J. L. McQUARRIE & C. L. GOODRUM.

TELEPHONE SYSTEM.

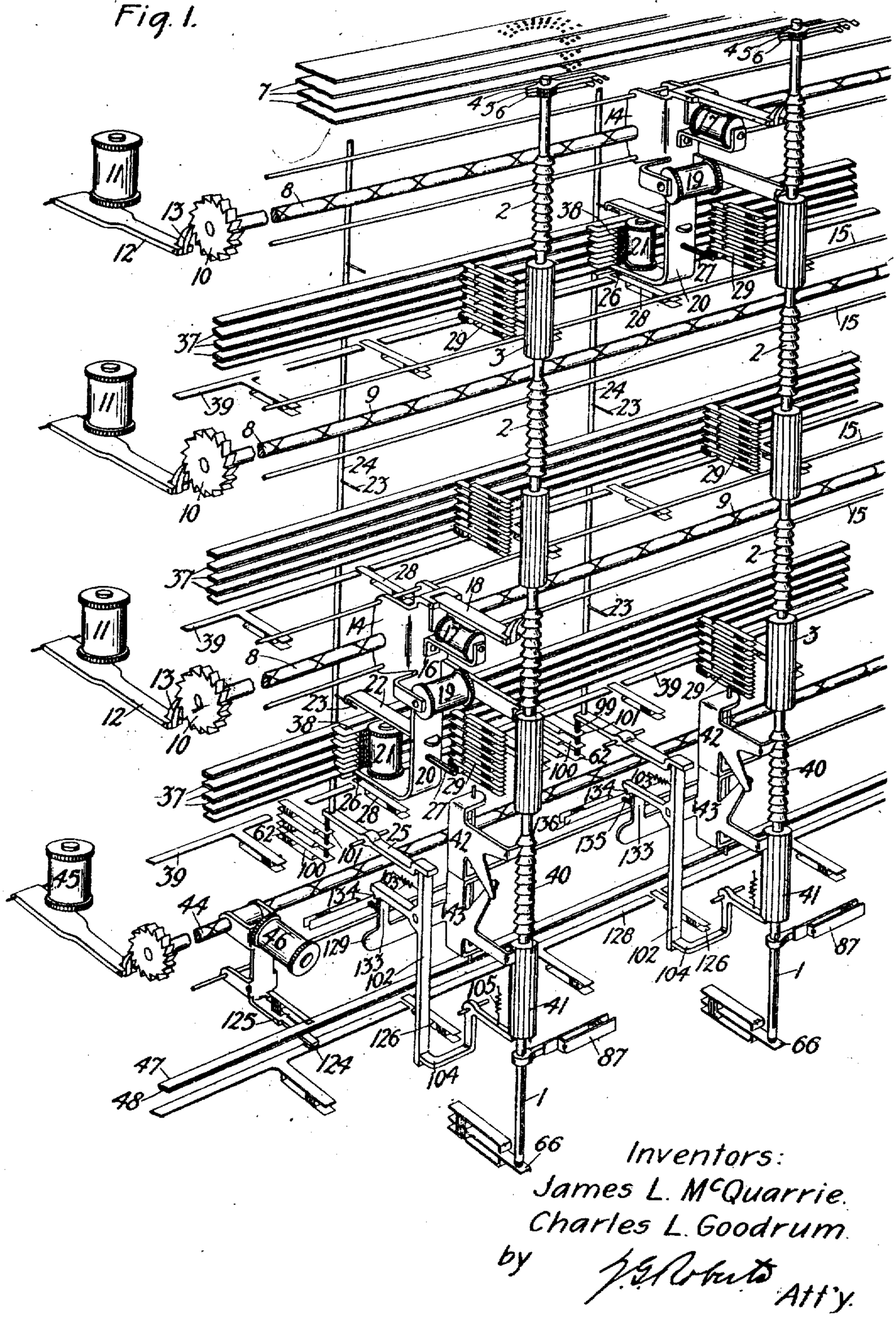
APPLICATION FILED NOV. 21, 1917.

1,298,237.

Patented Mar. 25, 1919.

2 SHEETS—SHEET 1.

Fig. 1.



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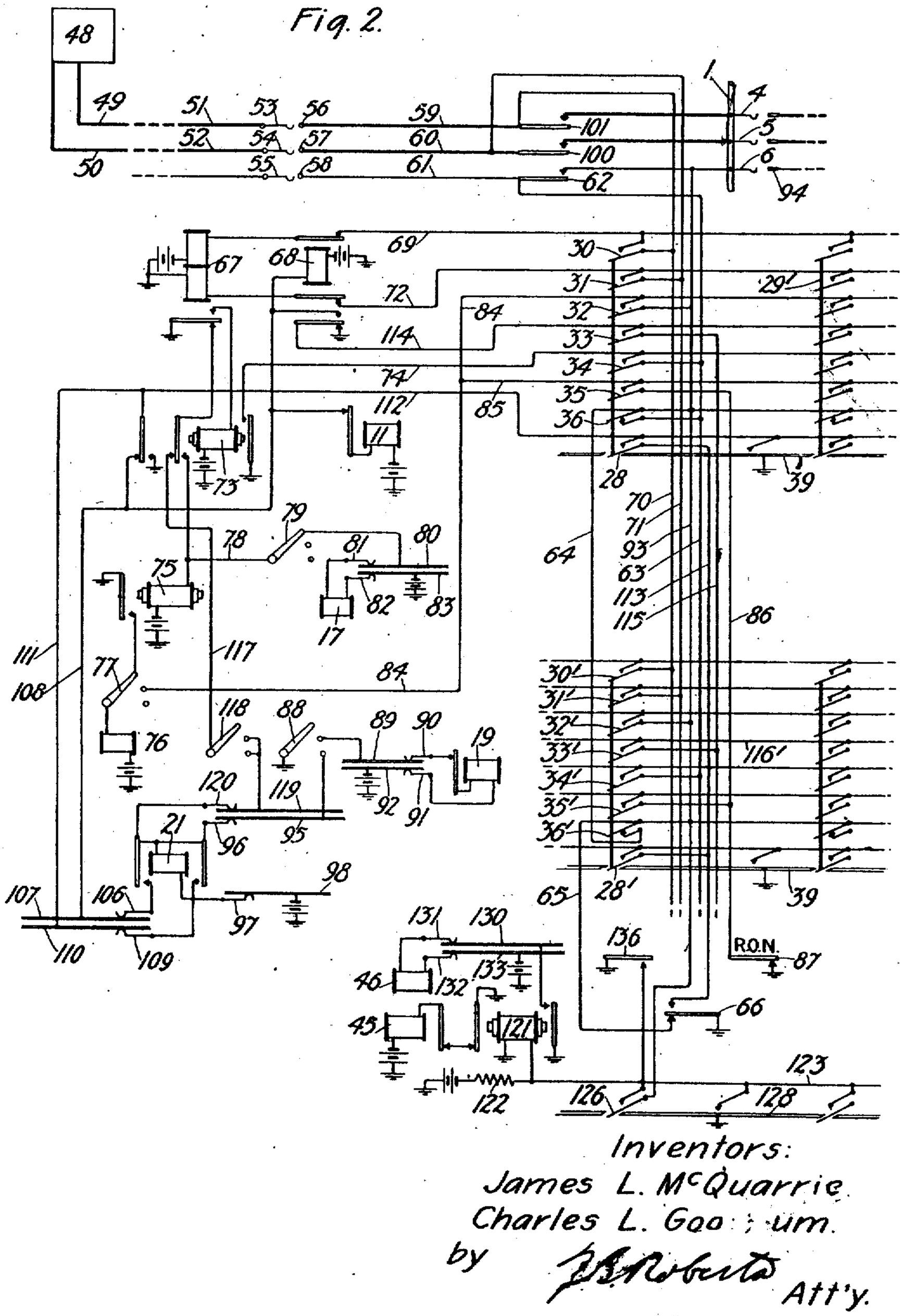
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

JAMES L. McQUARRIE, OF MONTCLAIR, NEW JERSEY, AND CHARLES L. GOODRUM, OF NEW YORK, N. Y., ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,298,237. Specification of Letters Patent. Patented Mar. 25, 1919.

Application filed November 21, 1917. Serial No. 203,092.

To all whom it may concern:

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

This invention relates to telephone systems employing machine switching apparatus for establishing connections, and more particularly to the circuit arrangement for controlling the operation of the switching apparatus.

In a copending application of J. L. McQuarrie, Serial No. 203,971, filed November 26, 1917, there is shown and described a switch structure in which a plurality of selectively operable step-by-step switches are arranged in a group and provided with a plurality of master actuating mechanisms, common to all the switches of the group, and with means for operatively associating any one of these mechanisms with any one of the switches.

An object of the present invention is the provision of circuits and means, to be used in connection with switches of the character described in the above mentioned application, whereby a switch will test busy either when engaged in extending a connection, or when idle and there is no common master mechanism operatively associated therewith.

Another object is the provision of means whereby a master device, in its search for an idle switch of the group, is capable of discriminating between switches which have some other master device allotted thereto and those which have not, thus preventing more than one of such devices becoming associated with a switch at the same time.

Still another feature consists in circuit means for controlling the operation of the release mechanism, which is common to the group of switches, and in such a manner that said mechanism is capable of positioning itself before and releasing any switch that is found in proper condition to be returned to normal.

These and other objects will be more clearly understood from a consideration of the following description, taken together with the accompanying drawings, wherein:

Figure 1 is a perspective view of a portion of a group of selective switches showing the master operating mechanisms and the common releasing apparatus associated therewith.

Fig. 2 illustrates a portion of the circuits arranged in accordance with the present invention for controlling the operation of the switches shown in Fig. 1.

Referring to Fig. 1, a group of switch shafts 1 are each provided with a plurality of vertical and rotary stepping ratchets 2 and 3. Fixed to the upper end of each shaft is a set of brushes 4, 5 and 6 arranged to be elevated into operative relation to any level in the bank 7 by shaft 1, and thereupon rotated onto a desired set of terminals in such level. A number of worm members 8, one for each set of vertical and rotary ratchets 2 and 3, are disposed parallel to one another adjacent to the switch shafts 1. The surface of these worms is provided with an endless spiral slot or groove 9. Attached to the end of each worm is a driving ratchet 10. A drive magnet 11, having an armature 12 and pawl 13, serves, when energized, to rotate worm 8 in its bearings (not shown).

A supporting frame 14 is loosely mounted upon each of the endless worms 8, and is provided with any suitable means for engaging the slot thereof, whereby rotation of such worm causes frame 14 to move back and forth before switch shafts 1. Frame 14 is also slidably mounted upon a pair of stationary rods 15, which accurately guide said frame in its movement from position to position. A mounting bracket 16 secured to the frame 14 supports the primary or vertical stepping magnet 17. Magnet 17 has an armature 18, pivotally attached to frame 14 with its working end provided with a stepping pawl so arranged as to engage and operate the vertical ratchet 2 when the master device is positioned before a switch shaft 1. A secondary or rotary stepping magnet 19 is also mounted on the frame 14 and likewise has an armature adapted to engage and rotate shaft 1 through the medium of rotary ratchet 3. The lower portion of the frame 14 is turned under to form a supporting table 20, upon which a magnet 21 is mounted. Said magnet has an armature 22, pivoted to

frame 14, and extending into coöperative relation with the pins 23 of vertical rods 24, whereby energization of the magnet, when frame 14 is positioned before a shaft 1, causes rod 24 to be moved downward against the end of a lever 25. Secured to frame 14 are two pins 26 and 27; the former of which serves to close a contact 28, and the latter to shift all the contacts of the set generally designated as 29 when the common device assumes its position before the switch 1. The contact set 29 comprises seven sets of individual contacts of which, as shown in Fig. 2, 30 to 35 inclusive are normally open, and contact 36 is normally closed at all times except when moved to their alternate positions by the pin 27 of a stepping device.

Arranged adjacent to the shafts 1 of the entire group of switches and individual to each master stepping device is a set of contact strips 37. These strips are insulated from each other and may be secured in position in any convenient manner. A set of brushes 38, insulatedly mounted upon the table 20, slidingly engage their respective contact strips 37 for the purpose of conveying current to and from the operating magnets 17, 19 and 21. The contact strips 39, which are arranged between adjacent switch shafts 1, serve a purpose hereinafter to be described.

Each shaft 1 also has a vertical and rotary holding ratchet 40 and 41, with which the pawls 42 and 43 respectively coact to retain said shaft in its actuated position. An endless worm 44, similar to worms 8 is mounted before the group of switches 1 to be rotated by a stepping magnet 45. A release magnet 46, mounted upon worm 44, and common to all switches, acts to withdraw holding pawls 42 and 43 when positioned before a switch that is in condition to be released. Contact strips 47 and 48 convey current to the magnet 46. As the operation of the switches will be understood from the following description of the circuits it is believed a further detailed explanation thereof is unnecessary. However, reference is made to the above mentioned application of J. L. McQuarrie, Serial No. 203,971, filed November 26, 1917, wherein a complete description is given of the switch structure.

A description will now be given of the operations involved in extending a telephone connection in a system where the present invention is employed. For the purpose of explanation it will be assumed that the telephone system illustrated in the drawings uses finder or other preliminary switches, first selectors, second selectors and connectors. The switches shown and described in the drawings will be considered as used in the capacity of second selectors. According to the well-known practice of trunking, each level of trunks in a first selector leads to a group of say, ten second selectors, all of which have access through the succeeding connectors to any line in a given 1,000 lines. Therefore, since the second selector switches may be considered as divided into groups according to the numerical grouping of subscribers' lines, a convenient adaptation of the present invention is to provide each such group of second selectors, as shown in the drawings, with a plurality of common stepping devices. A first selector in testing any particular level of its trunks may then obtain any second selector of a group that is served by a number of common actuating devices.

Assume that the subscriber at substation 48, Fig. 2, desiring to converse with some other subscriber, removes his receiver from its switchhook to start the operation of a finder or line switch. Such switch, which may be included in that portion of the connection illustrated by the broken lines in the figure, operates in the well-known manner to connect the line conductors 49 and 50 to the trunk conductors 51 and 52, terminating in brushes 53 and 54 of a first selector switch. The subscriber now operates his sender to transmit a desired number of impulses to the operating mechanism of the first selector, whereby the brushes 53, 54 and 55 are moved into operative relation to the desired level of trunk terminals. Terminals 56, 57 and 58 may represent the first set of terminals in such level and are associated by means of trunk conductors 59, 60, 61 with brushes 4, 5 and 6 of a second selector switch, as those shown in Fig. 1. Assume now that the switch shaft 1 associated with the trunk 59, 60, 61 is in its normal restored position, and that a master stepping mechanism, such as the one shown in Fig. 2, has previously been positioned before such switch in readiness to operate it as soon as it is taken for use. This being the case the pins 27 and 26 on the supporting frame 14 are holding the contacts of the set 29 and contact 28 respectively in their alternate positions, whereby contacts 30 to 35 inclusive and 28, Fig. 2, are closed, while contact 36 is open. The contact 36 by being open places a break point in the following circuit from the test contact 62 to ground: test contact 62, conductor 63, contact 36, conductor 64, contact 36', conductor 65, to ground at the off-normal contact 66.

Therefore, when the first selector switch begins its secondary or hunting movement and takes its first step onto the trunk terminals 56, 57 and 58, no guarding ground potential will be found by test brush 55 upon test terminal 58, thereby indicating that the switch associated with the trunk 59, 60, 61 is in proper condition to be selected.

Thereupon the first selector comes to rest and extends the connection by way of trunk

conductors 59 and 60 to the switch shown in the drawing. A circuit is now closed for the line relay 67 from free pole of battery, upper winding of such relay, upper armature and contact of cut-off relay 68, conductor 69, closed contact 30, conductors 70 and 59, terminal 56, brush 53, conductors 51 and 49, over the loop of substation 48, conductors 50 and 52, brush 54, terminal 57, conductors 60 and 71, closed contact 31, conductor 72, inner lower armature of cut-off relay 68, lower winding of relay 67 to ground. Relay 67 on attracting its armature closes a circuit for the slow relay 73, traceable from ground, armature and front contact of relay 67, winding of relay 73 to the free pole of battery. The relay 73 energizes and at its right-hand armature places a ground, by way of the following circuit, upon all multiples of the test conductor 61 at the first selector switches, so that any other switch testing such multiples will find the same guarded so long as relay 73 remains energized. This circuit extends from ground, right-hand armature and contact of relay 73, conductor 74, closed contact 34, conductors 63 and 61 to test contact 58 and other multiples thereof.

The calling subscriber, proceeding to manipulate his sender in accordance with the second digit of the called number, interrupts the above traced circuit of line relay 67, thereby causing the same to vibrate its armature a corresponding number of times. Upon the first retraction of said armature, the following circuit is closed for the slow relay 75: ground, armature and back contact of relay 67, inner left-hand armature and front contact of relay 73, winding of relay 75 to battery and ground. Relay 75 by energizing establishes a circuit for escape magnet 76 from ground, armature and contact of relay 75, side-switch arm 77 and its first position contact, winding of magnet 76 to battery and ground. The following circuit is also closed simultaneously with the energization of relay 75 for the primary stepping magnet 17 of the master mechanism: ground, armature and back contact of relay 67, inner left-hand armature and front contact of relay 73, conductor 78, side-switch arm 79 and its first position contact, contact strip 80, brush 81, winding of stepping magnet 17, brush 82, contact strip 83, to battery and ground. The magnet 17 thereupon attracts its armature 18, and through the agency of its stepping pawl and the vertical ratchet 2, steps the shaft 1 up one step. Likewise, for each succeeding retraction of the line relay 67 an impulse is sent to magnet 17 and the shaft 1 is elevated to position its brushes 4, 5 and 6 in operative relation to the desired level of contacts in the bank 7.

At the termination of the second series of impulses the line relay 67 holds its armature attracted, and after a sufficient period has elapsed, relay 75 deënergizes, thereby opening the circuit of the escape magnet 76. Magnet 76 by deënergizing allows the side switch to escape into second position. In this position magnet 76 is immediately energized over the following circuit: free pole of battery, winding of magnet 76, side-switch arm 77 and its second position contact, conductors 84 and 85, closed contact 35, conductor 86, secondary off-normal contact 87, to ground. With the side switch in second position a circuit is also completed as follows for the secondary magnet 19 of the master mechanism: ground, side-switch arm 88, contact strip 89, brush 90, contact and armature of magnet 19, winding of said magnet, brush 91, contact strip 92, to battery and ground. Upon energizing, the stepping magnet 19 attracts its armature to automatically rotate the shaft 1, carrying the brushes 4, 5 and 6 step by step, over the trunk terminals of the selected level. Busy trunks are identified by the presence of a ground upon their test terminals. At the first rotary step of the shaft 1 the secondary off-normal contact 87 is opened, thereby opening the energizing circuit previously traced for the escape magnet 76. If, however, the first trunk in the level, upon which the brushes 4, 5 and 6 are momentarily resting is busy, a holding circuit is established for escape magnet 76 as follows: battery, winding of magnet 76, side-switch arm 77 and its second contact, conductor 84, closed contact 32, conductor 93, test brush 6, to the grounded test terminal 94. The side switch thus remains in position 2 and the magnet 19, by interrupting its own circuit, continues to rotate the switch until its brushes encounter an idle trunk. When this occurs, the escape magnet becoming deënergized steps the side switch into position 3, thereby bringing the selector switch to rest.

As the side switch arrives in its third position a circuit is completed from ground, side-switch arm 88, contact strip 95, brush 96, winding of magnet 21, brush 97, contact strip 98, battery. Magnet 21 upon attracting its armature 22, Fig. 1, causes the same to engage the pin 23 on vertical rod 24 to move said rod downwardly against the end of lever 25. Lever 25 being tilted about its pivot presses against the pin 99 to engage the springs 62, 100 and 101 with their respective contacts. As seen in Fig. 2 this results in extending the trunk 59, 60, 61 through to brushes 4, 5 and 6 of the selector as soon as said selector has completed its secondary movement. Thus the connection is extended to the next switch in the train which may be operated in the well-known manner. The shouldered end of lever 25, against which the upper end of the intermediate lever 102 normally rests, as shown in Fig. 1, being tilted upwardly by the ac-

tion of rod 24 permits lever 102 to escape its engagement with the shouldered end of lever 25 and to rotate, by the tension of spring 103, so that its upper end now bears against the under straight surface of said lever 25. This new position of lever 102 locks lever 25 in the position to which it was actuated by magnet 21 to hold contacts 62, 100, 101 closed during the engaged period of the switch. This is necessary since, as will presently appear, the magnet 21 soon becomes inactive after having actuated the rod 24. The above described rotation of intermediate lever 102 is made possible at this time due to the fact that the ratchet 41 having moved up out of contact with lever 104, the retractile spring 105 withdraws lever 104 out of the path of said lever 102. The magnet 21 also acts upon its energization to reset the side switch to its normal position.

While the side switch is momentarily standing in position 3 before being reset by magnet 21, the following circuit is established: ground, side-switch arm 88, contact strip 95, brush 96, left-hand armature and contact of relay 21, brush 106, contact strip 107, conductor 108, thence by one path to the contact and armature of the master drive magnet 11, winding of said magnet to battery; and by another path to the winding of cut-off relay 68, to battery. Relay 68 and magnet 11 energize in the circuit traced. Reset magnet 21, which was momentarily energized while the side switch stood in position 3, does not, however, immediately deenergize when said switch restores, but locks up, as long as slow relay 73 retains its armatures attracted, over the following circuit: battery, contact strip 98, brush 97, winding of magnet 21, right-hand armature and contact of said magnet, brush 109, contact strip 110, conductor 111, outer left-hand armature and front contact of relay 73 to ground. Magnet 21 by holding its armatures attracted affords a new energizing circuit for relay 68 and magnet 11 during the time that slow relay 73 is holding its armatures in their attracted position. This circuit is traceable from ground, outer left-hand armature and front contact of relay 73, conductor 111, contact strip 110, brush 109, contact and right-hand armature of magnet 21, left-hand armature and contact of said magnet, brush 106, contact strip 107, conductor 108, to magnet 11 and relay 68 as above traced.

Relay 68 by energizing, cuts off the line relay 67, and the master drive magnet 11 by energizing in the above traced circuit vibrates its armature 12 to engage ratchet 10, and thereby rotate the endless worm 8. Rotation of said worm causes the supporting frame 14 with the master stepping magnets to move away from its operative position before the switch just actuated and to advance toward the next switch in the group. At the first movement of said master device, the pins 26 and 27 permit the contacts 30 to 36 inclusive and contact 28 to assume their normal positions as shown in Fig. 2. Furthermore, the pin 26, having moved onto the strip 39, presses the same into contact with its coöperating spring. This results in the closure of the following circuit which takes the place of the circuit previously traced from the magnet 11 and relay 68 in parallel therewith, to ground at slow relay 73: ground, contact strip 39 and its coöperating spring, conductor 112, outer left-hand armature and back contact of relay 73, conductor 108, to magnet 11 and also relay 68. This circuit keeps the magnet 11 actuating and insures a complete movement of the master device to its operative position before the next switch.

If, upon the master device reaching its position before the next switch, such as the switch represented generally by the contact group 29′, Fig. 2, and this switch is already actuated, the following circuit is established; from magnet 11 and relay 68 in parallel, conductor 108, outer left-hand armature and back contact of relay 73, conductor 112, to a closed contact corresponding to 28 of the set 29′, a conductor similar to 113, to ground at an off-normal contact 66 of the busy switch. Therefore the drive magnet 11 continues to move the master device past the actuated switch and on to the next one in order.

Assume now that this next switch is in its normal position and has a master mechanism standing before it, similar to the one illustrated diagrammatically in Fig. 2, and which in its travel before the switches cooperates with the lower sets of contacts in that figure, such as the set 30′ to 36′ inclusive. In such event the master device under discussion upon arriving before such switch completes the following circuit for relay 68 and drive magnet 11: relay 68 and magnet 11 in parallel, front contact and lower armature of relay 68, conductor 114, a closed contact similar to 33 of the set before the assumed switch, a conductor similar to 115, a closed contact similar to 33′, before which there is already a master device resting, over the conductor 116′, to ground at the lower armature and back contact of the cut-off relay similar to 68 of such master device. Hence the magnet 11 continues to be energized and the master device passes by said switch, which already has a master device resting before it, and in the manner already described goes on to the next selector switch.

If the next switch encountered is in normal position, and has no master device already before it, then, when the seeking master device assumes its position before such switch, the operating circuits above described for the drive magnet 11 and relay

68 are opened, and said device comes to rest, ready to operate said switch when taken for use.

Returning to the point where the first selector had positioned its brushes 53, 54 and 55 upon the terminals of trunk 59, 60, 61, it will be remembered the assumption was that the second selector switch associated with said trunk was idle and had a master device positioned before it. If, however, the switch is idle but has no master device associated therewith, it is obvious that said switch is not in proper condition to be selected and should therefore test busy to the preceding switch. This condition is obtained as follows: Since there is no master device before the switch, all of the contacts 36, 36′ etc., are closed, so that when brush 55 makes its test of trunk 61, a ground is found thereon. The circuit affording this ground is traceable from test trunk 61, conductor 63, through the closed contacts 36, 36′, etc., in series, to ground at the off-normal contact 66.

If the switch had been previously actuated and was busy extending a call when the above mentioned test was made, a ground would have been present on test conductor 61 by way of test terminal 94, brush 6 and contact 62. From the foregoing it is apparent that a switch, in order to be selectable to a preceding switch, must not only be idle and restored but must also have a master stepping mechanism associated therewith.

Should for any reason the subscriber abandon his call while the side switch is in second position, the following circuit is closed for the reset magnet 21 to restore the side switch to normal: ground, armature and back contact of relay 67, inner left-hand armature and back contact of relay 73, conductor 117, side-switch arm 118 and its second position contact, contact strip 119, brush 120, winding of magnet 21, brush 97, contact strip 98, to battery and ground. At the same time the following circuit is established for the drive magnet 11 to move the master device away from the selector switch: ground at the armature of relay 67, over the circuit just traced to the brush 120, thence by way of the left-hand armature and contact of magnet 21, brush 106, strip 107, conductor 108, magnet 11 to battery.

Considering now the release mechanism, it will be described how the magnet 46, which is common to all switches of a group is capable of locating such switches as are in proper condition to be returned to their normal position. The magnet 45, which drives the worm 44, receives its energization over the following circuit: free pole of battery, winding of magnet 45, armature and contact of said magnet, contact and armature of relay 121, to ground. So long as relay 121 remains inert, the magnet 45 interrupting its own circuit will drive the release magnet 46 back and forth before the switch shafts 1. Relay 121 is arranged to receive sufficient current through resistance 122 only when conductor 123 is free from ground connections. If magnet 46 passes before a switch that is idle the pin 124 on arm 125, by closing contact 126, places a ground on conductor 123 as follows: ground, off-normal contact 66, conductors 65 and 93, closed contact 126 to conductor 123. The relay 121 remains deënergized and magnet 45 continues its movement, due to a closed contact 128, to the next switch position. If the next switch before which the release magnet passes is being actuated a ground is extended to conductor 123 from a secondary off-normal contact 87, a conductor similar to 86, a closed contact similar to 35, conductors as 85 and 84, a closed contact similar to 32, a conductor similar to 93, a closed contact 126, to conductor 123, while said switch is in its primary movement. But if the switch is in its secondary movement, contact 87 is open, and the ground is now afforded from busy test terminals 94, by way of a conductor similar to 93 to conductor 123.

When, however, the release magnet 46 positions itself before a switch which is idle and in condition to be restored, no short-circuiting ground is present on conductor 123, and consequently relay 121 attracts its armatures. This opens the circuit of magnet 45, thus stopping magnet 46 in operative relation to the flange 129 of holding pawl 43, Fig. 1. A circuit is also closed for magnet 46 from ground, armature and contact of relay 121, strip 130, brush 131, winding of magnet 46, brush 132, strip 133, to battery. Magnet 46 thereupon attracts the flange 129 to rotate the holding dogs 42 and 43 out of engagement with the holding ratchets 40 and 41. This movement of flange 129 carries the trigger 133 behind the catch 134 of lever 102, thereby locking the holding dogs 42 and 43 away from their ratchets to insure a complete restoration of the shaft 1. At the same time finger 135 closes contact 136, whereupon a ground is again placed on conductor 123, which in turn deënergizes relay 121, and the drive magnet operates to move the release mechanism. When shaft 1 reaches normal the ratchet 41, through the agency of lever 104, restores levers 102 and 25 to their normal positions as shown in Fig. 1, thereby opening contacts 62, 100, 101 and 136, and also unlocking holding pawls 42 and 43.

In describing the features of our improved circuit arrangement we have assumed that the selective switches, in connection with which the same is used, are serving in the

capacity of second selectors. However, it is to be understood that this election is merely for the purpose of conveniently exemplifying the numerous applications contemplated by the present invention. It will be apparent that the circuit arrangement of the said invention is applicable to a group of switches employed at any particular point in a train of circuit extending switches, provision being made, as in the present embodiment, whereby any switch of such group is capable of rendering itself non-selectable to the preceding switch or other circuit extending means during the time said switch has no common operating device apportioned thereto, or is otherwise not in proper condition to be taken for use.

What is claimed is:

1. In a telephone system, a telephone line, trunk selecting means, means for extending said line thereto, a group of trunks terminating in said trunk selecting means, a group of switches, each one permanently associated with one of said trunks, a plurality of common stepping devices, means for moving any one thereof into position to engage and actuate any one of said switches, and means for rendering one of said trunks non-selectable to said selecting means when none of said devices are operatively associated with the corresponding switch.

2. In a telephone system, a telephone line, trunk selecting means, means for extending said line thereto, a group of trunks terminating in said trunk selecting means, a group of switches, each one permanently associated with one of said trunks, a plurality of common stepping devices, means for moving any one thereof into position to engage and actuate any one of said switches, and means under the control of said devices for rendering any one of said trunks non-selectable to said selecting means when none of said devices are operatively associated with the corresponding switch.

3. In a telephone system, a line, trunk selecting means, means for extending said line thereto, a group of trunks terminating in said trunk selecting means, a group of switch shafts, each one permanently associated with one of said trunks, a plurality of common stepping devices, means for moving any one thereof into position to engage and actuate any one of said switch shafts, and means under the joint control of said shafts and stepping devices for rendering any one of said trunks non-selectable to said selecting means when none of said devices are operatively associated with the corresponding switch.

4. In a telephone system, a group of trunks, a group of selective switches, each one being permanently associated with one of said trunks, circuit terminals for said switches, a plurality of common operating devices each arranged to engage and move said switches into connection with said circuit terminals, means to move any one of said devices into operative association with one of said switches, means for placing a busy condition upon the trunk corresponding to an actuated switch when said switch is in connection with a busy set of said circuit terminals, and means for placing a busy condition upon said trunk when said switch is in its normal position but has none of said common devices operatively associated therewith.

5. In a telephone system, subscribers' lines, a group of trunks, circuit-extending means for extending said lines to non-busy trunks of said group, a group of switches, each one being permanently associated with one of said trunks, a common stepping mechanism having a position for engaging and operating each switch of said group, means for moving said mechanism successively from one position to another, and means for placing a busy condition upon the trunk corresponding to one of said switches when said mechanism leaves its operative position with respect to said switch.

6. In a telephone system, a telephone line, a group of trunks, trunk selecting means for connecting said line to one of said trunks, a group of switches, each one being associated with one of said trunks, a common stepping magnet for actuating said switches, means for moving said magnet into operative association with any one of said switches, and means for rendering a trunk selectable to said trunk selecting means when said magnet is operatively associated with the corresponding switch and for rendering said trunk non-selectable when said magnet moves out of operative association therewith.

7. In a telephone system, a telephone line, a group of trunks, trunk selecting means for connecting said line to said trunks, a group of switches, each one being associated with one of said trunks, a plurality of magnets common to the switches of said group, means for moving any one of said magnets into position to actuate any one of said switches, and means for rendering any one of said trunks non-selectable when none of said magnets are operatively associated with the corresponding switch.

8. In a telephone system, a group of trunks, a group of switches, each one being associated with one of said trunks, a plurality of sets of actuating magnets common to said switches, each set including primary and secondary stepping magnets arranged to actuate said switches, means for moving any one of said sets to operatively associate the same with any one of said switches, and means for changing the electrical condition of one of said trunks when none of said sets

of magnets are operatively associated with the corresponding switch.

9. In a telephone system, a subscriber's station, a group of switches, a plurality of actuating mechanisms common to said switches, means for controlling the operation of one of said mechanisms from the subscriber's station to move one of said switches to its actuated position, automatic means for thereupon moving said mechanism into position to actuate some other switch in the group, and means to prevent said mechanism becoming associated with a switch having another common mechanism associated therewith.

10. In a telephone system, a subscriber's station, a group of switches, a plurality of switch actuating devices common to the switches of said group, each one being normally associated with a different switch, means for controlling one of said devices from the subscriber's station to move one of said switches to its actuated position, automatic means for thereupon moving said device into operative association with some other switch of the group, and means controlled by said common devices to prevent more than one thereof becoming associated with the same switch.

11. In a telephone system, a group of switch shafts, a common releasing device therefor having an operative position for each of said shafts, automatic stepping means for successively moving said device from one position to another, and means for stopping said device in operative relation to any one of said shafts.

12. In a telephone system, a group of switch shafts, a common release magnet having a position before each shaft for releasing the same, a stepping magnet for driving said magnet from position to position, and means for automatically arresting said release magnet in position to release a predetermined one of said shafts.

13. In a telephone system, a trunk, a switch associated with said trunk, an actuating device for moving said switch from its normal to its operative position, and means controlled by said device for placing a busy condition on said trunk when said switch is in its normal position.

14. In a telephone system, incoming circuits, outgoing circuits, a plurality of switches for interconnecting said circuits, a plurality of operating mechanisms common to said switches, means for moving any one of said mechanisms into position to actuate any one of said switches, and means for rendering a switch non-selectable to an incoming circuit when none of the common mechanisms are in position to actuate such switch.

15. In a telephone system, incoming lines, outgoing lines, a plurality of switches for interconnecting said lines, a plurality of stepping devices common to said switches, means for moving any one of said devices into position to operate any one of said switches, and means for rendering a switch ineffective to interconnect said lines when none of the common devices are in position to actuate such switch.

16. In a telephone system, subscriber's lines, a group of switches for interconnecting said lines, a plurality of actuating devices common to said switches, means for moving any one of said devices into position to actuate any switch of the group, and means controlled by said devices for rendering a switch ineffective to interconnect said lines.

17. In a telephone system, subscriber's lines, a group of switches for interconnecting said lines, a plurality of step-by-step devices common to said switches, means for moving any one of said devices into position to actuate any switch of the group, and means under the control of a subscriber's line for operating said devices.

18. In a telephone system, subscriber's lines, a group of switches for interconnecting said lines, a plurality of operating mechanisms common to the switches of said group, means for controlling the operation of one of said mechanisms to move a switch to its actuated position, automatic means for thereupon advancing said mechanism into position to actuate some other switch of the group, and means to prevent said mechanism becoming associated with a switch having another common mechanism associated therewith.

19. In a telephone system, subscriber's lines, a group of switches for interconnecting said lines, a plurality of sets of stepping magnets for said switches, each set being common to all switches of the group, means for controlling the operation of a set of magnets to move a switch to its operative position, and means for advancing said set into position to move some other switch of the group.

In witness whereof, we hereunto subscribe our names this 16th day of November, A. D., 1917.

JAMES L. McQUARRIE.
CHARLES L. GOODRUM.