F. R. QUAYLE.

AUTOMATIC TELEPHONE SYSTEM.

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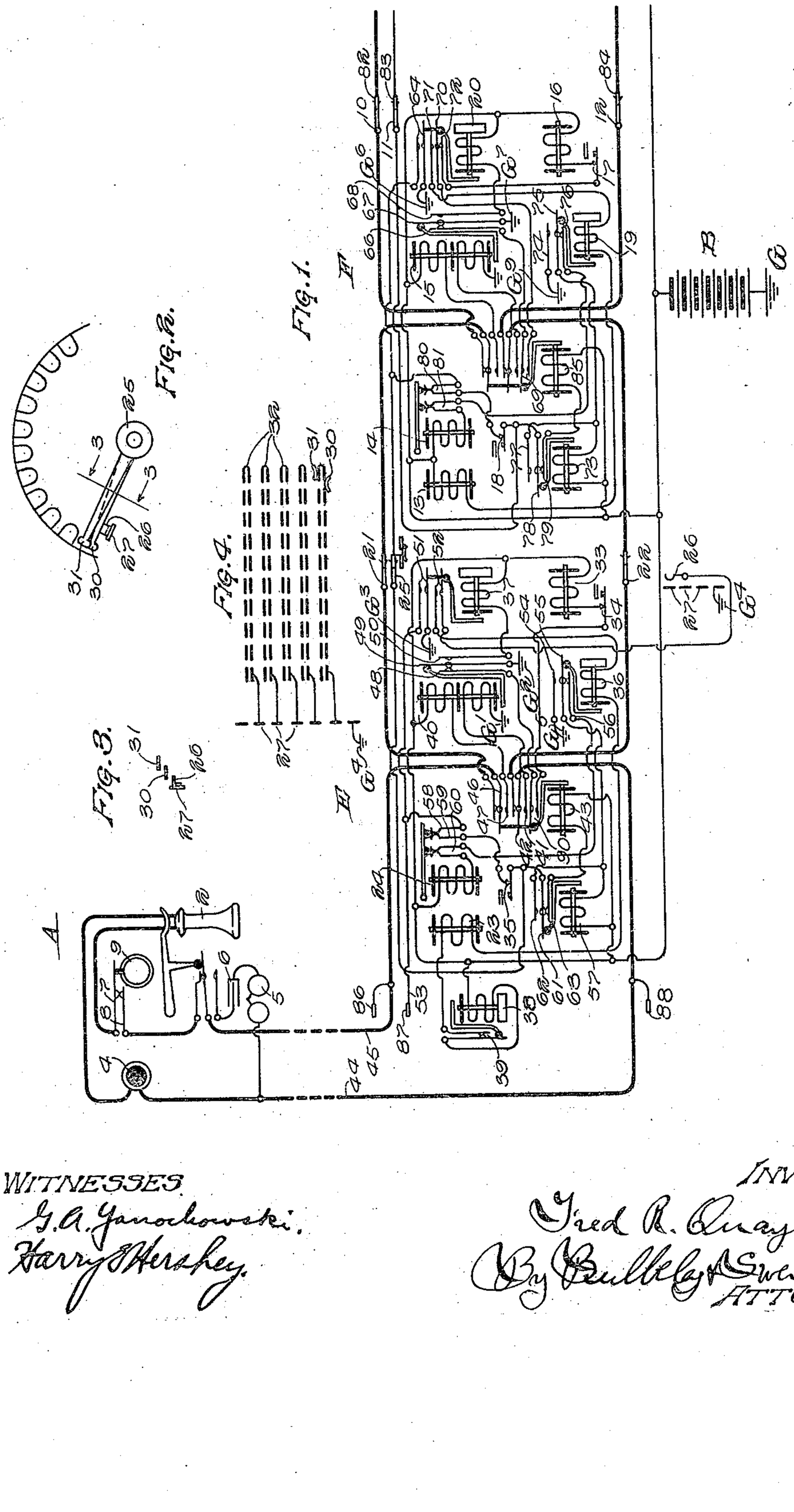

FIG. 1.

FIG. 2.

FIG. 3.

FIG. 4.

WITNESSES.

G. A. Yanochowski.

Harry J. Hershey.

INVENTOR:

Fred R. Quayle

By Bulkley & Swenson

ATTORNEYS.

UNITED STATES PATENT OFFICE.

FREDERICK R. QUAYLE, OF WILMETTE, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,243,761.

Specification of Letters Patent. Patented Oct. 23, 1917.

Application filed January 5, 1914. Serial No. 810,440.

To all whom it may concern:

Be it known that I, FREDERICK R. QUAYLE, a citizen of the United States of America, and resident of Wilmette, Cook county, Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to improvements in automatic telephone systems, and more particularly to an improved non-numerical trunk-selecting switch for use in said systems. Heretofore, non-numerical trunk-selecting switches have been provided which are enabled to automatically select an idle trunk from among a group of trunks. The object of my invention is, however, to provide a non-numerical trunk-selecting switch which is enabled to first automatically select a group of trunks, and then to automatically select an idle trunk in that group. In this manner the non-numerical switch is enabled to have access to a much larger number of trunk lines, and the operation is furthermore expedited owing to the fact that the first movement of the switch first automatically selects a smaller group in which there is an idle trunk, and the next movement automatically selects an idle trunk in this group.

These and other features of my invention will be more readily understood by reference to the accompanying drawings, in which I have illustrated one embodiment of my invention in connection with a portion of an automatic telephone system, showing the manner in which this non-numerical switch is enabled to select an idle trunk line extending from a subscriber's line to a selector switch.

In the drawing Figure 1 represents diagrammatically a portion of the central office apparatus necessary for completing a connection between a calling subscriber and a called subscriber.

Fig. 2 is a detail view showing a portion of the private bank contacts and the private wiper for making contact with said bank contacts.

Fig. 3 is a sectional view taken on the line 3—3 in Fig. 2.

Fig. 4 is a detail view of a portion of the non-numerical selector private bank contacts.

Referring to Fig. 1, the system as therein represented, consists of the substation A the conductor of which terminates in an individual non-numerical selector switch E which has access to a group of selector switches F. The trunk lines leading from the said selector switch F may terminate in any suitable type of automatic apparatus for the purpose of completing a connection. The apparatus for completing the connection may be similar to that disclosed in British patent to T. G. Martin No. 1419 of 1910.

The subscriber's substation A is of any suitable or approved type and comprises the usual receiver 2, transmitter 4, ringer 5 and condenser 6. Being an automatic substation it is also provided with an impulse transmitter or calling device, which is represented herein by a pair of impulse springs 7 and 8 and an impulse wheel 9, which latter is assumed to be controlled through the medium of a finger hole dial (not shown) in such a manner that the impulse springs 7 and 8 may be momentarily separated a number of times corresponding to the digit called.

The first selector switch F is of the general type of selector switch disclosed in United States Letters Patent No. 815,321, granted March 13, 1906, to Keith, Erickson and Erickson, except that the so-called side switch is omitted and the circuits are modified to adapt the switch to operate in a system in which it is controlled by impulses delivered over two sides of the line in series. Among other details, the selector switch F comprises banks of contacts arranged in horizontal rows or levels which are adapted to be engaged by a set of wipers 10, 11 and 12 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 13 and a rotary movement controlled by the rotary magnet 14. The operations of the various parts of the switch are controlled through the medium of the double-wound line relay 15. Means for permitting the switch to be restored to normal position are provided in the release magnet 16, which, upon energizing, withdraws the retaining pawls from the shaft. The springs 17 and 18 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 19 and 20 are slow acting—that is, relays which deënergize slowly after their energizing circuits are broken.

The non-numerical selector E for extending a connection from the subscriber's line A to the selector F is similar in construction to the selector switch F, the circuits being modified, however. Among other details, the non-numerical selector E comprises a bank of line contacts (not shown) arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of line wipers 21 and 22 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 23 and a rotary movement controlled by the rotary magnet 24. The vertical movement of the switch, instead of being controlled through the medium of the calling subscriber's substation impulse transmitter, as is the case with the selector F, is automatic and is controlled through the medium of the wiper 26 and the auxiliary bank contacts 27, as will be hereinafter described. There is also a bank of private contacts arranged in rows or levels, a portion of which is shown in Fig. 4. This bank of contacts consists of ten groups or levels, similar to the line banks, each group comprising ten pairs of contacts. The private wiper 25 is provided with a pair of wiping arms 30 and 31. The wiping arm 31 is adapted to make contact with any one of the upper contacts on any level, while the wiper 30 is arranged to make contact between the corresponding lower bank contact and the adjacent lower contact to the left. The end pair of contacts of each level are connected together by means of a short circuiting strip 32. A plurality of these selectors E are arranged in a group and have access to the same group of trunks, and the corresponding contacts in the bank of private contacts of each selector are multipled together, in the usual manner. Whenever the ten contacts of any certain level are all busy, there will be a wiper similar to the wiper 30 spanning the first and second contacts of one of these multiple private banks, another wiper spanning the second and third contacts, and so on, until we have a circuit passing from the first to the last contact, and as the last pair of contacts of said level are connected together, a guarding potential will be placed on the auxiliary bank contact 27 corresponding to said certain level. This circuit extends from ground through the wiper arm 31 of the switch resting on the tenth contact of said level, through the short-circuiting strip 32 and thence over the circuit through the lower row of contacts and the spanning wiper 30 to the auxiliary bank contact 27. The extra bank contacts 27 of the different levels form an auxiliary bank of contacts, as shown in Fig. 4. To the private wiper 25 is attached an extra wiper 26 arranged to wipe over the auxiliary bank contact 27, thereby controlling the vertical motion of the switch. The extra wiper 26 is shorter than the wipers 30 and 31, so that when the shaft is rotating, the said wiper 26 will be carried in front of the levels of the said bank. Means for permitting the switch to be returned to normal position are provided in the usual release magnet 33. The springs 34 and 35 close only when the switch shaft has been raised one or more steps from its lowest position. The relays 36, 37 and 38 are slow acting relays. The slow acting relay 38 is so arranged that it may operate its interrupter springs 39 without the slow acting relay 36 deënergizing.

Having given a general description of the apparatus involved in the system, in order to give a complete understanding of my invention, I will now describe the operation of the selector E when the calling subscriber A, upon removing his receiver, causes this non-numerical selector E to select an idle selector switch F. It will be assumed that all the trunk lines of the first two levels are busy, thus placing a guarding ground potential on the bank contacts 27 corresponding to the first two rows or levels of bank contacts. Upon the removal of the receiver from the switch-hook at the substation A preparatory to making a call, an energizing circuit is closed from ground G^1 through the lower winding of the line relay 40, springs 41 and 42 of the switching relay 43, line conductor 44, through the subscriber's substation A, over the return line conductor 45, springs 46 and 47 and the upper winding of the relay 40 to battery B, thence through battery B to ground G. The relay 40, upon energizing, closes a circuit through the relay 37 extending from ground G^2 through the contact of springs 49 and 50 and the relay 37 to the battery B. The relay 37, upon energizing, supplies a guarding ground potential to the connector private bank contacts 87 to prevent the calling line being seized by a connector switch. This circuit extends from ground G^3 through the contact of springs 51 and over the conductor 53 to said private bank contact. When the switch is in normal position, the wiper 26 contacts with the lowermost contact of the bank 27, which contact is connected to ground G^4. Therefore, the energization of the relay 37 also closes a circuit through the vertical magnet 23, said circuit extending from ground G^4 through the wiper 26, contact of springs 52, relay 36, vertical magnet 23, interrupter springs 39 and the relay 38 to battery B, thus energizing the vertical magnet 23 and the relays 36 and 38. The vertical magnet 23 operates to raise the switch shaft and wipers one step to a position opposite the first row or level of contacts. The relay 38, upon energizing, opens the above-traced circuit at the interrupter springs 39, thus deënergizing the vertical magnet 23 and allowing the armature of said vertical magnet to return to normal

position. The relay 38, however, deënergizes and again closes the above-traced circuit at the interrupter springs 39 before the relay 36 has had time to deënergize. It having been assumed that all the trunks of the first level are busy, and therefore the bank contact 27 connected to the first level of private bank contacts connected to ground, the wiper 26, upon engaging his grounded bank contact 27, again closes a circuit through the vertical magnet 23 and the relay 38 to battery B, thus causing the vertical magnet to operate to raise its shaft and wipers another step, *i. e.*, opposite the second row or level of bank contacts. The above operation will continue until the switch shaft and wipers are raised to a position opposite a row or level of bank contacts that contains one or more idle trunk lines, which, in this instance, has been assumed to be the third level As above stated, the relay 36 remains energized as long as impulses are being sent through the vertical magnet, and, in its energized condition, this relay closes a circuit from ground G^5 through the contact of springs 54 and 55 and the relay 57 to battery B. The relay 57, upon energizing, closes a locking circuit for itself extending from ground G^3 through the springs 51, rotary magnet springs 58 and 59, off-normal springs 35, springs 61 and 62 of the relay 57, thence through the relay 57 to battery B. It will be observed that the locking circuit for the relay 57 passes through the off-normal springs 35 and these off-normal springs are, of course, not closed until the switch shaft is raised at least one step. The relay 57 controls in part the circuit of the rotary magnet 24 and is locked in its energized position at this time for the purpose of preparing the circuit over which the rotary magnet 24 is subsequently to be operated. Thus, upon the deënergization of the relay 36 after the vertical shaft has raised its wipers opposite a level that contains one or more idle trunk lines, the circuit of the rotary magnet is closed. This circuit extends from ground G^3 through the contact of springs 51, springs 58 and 59, off-normal springs 35, springs 61 and 62, springs 55 and 56, interrupter springs 60 and the rotary magnet 24 to battery B. The rotary magnet, upon energizing, rotates the wipers one step, and, by opening the springs 58 and 59, disconnects ground G^3 from itself and the relay 57. If the first trunk line of the second level is idle, the relay 57 deënergizes as soon as the springs 59 and 58 are opened. If this trunk line is busy, however, the wiper arm 31 of the private wiper 25 finds the contact with which it engages provided with a guarding ground potential which is transmitted to the relay through the springs 61 and 62, thereby preventing it from deënergizing. The rotary magnet, however, deënergizes when the springs 60 disengage, regardless of whether the relay 57 remains energized, and the circuit of the rotary magnet will be again closed as soon as the armature drops back far enough to close the springs 58 and 59. The rotary magnet will, therefore, operate in a manner similar to that of a buzzer to advance the wipers step by step over the contacts until the non-grounded contact of the idle trunk line is reached by the wiper 25, whereupon the relay 57 deënergizes. The relay 57, upon deënergizing, whether after one or several operations of the rotary magnet, permanently breaks the circuit of the magnet 24 and closes the circuit of the switching relay 43. The circuit through the said relay extends from ground G^3 through the contact of springs 51, springs 58 and 59, off-normal springs 35, springs 61 and 63 and the relay 43 to battery B. The relay 43, upon energizing, disconnects the line relay 40 from the line and extends the line connection over the heavy conductors shown through the wipers 21 and 22 to the selector switch F.

When the connection is completed to the selector F, the circuit of the line relay 15 is closed. The relay 15, upon energizing, closes an energizing circuit through the slow relay 20. The relay 20, upon energizing, supplies a new holding ground to the relay 43 of the non-numerical selector E, the original circuit having been broken by the deënergization of the relay 37 of the non-numerical selector E. The said circuit extends from ground G^6 through the contact of springs 64, wiper arm 31 of the wiper 25, springs 61 and 63 and the relay 43 to battery B. The energization of the relay 20 also prepares a circuit for the vertical magnet 13 and opens the circuit of the release magnet 16.

The apparatus is now in condition to receive impulses corresponding to the first digit of the called number. The calling subscriber therefore operates his calling device, which causes impulses to be transmitted through the line relay of the selector F, which selector then operates in the well-known manner to extend connection to the trunk line 82—84. As any suitable type of selector switch can be employed in connection with my invention, and as the particular selector employed forms no part of my invention, it is not thought necessary to describe its operation in detail. The connection to the called line can then be completed either through other automatic switches or through a manual board, in a manner well understood in the art. After the conversation is completed, the release of the apparatus is brought about by hanging up the receiver at the calling substation in the usual manner. In the system here shown the usual form of trunk-release is employed—that is, the apparatus at the

called end of the connection is first released and the release of this apparatus destroys the holding circuit for the switching relays 43 and 85 of the non-numerical selector E and the selector F. The relay 85 of the selector F, upon deënergizing, closes a circuit through the release magnet 16 of said switch, thus causing the release of this switch in a well-known manner. The relay 43 of the non-numerical selector E, upon deënergizing, closes a circuit through the release magnet 33. This circuit extends from ground G^2 through the springs 49 and 48, springs 90, springs 34 and the release magnet 33 to battery B. The non-numerical switch E then releases in a well-known manner common to selector switches of this type and breaks the circuit of its own release magnet when the shaft reaches its lowest position.

It will thus be seen that I have devised a very efficient non-numerical selector switch which may have access to a large number of trunk lines without having to pass over the individual contacts of each busy trunk before engaging the contacts of an idle trunk—that is, by my invention I have provided a non-numerical trunk-selecting switch which, by one movement, can first select a comparatively small group in which an idle trunk is located, and then, by a second movement, can select an idle trunk in that group.

While I have illustrated one particular embodiment of my invention and have shown the same as extending connection to a selector switch of a well-known type, it will, of course, be understood that my invention is not in any way limited to the particular use to which this non-numerical selector switch is placed. Furthermore, various changes and modifications in the non-numerical selector switch will readily suggest themselves to those skilled in the art and come within the contemplated scope of my invention. For example, the contacts in one level of one non-numerical switch may be slipped to connect with the corresponding contacts in a different level of another non-numerical switch in the same group, and so on, thereby avoiding the objection of having all the first levels of all the switches become busy before the second level.

What I claim as my invention is:—

1. In a telephone system, a plurality of trunk lines divided into groups and each terminating in an automatic selector switch, a subscriber's line provided with an individual line switch having access to said trunk lines, means responsive to the removal of the receiver on said line for operating said individual switch to first select a group of trunk lines containing an idle trunk and then select an idle trunk in the selected group, whereby said subscriber's line is extended to an idle selector switch, and means responsive to the replacement of the receiver on said line for restoring the said individual switch to normal position.

2. In a telephone system, a plurality of trunk lines divided into groups and each terminating in an automatic selector switch, a subscriber's line provided with an individual line switch having access to said trunk lines, means responsive to the removal of the receiver on said line for operating said individual switch to first select a group of trunk lines containing an idle trunk and then select an idle trunk in the selected group, whereby said subscriber's line is extended to an idle selector switch, a holding circuit for preventing the release of said individual switch, and a relay in said selector switch energized over the extended subscriber's line to control the continuity of said holding circuit, whereby the release of said line switch may be controlled over said subscriber's line.

3. In a telephone system, a plurality of subscribers' lines, each provided with an individual switch, a plurality of groups of trunk lines accessible to said switches in common, means in each switch responsive to the initiation of a call on the associated line for selecting a group of trunk lines containing an idle trunk and for then selecting an idle trunk line in the selected group, multiple test contacts in said switches corresponding to groups of trunk lines and wipers coöperating therewith to control the group selection, and means in a plurality of switches coöperating to place a busy potential on one of said test contacts.

4. In a telephone system, a plurality of subscribers' lines each provided with an individual switch, a plurality of groups of trunk lines accessible to said switches in common, means in each switch responsive to the initiation of a call on the associated line for selecting a group of trunk lines containing an idle trunk and for then selecting an idle trunk line in the selected group, multiple test contacts in said switches corresponding to groups of trunk lines and wipers coöperating therewith to control the group selection, a circuit for the multiple test contacts of each group for placing a busy potential thereon, and means in a plurality of switches coöperating to complete one of said circuits.

Signed by me at Chicago, Illinois, this 27th day of December, 1913.

FRED. R. QUAYLE.

Witnesses:
RAYMOND H. BURFIEND,
T. E. MEYER.