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MACHINE SWITCHING TELEPHONE SYSTEM.

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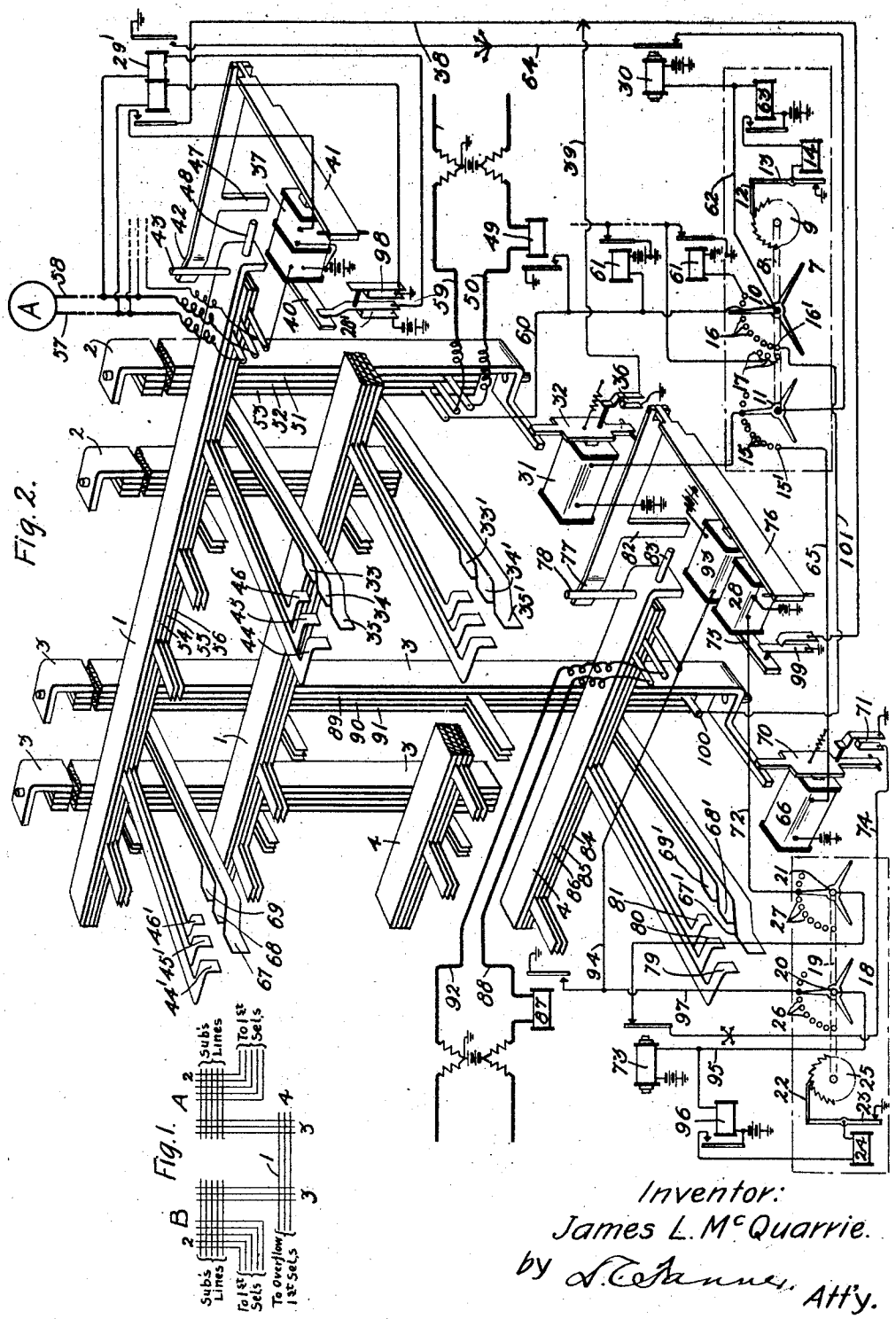


Fig. 2.

Fig. 1.

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UNITED STATES PATENT OFFICE.

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MACHINE-SWITCHING TELEPHONE SYSTEM.

1,293,494. Specification of Letters Patent. Patented Feb. 4, 1919.

Application filed April 24, 1917. Serial No. 164,217.

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 Machine-Switching Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to machine switching telephone systems, and more particularly to non-numerical switches for use in such systems.

The object of this invention is to effect an economy in the apparatus used in a telephone system through the use of an improved line switch, similar in operation to that described in Reissue Patent No. 14,236, December 26, 1916.

In the patent above mentioned the so-called cross bar type of switch is shown. Such a switch comprises line bars and trunk bars arranged transversely to each other and rotatably mounted. Contacts of the line bars are arranged in operative relation to contacts on the trunk bars, and through the action of the electromagnets, telephone lines connected to the line bars are extended through the interlocking of the contacts to the trunk bars, and thence to other circuits.

Due to the conditions of traffic a certain number of trunks must be allotted for the use of a certain number of lines, which arrangement results in the provision of a certain amount of apparatus which lies idle, except during the busiest periods of the day. An arrangement whereby all the apparatus provided can be kept more uniformly busy will effect an economy in such apparatus.

A feature of the present invention, then, is the provision of such an arrangement.

According to this feature, the ordinary arrangement as in the switch above mentioned, is curtailed, only a much smaller number of trunks being allotted to the use of the same number of lines. The difference, however, is made up by the allotment of a number of common trunks which serve a plurality of switches.

Under ordinary conditions the calling line will be extended through the individual trunk in a manner similar to that described in the above mentioned patent. When, however, all the individual trunks are busy, the line will be extended through an intersecting bar, similar to a trunk bar, thence to an overflow trunk bar, similar to a line bar. Since these overflow trunk bars are common to a number of switches, they become more uniformly busy than if they were individual to one switch, and since a number of switches are served by a number of common trunks the total number of trunks in an exchange is materially reduced.

It is thought that the invention will be best understood from the following description, reference being had to the accompanying drawings.

Figure 1 is a schematic representation of the line and trunk bars of two switches embodying the present invention. Fig. 2 shows a partial perspective view of a switch embodying the features of this invention with a circuit arrangement for operating the same.

In Fig. 1 the line bars 1 of each switch have access to the two sets of bars 2 and 3. Outgoing trunks which are individual to each switch and are connected directly to first selector switches terminate in bars 2. The bars of the other set have multiple terminals which are arranged to be engaged by terminals of a set of bars 4 which are common to the two switches. Trunks connected to the first selector switches terminate in the bars of this set of common trunk bars. It is obvious that the common bars may be common to any desired number of switches.

Referring to Fig. 2, the structure and means of operating the line bars 1 and trunk bars 2 is the same as that disclosed in an application of J. N. Reynolds, Serial No. 203,942, filed November 26, 1917. The structure of the overflow trunk bars and the intersecting bars 3 is the same as the line and trunk bars respectively. The intersecting bars 3 are pivotally mounted in the top and bottom of the frame of the switch (not shown) in the same manner as the trunk bars 2. The overflow trunk bars 4 are pivotally mounted and are rotated in the same manner as the line bars except that the overflow trunk bars have one end mounted in one side of the frame of one switch and the other end mounted in the opposite side of the frame of another switch so that the multiple contacts thereon may be en-

gaged by contacts on the intersecting bars of both switches.

Each switch has an allotter 7 for the group of trunk bars 2 and the intersecting bars 3. This allotter consists of a rotatable shaft 8 to which is secured the ratchet wheel 9, and the contact wipers 10 and 11. A pawl 12 carried by the armature 13 of an electromagnet 14 engages the teeth of the ratchet wheel 9, to rotate the shaft 8 and the wipers secured thereto. Wiper 11 engages contacts 15 in which terminate the circuits to the operating magnets of the trunk bars 2 and the intersecting bars 3. The wiper 10 engages test contacts 16 for testing the bars to preselect an idle one in a manner to be hereinafter described. The wiper 10 also engages the contacts 17 which are connected to ground as long as any one of the trunk bars 2 is idle.

Each group of overflow trunk bars 4 has associated therewith an allotter 18. This allotter consists of a rotatable shaft 19 which carries the ratchet wheel 25 and wipers 20 and 21. A pawl 22 carried by the armature 23 of the magnet 24 engages the teeth of the ratchet wheel 25 to rotate the shaft 19 and the wipers secured thereto. Wiper 21 engages contacts 27 in which terminate the circuits of the operating magnets 28 of the overflow trunk bars 4. Wiper 20 engages test contacts 26 for testing the overflow trunk bars to preselect an idle one in a manner to be hereinafter described.

It is believed that the invention will now be better understood by describing the operation of the switch. First, a description will be given of the operation of the switch where a line bar engages an idle trunk bar which is individual to the switch, and then a description will be given of the operation of the switch where a calling line is extended to a trunk terminating in an idle overflow trunk bar 4.

When the subscriber at substation A removes his receiver from the hook, a circuit is completed from grounded battery, contacts 28′, right-hand winding of relay 29, conductor 58, through telephone apparatus at substation A, conductor 57, left-hand winding of relay 29, contacts 98, to ground. Relay 29 becomes energized and completes a circuit from ground, right-hand armature and front contact of relay 29, conductor 64, armature and back contact of relay 30, wiper 11, contact 15, magnet 31 of the allotted trunk bar to grounded battery. The magnet 31 becomes energized and by attracting its armature 32 moves the trunk bar 2 into a position whereby its sets of contacts 33, 34 and 35, 33′, 34′ and 35′, etc., are in a position to be engaged by the subsequent operation of a line bar 1. The attraction of armature 32 also closes contacts 36 which complete a circuit from grounded battery, right-hand winding of magnet 37, front contact and left-hand armature of relay 29, conductors 38 and 39, contacts 36, to ground. Magnet 37 becomes energized and attracts its armatures 40 and 41. The attraction of the armature 40 opens the contacts 38′ and 98, which causes the deënergization of relay 29. The attraction of armature 41 through the engagement of cam 42 with pin 43 causes the line bar 1 to be rotated. This rotation of the line bar causes the sets of contacts 44, 45 and 46, 44′, 45′, and 46′, etc., of the line bar to move downward and places one set of terminals 44, 45 and 46 in operative relation to contacts 33, 34 and 35 of the allotted trunk bar 2. Upon further attraction of armature 41, the engagement of shoulder 47 with pin 48 forces the bar 1 to the left and moves the contacts 44, 45 and 46 into engagement with contacts 33, 34 and 35 of trunk bar 2, and also moves the unengaged terminals of the line bar to a position wherein they will not be engaged by the terminals of a subsequently operated trunk bar. Upon the engagement of contacts 44, 45 and 46 of the line bar with contacts 33, 34 and 35 of the trunk bar, a circuit is completed for supervisory relay 49 from grounded battery winding of relay 49, conductor 50, conducting strip 51, contacts 35 and 44, conducting strip 54, conductor 57, through the apparatus at substation A, conductor 58, conducting strip 55, contacts 45 and 34, conducting strip 52, conductor 59, to ground. Relay 49 becomes energized and completes a holding circuit for operating magnet 37 from grounded battery, left-hand winding of magnet 37, conducting strip 56, contacts 46 and 33, conducting strip 53, conductor 60, front contact and armature of relay 49, to ground.

The attraction of the armature of relay 49 also places ground upon the test terminal 16 associated with this trunk bar, which causes the energization of relay 63, through a circuit extending from grounded battery, winding of relay 63, conductor 62, wiper 10, contact 16, front contact and armature of relay 49, to ground. A circuit is completed for relay 30 from grounded battery, winding of relay 30, conductor 62, over the circuit previously described, to ground at the front contact and armature of relay 49. The attraction of the armature of relay 63 completes a stepping circuit for magnet 14 from grounded battery, left-hand armature and front contact of relay 63, winding of magnet 14, armature 13, to ground. The attraction of armature 13 of the magnet 14 causes, through the pawl 12, the rotation of the shaft 8, to successively move the wipers 10 and 11 into engagement with contacts 16 and 15 respectively. As long as wiper 10 engages test contacts 16 of busy trunk bars upon which ground is impressed, the cir-

cuit of relay 63 will be closed, thus holding the stepping circuit of magnet 14 closed. When, however, the wiper 10 engages a test contact 16 of an idle trunk, no ground will be found thereon and the test relay 63 will deënergize. The retraction of this armature opens the stepping circuit for magnet 14, thus stopping the shaft 8 with wiper 11 in engagement with the contact 15 to which the operating magnet 31 of the idle trunk bar is connected. Since relay 30 is made slow to release, it remains energized during this operation of the allotter 7 and by the attraction of its armature disconnects conductor 64, which is common to all the line magnets 29, from wiper 11, and thereby prevents the operation of any of the operating magnets 37 during the operation of the allotter 7. As soon as the wiper 11 leaves the contact 15 to which the magnet 31 is connected, the circuit of the magnet is opened and it becomes deënergized and allows the trunk bar 2 to return to its normal position. The set of terminals 33, 34 and 35 which is in engagement with the set of line terminals 44, 45 and 46 remains in contact therewith, due to the flexibility of said terminals. The other sets of terminals, however, carried by the trunk bar are rotated in a counterclockwise direction, as shown in the drawings, to place them in a position where they will not be engaged by terminals carried by the bar of the next calling line.

If, during the operation of the allotter 7 the wiper 10 engages test contact 16, associated with the intersecting bars 3, ground will be found upon a second row of test contacts 17 associated with the intersecting bars 3, as long as one of the trunk bars 2 is idle, this ground being placed upon contacts 17 at the armatures and back contacts of relays 61. Each of these relays 61 is individual to a trunk bar 2, and upon the operation of relay 49, associated with that trunk bar, the relay 61 becomes energized and removes ground from test terminal 17, but it is quite obvious that as long as any one of the trunk bars 2 is idle, ground will still be found upon the test contacts 17, and cause the allotter 7 to continue operating until this idle trunk bar is found.

When all the relays 61 are energized ground will be removed from all the test contacts 17 and the allotter wiper 10 will test the test contacts 16 associated with the intersecting bars 3 for an idle intersecting bar.

Upon the calling subscriber hanging up his receiver at the termination of a conversation, the circuit for supervisory relay 49 is interrupted, and upon the attraction of its armature opens the holding circuit for magnet 37. The deënergization of this magnet causes the retraction of its armature 42, thus releasing the line bar which is thereupon returned to normal by springs (not shown).

It will now be assumed that all the trunk bars 2 are in use at the time the subscriber at substation A calls, and that the allotter wipers 10 and 11 are in engagement with contacts 16′ and 15′, respectively, associated with an intersecting bar 3. Relay 29 is energized, in the manner as above described, upon the removal of the receiver at substation A. The attraction of the right-hand armature of this relay completes a circuit for operating magnet 66 from grounded battery, winding of magnet 66, conductor 65, contact 15′, wiper 11, back contact and armature of relay 30, conductor 64, front contact and right-hand armature of relay 29, to ground. Magnet 66 becomes energized and attracts its armature 70 to move the intersecting bar 3 into a position in which its sets of contacts 67, 68 and 69, 67′, 68′ and 69′, etc., are in operative relation to set of contacts 44′, 45′ and 46′ of the line bar, and set of contacts 79, 80 and 81 of the trunk bars 4 respectively.

The attraction of armature 70 also closes contacts 71 which complete an energizing circuit for operating magnet 28 of the trunk bar 46 from grounded battery, winding of magnet 28, conductor 72 contacts 27, wiper 21, back contact and armature of relay 73, conductor 74, contact 71, to ground. The magnet 28 attracts its armatures 75 and 76. The attraction of the armature 76 through the engagement of cam 77 with pin 78 causes the trunk bar 4 to be rotated. The rotation of this trunk bar causes the set of terminals 79, 80 and 81 to move downward and places them in operative relation to the set of terminals 67′, 68′ and 69′, respectively, of the preselected intersecting bar 3. Upon further attraction of the armature 76, the engagement of shoulder 82 with pin 83 forces the bar 4 to the left, bringing the terminals of the trunk bar into engagement with the terminals of the intersecting bar and also moves the unengaged terminals of the trunk bar to a position wherein they will not be engaged by the terminals of another intersecting bar. The attraction of armature 75 of magnet 28 closes contacts 99, and completes a circuit from grounded battery, right-hand winding of magnet 37, front contact and left-hand armature of relay 29, conductor 38, contacts 99, to ground. The magnet 37 becomes energized and operates the line bar 1 in the same manner as above described, to move the set of terminals 44′, 45′ and 46′ into engagement with set of terminals 67, 68 and 69 of the intersecting bar 3. Upon engagement of the line terminals 44′, 45′ with terminals 67 and 68, a circuit is completed for supervisory relay 87 from grounded battery, winding of relay 87, conductor 88, conducting strip 84, contacts 79

and 67′, conducting strip 89, contacts 67 and 44′, conducting strip 54, conductor 57, through the telephone apparatus of substation A, conductor 58, conducting strip 55, contacts 45′ and 68, conducting strip 90, contacts 68′ and 80, conducting strip 85, conductor 92, to ground. Relay 87 becomes energized and completes an energizing circuit for holding magnet 93 of trunk bar 4 from grounded battery, winding of this magnet, conductor 94, front contact and armature of relay 87, to ground. Magnet 93 is so arranged as to hold the armature 76 attracted upon the deënergization of magnet 28, but does not hold the armature 75 attracted.

The attraction of the armature of relay 87 also completes a holding circuit for the magnet 37 from grounded battery, left-hand winding of magnet 37, conducting strip 56, contacts 46′ and 69, conducting strip 91, contacts 69′ and 81, conducting strip 86, conductor 94, front contact and armature of relay 87 to ground. This ground at the front contact and armature of relay 87 is also connected to test contact 18′ of allotter 7 and causes this allotter to operate in search of an idle trunk bar or intersecting bar in the same manner as above described. This ground is extended to contact 16′ through conductor 94, conducting strip 84, contacts 81 and 69′, terminal 100, conductor 101, to test terminal 16′.

Circuits are also closed at this time for test relay 96 and pilot relay 73 from grounded battery, winding of relay 96, in parallel with relay 73, conductor 95, wiper 20, test contact 26, conductor 97, front contact and armature of relay 87, to ground. Relay 96 becomes energized and closes at its armature and front contact a circuit for the stepping magnet 24 of the allotter 18, from grounded battery, armature and front contact of relay 96, winding of magnet 24, armature 23, to ground. The attraction of armature 23 of magnet 24 causes, through the pawl 22, the rotation of the shaft 19 to successively move the wipers 20 and 21 into engagement with the contacts 26 and 27 respectively. As long as wiper 20 engages test contacts 26 of busy trunk bars 4, upon which ground is impressed at the armature and front contact of relay 87, the test relay 96 will be energized and the stepping circuit will be completed. The shaft 19 is rotated by the successive energization and deënergization of the magnet 24, due to the breaking of its circuit by the attraction of its armature 23. When, however, the wiper 20 reaches the test contact 26 of an idle trunk bar 4, no ground will be found thereon and test relay 96 will become deënergized. The retraction of its armature opens a stepping circuit for magnet 24, thus stopping the shaft 19 with the wiper 21 in engagement with the contact 27 to which the operating magnet 28 of the idle trunk bar 4 is connected.

The relay 73 is made slow to release its armature and, therefore, remains energized during this operation of the allotter 18 and by attracting its armature disconnects the conductor 74, which is common to all of the operating magnets 66 of the intersecting bars 3, from wiper 21 and prevents the operation of a trunk bar 4 until an idle bar is selected.

Upon the calling subscriber hanging up his receiver at the termination of a conversation the circuit of relay 87 is interrupted and the retraction of its armature opens the circuit of the holding magnet 93 of the trunk bar 4 and the holding circuit of magnet 37 of the line bar. The deënergization of magnet 93 causes the retraction of the armature 76, which allows the trunk bar 4 to be returned to its normal position by springs (not shown). The deënergization of magnet 37 causes the retraction of its armature 41, which allows the line bar 1 to be returned to its normal position by springs (not shown).

What is claimed is :

1. In a switch, a plurality of line bars, a plurality of trunk bars, a plurality of bars intersecting said line and trunk bars, multiple sets of terminals on said bars, and means for successively moving said bars whereby a set of terminals on a trunk bar is brought into engagement with a set of terminals on an intersecting bar and a set of terminals of a line bar brought into engagement with a multiple set of terminals on the same intersecting bar.

2. In combination, a plurality of switches, a plurality of trunk bars common to said plurality of switches, a plurality of line bars individual to each switch, a plurality of bars individual to each switch intersecting said line and common trunk bars, multiple sets of terminals on said bars, and means for rotating in a predetermined order a line and an intersecting bar of a switch and a common trunk bar to bring a set of terminals on the line and on the trunk bar into engagement with multiple sets of terminals on the intersecting bar.

3. In a switch, two groups of circuits, three sets of rotatable bars, multiple terminals of the circuits of said groups carried by bars of two of said sets respectively, said third set having multiple terminals arranged to be engaged by the terminals on said other two sets, and means for rotating a bar of each set in a predetermined order to effect interengagement of the multiple terminals on a predetermined one of said bars with the terminals on a predetermined bar of each of the other two sets to connect together a predetermined circuit of each group.

4. In combination, a plurality of switches each comprising three sets of rotatable bars, two groups of circuits associated with each switch, one of said groups being individual to each switch and the other group being common to the plurality of switches, multiple terminals of the circuits individual to each switch being carried by one set of said bars which are individual to said switch, the other group of circuits being carried by another set of said bars which are common to said plurality of switches, the other set of bars associated with each switch having multiple terminals arranged to be engaged by the terminals of the other two sets, and means for rotating a bar of each set associated with a switch in a predetermined order to effect interengagement of the multiple terminals of a predetermined one of said bars with the terminals of a predetermined bar of each of the other two sets to connect together a predetermined circuit of each group.

5. In a switch, a plurality of line bars, a set of trunk bars intersecting said line bars, a second set of trunk bars, a plurality of bars intersecting said line and said second set of trunk bars, multiple sets of terminals on all of said bars, means for successively rotating a line and an intersecting trunk bar to bring sets of terminals on each into engagement, means for successively rotating a line bar, a trunk bar of said second set, and an intersecting bar in a predetermined order to bring a set of terminals on the line bar and on the trunk bar of said second set into engagement with multiple sets of terminals on the intersecting bar, and means for preventing the operation of the last mentioned means as long as any one of said intersecting trunk bars is not in use.

6. In combination, a plurality of switches, each switch having individual thereto a set of line bars and a set of trunk bars intersecting said line bars, a set of trunk bars common to said plurality of switches, a plurality of bars at each switch intersecting the line bars thereat and the common trunk bars, multiple sets of terminals on all of said bars, means associated with each switch for successively rotating said line and intersecting trunk bars to bring sets of terminals on each into engagement, means for successively rotating the line, common trunk and intersecting bars associated with each switch in a predetermined order to bring a set of terminals of a line and a common trunk bar into engagement with multiple sets of terminals of an intersecting bar, and means for preventing the operation of the last mentioned means as long as one of the individual trunk bars in a switch is not in use.

7. In a switch, a group of bars, a second group of bars, a third group of bars, multiple sets of terminals on all of said bars, means for rotating bars in said first and second mentioned groups to bring sets of terminals on each into engagement, means for rotating bars in said first and third mentioned groups to bring sets of terminals on each into engagement, and means for preventing the operation of the last-mentioned means as long as any one of the bars of the second mentioned group is not in use.

In witness whereof, I hereunto subscribe my name this 20th day of April, A. D. 1917.

JAMES L. McQUARRIE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."