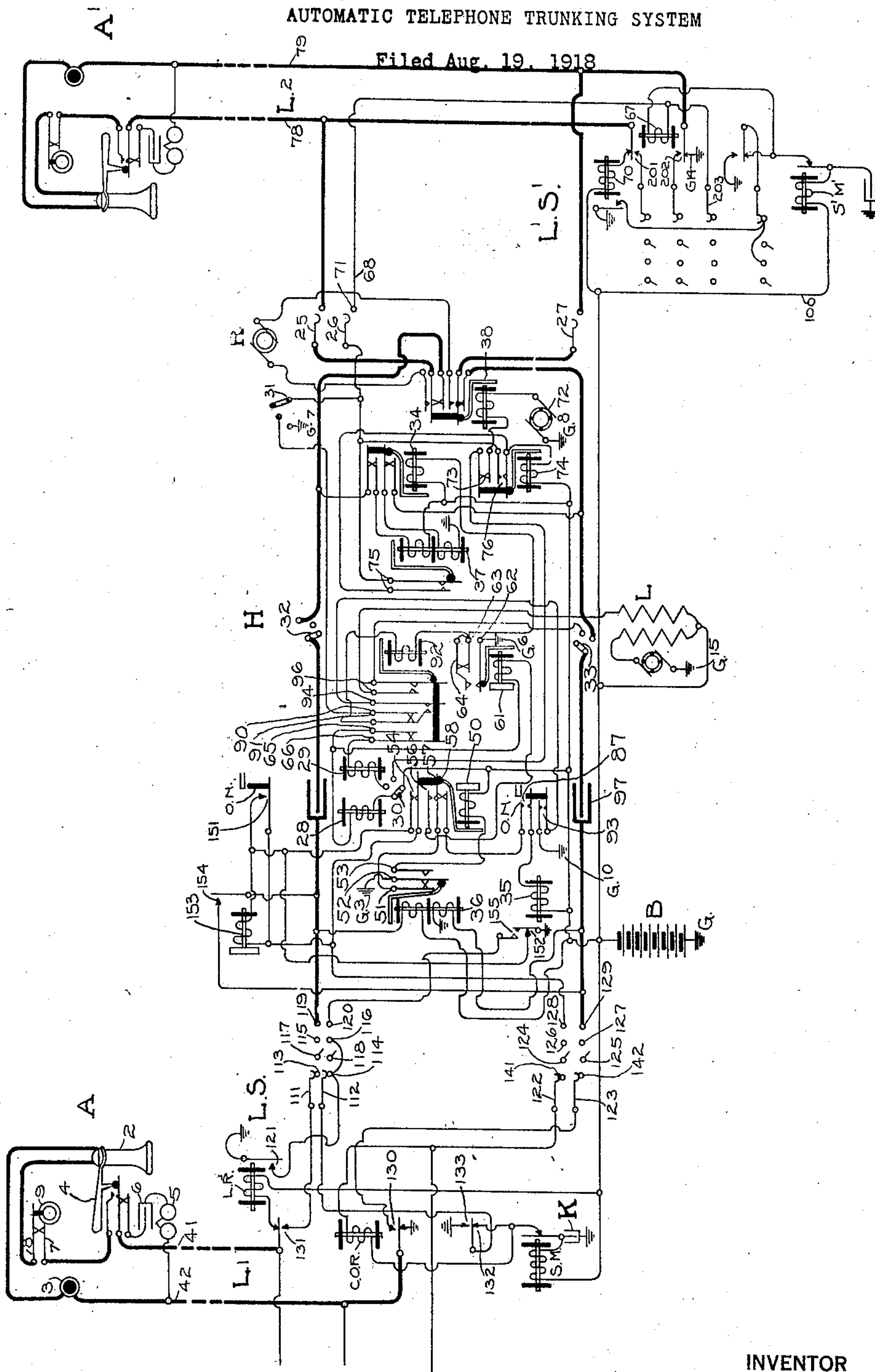


June 2, 1925.

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UNITED STATES PATENT OFFICE.

WINFRED T. POWELL, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

AUTOMATIC TELEPHONE TRUNKING SYSTEM.

Application filed August 19, 1918. Serial No. 250,617.

To all whom it may concern:

Be it known that I, WINFRED T. POWELL, a citizen of the United States, residing at Rochester, Monroe County, New York, have invented new and useful Improvements in Automatic Telephone Trunking Systems, of which the following is a specification.

My invention relates to improvements in automatic telephone systems and more particularly to an improved construction in non-numerical trunking switch line circuit for use in such a system.

While my invention in some of its aspects is of a broad nature and may be applied to a line circuit using switches of various construction, I prefer a form of my invention wherein use is made of a line switch, the wipers of which rotate in but one direction.

It is an object of my invention to provide a switch circuit arranged to provide for the traveling line switch with which it is associated, alternate home and trunk point resting positions, the trunk point resting positions being the positions in which the line switch may make connection between the line with which the switch is associated and the trunk circuit and the home point positions being positions wherein the line switch may come to rest after the release of a connection between the associated line circuit and the trunk circuit. In the operation of the system of my invention I so organize the apparatus thereof that immediately following the release of a connection through contacts of the line switch the line switch will immediately travel to the next home point position, the home point positions and the trunk point positions of the switch being preferably alternated although it is apparent that several trunk point positions may be interposed between successive home point positions, and conversely if desired, a plurality of home point positions may be interposed between successive trunk point positions. I am aware that line switch systems have been provided in which a single home point is provided for the switch to which home point the switch rotates in either one or the other direction after the release of an established connection. I am likewise aware that other line switch systems have been provided wherein the line switch does not travel after the release of an established connection but

remains with its wipers in contact with the last connected trunk contacts.

Among the objects of my invention are the securing of the following advantages over the aforesaid line switch systems of the art. The line switch circuit of my invention is simple. It contains few parts, such parts being positive in operation and may be cheaply constructed and easily maintained in operation.

It is a further object of my invention to eliminate the necessity of such expedients as slow acting line relays which give trouble in practice since slow acting line relays do not operate with the same speed on line circuits of different resistance.

Another object of my invention is the provision of a system in which mechanical interlocking of the line circuit relays are not necessary to cause a different kind of operation of one of the relays when the line is a called line from that which it would have when the line is a calling line.

Other objects of my invention and the invention itself will be apparent as the description thereof progresses. Referring to the figure accompanying this specification at A, I show a telephone sub-station located on a telephone line L¹ leading from the sub-station to the line switch apparatus at L—S. The line switch apparatus contains a cut off relay C. O. R. and line relay L. R. and stepping magnet S. M., the said stepping magnet being arranged in the well-known manner to step the line switch wipers from one position to another, the stepping preferably being accomplished on the back stroke of the armature of the stepping magnet S. M.

The line switch wipers are four in number, 111 and 123 being the line wipers which are provided for the purpose of extending the circuit of the line to the talking conductors of a trunk circuit such as the trunk circuit H. Wipers 112 and 122 are provided for the purpose of controlling circuits local to the exchange as will be later described. All of the four wipers of a line switch which is individual to a line such as a line L¹ are preferably mounted on a rotatable shaft, each adapted to successively engage contacts arranged in a circular row the alternate sets of contacts such as the set comprising the contacts 113, 114, 141, 142

and the set of contacts comprising the contacts 115, 116, 126, 127, being what I term home position contacts and upon one of which sets of contacts of the plurality provided for the purpose the switch will come to rest after the release of a connection previously established over one of the intermediate sets of contacts which I call trunk position sets.

The "subscriber's" station A is of any suitable or approved type and comprises the usual receiver 2, transmitter 3, switch hook 4, ringer 5 and condenser 6. Being an automatic sub-station it is also provided with an impulse transmitter or calling device, which is here represented 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 illustrated connector switch H is of the same general character as that disclosed in United States Letters Patent No. 815,176, granted March 13, 1906, to Keith, Erickson and Erickson, the circuits, however, being modified to adapt the switch to operate in a system in which the central office apparatus is controlled by impulses delivered over the two sides of the line in series. The connector is provided with a shaft (not shown) carrying the wipers 25, 26 and 27. The shaft is controlled by the vertical magnet 28 and the rotary magnet 29. The usual side switch comprising the wipers 30, 31, 32 and 33 is controlled by the private magnet 34 in the usual well-known manner. The magnet 35 is the usual release magnet. The operations of the switch are controlled through the medium of the double-wound line relay 36, through which the calling subscriber receives talking current. The called subscriber receives talking current through the so-called back-bridge relay 37. The ringing relay 38 is the means through which ringing current is applied to the called line.

The substation A' and the line switch L', S' are similar in all respects to the substation A and the line switch L. S.

For the purpose of supplying battery current for operating the central office apparatus, and for talking purposes, there is shown a battery B having one terminal grounded at G. The busy signaling machine, L, as represented herein, comprises an induction coil or transformer, the primary winding of which is included in a local circuit with a battery and an interrupter. Through the medium of this interrupter an intermittent current is supplied to the primary winding which induces an alternating current in the secondary winding, whereby when said winding is connected with the

subscriber's line, a buzzing sound is heard in the receiver.

Having given a general description of the apparatus involved in the system, and in order to give a complete understanding of my invention, I will now describe how the subscriber at substation A may call the subscriber at substation A'. By the removal of the receiver from the switch hook at the substation preparatory to making a call, an energizing circuit is closed through the line relay L. R. of the line switch L. S. This circuit extends from ground through normal contacts of the cut off relay C. O. R. over the line conductor 42, through the substation A, line conductor 41, normal contacts of the cut off relay C. O. R. through the winding of the line relay L. R. to negative battery B and thence to ground at G. The line relay L. R., upon energizing, operates to close the circuit of the stepping magnet S. M. At the time the call is initiated the line switch wipers 111, 112, 122 and 123 are in the position shown in the drawing, namely, upon different contacts of a set comprising home point contacts such as the home point contacts 113, 114, 141 and 142. All of the home point contacts in the second row of the contacts and adapted to be engaged by the line switch wiper 112, are connected together by a circuit conductor which is also connected through normally opened contacts 121 of the line relay L. R. to ground. Thus whenever these normally opened contacts 121 are operated, ground is placed on the alternate home point contacts for the purpose of operating the stepping magnet should the line at the time be a calling line. At this time therefore ground placed upon the home point contact 114 by the operation of the line relay contacts 121 will complete a circuit including the said contacts 121, the wiper 112, home point contact 114, normal contacts 132 of the cut off relay C. O. R. through normal contacts of the stepping magnet S. M. which contacts are adapted to be broken whenever the stepping magnet is energized, the circuit continuing through the winding of the stepping magnet S. M. and thence to the negative pole of the source of current B.

Current from the said source flowing over this circuit the stepping magnet S. M. will energize and will attract its armature thus breaking its own energizing circuit. This will cause its armature to be again retracted according to the well-known principle of any operating direct current buzzer, and the stepping magnet armature arranged in the well-known manner upon being retracted to advance the line switch wipers one step forward along their respective rows of contacts. When the first step is thus made if the wiper 112 which may be called the test wiper finds the next succeeding contact 115

without a ground connected to it the operation of the stepping magnet will cease since its circuit conductor leading to ground through normal contacts 132 of the cut off relay C. O. R. will be broken but we will assume in this description that due to the fact that the trunk circuit whose incoming terminals are connected to the contacts 117, 118, 124 and 125 as well as to multiples of these contacts on the different line switches of the group of the lines served by the group of trunks is a busy trunk circuit, that is, it has been seized for use by another line switch of the group and that therefore, in a manner which will later be made apparent, a connection will therefore be had to all of the test contacts 118 of this trunk circuit to the ground pole of battery that this ground will serve to cause the stepping magnet to continue to step the wipers of the line switch to succeeding contacts.

The substituted circuit for the stepping magnet may be traced from ground placed on the test contact 118 by the operation of apparatus actuated by virtue of the connection existing between the trunk circuit whose terminals are connected to the set of contacts 117, 118, 124 and 125 and a connected line circuit, contacting wiper 112 normal contacts 132 of the cut off relay C. O. R. through normal contacts and the winding of the stepping magnet S. M. to the negative pole of the battery B. Current flowing from the said battery will again operate the stepping magnet to propel the line switch wipers to the next set of contacts which is an alternate set of home point contacts 115, 116, 126 and 127, whereupon, the stepping magnet will be again operated to step line switch wipers in the manner described for the first stepping thereof, a circuit for the stepping magnet being again traced through normally opened contacts 121 of the operated line relay L. R. through the test contact 116 and the test wiper 112 so that the stepping magnet being again energized and automatically retracted in the manner previously described will cause the line switch wipers to occupy the fourth illustrated position bringing them into contact with the set of contacts 119, 120, 128 and 129 which are connected to an idle trunk circuit such as the illustrated trunk circuit H.

Due to the idle condition of this trunk circuit no ground will be connected to the test contact 120 thereof and the circuit to ground for the stepping magnet S. M. will be interrupted and the stepping magnet will cease to operate.

While the line switch was stepping and prior to the time that the wipers 112 and 122 came into contact with contacts of an idle trunk circuit the cut off relay C. O. R. is not operated for the reason that when the wipers 112 and 122 were on home point con-

tacts the home point contact on which wiper 122 is resting, has no connection and so no circuit would be completed for the cut off relay. Again when the wipers 112 and 122 are upon contacts of a busy trunk circuit, ground will be found upon both of these contacts being placed on the test contact upon which the wiper 112 rests by the closure of contacts such as the contacts 133 of the cut off relay, such as the cut off relay C. O. R. of such another line circuit as may at the time be connected to the busy trunk. The closure of such contacts 133 placing ground through its associated wiper like the wiper 112 of the line switch circuit being described upon the multiplied test contact of the trunk circuit at the time occupied. Ground is also placed upon the contact upon which the wiper 122 at the time rests by the operation of apparatus in the busy trunk circuit which is organized like the trunk circuit H and in such an organization the circuit to ground from the contact referred to would be traced from the said contact corresponding to the contact 128 of the trunk circuit H through off normal contacts 151 and through normally closed contacts 152 of the release magnet 35, thus at such a time when the line switch wipers of the line switch L. S. are traversing the contacts of such a busy trunk circuit, ground being found upon both of the wipers 112 and 122 will effectually short circuit the cut off relay C. O. R. to prevent its operation.

Now assuming that the stepping magnet has caused the wipers to encounter contacts of an idle trunk circuit and in the manner above described has ceased to operate, the cut off relay C. O. R. will be operated, the circuit for the operation of the cut off relay may be traced as follows. From the negative pole of the source of current B through relatively low resistance winding of the stepping magnet S. M. through the normal contacts of the said stepping contact through the relatively high resistance winding of the relay C. O. R. through the line switch wiper 122 trunk contact 128 of the idle trunk circuit through the winding of the special slow releasing relay 153 and thence through normal contacts 152 of the release magnet 35 to the ground pole of the source of current. Current from the said source flowing over this circuit will operate the relatively high resistance relay C. O. R. to cause it to attract its armatures but the flow of current through this circuit due to the high resistance of the relay C. O. R. will be insufficient to cause the stepping magnet S. M. to operate.

The third armature of the cut off relay being operated will close its contacts 133 to place guarding ground potential upon the multiplied contacts, one of which is shown at 120 of the seized trunk circuit H.

tacts 132 being opened to prevent further stepping of the stepping magnet.

The first and second armatures likewise being attracted will open the circuit of the line relay L. R. and the connection to ground respectively to clear the line strands and to retire the line relay which will open its contacts 121. These armatures being operated will also cause a closure of the contacts 131 and 130 respectively to extend the circuit of the line conductors 41 and 42 through the line wipers 111 and 123 and co-operating contacts 119 and 129 of the trunk circuit H to the talking strands of the trunk circuit H.

A circuit is now completed including the said line conductors and the substation instrument at A including tandem windings of the impulse relay 36, the said windings being directly connected to the trunk circuit talking strands, and the supply of talking battery to the transmitter 3 of the substation A being supplied through these windings which afford as well an impedance bridge across the talking circuit so that talking currents will not be unduly diverted through these windings.

Current flowing through the windings of the relay 36 will operate it and cause it to close its contacts 52—53 to operate the slow-releasing relay 50, the circuit for the slow-releasing relay being traced from ground G³ through the said contacts 52—53 through the winding of the slow relay 50 to the negative pole of the source of current. The relay 50 will be thereby operated attracting its armatures to close contacts 54 and 56 and to open contacts 57.

The slow releasing relay 153 having been operated as before described will close its contacts 154 to cause a conductive bridge of the line strands to be made and to thereby hold the relay 36 operated or to operate the relay 36 should the subscriber A retire his instrument from the line at the moment or preceding the seizure of the trunk circuit H by the line switch wipers and to provide that in such a case that a release be caused of the connection existing between the line switch circuit and the trunk circuit. This release will be effected as follows.

The relay 50 being operated attracting its armatures and closing contacts 54 and 56 as before described, the closure of the contacts 54 will short circuit the slow relay 153 which will slowly retract its armature and after a period open its contacts 154. At this time assuming the subscriber has retired his instrument, the relay 36 will retract its armature being a fast operating relay opening the circuit of the slow releasing relay 50 which will for a time hold its armature attracted and the relay 36 will restore its normal contacts 51—52 a circuit thereby being closed for the primary

stepping magnet 28 including the winding of the slow releasing change-over relay 61, the circuit being traced from the ground pole of battery through contacts 52—51 of the relay 36 through now made contacts 56 of the relay 50, the winding of the slow releasing relay 61, the winding of the primary stepping magnet 28 through first position contacts of the side switch wiper 30 to the negative pole of the source of current.

Current from the said source will operate the slow releasing relay 61 and the primary stepping magnet 28 and the switch carriage will be advanced, say in a vertical direction one step. This will close the off normal contacts 151 which will maintain the short circuiting of the slow releasing relay 153 and maintain the contacts 154 opened thus if the subscriber instead of retiring, had remained on the line, the conductive bridge across the talking strands would be removed and the talking currents would not be shunted.

However assuming that the subscriber has retired, as before stated, after an interval the slow releasing relay 50 will retract its armature, closing contacts in the release circuit of the release magnet 35, it being understood that the off normal switch contacts 87 and 93 are operated to close these contacts at the same time that off normal contacts 151 were likewise operated by the stepping of the switch. This circuit is traced as follows.

From the ground pole of the source of current through normal contacts 52—51 of the impulse relay 36, normal contacts 57 of the slow releasing relay 50 which is now restored, off normal contacts 87 which are now closed, through the winding of the release magnet 35 to the negative pole of the source of current. Current from the said source operating the said release magnet will cause the restoration of the switch carriage and at the same time functioning as a relay, will cause the closure of contacts 155 to place ground potential upon the multiplied test contact 120 of the trunk circuit and will open the contacts 152 in the circuit to ground leading to the holding contacts 122—128 in the circuit of the cut off relay C. O. R. before traced, to release the cut off relay of the line.

The cut off relay being released will retract its armatures and the lower armature being retracted will open contacts 133 and close contacts 132 which last named contacts are in the stepping circuit of the stepping magnet S. M. The circuit of the said stepping magnet S. M. is now completed, being traced from ground through now closed contacts 155 of the release magnet 35, test contact 120, line switch wiper 112, now closed contact 132 of the cut off relay, normal contacts and the winding of the stepping mag-

net S. M. to the negative pole of the source of current. The current from the said source will energize the stepping magnet to cause it to attract its armature which will
 5 cause it to break its own circuit in the manner previously described and upon such breaking will cause the advance of the switch wipers of the line switch one step carrying the switch wipers off the contacts of the
 10 previously occupied trunk circuit H and on to the next succeeding home point contacts.

There being no ground however on the home point contact which the switch wiper
 15 112 next encounters, due to the fact that the line relay L. R. is not at the time operated, the circuit of the stepping magnet is interrupted and ceases to operate to step the switch wipers, leaving them resting upon
 20 the said next succeeding home point contacts.

In the meantime the switch mechanism of the trunk circuit switch H has been restoring to normal and when fully restored the
 25 off normal contacts 87 are broken to open the circuit of the release magnet 35 which will restore its contacts to normal position. The other off normal contacts 93 and 151 are also restored to normal open position
 30 and the circuits controlled thereby are restored to normal.

Assuming, however, that the calling subscriber remains on the line, he may now operate his calling device for the first digit
 35 2 of the called number, whereby the substation impulse springs 7 and 8 are operated twice momentarily, each time breaking the circuit of the connector line relay 36. The relay 50 of the connector being slow acting
 40 does not deenergize during the momentary interruptions of its circuit by the line relay 36, and consequently each time the latter deenergizes, an impulse is transmitted through the vertical magnet 28. This circuit
 45 extends from ground G^3 through the contact of springs 52 and 51, springs 57 and 56, relay 61, vertical magnet 28 and the side switch wiper 30 (in first position) to the battery B. The vertical magnet 28 receives
 50 two impulses over this circuit and operates to raise the switch wipers 25, 26 and 27 to a position opposite the second level of bank contacts. The relay 61, which is included in series with the vertical magnet, remains
 55 energized during the entire time that impulses are being transmitted through it and operates to close the circuit of the private magnet 34. The circuit for the private magnet 34 extends from ground G^6 through the
 60 contact of springs 62 and 64 and the said magnet to the battery B. After the last impulse is delivered, the relay 61 opens the circuit of the private magnet 34, which, upon deenergizing, permits the side switch to advance
 65 from first to second position. The

movement of the side switch wiper 30 from first to second position transfers the battery connection from the vertical magnet 28 to the rotary magnet 29.

The calling subscriber now operates his
 70 calling device for the last digit 0, in response to which the connector line relay operates to transmit ten impulses through the rotary magnet 29 in series with the relay 61, whereby the shaft wipers are rotated
 75 onto the contacts of the desired line. The said circuit extends from ground G^3 through the contact of springs 52 and 51, springs 57 and 56, relay 61, springs 65 and 66, rotary magnet 29 and the side switch wiper 30 (in
 80 second position) to the battery B. The relay 61 operates in response to the impulses for this digit in the same manner as for the previous digit to cause the private magnet 34 to advance the side switch one more position,
 85 i. e., from second to third position. By the engagement of the side switch wipers 32 and 33 with their third-position contact points, the connection is completed with the called substation, and by the engagement
 90 of the side switch wiper 31 with its third-position contact point a circuit is established for the cut-off relay winding 67 of the line switch C' as well as for the slow relay 70. The circuit for the cut-off winding 67 extends
 95 from ground G^7 through the side switch wiper 31 (in third position), private wiper 26, conductor 68, and the cut-off winding 67 to the battery lead 100, through the low resistance winding of the line stepping
 100 magnet S' M' of the called line L' S'. The called line cut-off relay 67 will be energized to break the circuit of the line relay 70 thereof and ground at G^{14} , but since the line wipers of the called line switch rest upon
 105 the home point contacts to which no conductors are connected, the closure of the contacts 201 and 202 in their circuit, will be without effect. The line switch wiper 203 will likewise be functionless, as it will be resting
 110 upon a home point contact to which nothing is connected. A guarding ground potential is supplied to the connector private bank contact 71 of the called line which prevents the same from being seized by some
 115 other connector switch. By the engagement of the side switch wiper 30 with its third position contact point, the circuit of the ringer relay 38 is closed. This circuit extends from ground G^8 through the interrupter 72, relay 38, contact of springs 73 and the side switch wiper 30 (in third position) to the battery B. The ringer relay disconnects the calling line from the called line
 120 and bridges the ringing current generator R across the called line to signal the called subscriber. The ringer relay is energized only intermittently through the medium of the interrupter 72. Upon the response of the
 125 called subscriber, his line is provided with
 130

talking current through the windings of the back-bridge relay 37, which relay, upon energizing, closes the circuit through the ringer cut-off relay 74. The said circuit extends
 5 from ground G^7 through the side switch wiper 31 (in third position), contact of springs 75 and the said relay 74 to the battery B. The relay 74, upon energizing, interrupts the circuit of the ringer relay 38
 10 at the springs 73 and closes a locking circuit for itself through the springs 76 independent of the springs 75. After the conversation is completed, the connection is released by hanging up the receiver at the calling sub-
 15 station in the following manner: When the receiver at the substation A is restored to the switch-hook, the separation of the hook-switch springs destroys the energizing circuit of the connector line relay 36. The
 20 relay 36 is thereupon deenergized and opens the circuit of the relay 50. The relay 50, upon deenergizing, completes a circuit extending from ground G^3 through the contact of springs 52 and 51, springs 57 and
 25 58, off-normal springs 87 and the release magnet 35 to the battery B. The magnet, upon energizing, restores the switch shaft and side switch to normal position and its own circuit is broken at the off-normal
 30 springs 87 when the shaft reaches its lowest position. The relay 50 upon deenergizing, also opens the holding circuit for the winding of the calling line cut off relay C. O. R. at the springs contact 54. This will complete
 35 the circuit of the stepping magnet S. M. of the calling line through the lower normal contacts 132 in its circuit, and through wiper 112, contact 120 of the trunk circuit and contact 155 of the release magnet 35; this cir-
 40 cuit being completed to ground through contacts of the said release magnet and to battery connected to the opposite side of the stepping magnet S. M. The contacts 155 are closed while the connector switch is re-
 45 turning to normal, by the energization of the release magnet 35 whose circuit has been above traced.

The stepping magnet S. M. of the calling line having its circuit closed as before described, will step the wipers 111, 112, 122 and 123 of the calling line switch to the next position and out of contact with the contacts 119, 120, 128 and 129 of the connector switch H, the said next position con-
 50 tacts being home point contacts, since as before related, the home point contacts and the trunk point contacts alternate in the switch construction herein illustrated and described.

60 The connector switch returning to normal opens the circuit of the cut-off relay winding 67 of the called line, by the opening of the wiper 26 of the connector switch and private contacts 71 of the called line, co-
 65 operating therewith, thus returning the

apparatus of the called line to normal position.

While I have illustrated my invention in connection with one particular type of automatic system, it will, of course, be under-
 70 stood that it is capable of use with many other forms of systems and is equally as well adapted for use in connection with semi-automatic systems—that is, systems in
 75 which a manual link circuit is employed in combination with automatic means for establishing a connection between two subscribers' lines.

What I claim is:—

1. In a telephone system, the combination
 80 with a line switch, a line relay therefor, a plurality of sets of stationary contacts for the said line switch, each of the said sets of contacts being connected to a trunk line circuit,
 85 sets of home point contacts for the said switch, one of the said sets of home point contacts being interposed between adjacent sets of trunk point contacts, line switch
 90 wipers, means to cause the said line switch wipers to move from a contacting set of home point contacts, under the control of the said
 95 line relay, means to cause the said line switch wipers to move from a busy set of trunk contacts, said first-named and said last-named moving means including a motor
 100 magnet for the said switch, and means associated with each of the said trunk circuits responsive to the idle condition thereof, to disable the said motor magnet to stop the
 105 said switch wipers upon its set of contacts.

2. In a telephone system, the combination
 110 with a line switch, a plurality of stationary contacts for the said line switch, each of the said contacts being connected to a trunk line circuit, home point contacts for the said
 115 switch, each of the said home point contacts being separated from the next home point contact by one of the said trunk point contacts, a line switch wiper, means to cause
 120 the said line switch wiper to move from a contacting home point contact, means to cause the said line switch wiper to move from a contacting busy trunk contact, said
 125 first-named and said last-named moving means including a motor magnet for the said switch, and means associated with each of the said trunk circuits responsive to the
 130 idle condition thereof, to disable the said motor magnet.

3. In a telephone system, the combination
 135 with a line switch, a plurality of stationary contacts for the said line switch, each of the said contacts being connected to a trunk line circuit, home point contacts for the said
 140 switch, each of the said home point contacts being separated from the next home point contact by one of the said trunk point contacts, a line switch wiper, means to cause
 145 the said line switch wiper to move from a contacting home point contact, means to

cause the said line switch wiper to move from a contacting busy trunk contact, said first-named and said last-named moving means including a motor magnet for the said switch, means associated with each of the said trunk circuits responsive to the idle condition thereof, to disable the said motor magnet, a cut-off relay for the said switch, said last-named means including means for serially connecting the relatively high resistance winding of said cut-off relay in series with the winding of the said motor magnet.

4. In a telephone system, the combination with a line switch, a plurality of stationary contacts for the said line switch, each of the said contacts being connected to a local conductor of a trunk line circuit, associated contacts for each local conductor contact, each associated contact being connected to a talking conductor of a trunk line circuit, a pair of line switch wipers for said line switch, means to progressively move the said pair of line switch wipers from a contact of the busy trunk set of contacts, home point sets of contacts for the said switch also adapted to be traversed by the said pair of wipers, each set of home point contacts being separated from the next home point contact by a set of the said trunk point contacts, means to cause the said pair of wipers to move from a contacting home point contact, a line relay for the said switch, said last-named moving means including a motor magnet and contacts of the said line relay, said first-named moving means including the said motor magnet and the said local conductor of the said busy trunk, and means associated with each of the said trunk circuits controlling the circuit of the said conductor, to disable the said motor magnet.

5. In a telephone system, the combination with a line switch, a plurality of pairs of stationary contacts for the said line switch, each of the said pairs of contacts being associated with a trunk line circuit, one of the contacts of each pair being a local contact and the other being a line contact of their associated trunk circuit, a motor magnet for the said switch, a pair of line switch wipers, intervening pairs of home point contacts between all of the said trunk point contact pairs, controlling contacts and a source of current adapted to be connected to a contact of the home contact pairs by apparatus of the calling line with which the said line switch is associated, to cause the said motor magnet to move the line switch wipers from a contacting pair of home point contacts, and means associated with each of the said trunk circuits and responsive to the busy condition thereof, to alter the electric potential of a contact of its associated line switch contact pair, and means responsive to such altered potential

to cause the said motor magnet to move the said pair of wipers from their contacting position with the said pair of busy trunk line contacts.

6. In a telephone system, the combination with a line switch, a plurality of pairs of stationary contacts for the said line switch, each of the said pairs of contacts being associated with a trunk line circuit, one of the contacts of each pair being a local contact and the other being a line contact of their associated trunk circuit, a motor magnet for the said switch, a pair of line switch wipers, intervening pairs of home point contacts between all of the said trunk point contact pairs, controlling contacts and a source of current adapted to be connected to a contact of the home contact pairs by apparatus of the calling line with which the said line switch is associated, to cause the said motor magnet to move the line switch wipers from a contacting pair of home point contacts, means associated with each of the said trunk circuits and responsive to the busy condition thereof, to alter the electric potential of a contact of its associated line switch contact pair, means responsive to such altered potential to cause the said motor magnet to move the said pair of wipers from their contacting position with the said pair of busy trunk line contacts, said means associated with each of the said trunk circuits being responsive to the idle condition thereof, to disable the said motor magnet, to stop the said switch wipers upon its pair of contacts.

7. In a telephone system, the combination with telephone lines thereof, line switches for each of the said telephone lines, a plurality of stationary contacts for each of the said line switches, one of the contacts of each line switch being multiply connected to a terminal of a trunk line circuit, another of the said contacts of each line switch being multiply connected to a different trunk line circuit, a home point contact for each line switch, arranged before the said trunk line contacts in one of the switches, an additional home point contact being arranged between the trunk line contacts on the said switch, a line switch wiper for each of the said switches, means to cause the said line switch wiper to move from either home point contact upon which it rests, the said means being responsive to the calling condition of its associated telephone line, means to cause the said line switch wiper to move from a contacting busy trunk line contact, said first-named and said last-named moving means including a magnet for the said switch, and means associated with each of the said trunk circuits responsive to the idle condition thereof, to disable the said magnet.

8. In a telephone system, the combination

with telephone lines thereof, line switches for each of the said telephone lines, a plurality of stationary contacts for each of the said line switches, one of the contacts of each line switch being multiply connected to a terminal of a trunk line circuit, another of the said contacts of each line switch being multiply connected to a different trunk line circuit, a home point contact for each line switch, arranged before the said trunk line contacts in one of the switches, an additional home point contact being arranged between the trunk line contacts on the said switch, a line switch wiper for each of the said switches, means to cause the said line switch wiper to move from either home point contact upon which it rests, the said means being responsive to the calling condition of its associated telephone line, means to cause the said line switch wiper to move from a contacting busy trunk line contact, said first-named and said last-named moving means including a magnet for the said switch, means associated with each of the said trunk circuits responsive to the idle condition thereof, to disable the said magnet, the said last-named means including contacts for serially connecting a relatively high resistance winding of the said cut-off relay in series with the said magnet.

9. In a telephone system, the combination with a telephone line, a line switch therefor, a plurality of stationary trunk contacts for the said line switch, a plurality of home point contacts for the said line switch interposed between the said trunk contacts, a line relay for the said line, a motor magnet for the said switch, means to cause the motor magnet when operated to move a switch wiper of the said switch from switch point to switch point, a circuit including a source of current to energize the said motor magnet, said circuit including normally open contacts of the said line relay, the said line switch wiper and the said motor magnet, a cut-off relay for the line adapted to disable the said line relay, an energizing circuit for the said motor magnet including the said switch wiper, a contacting trunk point contact, and controlling contacts operated responsive to the busy condition of the said trunk circuit, both of the said energizing circuits for the said motor magnet excluding the winding of the said cut-off relay, and a shunting circuit for said cut-off relay, the said shunting circuit including the said line switch wiper.

10. In a telephone system, the combination with a telephone line, a line switch therefor, a plurality of stationary contacts for the said line switch, the said stationary contacts being arranged in sets, each set of stationary contacts being connected to trunk line terminals, a motor magnet for the said line switch adapted to advance the wipers

of the line switch over the said stationary terminals, means responsive to the idle condition of a trunk line to cause the said motor magnet to be stopped when the line switch wipers are brought into contact with the said idle trunk line contacts, a normal position for the said line switch, a holding circuit for the said line switch, said holding circuit comprising in an established connection, a wiper and a trunk line of the said line switch, a releasing mechanism associated with the said trunk circuit adapted to disable the said holding circuit, means to start the said releasing mechanism to operating whenever an idle trunk circuit is seized by the said line switch to interconnect a calling telephone line to the terminals of the said idle trunk line, and a relay for the said trunk line circuit responsive to the busy condition of the said line, to disable the said releasing mechanism.

11. In a telephone system, the combination with a telephone line, a line switch therefor, a plurality of stationary contacts for the said line switch, the said stationary contacts being arranged in sets, each set of stationary contacts being connected to trunk line terminals, a motor magnet for the said line switch adapted to advance the wipers of the line switch over the said stationary terminals, means responsive to the idle condition of a trunk line to cause the said motor magnet to be stopped when the line switch wipers are brought into contact with the said idle trunk line contacts, a normal position for the said line switch, a holding circuit for the said line switch, said holding circuit comprising in an established connection, a wiper and a trunk line of the said line switch a slow releasing mechanism associated with the said trunk circuit adapted to disable the said holding circuit, means to start the said slow releasing mechanism to operating whenever an idle trunk circuit is seized by the said line switch to interconnect a calling telephone line to the terminals of the said idle trunk line, and a relay for the said trunk line circuit responsive to the busy condition of the said line, to disable the said slow releasing mechanism.

12. In a telephone system, the combination with a telephone line, a line switch therefor, a plurality of stationary contacts for the said line switch, the said stationary contacts being arranged in sets, each set of stationary contacts being connected to trunk line terminals, a motor magnet for the said line switch adapted to advance the wipers of the line switch over the said stationary terminals, means responsive to the idle condition of a trunk line to cause the said motor magnet to be stopped when the line switch wipers are brought into contact with the said idle trunk line contacts, a normal

position for the said line switch, a holding circuit for the said line switch, said holding circuit comprising in an established connection, a wiper and a trunk line of the said line switch, a slow releasing mechanism associated with the said trunk circuit adapted to disable the said holding circuit, means to start the said slow releasing mechanism to operating whenever an idle trunk circuit is seized by the said line switch to interconnect a calling telephone line to the terminals of the said idle trunk line, and quick operating means for the said trunk line circuit responsive to the busy condition of the said line, to disable the said slow releasing mechanism.

13. In a telephone system, the combination with a calling telephone line, a line switch therefor having a line wiper and a holding circuit wiper, means to cause the said line switch to engage the line contacts of a non-busy trunk circuit, a normal position for the said line switch, means to advance the said switch from the said idle trunk circuit contacts to the said normal position, the said means including slow operating mechanism in a connected idle trunk circuit, and a quick operating mechanism in the said trunk circuit responsive to the busy condition of a connected line, to disable the said slow operating mechanism.

14. In a telephone system, telephone lines arranged to initiate and receive telephone calls, a switch for the use of a telephone line, each switch being provided with home contacts and trunk contacts, said home contacts being interspersed between said trunk contacts, trunk lines terminating in said trunk contacts, means for advancing a line switch to a trunk contact when its telephone line initiates a call, and means maintaining said switch on a home contact when its telephone line receives a call.

15. In a telephone system, telephone lines arranged to initiate and receive telephone calls, a switch individual to each line, each switch being provided with home contacts and trunk contacts, said home contacts being interspersed between said trunk contacts, trunk lines terminating in said trunk contacts, means for advancing a line switch to a trunk contact when its telephone line initiates a call, means for maintaining said switch on a home contact when its telephone line receives a call, and when said telephone line is inactive.

16. In a telephone system, a plurality of telephone lines, a line switch individual to each line, each line switch being provided with home contacts and trunk contacts, said home contacts being interspersed between said trunk contacts, trunk lines terminating in the trunk contacts of each switch, any one of said trunk lines being selectable by a line switch when idle, means for releasing

a selected trunk, and means for moving the operated switch to a home contact when the selected trunk is released.

17. In a telephone system, a line, a trunk selecting switch individual to the line comprising a series of contacts some of which are home contacts and others are trunk contacts, said home contacts being scattered among said trunk contacts, a contact arm adapted to engage with said contacts, and means for normally maintaining said arm in engagement with a home contact.

18. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, a holding circuit completed on the seizure of one of said outgoing lines, means in said holding circuit for temporarily bridging together the two sides of a seized outgoing circuit, means responsive to said operation for initiating the release of said seized outgoing circuit, and other means normally effective to prevent said releasing operation.

19. In a telephone system, an incoming line, a plurality of outgoing lines, a switch for interconnecting said incoming line with any of said outgoing lines, an impulse relay connected to one side of each outgoing line, a holding circuit for said switch completed on the seizure of an outgoing line, a slow releasing relay in said holding circuit, means controlled by said slow releasing relay for closing the operating circuit of said impulse relay independent of said incoming line, means responsive to the operation of said impulse relay for initiating the release of said outgoing line, and other means including a second energizing circuit for said impulse relay extending through said incoming line for preventing said releasing operation.

20. In a telephone exchange system, a telephone line, a line switch connected thereto, a normal terminal for said switch, test terminals associated with said switch, a test brush engaging said normal terminal, a relay operated upon the selection of said switch, electromagnetic means energized upon operation of said relay over a circuit through said test brush and terminals for stepping said brush from normal until an idle trunk is found, and other electromagnetic means energized upon the finding of an idle terminal for extending said line, and a circuit independent of said other electromagnetic means and including the first named electromagnetic means for returning said switch to engage said normal terminal.

21. In a telephone exchange system, a telephone line, a line switch connected thereto and automatically operated to seize an idle trunk upon initiation of a call, a selector switch to which said idle trunk is connected, means at said selector switch for

preventing the return of the line switch to normal after the selector switch has been seized, and means for rendering the last named means ineffective should the subscriber replace his receiver before seizure of said selector switch, whereby said line switch will be returned to normal.

22. In a telephone exchange system, a telephone line, a line switch connected thereto and automatically operated to seize an idle trunk upon initiation of a call, a selector switch to which said idle trunk is connected, means at said selector switch for preventing return of the line switch to normal after the selector switch has been seized, means actuated upon the seizure of said selector switch for stepping the same from normal should a subscriber replace his receiver before seizure of said selector switch, and means for further operating said selector switch to again return the same to normal whereby the means for preventing return of said line switch to normal will be rendered ineffective.

23. In a telephone exchange system, a telephone line, a selector switch having a definite normal position, a line switch con-

nected to said line and operable to extend the same to said selector switch, said line switch also having a definite normal position, means for moving said selector switch from its normal position should a subscriber replace his receiver before the selector switch has been seized, and means for returning the selector switch to its normal position whereby said line switch is also returned to normal.

24. In a telephone exchange system, a telephone line, a selector switch having a definite normal position, a line switch connected to said line and operable to extend same to said selector switch, said line switch also having a definite normal position, electromagnetic means at said selector switch for moving the same from its normal position should a subscriber replace his receiver before the selector switch has been seized, and means for returning the selector switch to its normal position whereby the line switch is also returned to normal.

In witness whereof, I hereunto subscribe my name this 17th day of August, A. D. 1918.

WINFRED T. POWELL.