 12 and 13 disposed in the respective sets of movable conductors, in a manner more

fully described subsequently. Each of the conductors 12 and 13 comprises a relatively long section of flexible round stock, a contact portion of each conductor adjacent the outer end thereof being arranged in alignment with respect to an adjacent one of the guiding grooves provided in the head of one of the wiper sets 11 and the shank of the conductor being embedded in the supporting plate 10 and extending therethrough to provide a terminal on the outer end thereof. These terminals provided on the conductors 12, comprising the first set of movable conductors, and on the conductors 13, comprising the second set of movable conductors, are adapted to terminate the respective conductors of two respective groups of lines. Preferably, the shanks of the conductors 12 and 13 and the stems of the wipers 11a and 11b comprising the wiper sets 11 are molded directly in the supporting plate 10.

The head of every other one of the wiper sets 11 is of the same length, while the heads of adjacent ones of the wiper sets 11 are of different lengths so that the guiding grooves provided in the heads of the wiper sets are arranged in two longitudinally extending rows, adjacent guiding grooves in each of the rows being staggered laterally therealong, thereby to accommodate separating movements between the complementary wipers of each wiper set without any interference with adjacent wiper sets. Similarly, adjacent ones of the conductors 12 in the first set of movable conductors are staggered laterally along the longitudinally extending row; and adjacent ones of the conductors 13 in the second set of movable conductors are staggered laterally along the longitudinally extending row.

From the foregoing description of the construction and arrangement of the longitudinally extending set of wiper sets 11 and the longitudinally extending sets of conductors 12 and 13, it will be understood that a contact portion of each of the conductors adjacent the outer end thereof is arranged adjacent and disposed a fixed distance from a corresponding one of the guiding grooves provided in the head of a corresponding one of the wiper sets.

Two flanged supporting members 14 and 15, respectively, are securely fastened to the opposite sides of the supporting plate 10 by a number of screws 16. The supporting member 14 carries an electromagnetic device 18 suitably secured thereto; and the supporting member 15 carries an electromagnetic device 19 suitably secured thereto. The electromagnetic device 18 comprises a magnetic core 20 provided with pole pieces 21 and 22, a movable armature 23 pivotally supported by a pivot pin 24 upon the pole piece 22 and an electromagnetic coil 25 associated with the core 20. Similarly, the electromagnetic device 19 comprises a magnetic core 26 provided with pole pieces 27 and 28, a movable armature 29 pivotally supported by a pivot pin 30 upon the pole piece 28 and an electromagnetic coil 31 associated with the core 26. The upper end of the armature 23 is provided with two oppositely and longitudinally extending arms 32 and 33, respectively, having inwardly turned portions 34 and 35, respectively. Similarly, the upper end of the armature 29 is provided with two oppositely and longitudinally extending arms 36 and 37, respectively, having inwardly turned portions 38 and 39, respectively.

Also, the shanks of the longitudinally extending row of conductors 12 are embedded in a longitudinally extending insulating bar 40 adjacent

the outer ends thereof; and the shanks of the longitudinally extending row of conductors 13 are embedded in a longitudinally extending insulating bar 41 adjacent the outer ends thereof.

5 Preferably, the bars 40 and 41 are formed of moldable insulating material, such as "Bakelite," and the shanks of the conductors 12 and 13, respectively, are molded directly therein. The bar 40 is securely retained between the inwardly turned portions 34 and 35 of the arms 32 and 33, respectively, by two screws 42 extending through openings provided in the inwardly turned portions 34 and 35 and threaded into tapped holes provided in the opposite ends of the bar 40. Similarly, the bar 41 is securely retained between the inwardly turned portions 36 and 37 of the arms 36 and 37, respectively, by two screws 43 extending through openings provided in the inwardly turned portions 36 and 37 and threaded into tapped holes provided in the opposite ends of the bar 41.

From the foregoing description of the construction and arrangement of the switching unit, it will be understood that the portions of the shanks of the conductors 12 and 13 adjacent the inner ends thereof are securely anchored in the supporting plate 10 and that the portions of the shanks of the conductors 12 and 13 adjacent the outer ends thereof are securely anchored in the bars 40 and 41, respectively, while the portions of the stems of the wiper sets 11 adjacent the inner ends thereof are securely anchored in the supporting plate 10. The outer ends of the flexible conductors 12 are flexible as a unit with the bar 40 to move the contact portions thereof into engagement with the respective guiding grooves provided in the heads of the respective wiper sets 11; and the outer ends of the flexible conductors 13 are flexible as a unit with the bar 41 to move the contact portions thereof into engagement with the respective guiding grooves provided in the heads of the respective wiper sets 11. Accordingly, the row of wiper sets 11 constitute a set of stationary contacts, while the rows of conductors 12 and 13 constitute sets of movable contacts adapted to be moved into engagement therewith.

In the operation of the switching unit the sets of conductors 12 and 13 are adapted to be selectively and independently moved into engagements with the associated sets of wiper sets 11, the set of conductors 12 being moved into engagements with the associated set of wiper sets 11 when the winding 25 of the electromagnetic device 18 is energized, and the set of conductors 13 being moved into engagements with the associated set of wiper sets 11 when the winding 31 of the electromagnetic device 19 is energized. More particularly, when the winding 25 of the electromagnetic device 18 is energized, the armature 23 is rotated about the pivot pin 24 in a counter-clockwise direction in order to cause the bar 40 carried thereby and the set of conductors 12 embedded in the bar 40 to be moved laterally toward and into engagement with the associated set of wiper sets 11. Similarly, when the winding 31 of the electromagnetic device 19 is energized, the armature 29 is rotated about the pivot pin 30 in a clockwise direction in order to cause the bar 41 carried thereby and the set of conductors 13 embedded in the bar 41 to be moved laterally toward and into engagement with the associated set of wiper sets 11. Thus, it will be apparent that by energizing selectively the windings 25 and 31 of the electromagnetic de-

vices 18 and 19, respectively, the groups of lines terminated by the sets of conductors 12 and 13, respectively, may be selectively connected to the group of lines terminated by the set of wiper sets 11; and by energizing simultaneously the windings 25 and 31 of the electromagnetic devices 18 and 19, respectively, the groups of lines terminated by the sets of conductors 12 and 13, respectively, may be simultaneously connected to the group of lines terminated by the set of wiper sets 11.

In Fig. 2 of the drawings a circuit arrangement for controlling the energization of the windings 25 and 31 of the electromagnetic devices 18 and 19, respectively, included in the switching unit of Fig. 1, is diagrammatically illustrated. This circuit arrangement comprises a multiposition switch 45 of the rotatable type including two contact banks 46 and 47 and a wiper 48 of the double-ended type, the ends of the wiper 48 engaging corresponding contacts in the contact banks 46 and 47, respectively, during operation of the switch 45. The switch 45 may be either of the automatic or manually operable types as desired; and the wiper 48 is rotatable in a counter-clockwise direction from a normal position in which the first contacts in the respective contact banks 46 and 47 are engaged thereby. A circuit network is provided which includes the windings 25 and 31 of the electromagnetic devices 18 and 19, respectively, and the wiper 48 and the contacts in the contact banks 46 and 47 of the switch 45. The circuit network is so connected and arranged that both of the windings 25 and 31 are deenergized when the wiper 48 engages the first contacts in the respective contact banks 46 and 47; the winding 25 is energized when the wiper 48 engages the second contacts in the respective contact banks 46 and 47; the winding 31 is energized when the wiper 48 engages the third contacts in the respective contact banks 46 and 47; and both of the windings 25 and 31 are energized when the wiper 48 engages the fourth contacts in the respective contact banks 46 and 47. The energizing circuits mentioned above are obvious and have not been specifically traced in the interest of brevity.

In Fig. 3 of the drawings a modified form of the switching unit is shown which comprises an insulating supporting plate 10 carrying a set of wiper sets 11 and two sets of conductors 12 and 13 which are constructed and arranged in a manner precisely the same as that previously described in connection with the preferred embodiment of the switching unit shown in Fig. 1. Also, this embodiment of the switching unit comprises two insulating bars 40 and 41 in which the shanks of the conductors 12 and 13, respectively, are embedded in the previously described manner; and a unitary supporting member 50 of substantially inverted U-shape configuration is secured to the supporting plate 10 by a number of screws 51. Furthermore, the supporting member 50 is provided with a cut-out portion adjacent the top end thereof in order to provide two upstanding side walls 52 and 53 arranged in spaced relationship with respect to each other and secured together adjacent the ends thereof by two straps 54. The side walls 52 and 53 of the supporting member 50 enclose the sides of the sets of conductors 12 and 13 disposed on opposite sides of the set of wiper sets 11, the ends of the sets of conductors 12 and 13 and the heads of the wipers comprising the set of wiper sets 11 being arranged in alignment with the cut-out portion provided

in the supporting member 50. The side wall 52 is provided with an outwardly extending arm 55 to which an electromagnetic device 56 is secured by a screw 57; and the side wall 53 is provided with an outwardly extending arm 58 to which an electromagnetic device 59 is secured by a screw 60, the electromagnetic devices 56 and 59 being arranged on opposite sides of the supporting member 50 in substantial alignment with each other.

The electromagnetic device 56 comprises a core, a movable armature 61 extending through an elongated slot 62 provided in the side wall 52 and an electromagnetic winding 63; and the electromagnetic device 59 comprises a core, a movable armature, not shown, extending through an elongated slot, not shown, provided in the side wall 53 and an electromagnetic winding 64. A connecting element 65 provided with a downwardly extending body portion 66 having an outwardly turned arm 67 secured to the movable armature 61 is associated with the electromagnetic device 56. Also, the connecting element 65 is provided with two outwardly extending arms 68 and 69 having inwardly turned portions 70 and 71, respectively, between which inwardly turned portions 70 and 71 the bar 40 is secured by two screws 72 extending through openings provided in the inwardly turned portions 70 and 71 and threaded into tapped holes provided in the opposite end of the bar 40. A connecting element 73 of a construction similar to the connecting element 65 is associated with the electromagnetic device 59, the connecting element 73 being secured to the movable armature of the electromagnetic device 59 and provided with two outwardly extending arms 74 and 75 having inwardly turned portions 76 and 77, respectively, between which the insulating bar 41 is secured by two screws 78 extending through openings provided in the inwardly turned portions 76 and 77 and threaded into tapped holes provided in the opposite ends of the bar 41. Preferably, the connecting elements 65 and 73 are formed of a non-magnetic material such as brass in order to prevent these elements from carrying magnetic flux and tending to stick to the adjacent portions of the side walls 52 and 53, respectively. The elongated slot 62 formed in the side wall 52 constitutes a fulcrum edge for the movable armature 61 of the electromagnetic device 56 due to the fact that the upper end of the connecting element 65 is positioned by the bar 40. Similarly, the elongated slot, not shown, formed in the side wall 53 constitutes a fulcrum edge for the movable armature of the electromagnetic device 59 due to the fact that the upper end of the connecting element 73 is positioned by the bar 41.

From the foregoing description of the construction and arrangement of this embodiment of the switching unit, it will be understood that the sets of conductors 12 and 13 may be selectively and independently moved into engagement with the associated set of wiper sets 11 by selectively energizing the windings 63 and 64 of the electromagnetic devices 56 and 59, respectively. More particularly, when the winding 63 of the electromagnetic device 56 is energized, the movable armature 61 thereof is pivoted in a counterclockwise direction, thereby to cause the connecting element 65 to move the bar 40 and the set of conductors 12 embedded therein laterally into engagement with the associated set of wiper sets

11. Similarly, when the winding 64 of the electromagnetic device 59 is energized, the movable armature thereof is pivoted in a clockwise direction, thereby to cause the connecting element 73 to move the bar 41 and the set of conductors 13 embedded therein laterally into engagement with the associated set of wiper sets 11. Accordingly, the group of lines terminated by the sets of conductors 12 and 13, respectively, may be selectively and simultaneously connected to the group of lines terminated by the set of wiper sets 11.

While there have been described what are at present considered to be the preferred embodiments of the invention, it will be understood that various modifications may be made therein, and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. Switching apparatus comprising, in combination, a stationary contact provided with a wiper portion, first and second conductors each having a resilient shank portion and a contact portion associated in spaced relation with the wiper portion of said stationary contact, means including an insulating support for fixedly mounting said stationary contact at a point remote from the wiper portion thereof and for fixedly mounting the shank portions of said first and second conductors at points remote from the respective contact portions thereof, means including a first electromagnetic device carried by said support for flexing the shank portion of said first conductor to move the contact portion thereof into engagement with the wiper portion of said stationary contact, and means including a second electromagnetic device carried by said support for flexing the shank portion of said second conductor to move the contact portion thereof into engagement with the wiper portion of said stationary contact.

2. Switching apparatus comprising, in combination, a set of stationary contacts, each of said stationary contacts having a wiper portion, first and second sets of conductors, each of said conductors having a resilient shank portion and a contact portion, the contact portion of a corresponding conductor in each of said first and second sets of conductors being associated in spaced relation with the wiper portion of a corresponding stationary contact in said set of stationary contacts, means including an insulating support for fixedly mounting the stationary contacts in said set of stationary contacts at points remote from the wiper portions thereof and for fixedly mounting the shank portions of the conductors in each of said first and second sets of conductors at points remote from the respective contact portions thereof, means including a first electromagnetic device carried by said support and associated with said first set of conductors for simultaneously flexing the shank portions of the conductors therein to move the contact portions thereof into engagement with the wiper portions of the corresponding stationary contacts in said set of stationary contacts, and means including a second electromagnetic device carried by said support and associated with said second set of conductors for simultaneously flexing the shank portions of the conductors therein to move the contact portions thereof into engagement with the wiper portions of the corresponding stationary contacts in said set of stationary contacts.

3. Switching apparatus comprising, in com-

5 bination, a longitudinally disposed set of station-  
 10 ary contacts, each of said stationary con-  
 15 tacts having a wiper portion, first and second  
 20 longitudinally disposed sets of conductors ar-  
 25 ranged on opposite sides of said longitudinally  
 30 disposed set of stationary contacts, each of said  
 35 conductors having a resilient shank portion and  
 40 a contact portion, the contact portion of a cor-  
 45 responding conductor in each of said first and  
 50 second sets of conductors being associated in  
 55 spaced relation with the wiper portion of a cor-  
 60 responding stationary contact in said set of sta-  
 65 tionary contacts, means including a longitudi-  
 70 nally disposed insulating plate for fixedly mount-  
 75 ing the stationary contacts in said set of sta-  
 80 tionary contacts at points remote from the wiper  
 85 portions thereof and for fixedly mounting the  
 90 shank portions of the conductors in each of said  
 95 first and second sets of conductors at points re-  
 100 mote from the respective contact portions there-  
 105 of, means including a first electromagnetic de-  
 110 vice carried by said insulating plate and asso-  
 115 ciated with said first set of conductors for simul-  
 120 taneously flexing laterally the shank portions of  
 125 the conductors therein to move the contact por-  
 130 tions thereof into engagement with the wiper  
 135 portions of the corresponding stationary con-  
 140 tacts in said set of stationary contacts, and means  
 145 including a second electromagnetic device carried  
 150 by said insulating plate and associated with said  
 155 second set of conductors for simultaneously  
 160 flexing laterally the shank portions of the con-  
 165 ductors therein to move the contact portions  
 170 thereof into engagement with the wiper portions  
 175 of the corresponding stationary contacts in said  
 180 set of stationary contacts.

4. Switching apparatus comprising, in combi-  
 40 nation, a set of stationary contacts, each of said  
 45 stationary contacts having a wiper portion, first  
 50 and second sets of conductors, each of said con-  
 55 ductors having a resilient shank portion and a  
 60 contact portion, the contact portion of a cor-  
 65 responding conductor in each of said first and  
 70 second sets of conductors being associated in  
 75 spaced relation with the wiper portion of a cor-  
 80 responding stationary contact in said set of sta-  
 85 tionary contacts, means including an insulating  
 90 support for fixedly mounting the stationary con-  
 95 tacts in said set of stationary contacts at points  
 100 remote from the wiper portions thereof and for  
 105 fixedly mounting the shank portions of the con-  
 110 ductors in each of said first and second sets of  
 115 conductors at points remote from the respective  
 120 contact portions thereof, a first bar associated  
 125 with the conductors in said first set of conductors  
 130 adjacent the contact portions thereof, a second  
 135 bar associated with the conductors in said second  
 140 set of conductors adjacent the contact portions  
 145 thereof, means including a first electromagnetic  
 150 device carried by said support for moving said  
 155 first bar to flex simultaneously the shank por-  
 160 tions of the conductors in said first set of con-  
 165 ductors, thereby to move the contact portions  
 170 thereof into engagement with the wiper portions  
 175 of the corresponding stationary contacts in said  
 180 set of stationary contacts, and means including  
 185 a second electromagnetic device carried by said  
 190 support for moving said second bar to flex simul-  
 195 taneously the shank portions of the conductors  
 200 in said second set of conductors, thereby to move  
 205 the contact portions thereof into engagement  
 210 with the wiper portions of the corresponding sta-  
 215 tionary contacts in said set of stationary con-  
 220 tacts.

75 5. Switching apparatus comprising, in combi-

8 nation, a stationary contact having a substan-  
 9 tially T-shaped configuration and including a  
 10 stem portion and a head portion providing two  
 11 wiper portions, first and second conductors ar-  
 12 ranged on opposite sides of said stationary con-  
 13 tact, each of said conductors having a resilient  
 14 shank portion and a contact portion, the contact  
 15 portions of said first and second conductors be-  
 16 ing associated in spaced relation with the re-  
 17 spective wiper portions of said stationary con-  
 18 tact, means for fixedly mounting the stem por-  
 19 tion of said stationary contact at a point remote  
 20 from the head portion thereof and for fixedly  
 21 mounting the shank portions of said first and  
 22 second conductors at points remote from the re-  
 23 spective contact portions thereof, means for  
 24 flexing the shank portion of said first conductor  
 25 to move the contact portion thereof into engage-  
 26 ment with the associated wiper portion of said  
 27 stationary contact, and means for flexing the  
 28 shank portion of said second conductor to move  
 29 the contact portion thereof into engagement with  
 30 the associated wiper portion of said stationary  
 31 contact.

6. Switching apparatus comprising, in combi-  
 40 nation, a longitudinally disposed set of station-  
 45 ary contacts, each of said stationary contacts  
 50 having a substantially T-shaped configuration  
 55 and including a stem portion and a head portion  
 60 providing two wiper portions, first and second  
 65 longitudinally disposed sets of conductors ar-  
 70 ranged on opposite sides of said longitudinally  
 75 disposed set of stationary contacts, each of said  
 80 conductors having a resilient shank portion and  
 85 a contact portion, the contact portion of a cor-  
 90 responding conductor in each of said first and  
 95 second sets of conductors being associated in  
 100 spaced relation with the respective wiper por-  
 105 tions of a corresponding stationary contact in  
 110 said set of stationary contacts, means including  
 115 a longitudinally disposed insulating plate for  
 120 fixedly mounting the stem portions of the sta-  
 125 tionary contacts in said set of stationary con-  
 130 tacts at points remote from the respective head  
 135 portions thereof and for fixedly mounting the  
 140 shank portions of the conductors in said first  
 145 and second sets of conductors at points remote  
 150 from the respective contact portions thereof,  
 155 means associated with said first set of conductors  
 160 for simultaneously flexing laterally the shank  
 165 portions of the conductors therein to move the  
 170 contact portions thereof into engagement with  
 175 the associated wiper portions of the correspond-  
 180 ing stationary contacts in said set of stationary  
 185 contacts, and means associated with said second  
 190 set of conductors for simultaneously flexing lat-  
 195 erally the shank portions of the conductors  
 200 therein to move the contact portions thereof into  
 205 engagement with the associated wiper portions  
 210 of the corresponding stationary contacts in said  
 215 set of stationary contacts.

7. Switching apparatus comprising, in combi-  
 40 nation, a longitudinally disposed set of station-  
 45 ary contacts, each of said stationary contacts having  
 50 a substantially T-shaped configuration and in-  
 55 cluding a stem portion and a head portion pro-  
 60 viding two wiper portions, first and second lon-  
 65 gitudinally disposed sets of conductors arranged  
 70 on opposite sides of said longitudinally disposed  
 75 set of stationary contacts, each of said con-  
 80 ductors having a resilient shank portion and a con-  
 85 tact portion, the contact portion of a correspond-  
 90 ing conductor in each of said first and second  
 95 sets of conductors being associated in spaced re-  
 100 lation with the respective wiper portions of a

corresponding stationary contact in said set of stationary contacts, means including a longitudinally disposed insulating plate for fixedly mounting the stem portions of the stationary contacts in said set of stationary contacts at points remote from the respective head portions thereof and for fixedly mounting the shank portions of the conductors in said first and second sets of conductors at points remote from the respective contact portions thereof, a first bar associated with the conductors in said first set of conductors adjacent the contact portions thereof, a second bar associated with the conductors in said second set of conductors adjacent the contact portions thereof, means including a first electromagnetic device for moving said first bar to flex simultaneously and laterally the shank portions of the conductors in said first set of conductors, thereby to move the contact portions thereof into engagement with the associated wiper portions of the corresponding stationary contacts in said set of stationary contacts, and means including a second electromagnetic device for moving said second bar to flex simultaneously and laterally the shank portions of the conductors in said second set of conductors, thereby to move the contact portions thereof into engagement with the associated wiper portions of the corresponding stationary contacts in said set of stationary contacts.

CLARENCE E. LOMAX. 15  
GEORGE T. MARTIN.