F. R. McBERTY.

AUTOMATIC TELEPHONE EXCHANGE SELECTOR.

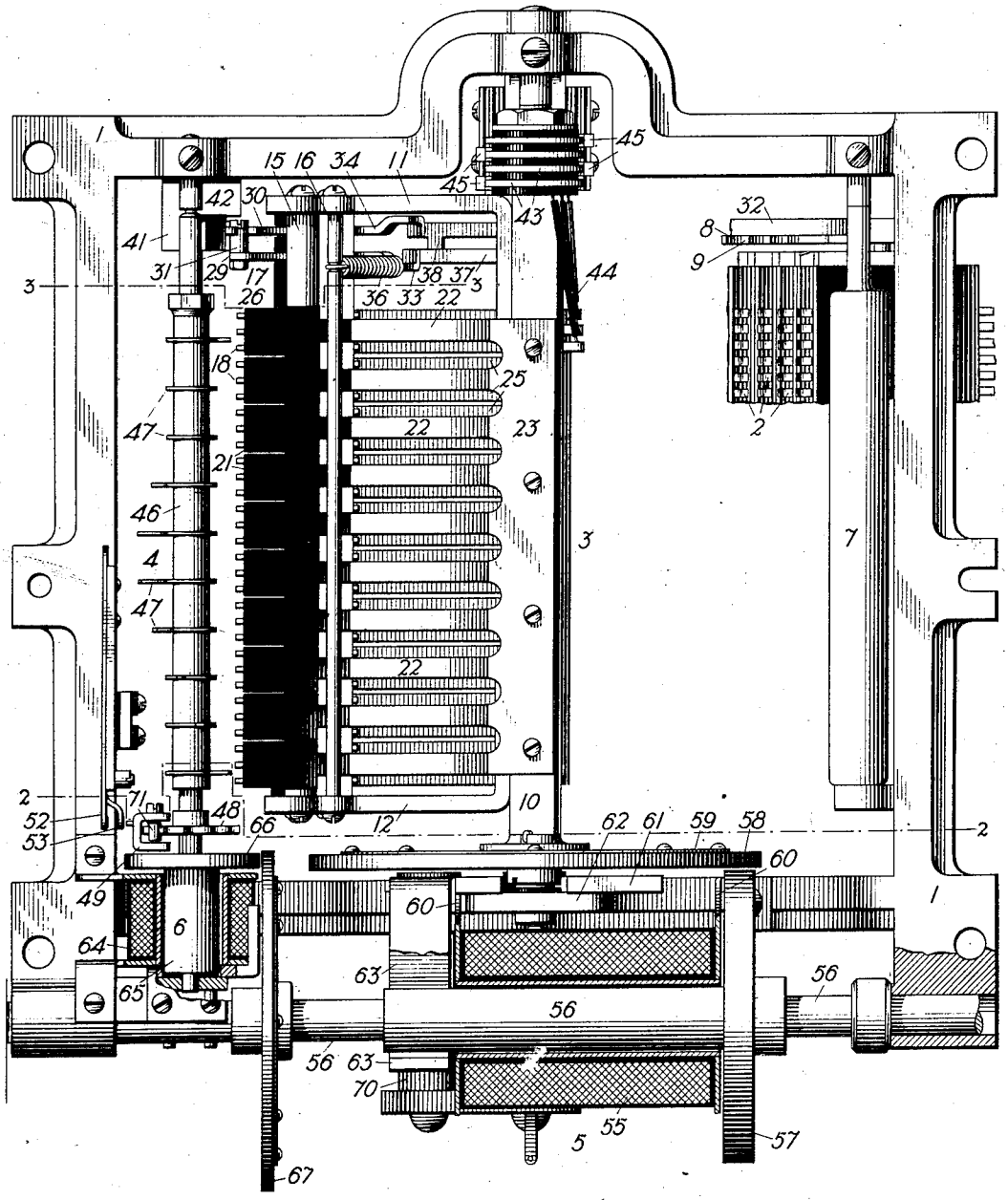
APPLICATION FILED JULY 23, 1910.

1,097,868.

Patented May 26, 1914.

4 SHEETS—SHEET 1.

Fig. 1.



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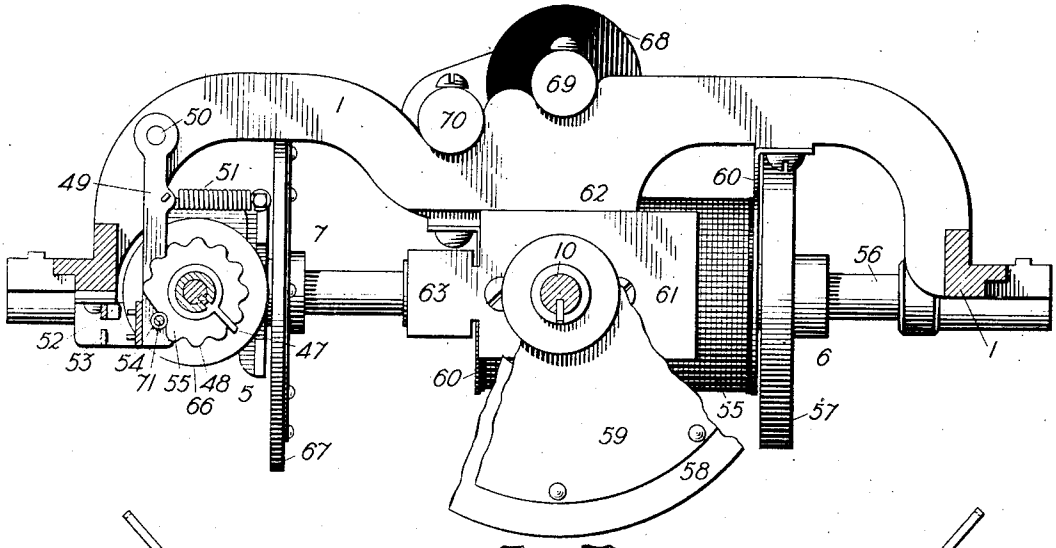
4 SHEETS—SHEET 2.

Fig. 2.



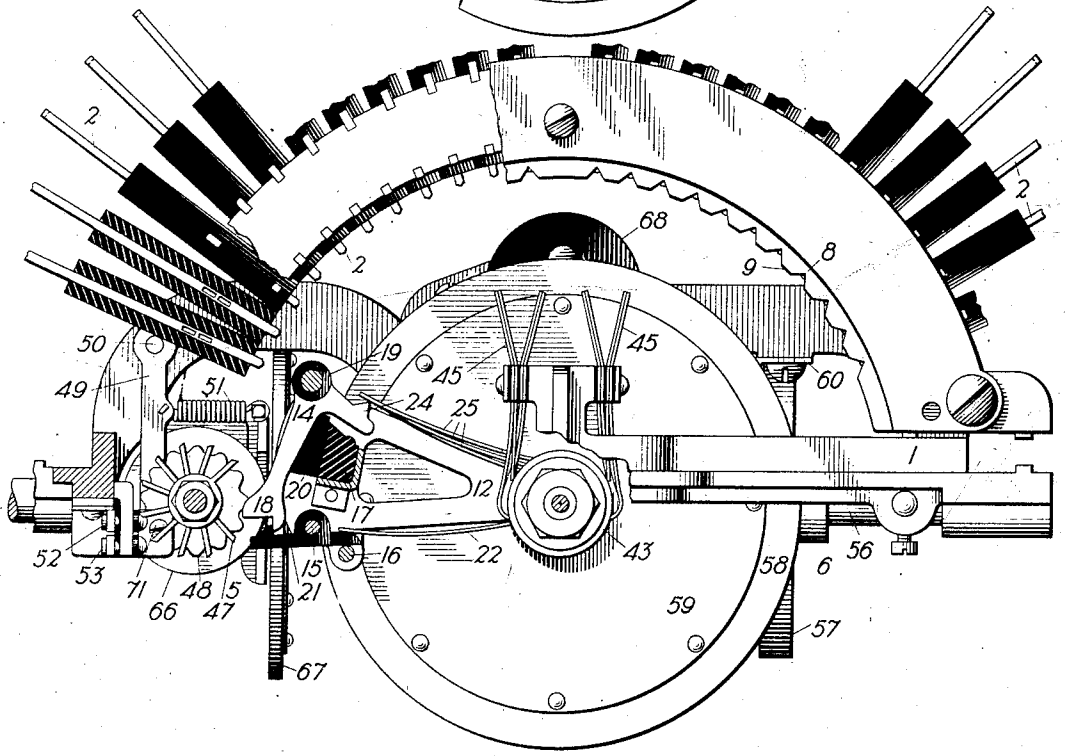


Fig. 3.

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4 SHEETS—SHEET 3.

Fig. 4.

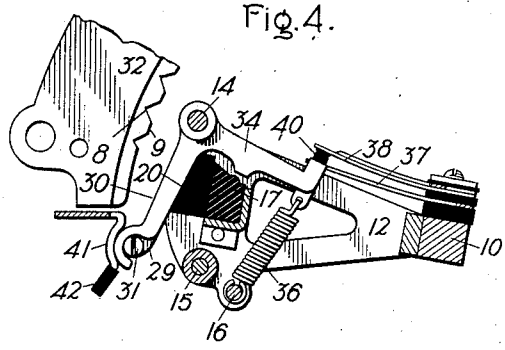


Fig. 6.

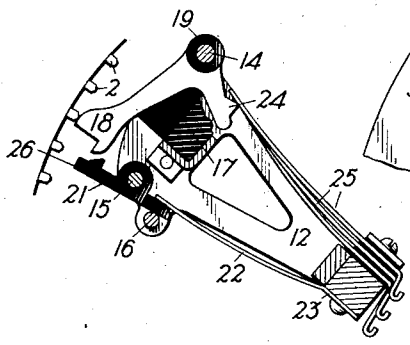


Fig. 5.

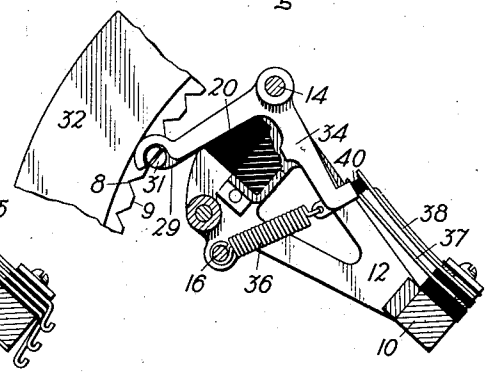


Fig. 8.

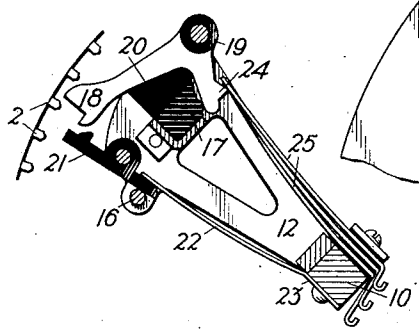
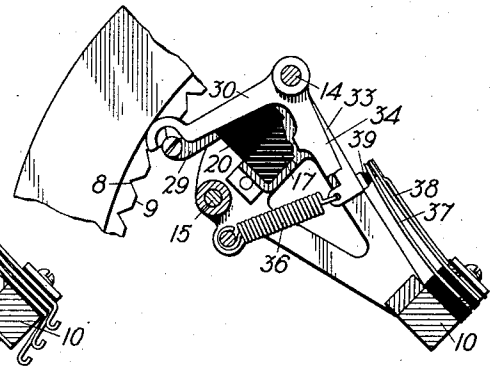


Fig. 7.



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APPLICATION FILED JULY 23, 1910.

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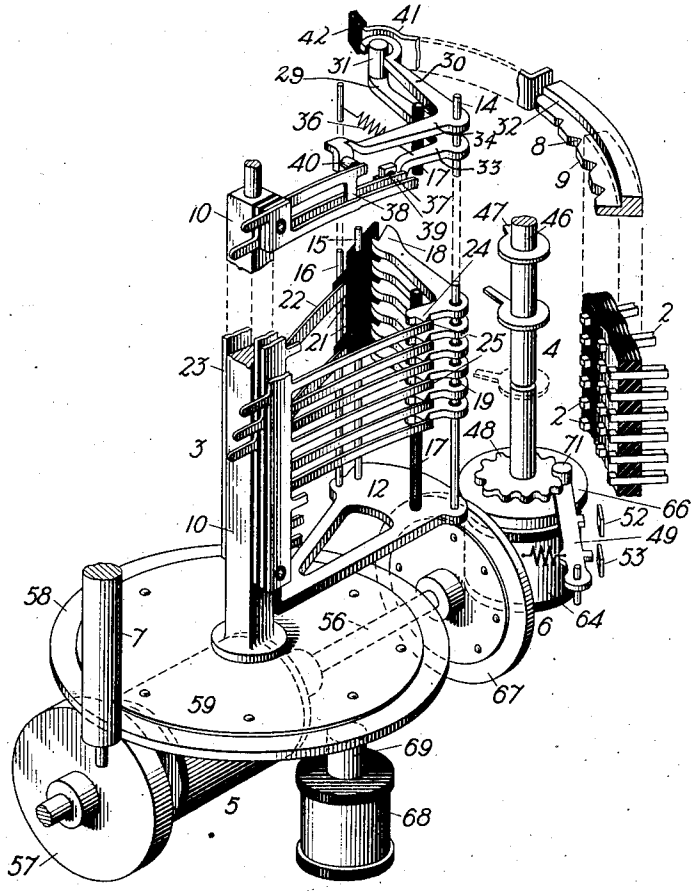
4 SHEETS—SHEET 4.

Fig. 9.



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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE-EXCHANGE SELECTOR.

1,097,868. Specification of Letters Patent. Patented May 26, 1914.

Application filed July 23, 1910. Serial No. 573,516.

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, citizen of the United States, residing at New Rochelle, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Automatic Telephone-Exchange Selectors, of which the following is a full, clear, concise, and exact description.

My invention relates to automatic switches for use in telephone exchange systems. Its object is in general to improve the construction and arrangement of the parts of the switch mechanism whereby the interconnection of a large number of lines may be effected with rapidity and precision.

One feature of my invention relates particularly to means whereby any one of a plurality of normally inactive terminals in an automatic switch may be selected and rendered active for connection with other terminals. The normally inactive terminals or brushes are held in a retracted position until released by the selecting means. They are preferably arranged in a row upon a movable carriage and held by latches, any one of which may be lifted by the selecting means to permit engagement of the selected terminal or terminals with the other terminals. These other terminals are preferably held stationary and arranged in suitable rows transverse to the row of movable terminals but in their line of travel when advanced in the movement of the carriage. The selecting means may be arranged to trip the latches during the initial movement of the brush carriage. In practice the movable terminals are arranged in sets, each set being held by a single latch, and the several sets being joined electrically in multiple-connected groups. In the form of structure herein described, the multiple connection of the sets of movable terminals is secured by metallic combs, the teeth of which press against the movable terminals, form electrical connection therewith and impart to them a tendency to move outwardly into position to engage the stationary terminals. The movements of the brush carriage and of the brush selector are controlled preferably by means of two electromagnetic clutches, each of which has a part associated with a single continuously rotating power shaft.

According to the preferred mode of operation of this feature of my invention, the brush selector is first operated and set in one position or another to subsequently engage a particular one of the latches. Then the brush carriage is advanced and in its initial movement the selected latch is lifted by an operative point on the brush selector. Further movement of the brush carriage causes the released brush or brushes to trail over a particular row or rows of the stationary terminals until the carriage is finally stopped with said brush or brushes in contact with the desired terminal or set of terminals.

My invention also relates to the construction of the brush selector which is a device having a number of operative points, one for each brush or set of brushes, means being provided for moving the device into one of several positions to select and render active any one brush or set of brushes. More in detail the brush selecting device comprises a shaft with a plurality of fingers extending outwardly from the shaft in different directions. The rotation of the shaft is preferably controlled by an electromagnetic clutch in a manner similar to that of the brush carriage. The fingers are preferably arranged spirally about the surface of the shaft and are adapted to be brought successively into the line of travel of the latches on the brush carriage so that when the brush carriage is moved from its normal position to carry the brushes over the stationary terminals one of the latches engages a finger of the brush selector in passing, and the brushes normally held thereby are thrust outwardly in position to trail over the terminals. For restoring the selected brushes to their normal latched position, a restoring surface, preferably in the form of a roller, is placed in position to be engaged by said brushes in the return movement of the brush carriage. This return movement, in the form of switch herein disclosed, is accomplished by continuing the rotation of the brush carriage in the same direction as that of the advance movement until one complete revolution has been made. The restoring roller is accordingly located in the line of travel of the brushes beyond the rows of stationary terminals. The general arrangement is thus one in

which the brush selector is set into operative position to release a brush or set of brushes, after which the brush carriage is moved first into operative relation to the brush selector, then over the rows of stationary terminals, then into operative relation to the restoring device, and finally back to normal.

The brush carriage as a whole possesses considerable inertia, and as it is desirable to move the same at high speed in making the connection between the brushes and the stationary terminals, and also in returning the brush carriage to its normal position, means is provided for stopping the brush carriage quickly when the power mechanism is disengaged therefrom. This means is preferably in the form of an electromagnet to be energized at the moment the power mechanism is disengaged and adapted thereupon to cause a moving part of the brush carriage to come into frictional contact with a stationary part of the electromagnet, such as its core.

My invention will be better understood by reference to the accompanying drawings, in which—

Figure 1 is a front elevation of the complete switch mechanism with certain parts in section and other parts broken away. Fig. 2 is a plan view of the same in section along the line 2—2 of Fig. 1. Fig. 3 is a plan view of the same partly in section along the line 3—3 of Fig. 1. Figs. 4 to 8 inclusive are detail views of parts of the switch mechanism, Fig. 4 showing a contact device and its controlling mechanism in the normal position of the switch, Figs. 5 and 7 the same in different off-normal positions, and Figs. 6 and 8 the brushes of the automatic switch in off-normal positions corresponding respectively to those of Figs. 5 and 7, and Fig. 9 is a perspective view of the principal elements of the switch mechanism but with the frame and certain other parts omitted to give a clear understanding of the general arrangement and mode of operation of the mechanism.

Referring to the drawings, the switch mechanism comprises in general a frame 1, a bank of stationary terminals 2, a brush carriage 3, a brush selector 4, two electromagnetic clutches 5, 6, one for controlling the rotation of the brush carriage and the other for controlling the rotation of the brush selector, and a brush restoring roller 7. The brush carriage 3 is pivotally mounted centrally in the frame. The brush selector and the brush restoring roller are also pivotally mounted in the frame, one on one side and the other on the other side of the brush carriage. The stationary terminals are secured to the frame and are arranged so that their inner ends are disposed about a semicylindrical surface and form horizontal curved rows and intersecting vertical rows. The outwardly projecting ends of the terminals form solder clips for wiring connections.

The brush carriage 4 comprises a shaft 10, to the upper and lower ends of which are secured arms 11 and 12 respectively. At the outer or free ends of these arms and extending vertically between them are rods 14, 15, 16, and a block of insulating material 17. A plurality of brushes 18 are pivotally supported upon the rod 14. The brushes are insulated from the rod 14 by insulating bushings 19. The block of insulating material 17 is provided with slots 20 in which the free ends of the brushes are guided. Rotatably held upon the rod 15 are a plurality of latches 21 for the brushes, these latches being of insulating material and normally engaging the free ends of the brushes 18. The latches 21 may each engage a set of three brushes as shown and they are normally thrust forward to engage the brushes by means of springs 22, the rod 16 forming a stop to prevent the latches from swinging around too far when the brushes are released. The springs 22 form the teeth of a comb-shaped member 23 secured to one side of the shaft 10 of the brush carriage. The brushes 18 have arms 24 extending inwardly, and these arms are engaged by metallic springs 25 which bear against them with pressure and tend to swing the brushes outwardly into position to engage the stationary terminals. In their normal latched position these brushes would be carried over the rows of terminals without making contact therewith, but when released by the lifting of the latches 21 the free ends of the brushes are swung outwardly. The insulating block 17 by engaging the levers 24 limits the outward movement. The springs 25 make electrical contact with the brushes; they form the teeth of comb-shaped members (like the member 23) secured to the shaft 10 on the opposite side thereof. There are three of these comb-shaped members for the brushes. They are insulated from each other and from the brush carriage, as shown in Figs. 6, 8 and 9, and serve to connect in multiple the corresponding brushes of the several sets on the brush carriage. This construction is shown most clearly in Fig. 9 from an inspection of which it is clearly evident that the combs are punched with the space of two brushes between each tooth and the next adjacent one, and the teeth of the three combs are offset so as to cause the teeth of the first comb to engage the lateral arms 24 of the first, fourth and seventh brush levers, the teeth of the second comb to engage the arms of the second, fifth and eight levers and the teeth of the third comb to engage the arms of the third, sixth and ninth levers and so on throughout the series.

It will be noted that since the brushes are pivotally mounted and under tension they will have a swinging movement in passing over the projecting line terminals, thereby causing a to and fro movement of the contact surfaces of the brush arms, which are preferably knife-edged, over the spring tongue conducting leads, the consequent wiping action effectually preventing accumulation of dust or other foreign matter which would tend to form an insulating coating and prevent positive electrical contact being maintained.

Located at the upper part of the brush carriage is an interrupter device comprising two members or levers 29 and 30, pivotally mounted on the rod 14 and guided in slots in the insulating block 17 in a manner like that of the brushes. These members or levers 29 and 30 engage the inner surfaces of a semi-circular plate 8. At the free end of lever 29 is a roller 31. The roller is adapted when the brush carriage is trailing the brushes over the stationary terminals to engage the teeth 9 and depressions between the teeth which form one part of the inner surface of plate 8, while a curved end of lever 30 engages the smooth surface or rim 32 of plate 8. The levers 29 and 30 have inwardly extending arms 33 and 34 which engage contact springs 37 and 38 respectively, the said springs being secured to and suitably insulated from the shaft 10 of the brush carriage, as shown in Figs. 4, 5 and 7. Insulating buttons 39 and 40 are secured to the ends of the arms 33 and 34 to insulate them from the contact springs.

In the normal position of the brush carriage, the free ends of the levers 29 and 30 (as shown in Fig. 4) engage a normal stop plate 41 which is secured to but insulated from the upper part of the frame 1. This normal stop plate is shaped to form a depression for the free ends of the levers 29 and 30, and it has at the entering edge an insulating covering 42, the purpose of which will be presently explained. Lever 29 is pressed outwardly by means of a coil spring 36 of considerable strength, while the lever 30 is pressed outwardly, but with less force, by the contact spring 38. When the brush carriage is moved forward from its normal position to trail the brushes 18 over the stationary terminals 3, the lever 29 is rocked back and forth by engagement of the roller 31 with the teeth 9 and intervening depressions of the plate 8, while the lever 30, which controls one of the contact springs 38, rides smoothly over the rim 32. While the roller 31 is resting in any one of the depressions in the toothed part of the plate 8, the contact between springs 37 and 38 is open (see Fig. 5). The corresponding position of the brushes is shown in Fig. 6 where a brush is shown resting directly in contact with one of the terminals 3. But when the roller 31 is riding over the tooth 9, as shown in Fig. 7, the contact between springs 37 and 38 is closed. The corresponding position of the brushes is shown in Fig. 8 wherein the free end of a brush is passing between two adjacent stationary terminals and out of contact with both of them. Thus in the movement of the switch carriage to trail the brushes over the stationary terminals, the connection between springs 37 and 38 is opened once for each terminal traversed by the brushes and is closed while the brushes are traveling between successive terminals. The function of this switching device is to measure the movement of the brushes over the stationary terminals and by coöperation with suitable controlling mechanism to cause the brush carriage to stop with the selected brushes in contact with the desired set of stationary terminals.

To provide for connections to the comb-shaped contact members 25 and to the contact springs 37 and 38 a bank of collector rings 43 is mounted near the upper end of the shaft 10. Wires 44 join these collector rings with the terminal clips of the several contact members and springs and bearing against the collector rings are a group of brushes 45 which are secured to the frame and insulated from the same and from one another as shown in Figs. 1 and 3.

The brush selector 4 comprises a shaft 46 having a plurality of operative points or fingers 47 spirally arranged about the surface of the shaft. There is one finger for each latch of the brush carriage. Secured to the lower end of the spindle 46 is a starwheel or cam 48. A contact switch arm 49 is pivoted to the frame and provided at its free end with a roller 71 to engage the surface of the wheel. A coil spring 51 serves to hold the arm with considerable pressure against the starwheel. One of the depressions on the wheel 48 is deeper than the others and in the normal position of the brush selector the roller 54 rests in this depression. When the shaft is rotated away from its normal position the arm is lifted and rocked back and forth as the roller 54 engages the teeth and depressions of the starwheel 48. Two contact springs 52 and 53 secured to the frame but insulated therefrom are engaged by the rocking arm 49 in the movement of the brush selector shaft 46, contact being made continuously with the spring 53 and intermittently with the spring 52 when the shaft is away from normal position. The function of this switching device comprising the arm 49 and the springs 52 and 53 is the same as that of the switching device controlled in the movement of the brush carriage. That is to say the intermittent connection with spring 52 serves by coöperation with suit-

able controlling mechanism to measure the movement of the brush selector shaft and to stop it with the proper finger 47 in position to engage the latch 21 of the desired set of brushes.

To provide for the restoration of the brushes to their normal latched position after being released, the restoring roller 7 is placed in the line of travel of the free end of the brushes 18 beyond the bank of terminals so that as they ride over the roller in the return movement of the switch they are forced back into position where they are engaged by the latch 21.

The electromagnetic clutch 5 comprises coil 55, through the center of which a continuously rotating shaft 56 freely extends. A portion of this shaft forms the magnet core for coil 55. At one end of the coil is an iron roller 57 which rotates in close proximity to the underneath surface of an annular iron disk 58. This disk 58 is flexibly secured to the lower end of the shaft 10 of the brush carriage by means of a thin circular plate 59 to which it is riveted. The coil 55 is held stationary by extensions 60 of the spool heads which are fastened to the frame. In order that the magnetic circuit may be nearly complete, an iron plate 61 secured to an extension 62 of the frame is held in close proximity to but out of contact with the underneath surface of the disk 58. At one end of the plate 61 is an iron extension piece 63 in the form of a yoke embracing but not quite touching the shaft 56 at the end of the coil 55 opposite the roller 57. The complete magnetic circuit for the coil 55 thus comprises a portion of the rotating shaft 56, the roller 57, the rotatable disk 58, the stationary plate 61 and the extension piece 63. When current is passed through the coil 55, the disk 58 is attracted to the periphery of the roller 57 and the brush carriage is caused to rotate by frictional engagement between the roller and disk.

The electromagnetic clutch 6 is somewhat similar in construction to 5, it comprising coil 64 through the center of which an iron core 65, secured to the lower end of the spindle 46 of the brush selector, freely extends. At the upper end of this core 65 is secured a circular iron roller 66 which is adapted, when current flows through the coil, to be engaged by a rotating disk 67 flexibly secured to the power shaft 56.

An electromagnet 68 is provided for the purpose of quickly stopping the movement of the brush carriage when the power mechanism for driving it is disengaged. This electromagnet 68 has a projecting pole piece 69 and a return pole piece 70, both of which extend upwardly and lie in close proximity to the underneath surface of the disk 58. When current is directed through the winding of this electromagnet, the disk 58 is strongly attracted and held in frictional engagement with the projecting pole pieces 69 and 70.

The complete operation of the switch mechanism herein described is as follows: Current being directed through the coil 64 of the clutch 6, the disk 67, secured to the power shaft 56, engages the roller 66 and causes the shaft 46 to rotate. The fingers 47 on the shaft are thereby brought one after another into position where they may engage the corresponding latches 21 on the brush carriage. The extent of movement of the brush selector shaft 4 is controlled by the interrupter spring 52. When the desired movement is secured, current will be cut off from the coil 64 of the clutch and the shaft will stop with one of the fingers 47 in position to engage a particular one of the latches 21. The engagement of the roller 71 at the free end of the arm 49 with the starwheel 48 insures the stopping of the shaft in proper position for the release of the desired set of brushes. That is to say, the roller will be forced into a depression between teeth on the starwheel 48, thus insuring that the proper finger 47, will be in position to engage a latch 21.

The brush selector having been set, current will be directed through the coil 55 of clutch 5 and the brush carriage will leave its normal position and advance toward the rows of stationary terminals. In its initial movement the latch 21 will be lifted by the finger 47 and a set of three brushes 18 will be released and swung outwardly with the arms 24 thereof resting against the surface of the insulating block 17. Continued movement of the brush carriage will cause the selected brushes to make contact one after another with the terminals in the corresponding rows or levels. At the same time the switching device controlled by the levers 29 and 30 at the upper part of the switch carriage will be measuring the extent of movement of the brush carriage. After a predetermined number of interruptions current may be cut off from the coil 55 and the brush carriage stopped with the selected set of brushes 18 in contact with the desired set of fixed terminals. The brushes will be centered upon the terminals by the engagement of the roller 31 at the free end of the lever 29 with one of the depressions between teeth in the plate 8. When current is cut off from the coil 55, current may be directed at that moment through the winding of the holding magnet 68 to cause the pole pieces of the holding magnet 68 to engage the disk 58 and instantly stop the movement of the brush carriage.

To return the switch carriage to normal position, current is again directed through coil 55 and the brush carriage is again advanced to complete its revolution about the

shaft 10. As the selected set of brushes passes away from the rows of terminals they engage the surface of the roller 7 and are forced back into position to be reëngaged by the latch 21. The movement of the brush carriage continues until its normal position is reached, whereupon the levers 29 and 30 ride over the insulated entering edge 42 of the normal stop plate 41 and drop into the depression of that plate, making an electrical contact therewith. This contact may be used to cause current to be cut off from coil 55 so that the brush carriage will stop in its normal position. The holding magnet 68 may be again brought into operation at this time to prevent the inertia of the switch carriage from advancing the same beyond its normal position. In a similar manner the brush selector may be returned to normal position, current being directed through coil 64, causing the clutch to engage the brush selector 4 to complete its revolution and bring it back to its normal position. Upon reaching this normal position, contact will be broken between spring 53 and the arm 49 and the breaking of this contact may be used to cut off current from coil 64 of the clutch.

Having thus described my invention, I claim:—

1. In an automatic switch, the combination of a plurality of normally retracted movable terminals, means for moving said terminals, other terminals adapted to cooperate therewith, and a selector adapted in the initial movement of said normally retracted terminals to release any of the same.

2. An automatic switch comprising a plurality of stationary terminals, a plurality of normally inactive movable terminals, means for moving said movable terminals over said stationary terminals in company, a brush selector, and means for setting said selector, whereby any of said movable terminals will be released by the movement thereof.

3. An automatic switch comprising a plurality of stationary terminals, a plurality of normally, inactive movable terminals, means for causing said movable terminals to traverse said stationary terminals and mechanism adapted to select any of said movable terminals, said mechanism coöperating with said movable terminals to render any of the same active in the initial movement of the latter to traverse said stationary terminals.

4. In an automatic switch, the combination of a plurality of stationary terminals arranged in rows and a plurality of movable terminals adapted to traverse said rows, said movable terminals being normally retracted, a carriage for said movable terminals and tripping means actuated by the movement of said carriage selectively to release any of said movable terminals to permit it to make contact with the terminals in the row traversed thereby.

5. An automatic switch comprising a plurality of rows of stationary terminals, a plurality of movable terminals, brush controlling devices for normally retaining said movable terminals in inoperative position, means for moving said movable terminals past said rows of stationary terminals, selecting mechanism, and means for positioning said selecting mechanism in the path of one of said controlling devices whereby said selecting mechanism will be made effective by the movement of said terminals.

6. An automatic switch comprising a plurality of stationary terminals arranged in parallel rows, a plurality of movable terminals corresponding in number and position to the rows of stationary terminals, means for causing said movable terminals to move in company over the stationary terminals in the corresponding rows, a latch associated with each of said movable terminals adapted normally to hold the same out of engagement with the stationary terminals over which it passes, and an electrically actuated tripping device adapted to be operated selectively to trip any predetermined latch to bring its associated movable terminal into position for engagement with the stationary terminals over which it passes.

7. In a switch, the combination with a plurality of stationary terminals arranged in parallel rows, of a transverse row of movable terminals adapted to move over said stationary terminals, each movable terminal being adapted to traverse a particular row of stationary terminals, a metallic comb, the teeth of which are adapted to connect said movable terminals in multiple and impart to them a tendency to engage the stationary terminals in the corresponding rows, latches for holding said movable terminals normally out of engagement with the stationary terminals which they traverse and tripping mechanism adapted to operate one or another of said latches to release the corresponding movable terminal.

8. An automatic switch comprising a plurality of stationary terminals, a plurality of normally retracted movable terminals, motor mechanism for causing the movement of said movable terminals over said stationary terminals at uniform speed, and means mechanically coöperating with said motor mechanism during the uninterrupted movement of the movable terminals to select and thrust forward any of said movable terminals into position to engage the stationary terminals over which it passes.

9. A switch comprising a plurality of stationary terminals, a row of movable terminals, a switch carriage upon which said row of movable terminals is supported, means for moving said switch carriage to cause said movable terminals to traverse said stationary terminals, means carried by said switch

carriage for thrusting forward said movable terminals into position to engage said stationary terminals, said means serving also to complete electrical connection with said movable terminals, latches supported upon said switch carriage, one for each of said movable terminals, adapted to hold the same normally retracted, and tripping mechanism adapted to be placed in position to lift one or another of said latches during the initial movement of the switch carriage.

10. A switch comprising a plurality of stationary terminals, a row of movable terminals, a switch carriage upon which said row of movable terminals is supported, means for moving said switch carriage to cause said movable terminals to traverse said stationary terminals, means carried by said switch carriage for thrusting forward said movable terminals into position to engage said stationary terminals, said means serving also to complete electrical connection with said movable terminals, latches supported upon said switch carriage, one for each of said movable terminals, adapted to hold the same normally retracted, and tripping mechanism adapted to lift one or another of said latches in the movement of the switch carriage.

11. An automatic switch, comprising a plurality of stationary terminals, a plurality of normally inactive movable terminals adapted to traverse said stationary terminals in the movement of the switch, mechanism adapted to be selectively operated and in the movement of the switch to render active a predetermined one of said movable terminals, and mechanism for causing an uninterrupted movement of the movable terminals of the switch first into operative relation with said selecting mechanism and then into operative relation with said stationary terminals.

12. In an automatic switch, the combination with a plurality of stationary terminals, a plurality of movable terminals, and a row of latches holding the latter normally inactive, of a selective tripping device, and motor mechanism adapted to cause first a movement of said tripping device and then a movement of said latches to bring the selected latch into operative relation to said tripping device.

13. An automatic switch comprising a plurality of stationary terminals, a plurality of normally retracted movable terminals, motor mechanism for causing movement of said movable terminals over said stationary terminals, and mechanism adapted to select a particular one of the same and during the uninterrupted movement of the movable terminals to thrust forward said selected terminal in position to make connection with said stationary terminals.

14. A switch comprising a plurality of stationary terminals, a switch carriage carrying a plurality of normally inactive movable terminals adapted to coöperate with said stationary terminals, a constantly rotating power shaft, a magnetic clutch adapted to control the connection of said switch carriage with said power shaft, and mechanism adapted to select one or another of said movable terminals and in the movement of said switch carriage to render the selected terminal operative.

15. An automatic switch comprising a plurality of fixed terminals, a row of normally active movable terminals, a selecting device for rendering active any of said movable terminals, a power shaft and two electromagnetic clutches each having a part mounted upon said shaft, one of said clutches being arranged to drive said selecting device and the other of said clutches being arranged to drive said movable terminals first into operative relation to said selecting device and then into operative relation to said stationary terminals.

16. In an automatic switch, the combination with a movable member, a power shaft adapted to move said member, and an electromagnetic clutch controlling the engagement of said power shaft with said member, of an electromagnetic holding device adapted to stop the movement of said member when the power shaft is disengaged by said clutch.

17. In an automatic switch, the combination with a moving member, a power shaft for moving said member, and a clutch comprising an electromagnet and two friction rollers, one carried by said member, of a holding device comprising an electromagnet adapted to engage said friction roller carried by the moving member when the power shaft is disengaged from said moving member.

18. In an automatic switch, the combination with a plurality of movable normally retracted terminals and other terminals adapted to coöperate therewith, of power means for causing said movable terminals to traverse said other terminals, and a selecting mechanism having a plurality of operative parts one for each of said movable terminals, each said part adapted in the movement of such terminals to release the cooperating movable terminal from its retracted position.

19. In an automatic switch, the combination with a plurality of movable normally retracted terminals and other terminals adapted to coöperate therewith, of power means for causing said movable terminals to traverse said other terminals, and a shaft having a plurality of operative points one for each of said movable terminals, each

point adapted in the movement of such terminals to release the coöperating movable terminal from its retracted position.

20. In an automatic switch, the combination with a plurality of movable normally retracted terminals and other terminals adapted to coöperate therewith, of power means for causing said movable terminals to traverse said other terminals, a shaft having a plurality of operative points one for each of said movable terminals, each point adapted in the movement of such terminals to release the coöperating movable terminal from its retracted position, and means for rotating said shaft to bring one or another of said points into operative position.

21. In an automatic switch, the combination with a plurality of movable normally retracted terminals and other terminals adapted to coöperate therewith, of power means for causing said movable terminals to traverse said other terminals, and a shaft having a plurality of radial spirally arranged fingers thereon, one of said fingers coöperating with each of said movable terminals and adapted in the movement of such terminal to release it from its retracted position.

22. In an automatic switch, the combination with a plurality of movable normally retracted terminals, and other terminals adapted to coöperate therewith, of power means for causing said movable terminals to traverse said other terminals, a shaft having a plurality of radial spirally arranged fingers thereon, one of said fingers coöperating with each of said movable terminals adapted in the movement of such terminal to release it from its retracted position, and means for rotating said shaft.

23. An automatic switch comprising a plurality of stationary terminals, a movable switch carriage carrying a row of movable terminals and a row of latches adapted to hold said movable terminals normally retracted, means for moving said switch carriage to cause said row of movable terminals to traverse said stationary terminals, and a selective tripping device comprising a shaft having a plurality of operative points arranged about the surface thereof, and means for rotating said shaft to bring said points one after another into position to be engaged by said latches in the movement of the switch carriage.

24. A switch, comprising a plurality of stationary terminals, a movable switch carriage carrying a row of movable terminals and a row of latches adapted to hold said movable terminals normally retracted, means for moving said switch carriage to cause said row of movable terminals to traverse said stationary terminals and selective tripping mechanism adapted to coöperate with said latches to release one or another of said movable terminals, said mechanism comprising a member having operative points, one for each latch arranged spirally thereon, and means adapted to rotate said member to bring one or another of said points into operative relation to the corresponding latch to effect the release of a predetermined one of said movable terminals.

25. A switch, comprising a plurality of stationary terminals, a plurality of movable terminals, means for moving said movable terminals over said stationary terminals, latches for normally holding said movable terminals clear of said stationary terminals, tripping mechanism for actuating one or another of said latches to release the associated movable terminal, and re-setting mechanism adapted to restore the released movable terminal to its normal position in the return movement of the switch.

26. The combination with a plurality of curved rows of stationary terminals and a switch carriage comprising a row of movable terminals and a row of latches, said latches being adapted to hold said movable terminals normally retracted, motor mechanism for rotating said switch carriage to cause said movable terminals to traverse said rows of stationary terminals, a selective tripping device adapted to engage one or another of said latches to release a predetermined one of said movable terminals, and a resetting device adapted to engage and thrust back the released terminal, the several parts of the complete mechanism being so arranged that the movable terminals are driven by the motor mechanism in one direction, first into operative relation to said selective tripping mechanism, then over the rows of stationary terminals, and finally into operative relation to the resetting device.

27. A switch, comprising a plurality of stationary terminals, a plurality of movable terminals, means for causing said movable terminals to traverse said stationary terminals, latches adapted to hold said movable terminals normally clear of said stationary terminals, tripping mechanism adapted to actuate one or another of said latches to release the associated movable terminal and permit it to be thrust forward into position to engage the stationary terminals which it traverses, and a resetting surface over which said movable terminals are adapted to be drawn in the return movement of the switch to restore to its normal position the movable terminal that has been released and thrust forward.

28. A switch, comprising a plurality of stationary terminals, a plurality of normally retracted movable terminals, means for causing said movable terminals to move over said stationary terminals, mechanism

adapted to select and thrust forward one or another of said movable terminals in position to engage the stationary terminals over which it passes, and a device adapted to engage and thrust back to its normal position the movable terminal which has been selected and thrust forward.

29. A switch, comprising a plurality of stationary terminals, a switch carriage having a row of movable terminals and a row of latches, one for each of said movable terminals, said latches operating to hold said movable terminals normally retracted, selective mechanism adapted to engage one or another of said latches to release a predetermined one of said movable terminals, and a resetting device adapted to engage and restore to its normal position the movable terminal which had been selected and thrust forward.

30. A switch, comprising a plurality of stationary terminals, a plurality of normally retracted movable terminals, means for causing a movement of said movable terminals over said stationary terminals, mechanism adapted to select and thrust forward one of said movable terminals into position to engage the stationary terminals over which it passes and a resetting device in the form of a roller adapted to engage the movable terminal which had been thrust forward to restore it to its normal position.

31. In the movable element of a telephone exchange selector, a plurality of sets of independently movable terminals, a single pivot rod on which said sets of terminals are mounted in combination with a device for each set of terminals for maintaining the same normally inactive.

32. A movable element of a telephone exchange selector comprising a plurality of co-axial pivotally mounted terminals arranged to move independently in sets, and a latch for each set of terminals for maintaining said sets of terminals normally inactive.

33. A movable element of a telephone exchange selector comprising a plurality of co-axial pivotally mounted and independently adjustable terminals, means for advancing said terminals in company, and latches for maintaining said terminals normally inactive.

34. In a switch carriage, the combination with a plurality of brushes pivotally mounted upon a common insulating rod secured to said carriage, and latches for each of said brushes adapted to maintain the same normally inactive.

35. In a switch carriage, the combination with a plurality of brushes pivotally mounted upon a common insulating support secured to said carriage, said brushes being arranged in sets, corresponding brushes in each set being multipled, means tending to thrust said brushes outwardly and a latch bar for each of said sets maintaining the same normally inactive.

36. In a line switching device, a carriage, a plurality of movable terminals secured thereto, a comb-like metallic member carried by said line switching device for thrusting said movable terminals outwardly, said metallic member also serving to complete electrical connection between the corresponding terminals, and means for maintaining said terminals normally retracted.

37. In a switch carriage, the combination with a plurality of terminals movably mounted upon said carriage, conductor leads in the form of spring tongues mounted at one end upon but insulated from said carriage and having their opposite ends bearing against said terminals, thereby exerting pressure tending to force said terminals outwardly, and latches adapted normally to engage said terminals and thereby neutralize said pressure.

38. In a switch, a carriage, a plurality of terminals pivoted thereon, and a conductor lead in the form of a metal strip having tongues exerting tension upon the individual terminals.

39. In a switch, a carriage, a plurality of brushes pivoted to swing independently upon an insulating support secured to said carriage, spring tongue conductor leads anchored to said switch carriage and bearing against said brushes, said spring tongues being formed as integral projections from a metallic strip.

40. A switch carriage comprising a plurality of brushes movably mounted thereon, conductor leads in the form of spring tongues, anchored to said carriage and bearing against said brushes, thereby imparting to said brushes a tendency to be thrust outwardly, the brushes being arranged in multiple sets, the spring tongues bearing against corresponding brushes being electrically united.

41. In a switch carriage, the combination with a plurality of movable terminals mounted upon said carriage, a metallic comb mounted upon but insulated from said carriage, the teeth of said comb being adapted to connect said terminals in multiple and impart to them a tendency to be thrust outwardly, and means for maintaining said terminals normally retracted.

42. In a switch carriage, the combination with a row of terminals fulcrumed to swing upon said carriage and arranged in sets, a plurality of metallic combs mounted upon but insulated from said carriage and from each other, the teeth of the respective combs bearing against corresponding terminals of the sets, thereby connecting them in multiple and imparting to them a tendency to

be thrust outwardly, latches maintaining said terminals normally retracted, each latch controlling the normal retraction of a set of terminals.

43. In a switch carriage, the combination with a plurality of brushes fulcrumed to swing upon an insulating support secured to said carriage, a spring tongue conductor lead for each of said brushes, said spring tongues being anchored at one end to said carrier frame and bearing at their opposite ends against said brushes, thereby imparting to said brushes a tendency to be thrust outwardly, insulating latch bars engaging said brushes, and a comb anchored to said carriage and having its teeth bearing against said latch bars thereby serving to maintain said brushes normally retracted against the thrust of said leads.

44. In a switch carriage, the combination with a plurality of brushes fulcrumed to swing upon an insulating support secured to said carriage, said brushes being arranged in sets, corresponding brushes in each set being multipled, insulating latch bars, one for each of said sets of brushes, a comb-spring mounted upon said carriage and having a tongue for each of said sets of brushes, said tongues bearing against said insulating latch bars, and thereby serving to maintain the brushes normally retracted.

45. In a switch carriage, the combination with a brush movably mounted upon said carriage, a spring tongue conductor lead mounted at one end upon but insulated from said carriage and bearing at its opposite end against said brush, thereby imparting to said brush a tendency to be thrust outwardly, the said spring tongue, in the movement of the carriage, having an alternate to and fro movement over the portion where it contacts with said brush, whereby free contact between said lead and brush is insured.

46. The combination with a switch carriage, of a plurality of brushes rotatably mounted to move independently upon said switch carriage, and a bar of insulating material having slots formed therein to provide teeth between which said brushes are arranged to move.

47. In a switch carriage, the combination with a vertical insulating shaft secured to said carriage, of a plurality of contact brushes fulcrumed to said shaft, a bar of insulating material mounted adjacent to said shaft and extending substantially parallel thereto, and a transverse slot for each brush extending across the face of said bar opposite the point where said brush is fulcrumed to said shaft, the said brush normally resting within the same.

48. In an interrupter, the combination with two contact-operating arms pivotally mounted upon a movable carriage, a trackway for each of said arms, one of said trackways being provided with teeth, and means for maintaining said arms in engagement with said trackways in the movement of said carriage, whereby the arm traveling upon the toothed trackway is caused to vibrate to make and break an electrical contact.

49. An interrupter comprising a pair of contact-operating arms mounted upon a movable carriage, in combination with two trackways of different contours, in fixed relation to each other, upon which the respective arms are adapted to ride in the movement of the carriage, whereby the operation of the contact is controlled in accordance with the variations in contour of said tracks.

50. An interrupter comprising a pair of contact-operating arms mounted upon a movable carriage, in combination with a plate formed to constitute two trackways of different contours mounted in fixed relation to each other, whereby the movement of said carriage over said trackways causes relative movement between said arms to make and break a contact.

51. An interrupter comprising pivotally mounted contact arms, a carriage for said arms, trackways over which said arms are arranged to travel, the configuration of said trackways causing relative movement of said arms to make and break an electrical contact therebetween in the movement of said carriage.

52. An interrupter comprising two trackways, one in the form of a rack and the other in the form of a rim, in combination with a pair of members mounted upon a carriage and adapted to travel over said trackways, an electrical contact controlled by said members, the member traveling over the rack making and breaking said contact in the movement of the carriage.

53. An interrupter comprising two trackways, one of said trackways being provided with a series of depressions, a pair of pivoted arms adapted to travel over said trackways, a carriage for said arms, the travel of said arms over their respective trackways causing a relative movement between them to make and break an electrical contact.

54. An interrupter comprising arms pivotally mounted upon a movable carriage, trackways for said arms, the configuration of said trackways causing relative movement of said arms, an electrical contact controlled by the said arms, the movement of the carriage causing the operation of said contact.

55. An interrupter comprising members mounted upon a carriage and movable toward and from each other to operate an electrical contact, an actuating member for causing relative movement of said members in the movement of said carriage, and means for compensating for variations in distance

between the line of travel of the carriage and the said actuating member.

56. An interrupter for automatic telephone exchange selectors comprising a rotatable support carrying contact controlling arms pivoted thereto, a segmental actuating plate adapted to cause relative movement of said arms to operate an electrical contact in the movement of said carriage, and means for compensating for eccentricities in radial distance between the axis of rotation of the rotatable support and said actuating plate.

57. An interrupter comprising members movable toward and from one another to control a contact, an actuating member cooperating with a contact controlling member, said members traveling relatively to produce the contact controlling movement and with the path traveled subject to deviations from the normal, and means for moving another of the contact members to compensate for such deviations.

58. A switching device provided with stationary contact terminals and a movable switch carriage having a contact brush adapted to traverse said terminals, in combination with an interrupter comprising a track mounted in fixed relation to said terminals, said track having variations in contour in definite correspondence with the positions of said terminals, and a contact-operating arm mounted upon said switch carriage and riding upon said track, whereby the operation of the contact is regulated in accordance with the passage of the contact brush over said terminals.

59. The combination with a switching device provided with stationary contact terminals and a movable switch carriage having contact brushes adapted to traverse said terminals, of an interrupter comprising a notched track mounted in fixed relation to said terminals, the notches in said track being in unvarying correspondence with the locations of said line terminals, and a pair of contact-operating arms mounted upon the said movable carriage and arranged to travel over said track, whereby the contact controlled by said arms is operated in accordance with the advance of the brush carrier over said terminals.

60. A switching device provided with stationary contact terminals and a movable switch carriage having a contact brush adapted to traverse said terminals, in combination with an interrupter comprising two trackways mounted in fixed relation to each other, one of said trackways being smooth, the other having variations in contour in definite correspondence with said contact terminals, a contact-operating arm riding upon said smooth trackway, and a second contact-operating arm riding over the other trackway and arranged to be vibrated to make and break a contact in accordance with the travel of said contact brush over said fixed terminals.

61. A switching apparatus provided with contact terminals and a movable switch carriage having contact brushes arranged to travel over said terminals, in combination with an interrupter comprising trackways mounted in fixed relation to said terminals, arms mounted upon the movable carriage and arranged to travel over said trackways, the configuration of said trackways causing a relative movement of said arms to make and break an electrical contact in the movement of said carriage.

62. A switching apparatus provided with contact terminals and contact brushes arranged to engage with said terminals, in combination with an interrupter comprising track-ways differing in contour, arms pivotally mounted upon a movable support and arranged to engage with said trackways, whereby relative movement of said arms with respect to said trackways causes said arms to make and break an electrical contact.

63. A switching apparatus for automatic telephone exchanges comprising line terminals arranged in rows, contact brushes arranged to traverse said terminals, a carriage for said brushes, in combination with an interrupter comprising a pair of trackways, each trackway being of a different configuration, a pair of arms arranged to ride over said trackways, an electrical contact controlled by said arms, said contact being made and broken in the movement of said arms over their respective tracks.

64. A switching apparatus provided with stationary contact terminals arranged in rows, brushes arranged to traverse said terminals, a carriage for said brushes, an interrupter associated with said switching apparatus comprising a pair of trackways differing in configuration and mounted in fixed relation to said rows of terminals, a pair of arms mounted upon the carriage and arranged to ride over said trackways, the configuration of said trackways causing said arms to make and break said contact for each of said rows of terminals in the movement of the carriage.

65. A switching apparatus provided with stationary line terminals arranged in vertical rows, brushes adapted to traverse said terminals, a carriage for said brushes, in combination with an interrupter comprising two trackways, one in the form of a rack, the other in the form of a rim, each notch in said rack bearing a definite relation to each vertical row of terminals, a pair of arms arranged to travel over said trackways, said arms being mounted on said brush carriage, an electrical contact con-

trolled by said arms, the movement of said arms over said trackways causing the operation of said contact in accordance with the travel of said brushes over said line terminals.

66. A switching apparatus comprising stationary terminals and a movable contact member coöperating therewith, a member associated with the terminals and being provided with depressions, one for each of said terminals, and a member movable with the contact member and coöperating with the depressions, said coöperation tending to stop the contact member in a definite relation to some one of the terminals.

67. A switching apparatus comprising stationary terminals, a movable contact brush adapted to traverse said terminals, a plate fixed to the terminal support and provided with depressions, one for each of said terminals, an arm movable with the contact brush, and a roller carried by said arm adapted to register with said depressions, whereby the coöperation of the roller and depressions tends to anchor the contact brush in definite relation to some one of the terminals.

68. A switching apparatus comprising an insulating support, of line terminals mounted in rows thereon, contact brushes adapted to traverse said line terminals, a movable carriage for said brushes, a plate secured to said insulating support and being provided with a series of depressions in definite correspondence with said rows of terminals, an arm carried by said support, a roller secured to said arm and adapted to register with said depressions, whereby the contact brushes are brought to a stop in definite relation to said rows of line terminals.

69. A switching apparatus comprising an insulating support, of line terminals arranged in vertical rows therein, a movable switch carriage having contact brushes adapted to traverse said rows of line terminals, a metallic plate secured to said insulating support and being provided with a series of depressions, each depression lying in the same plane with its corresponding row of terminals, a spring-pressed arm secured to said switch carriage and moving with said brushes, a roller carried by said arm and arranged to register with said depressions in the movement of said carriage, whereby when the contact brushes are brought to a stop, the roller tends to hold them centrally on the line terminals.

70. In a switch, the combination with a row of stationary terminals and a movable terminal adapted to traverse the same, of a device for measuring the movement of said movable terminal, said device having a contact adapted to be closed while the movable terminal is passing between successive stationary terminals and to be opened momentarily when the movable terminal is in contact with each of said stationary terminals.

71. In a switch, the combination with a plurality of stationary terminals arranged in a row and a movable terminal adapted to traverse said row, of a device having one part associated with said movable terminal and another part associated with said stationary terminals, one of said parts having a plurality of operative points corresponding in number and arrangement to the number and arrangement of said stationary terminals, and an interrupter operated by said device to measure the movement of said movable terminal over said stationary terminals.

72. In a switch, the combination with a row of stationary terminals and a movable terminal adapted to traverse said row, of a contact operating device adapted to be actuated in the movement of said movable terminal over said stationary terminals, said device having one part associated with said movable terminal and another part associated with said stationary terminals, one of said parts having a cam surface with depressions corresponding in number and arrangement to the number and arrangement of said stationary terminals.

73. In a switch, the combination with a movable member, of a device carried in part by said movable member and arranged to retain said member in any one of a number of positions away from normal, and a switch contact intermittently operated by said device to measure the movement of the movable member.

74. In a switch, the combination with a movable member, of a device comprising a cam and an arm coöperating therewith and arranged to retain the movable member in any one of a number of positions away from normal, and a switch contact intermittently operated by said device to measure the movement of the movable member.

75. In a switch, the combination with a movable member, of a device carried in part by said movable member and comprising a cam and an arm coöperating therewith, said device being arranged to retain said movable member in any one of a number of positions away from normal, and an interrupter actuated by said device as the movable member passes each of said positions.

76. A switch, comprising a movable member and a stationary member, a device having two coöperating parts associated with said movable member and said stationary member respectively, one of said parts being an arm and the other a cam, said device being adapted to retain the movable member of the switch in any one of several

positions away from normal, and a switch contact adapted to be intermittently operated by said device in the movement of the movable member.

77. A switch comprising a row of stationary terminals and a movable terminal adapted to traverse said row of stationary terminals, a switch contact adapted to measure the movement of said movable terminal over said stationary terminals, and a holding device adapted to retain said movable terminal in definite contact position with respect to any one of said stationary terminals, said contact device and said holding device having in common an arm associated with said movable terminal and a cam associated with said stationary terminals.

78. A switch comprising a row of stationary terminals and a movable terminal adapted to traverse the row of stationary terminals at uniform speed, a device for retaining said movable terminal in definite contact position with respect to any one of said stationary terminals, said device having a cam with depressions corresponding in number and arrangement to the number and arrangement of said stationary terminals, and an arm coöperating with said cam associated with said movable terminal, and a switch contact intermittently operated by said arm to measure the movement of said movable terminal.

79. The combination with a switch having stationary terminals and a movable terminal adapted to traverse the same, of switching mechanism for measuring the movement of said movable terminal over said stationary terminals, said switching mechanism having coöperating contact parts adapted to make and break contact with each other and means associated with the stationary terminals of the switch for controlling the engagement between the contact parts of said switching mechanism.

80. The combination with a switch having a plurality of stationary terminals and a movable terminal adapted to traverse the same, of switching mechanism adapted to measure the movement of said movable terminal over said stationary terminals, said switching mechanism having coöperating contact parts, and means associated with said stationary terminals for moving said contact parts out of engagement with each other once for each of the stationary terminals traversed by said movable terminal.

81. The combination with a switch having a plurality of stationary terminals and a movable terminal adapted to traverse the same, of switching mechanism adapted to measure the movement of said movable terminal over said stationary terminals, said switching mechanism having two coöperating contact parts, and means associated with said stationary terminals adapted to govern the relative movement of the contact parts of said switching mechanism.

82. In a switch, the combination with a plurality of stationary terminals arranged in parallel rows, of a plurality of movable terminals arranged in a row transverse to said rows of stationary terminals and adapted to be moved over the same, each of said movable terminals being adapted to traverse a particular row of stationary terminals, and connections between said movable terminals adapted to join the same in multiple connected groups.

83. An automatic switch, comprising a plurality of stationary terminals arranged in different levels, a plurality of normally retracted movable terminals one for each level of stationary terminals, means for causing the movement of said movable terminals over the stationary terminals in the corresponding levels, and means operating during the movement of said movable terminals to release a predetermined one of the same.

84. An automatic switch, comprising a plurality of stationary terminals arranged in different levels, a plurality of normally inactive movable terminals corresponding with the different levels of stationary terminals, mechanism adapted to cause a continuous and uni-directional movement of said movable terminals in two stages, mechanism actuated during the first stage of movement of said movable terminals and adapted to render active a particular one of the same, and mechanism adapted for operation in the second stage of the movement of said movable members to stop the same with the active movable terminal in engagement with a predetermined stationary terminal in the corresponding level.

85. A switch, comprising a plurality of stationary terminals and a plurality of normally inactive movable terminals adapted for uninterrupted and uni-directional movement in two stages, mechanism actuated in the first stage of the movement of said movable terminals to render active a particular one of the same, and mechanism adapted to be made operative to cause said selected movable terminal to select and engage a stationary terminal in the second stage of the movement of said movable terminals.

86. An automatic switch, comprising a plurality of stationary terminals, a plurality of normally retracted and inactive movable terminals arranged for uni-directional movement over said stationary terminals, mechanism actuated by the movement of said movable terminals to release and render active a predetermined one of the same, and mechanism adapted to be operated in the movement of said movable ter-

minals to cause said selected active terminal to stop in engagement with a particular one of said stationary terminals.

87. An automatic switch, comprising a plurality of stationary terminals, a plurality of normally inactive movable terminals adapted to traverse said stationary terminals in the movement of the switch, selecting mechanism adapted to be operated in the movement of the switch to render active any predetermined one of said movable terminals and mechanism for causing an uninterrupted movement of the movable terminals of the switch, first into operative relation with said selecting mechanism to select and render active a particular one of said movable terminals, and then into operative relation with said stationary terminals to cause said active movable terminal to engage a particular one of the stationary terminals.

88. An automatic switch, comprising a plurality of stationary terminals, a plurality of normally retracted movable terminals, motor mechanism for causing a predetermined movement of said movable terminals over said stationary terminals, and mechanism actuated during the uninterrupted movement of the movable terminals to select and thrust forward a particular one of the same into position to complete connection with the stationary terminal upon which it comes to rest.

89. A switch, comprising a plurality of stationary terminals, a switch carriage carrying a plurality of normally retracted and inactive movable terminals adapted to cooperate with said stationary terminals, and mechanism actuated by the movement of said switch carriage to release and render operative one or another of said movable terminals.

90. A switch, comprising stationary terminals, a switch carriage carrying a movable terminal adapted to coöperate with said stationary terminals, a constantly rotating power shaft, and a magnetic clutch controlling the connection of said switch carriage with said power shaft, said magnetic clutch having a core rotating with said shaft, and a stationary energizing winding.

91. A switch, comprising a row of stationary terminals mounted in a terminal block with one end of each terminal projecting slightly beyond the plane of one face of said terminal block, and a switch carriage carrying a movable terminal adapted to traverse said stationary terminals in the movement of the carriage, said movable terminal being in the form of a lever fulcrumed upon said switch carriage and having a face adapted to engage the projecting ends of said stationary terminals, and a spring adapted to complete electrical connection with said movable terminal lever and thrust the same against the faces of said stationary terminals as it is moved over them.

In witness whereof, I hereunto subscribe my name this 22nd day of July, A. D., 1910.

FRANK R. McBERTY.

Witnesses:
MORGAN WASHBURN, Jr.,
GUY M. CAMPBELL.