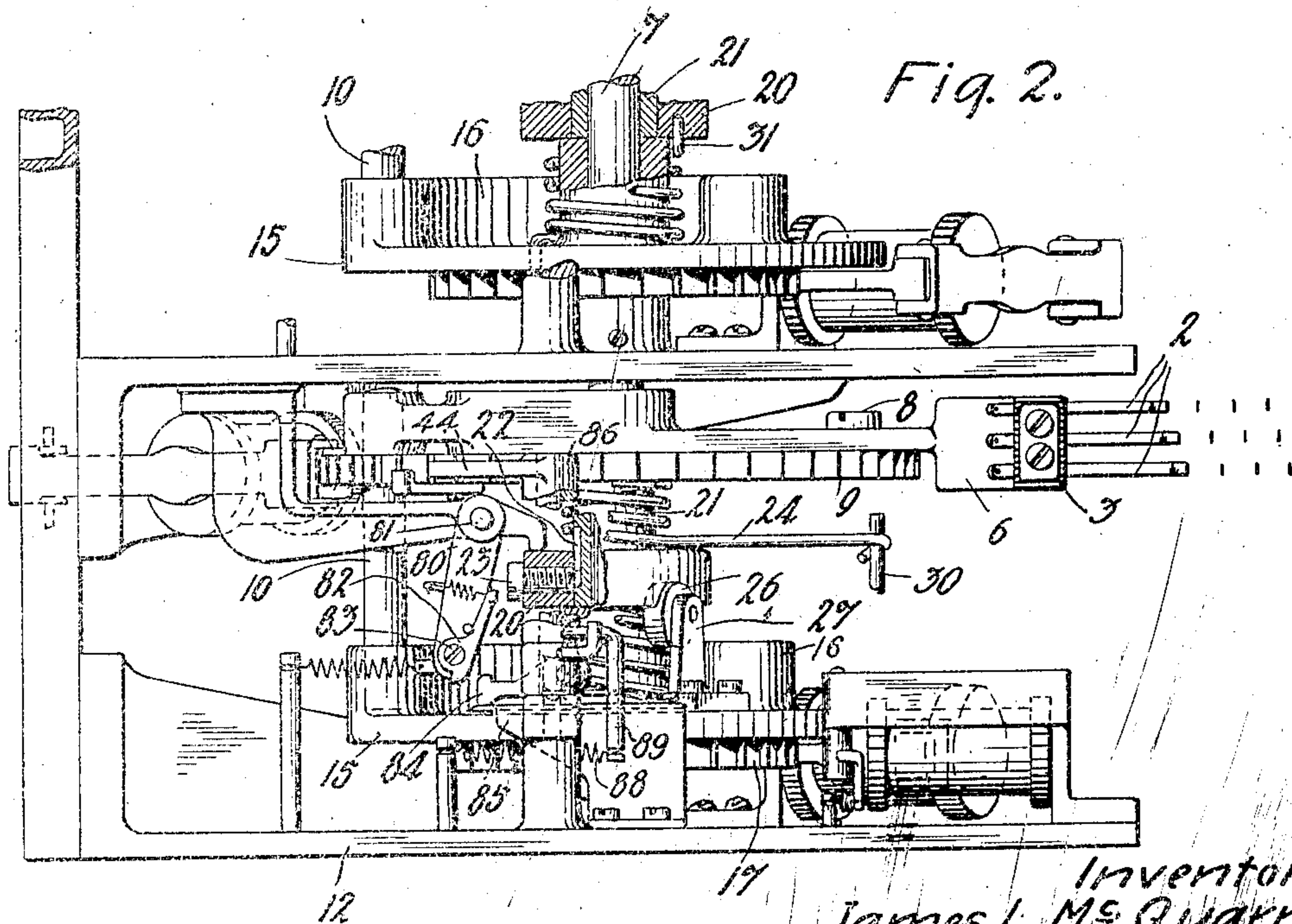


1,298,365.

2 SHEETS—SHEET 1.



Inventor:  
James L. McQuarrie.

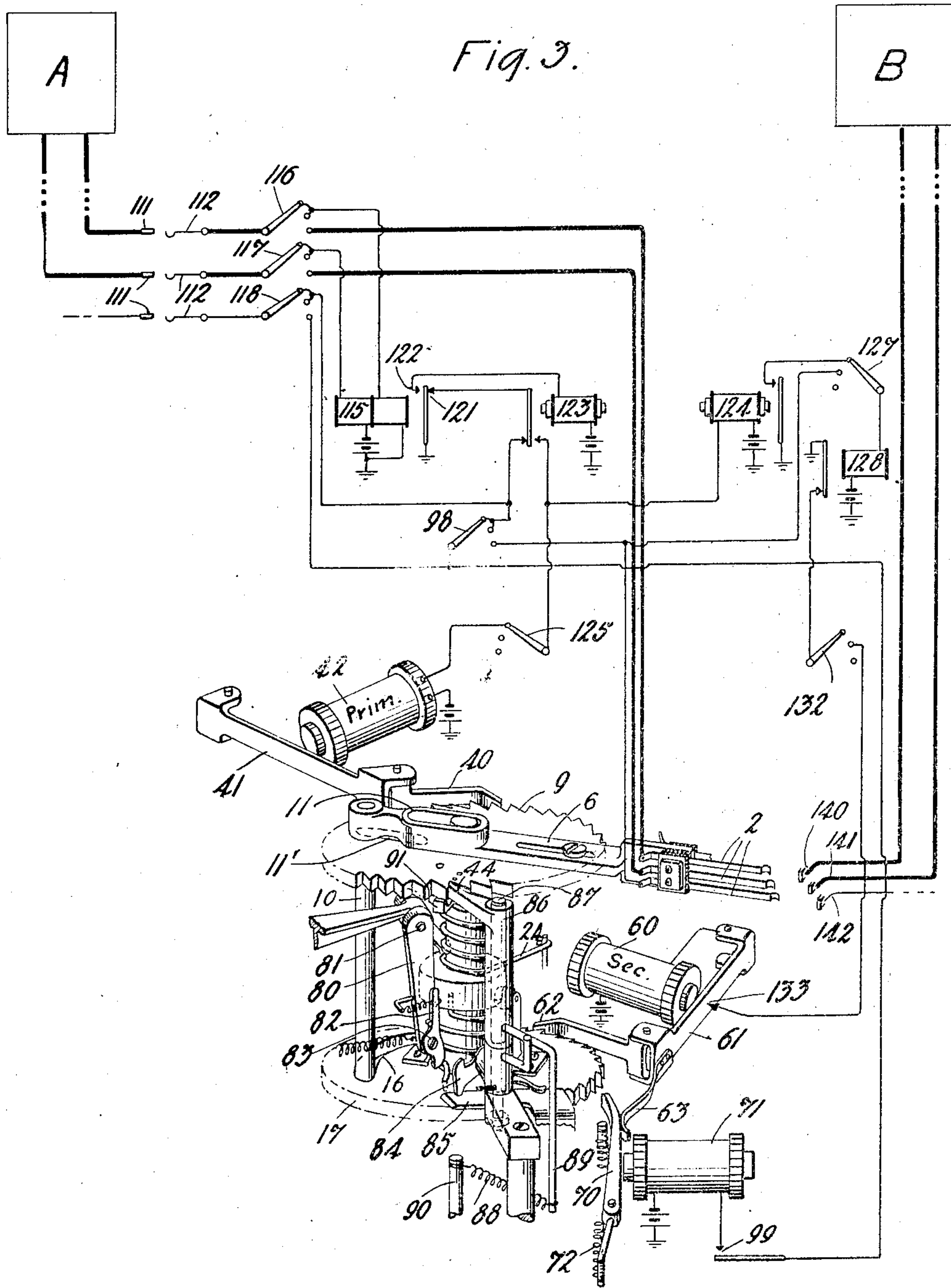
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J. E. Roberts Att'y

1,298,365.

Patented Mar. 25, 1919.

2 SHEETS—SHEET 2.



Inventor:  
James L. McQuarrie.

by *J. G. Roberts* Att'y.



# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

1,298,365.

Specification of Letters Patent. Patented Mar. 25, 1919.

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*To all whom it may concern:*

Be it known that I, JAMES L. McQUARRIE, a citizen of the United States, residing at Montclair, in the county of Essex and State of New Jersey, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to automatic switching apparatus for telephone exchange systems, and has for its object the provision of apparatus of this type which will be compact in structure, efficient in operation, and low in cost of production and maintenance.

A switching mechanism made in accordance with this invention comprises in general a brush operating mechanism arranged to move contact brushes from their normal position, in two separate directions in the same plane into engagement with contacts, one of the movements being rotary and the other radial. The contacts are arranged in groups in banks circumscribing the axis of rotation of the switch and are adapted to be engaged by the brushes in their radial movement. That is, a brush set is rotated to select a desired group and is then moved radially to establish connection with a desired terminal set in the selected group. The panel contact banks may be multiple banks of the well-known type of construction, but instead of being multiplied horizontally, the contacts are multiplied vertically.

In the drawings illustrating this invention,

Figure 1 is a plan view of the switch;

Fig. 2 is a side elevation of the switch; and

Fig. 3 is a view showing a partial perspective of the switch, in conjunction with a circuit arrangement suitable for operating such switch in a telephone system.

The brush operating mechanism which is illustrated in Figs. 1 to 3 inclusive is designed to rotate step by step to a group of lines and then moved radially into engagement with a desired contact in the selected group. As shown in the drawings 2, 2 designate brushes mounted upon a carriage 6, which is supported by a toothed wheel 9 rotatably mounted on a shaft 7 secured to a frame 12. The brush carriage 6 has two slots, 11 and 12. The shaft 7 extends

through the slot 11. A third slot 11' (see Fig. 3) is provided in the toothed wheel 9, through which a shaft 10 fixed to the brush carriage 6 extends. The shaft and the stud guide the brush carriage in its radial movement.

A toothed wheel 17 arranged to be rotated in a direction opposite to that of toothed wheel 9 and having a plate 15 secured thereto is also mounted rotatably on the shaft 7. A hub 21 is secured to the toothed wheel 9. A collar 20, keyed to the hub 21 by means of a slot 22 and a stud 23, is slidable upon the hub 21 and rotates therewith. The collar 20 is limited in its downward movement by a flange on the hub 21. The lower side of collar 20 has a cam surface and is engaged by two cam rollers 26 and 26' pivoted to two angle irons 27 and 27' fixed to plate 15 and located upon opposite sides of the shaft 7. Return movement of the toothed wheel 9 is effected by means of a spring 24 fastened at one end to a pin 30 secured to the frame and at the other end to any convenient point on the wheel 9. An other function of the spring 24 is to hold the collar 20 in its lowermost position in the normal position of the switch. The downward pressure of the spring 24 upon the collar 20 in conjunction with the rollers 26 and 26' provide a flexible connection between the toothed wheels 9 and 17, that is, when said rollers rest in the grooves in collar 20 the toothed wheels 9 and 17 rotate together and when said rollers rest upon the straight surface of collar 20 the wheel 17 may be rotated alone.

In the first movement of the apparatus in response to impulses through the stepping magnet 42, the pawl 40 pivoted upon the armature 41 will engage the toothed wheel 9 to rotate said toothed wheel, the brush carriage, the collar 20 and the toothed wheel 17 to a desired group of terminals. This action tensions the spring 24. A pawl 44 of a member 86 holds the toothed wheel 9 in the selected position. At the cessation of the first series of impulses through the stepping magnet 42, a side switch 128 will be caused to operate, thus disconnecting magnet 42 from the stepping circuit, and bringing into service magnet 60. Magnet 60 has an armature 61 carrying a pawl 62 adapted to engage the toothed wheel 17. The plate 15 has



an eccentrically arranged raised portion 16, provided with a groove which acts as a cam for shaft 10, secured at its upper end to the brush carriage 6. When the toothed wheel 17 is rotated and the toothed wheel 9 is locked, the resultant radial movement of shaft 10, in the groove of the raised portion 16, and the slot 11' in the toothed wheel 9, moves the brush carriage to advance the brushes into engagement with the desired terminal.

As stated heretofore, after the first series of impulses has been sent, magnet 60 is connected in the circuit. In response to impulses, magnet 60 operates to rotate the toothed wheel 17 and the plate 15. The cam rollers 26 and 26' force the collar 20 upwardly, compressing the spring 24. This upward movement of the collar 20 disconnects toothed wheels 9 and 17 so that the rotation of the latter does not move the former. The rotation of toothed wheel 17 and plate 15, however, causes the brush carriage to be moved radially, due to shaft 10 extending into the groove of the raised portion 16, of the plate 15. The first attraction of the armature 61 of the magnet 60 moves the holding pawl 70 of the magnet 71 by means of the arm 63 of the armature 61 into engagement with a tooth of the toothed wheel 17. A spring 72 holds the pawl in this position, thus preventing a backward movement of the toothed wheel 17.

Restoration of the switch to normal position is effected by magnet 71 being energized. This attracts the pawl 70, thus releasing the toothed wheel 17. Toothed wheel 17, in moving back to normal position under action of the spring 31, permits the cam rollers 26 and 26' to again enter the cut-out portions of the collar 20. The downward movement of collar 20 permits the bell crank lever 80 to be moved about its pivot 81, thus withdrawing pawl 82, pivoted at 83, from engagement with arm 84, said pawl having previously engaged arm 84 when the collar 20 was moved upwardly. In assuming its normal position pawl 82 pulls arm 84 over the edge of plate 85 until the pawl is released. The arm 84 is secured to the member 86, which is rotatably mounted on a shaft 87. When the member 86 is pulled around by the pawl 82 acting upon the arm 84, the pawl 44 is moved out of engagement with the teeth of the wheel 9, thus permitting said wheel to return to normal position under action of the spring 24. The spring 88, having one end fastened to a pin 90 on the frame and the other to a lever 89 fixed to the member 86, holds the pawl 44 out of engagement with the teeth of wheel 9 until a lug 91 fastened to said wheel engages said pawl. Lug 91 striking the pawl 44 forces said pawl back into engagement with the teeth of wheel 9 and the switch is ready for another call.

In Fig. 3 the switch mechanism of this invention is shown connected in a circuit to function as a selector, although it is obvious that the device is not limited to this specific use.

Referring to Fig. 3, A may represent a calling subscriber's station, the line for which is connected with line switch terminals 111, 111 adapted to be engaged by movable contacts 112, 112. Assuming that the subscriber at station A desires connection with a subscriber, say at substation B, the operation will be as follows. The subscriber A, upon removal of his receiver from the switchhook, will automatically have his line connected with the movable contacts 112, 112 in a well-known manner through the operation of the line switch. Following the closure of the line switch contacts, a relay 115 will be energized over the line circuit through position one of the side-switch wipers 116 and 117, controlled by the selector switch embodying the features of this invention. The energization of relay 115 will cause it to open its back contact 121 and close its front contact 122 to ground, thereby completing a circuit including a slow release relay 123.

After removing his receiver from the hook the subscriber A will operate his dial in the usual manner to send the required number of impulses to move the brushes 2 into position to engage contacts in the group with which the switching apparatus associated with subscriber B may be connected. In the particular instance, we will assume that contacts in the second group of contacts are sought, in which case two impulses will be sent from station A. These impulses open the circuit of relay 115 to cause it to intermittently close its back contact 121, thereby completing a parallel circuit, one limb including slow release relay 124, the other limb including primary magnet 42, the latter circuit including a side-switch wiper 125 in its first position. Relay 124, upon energization, closes its contact to complete a circuit from ground, through the armature and front contact thereof, side-switch wiper 127 in its first position and escapement magnet 128 to grounded battery. The relays 123 and 124 both being of the slow release type, will retain their armatures attracted during the sending of impulses. The stepping magnet 42, however, will respond to the impulses resulting from the opening and closing of the contact 121 to step the toothed wheel 9 and with it the toothed wheel 17 and the brushes 2 around to the desired group of contacts. At the end of the second step or impulse from the station A, the relay 115 will remain energized and open the circuit of the relay 124 at contact 121, causing its armature to be released, thus opening the



circuit of the escapement magnet 128. The armature of the escapement magnet 128, a releasing moves all of the side-switch brushes from their first to their second position.

5 As soon as the side-switch wiper 132 is moved to its second position, a circuit will be completed for the stepping magnet 60, which may be traced from ground through armature and contact of escapement magnet 128, 10 side-switch wiper 132 (second position), a contact 133 at armature 61 of stepping magnet 60, armature 61 and through the winding of magnet 60 to grounded battery. This circuit will exist so long as magnet 128 is not 15 energized. Upon the first energization of magnet 60 the arm 63 secured to the armature 61 causes the pawl armature 70 of magnet 71 to be moved into engagement with the teeth of toothed wheel 17 to act as a holding 20 pawl. The magnet 60 upon energization steps the toothed wheel 17 around in a direction opposite to that which it had been previously stepped by the magnet 42. The magnet 60 in stepping the toothed wheel 17 causes 25 the collar 20 to be moved upwardly, thus disconnecting the toothed wheel 9 from the toothed wheel 17 and moving the brushes 2, 2 radially into engagement with the desired terminal. If any of the contacts of this 30 group have been taken for use by another switch, there will be battery potential on the test contacts 142, so that escapement magnet 128 will not be energized. The stepping operation will be continued until the brushes 35 2, 2 rest on a set of contacts, the contact 142 of which is grounded. When this occurs, a circuit for the escapement magnet 128 will be closed, which may be traced through the grounded contact 142, lower brush 2, side-switch wiper 127 (second position), winding 40 of magnet 128 to grounded battery. Escapement magnet 128 upon energization attracts its armature, thus opening the circuit of magnet 60 and moving all of the side-switch 45 wipers into position 3. It should be noted that the teeth on the escape wheel for escapement magnet 128 are so arranged that the wipers are moved from position 1 to 2 upon deenergization and from 2 to 3 upon energiza- 50 tion.

In their third position the wipers 116, 117 connect the circuit of station A with contacts 140, 141 leading through the two upper brushes 2, 2. When conversation has been 55 completed and the succeeding switches have returned to normal position, a ground will be placed upon brush 142, causing release and return of the switch to normal position. The release circuit may be traced from grounded 60 contact 142, lower brush 2, side-switch wiper 98 (third position), off normal contact 99, winding of magnet 71, to grounded battery. The attraction of armature 70 of magnet 71 releases toothed wheel 17, which when it has 65 reached normal position, causes, by the sys-

tem of levers hereinbefore described, the pawl 44 to be disengaged from the teeth of toothed wheel 9, allowing it to return to normal position. The return of toothed wheel 17 to normal position causes the brushes 2, 2 to be 70 radially withdrawn from the contacts, and the return of the toothed wheel 9 causes the brushes to be rotated back to their normal position.

From the description of the invention it is 75 obvious that the switching mechanisms are compact in form and may be mounted one over the other, thus economizing in space and providing apparatus which will select 80 contacts accurately and rapidly.

What is claimed is:

1. The combination with a plurality of terminal banks arranged vertically, of a plurality of superimposed switches each having a set of brushes movable in a horizontal 85 plane, said brushes being arranged to select a bank by a rotative movement and to select a terminal in the selected bank by a radial movement.

2. The combination with a plurality of 90 panel type multiple terminal banks arranged vertically and in a circle, the faces of said banks being in a radial plane with respect to said circle, of a plurality of superimposed switches each having a set of brushes pivoted 95 at the center of said circle and movable in a horizontal plane, said brushes being arranged to select a bank by a rotative movement, and to select a terminal in said bank by a radial 100 movement.

3. In an automatic switch, a shaft, a brush carriage movably mounted thereupon, brushes mounted on said carriage on a plane at an angle to the plane of said carriage, a plurality of groups of contacts, said groups 105 of contacts being in separate banks and arranged to extend radially from the shaft, means to rotate said brushes to select a group of contacts, and means to radially move said brushes to select a desired contact in the se- 110 lected group.

4. In an automatic switch, a shaft, a brush carriage movably mounted upon said shaft, brushes for said brush carriage mounted in a plane at an angle to the plane of said car- 115 riage, a plurality of groups of contacts in a horizontal plane, each of said groups of contacts extending radially from the axis of rotation of said shaft and lying in the same plane as the plane of said brushes, means for 120 rotating said brush carriage to cause said brushes to select a group of contacts, means for radially moving said brush carriage to cause said brushes to select a desired contact in the selected group of contacts, and means 125 for returning said brush carriage to normal position.

5. In an automatic switch having two selective movements only, a frame, a shaft se- 130 cured to said frame, a toothed wheel mounted



on said shaft, a set of brushes mounted on said toothed wheel and arranged to be moved radially with respect to the shaft, an escapement mechanism, means controlling said escapement mechanism for causing said set of brushes to be rotated with said toothed wheel, and means for holding said toothed wheel stationary and moving said brushes radially.

In witness whereof, I hereunto subscribe my name this 18th day of October, A. D., 1917.

JAMES L. McQUARRIE.