T. G. MARTIN.

AUTOMATIC TELEPHONE SYSTEM,

APPLICATION FILED FEB. 21, 1916.

1,289,854.

Patented Dec. 31, 1918.

2 SHEETS—SHEET 1.

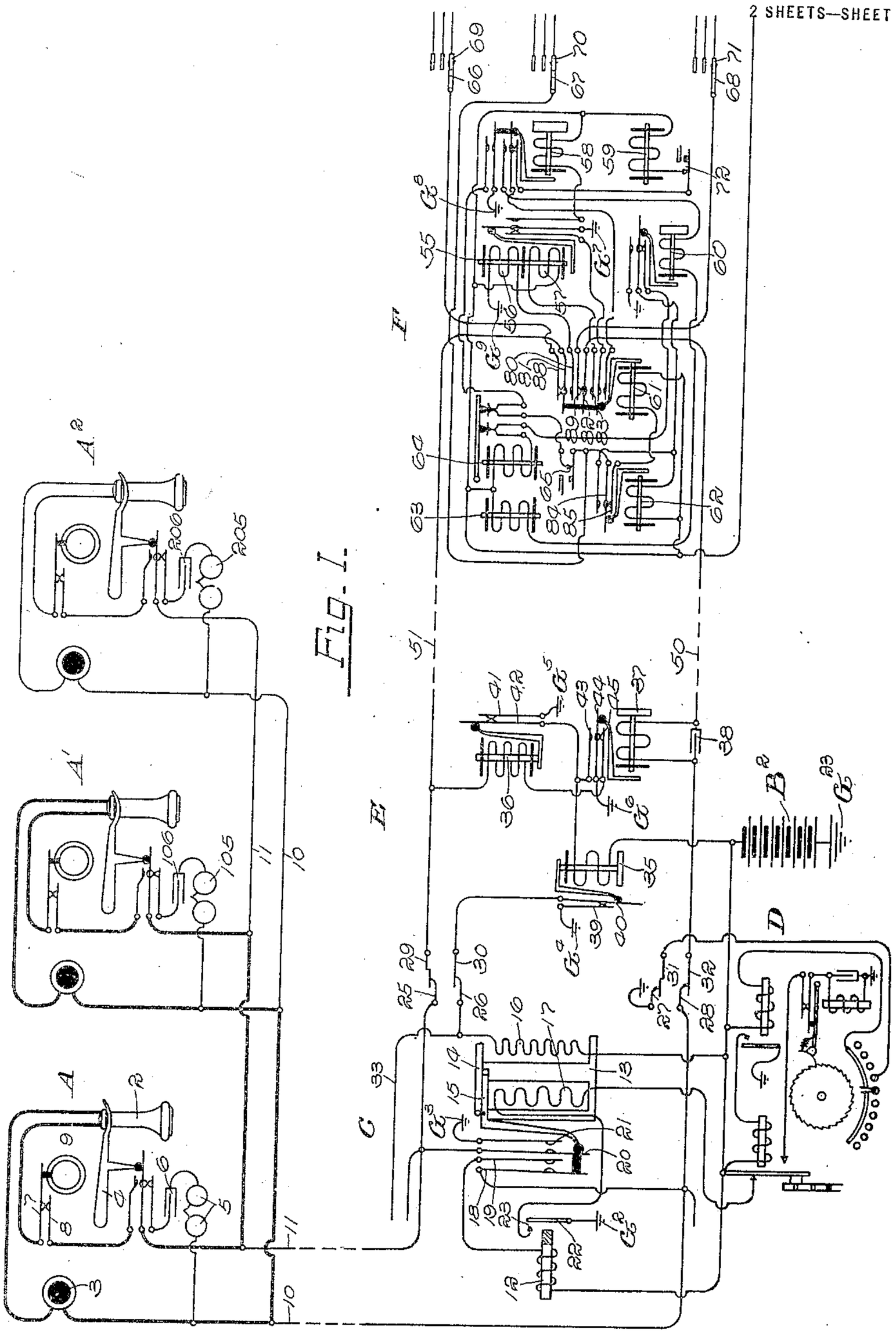

FIG. 1.

Witnesses

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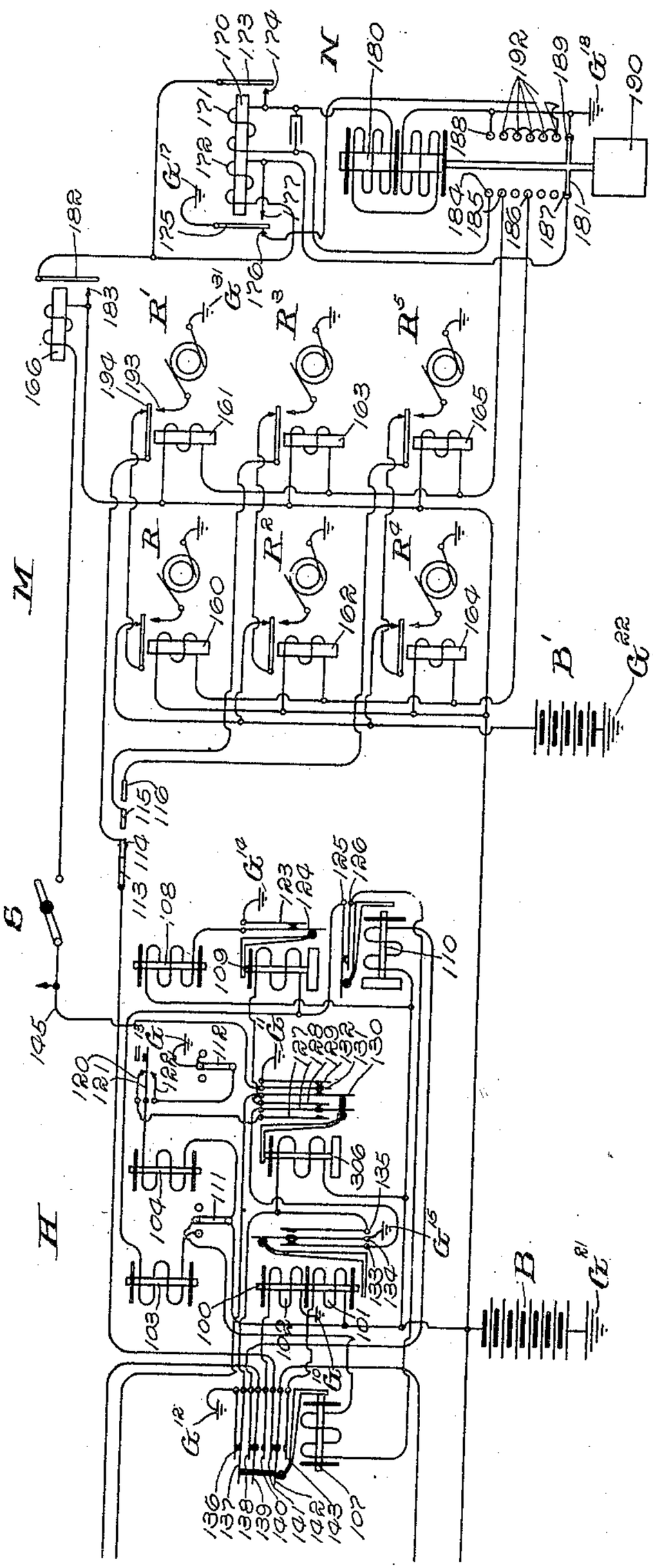
2 SHEETS—SHEET 2.

Fig. 2.



Witnesses

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TALBOT G. MARTIN, OF CHICAGO, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,289,854. Specification of Letters Patent. Patented Dec. 31, 1918.

Application filed February 21, 1916. Serial No. 79,622.

To all whom it may concern:

Be it known that I, TALBOT G. MARTIN, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Telephone Systems, of which the following is a specification.

My invention relates to automatic telephone systems and more particularly to such automatic systems as comprise a main exchange and one or more subexchanges.

In systems of the above general character the subscribers' lines terminating at a sub-exchange may be provided with individual line switches which have access to a group of outgoing trunk lines extending to the main exchange and terminating there in selector switches. When a calling subscriber at the sub-exchange raises his receiver to make a call his line is at once trunked through to a selector switch at the main exchange through the medium of his individual line switch and an idle outgoing trunk line. Connector switches are of course provided at the sub-exchange to connect with called lines terminating therein and these connector switches are accessible to selector switches in the main exchange over a second group of trunk lines.

In general my invention renders more practicable the use of sub-exchanges of the above general description in a system comprising polystation lines; or, more specifically, my invention makes it possible for a subscriber on a polystation line terminating in a sub-exchange to signal other subscribers on his own line through the medium of selective signaling apparatus of well known type located at the main exchange.

Automatic connections by which subscribers on party lines may signal other subscribers on their own lines are usually termed reverting calls and may be handled by setting aside a certain selector level in the main exchange and terminating the trunks from this level in a group of so called frequency selectors. The frequency selectors are given common access to a number of different sets of ringing relays, each of such sets being provided with a different combination of ringing current. All polystation subscribers are furnished with a list of special numbers by which they are informed of the proper digits to call to signal the other parties on their lines.

In accomplishing this object the subscriber removes his receiver and dials the proper special number, thereby connecting, through the medium of one or more selector switches and a frequency selector, with a set of ringing relays having the proper ringing current combination. He then replaces his receiver. The bells at the calling and called substations now begin ringing alternately, and continue to ring until one of the subscribers answers. Ordinarily the calling subscriber will wait until his bell stops ringing by which he knows that the wanted party has answered. He may then remove his receiver and talk, current for the two transmitters being supplied from the frequency selector. When the subscribers replace their receivers all the switches are restored to normal.

It is evident that in a system of the foregoing character means must be provided for preventing the release of the switches after the calling subscriber has replaced his receiver to start the automatic ringing. The third conductor or holding trunk affords a convenient means of doing this in the case of the selector or selectors in the main exchange. But as regards the individual line switch at the sub-exchange, some special means must be provided for this purpose.

The principal object of my invention is to provide a simple and efficient apparatus in connection with each of the outgoing sub-exchange trunks, which apparatus, during a reverting call ringing period, is made effective to complete a holding circuit for the line switch which is at that time connected with its associated trunk.

Further objects of my invention relate to means whereby the above apparatus is prevented from performing its function except at the proper time; means whereby the apparatus is prevented from interfering with the sending of impulses over its associated trunk line; and means whereby the talking efficiency of trunk lines so equipped is not impaired.

The foregoing and other useful ends are attained in a manner and through means which will be hereinafter fully explained,

reference being had to the accompanying drawings, wherein Figures 1 and 2 taken together show a complete circuit connection in a system embodying the principles of my invention.

Referring now to Fig. 1, I have shown at A, A′, and A² three substations which may be of the general type of substation shown in British patent to T. G. Martin, No. 1419 of 1910. Substation A, except for its ringer 5, is representative of the group and consists of the receiver 2, transmitter 3, receiver hook 4, ringer 5, and condenser 6. Being an automatic substation it is also provided with a pair of impulse springs 7 and 8 controlled by the impulse wheel 9 through the medium of a finger hole dial (not shown). Since the substations shown herein are of the polystation type, the ringers 5, 105, and 205 are adapted to respond to different kinds of ringing current, the principle of selection depending preferably on what is commonly known as the "harmonic system," in whi h the ringers are tuned to respond to different frequencies of ringing current.

The line conductors 10 and 11, to which the three substations are connected in parallel, extend to a sub-exchange where they terminate in the individual line switch C, which is of the general type disclosed in British patent to R. W. James, No. 26301 of 1906; being, however, of the particular type shown in U. S. Letters Patent No. 1,078,690, granted Jan. 17th, 1912, to Frank Newforth.

The line switch comprises among other details a plunger (not shown) attached to the end of a so called plunger arm 14. The plunger arm 14 and the cut-off armature 15 are controlled by the magnet 13 which has two windings; one of which, the pull-in winding 17, operates both the plunger arm and the cut-off armature; while the other, the holding winding 16, is only strong enough to operate the cut-off armature and to hold the plunger arm in an operated position after it has been operated by the pull-in winding. When the plunger arm is operated, the plunger is forced into a bank of contact springs, forcing the springs 25, 26, 27, and 28 into engagement with the contacts 29, 30, 31, and 32, respectively. Although only one set of springs and contacts (25 to 32, inclusive) is shown, it is understood that each line switch is provided with a plurality of such sets, each set forming the terminal of a trunk line extending to a selector switch. Each trunk line is connected in multiple with the corresponding springs of all the line switches of the group which is controlled by the master switch D. The line switch is initially controlled by the subscriber through the medium of the line relay 12.

The master switch D is of the general type disclosed in British patent to R. W. James, No. 26301 of 1906; being however, more nearly of the particular type disclosed in British patent to T. G. Martin, No. 1419 of 1910. The function of the master switch, as is well known, is to maintain the plungers of all the idle line switches in position before the terminals of an idle trunk line.

The relays shown at E are located at the sub-exchange and a set similar to the one shown is provided for each trunk line to which the line switch C has access. In practice, relay 36 is preferably made of high resistance while relay 37 is of low resistance and is shunted by the condenser 38 in order to provide a good path for talking currents when the trunk is used for establishing an ordinary connection. The relay 37 is also made slow acting, as is relay 35. By slow acting is meant that property of a relay by virtue of which it is enabled to retain its armature for an instant after the energizing circuit is broken.

The trunk line shown herein is extended, by means of conductors 50 and 51, to the main exchange where it terminates in the selector switch F, which is of the general type of selector switch disclosed in U. S. Letters Patent No. 815,321, granted March 31, 1906 to Keith, Erickson and Erickson; except that the so-called side switch is omitted, and the circuits are modified to enable 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. Among other details the selector F comprises a bank of contacts arranged in horizontal rows or levels, which contacts are adapted to be engaged by a set of wipers 66, 67, and 68 carried upon a shaft (not shown) which has a vertical movement controlled by the vertical magnet 63, and a rotary movement controlled by the rotary magnet 64. The operation of the various parts of the switch is controlled through the medium of the double wound line relay 55. Means for permitting the switch to be restored to normal position is provided in the release magnet 59 which, upon energizing, withdraws the retaining pawls from the shaft. The contacts 65 and 72 are closed only when the shaft has been raised one or more steps from its normal position. The relays 60 and 58 are slow acting.

The selector switch F has access through certain of its bank levels to similar selectors by means of which connection may be extended toward the lines of the main exchange subscribers, and it also has access through a separate bank level to a group of frequency selectors one of which is shown at H. The frequency selector H has access, in common with others of the same group,

to the ringing relays shown at M which are controlled by the solenoid interrupter N. The entire reverting call equipment comprising the frequency selector H, the ringing relays M, and the interruptor N is similar in principle to that shown in my copending application, Serial No. 821,246, although the circuits are somewhat modified; that of the frequency selector H, in particular, being revised to enable it to operate in accordance with the principles of my invention.

Among other details the frequency selector H comprises a single horizontal level of contacts, indicated by reference characters 114, 115, and 116, which contacts are adapted to be engaged by the wiper 113 carried upon a shaft (not shown) which has a rotary movement controlled by the rotary magnet 103. The operation of the various parts of the switch is controlled by the double wound line relay 100. A side switch comprising the wipers 111 and 112 is controlled by the private magnet 108 in the usual manner. Means for permitting the switch to be restored to its normal position is provided in the release magnet 104 which, upon energizing, withdraws the retaining pawl from the shaft and restores the side switch to its first position. The relays 306, 109, and 110 are slow acting and together with relay 107 will be more fully described later.

The three party line illustrated in Fig. 1 will require three different combinations of ringing current in order that each subscriber may be able to signal each of the others. I have shown, therefore, three different contacts in the banks of the frequency selector H, each contact being associated with a separate pair of ringing relays. For example, the contact 114 is associated with ringing relays 160 and 161, and the contact 115 is associated with ringing relays 162 and 163, etc. For the sake of simplicity I have shown a separate ringing current generator R, R′, etc., associated with each ringing relay although there might well be but three of these generators. Remembering that the ringers at each of the sub-stations A, A′, and A^2 will respond to a different frequency of ringing current, the generators R to R^5, inclusive, are arranged with regard to their respective frequencies as follows: Generators R and R′ will actuate the ringers at substations A and A′, respectively; generators R^2 and I^3 will actuate the ringers at substations A and A^2, respectively; while generators R^4 and R^5 will actuate the ringers at substations A′ and A^2, respectively. The above arrangement makes it possible for each of the subscribers to ring his own bell and that of either of the other subscribers, which is the required condition.

At S I have shown a hand operated switch by means of which the common conductor 145 may be extended to the starting relay 166 which controls the solenoid interrupter N. The interrupter N comprises among other details a solenoid 180 which is adapted to raise a contactor 181 to the level of its uppermost set of contacts, after which the energizing circuit of the solenoid is broken and the contactor descends by gravity to the bottom level of contacts, whereupon the operation is repeated. The reference character 190 represents a dash pot or equivalent device for retarding the movement of the contactor.

At B and B^2 I have shown two batteries for supplying operating and talking current having their positive poles grounded at G^{21} and G^{23}, respectively. At B′ I have shown another battery having its negative pole grounded at G^{22}. The purpose of this battery will be explained in the detailed specification.

Having given a general description of the apparatus, I will now explain the operation of the system shown herein. It will be described how the subscriber at substation A may signal the subscriber at substation A′, hold conversation with him, and finally disconnect the apparatus, all according to the general method previously outlined. Since much of the automatic apparatus shown herein is well known in the art, having been fully described in the publications above referred to, its operation will be described in a more or less general manner, the details being given only where they have to do with the operation of my invention.

Referring now to Fig. 1, the subscriber at substation A, upon removing his receiver to initiate a call, completes an energizing circuit for the line relay 12 of the individual line switch C over the following path: ground at G^3, contact springs 21 and 20, line conductor 11, to and through substation A, line conductor 10, contact springs 18 and 19, and winding of line relay 12 to battery B^2. The line relay 12 is energized over the above circuit and, upon attracting its armature 22, completes a circuit for the pull-in winding 17. The pull-in winding, upon energizing, attracts the plunger arm 14 and the cut-off armature 15; the former, by means of its plunger, forcing the springs 25—28, inclusive, into engagement, respectively, with contacts 29—32, inclusive; and the latter disconnecting the line conductors 10 and 11 from ground and battery, respectively, by separating contact springs 18 and 19, and 20 and 21.

By the engagement of springs 25 and 28 with contacts 29 and 32, respectively, the line conductors 10 and 11 are extended over

the trunk conductors 50 and 51 to the main exchange where they terminate in the double wound line relay 55 of the selector F. The line relay 55 thereupon is energized over a circuit which includes the relay 37 at the sub-exchange and which may be traced as follows: ground at G^9, winding 56 of line relay 55, contact springs 80 and 81, trunk conductor 51, contact 29, spring 25, line conductor 11, substation A, line conductor 10, spring 28, contact 32, winding of relay 37, contact springs 82 and 83, and winding 57 of relay 55 to battery B. Relay 37, upon energizing, completes a circuit from ground at G^6 by way of contact springs 44 and 43 to the slow acting relay 35, which relay, upon attracting its armature, completes a holding circuit for the line switch C over the following path: ground at G^4, contact springs 39 and 40, contact 30, spring 26, and holding winding 16 to battery B^2. Although the circuit of the line relay 12 has already been broken it retains its armature long enough to allow the above holding circuit to be established. A branch of the holding circuit extends from spring 26 over conductor 33 to multiple test contacts in the banks of connectors having access to the line of substation A, where by a ground potential on these test contacts, the said line is made busy. Returning now to the line relay 55, it completes, upon attracting its armature, a circuit from ground at G^7 to the slow acting relay 58 which relay, upon energizing, prepares circuits for the vertical and rotary magnets 63 and 64 in the well known manner.

The foregoing operations have all occurred in response to the removal of the receiver from the hook. Having been informed of the special numbers to be used for connections between parties on the same line, the subscriber at substation A may now operate his dial in accordance with the first digit of the proper special number, thereby breaking the continuity of his loop a number of times at the impulse springs 7 and 8. As a result of these interruptions the line relay 55 is deënergized a corresponding number of times, sending an impulse at each deënergization from ground at G^7 to the slow acting relay 60 and the vertical magnet 63 in series. The vertical magnet, in response to these impulses, steps up the shaft until the wipers stand opposite the horizontal level in which are located contacts which are terminals of the group of frequency selectors of which H is one. The relay 60, being slow acting, retains its armature during the series of impulses and closes a circuit for the test relay 62, which relay locks itself to ground at G^8 and closes contact springs in the rotary magnet circuit. At the end of the series of impulses the relay 60 deënergizes, thereby completing the circuit for the rotary magnet 64, whereupon the wipers 66, 67, and 68 are started rotating in search of a trunk line extending to an idle frequency selector. As is well known, the rotary magnet interrupts its own circuit and also the locking circuit of the test relay at every energization, the contacts in the latter circuit, however, being short circuited by the test wiper 67 while passing over busy or grounded test contacts. As soon, therefore, as the test wiper reaches an ungrounded test contact the test relay 62 falls back and opens the rotary magnet circuit, thereby bringing the wipers to rest upon the contacts of an idle frequency selector H. The test relay 62, upon deënergizing, completes a circuit for the line switching relay 61, which latter relay, upon energizing, disconnects the trunk conductors 51 and 50 from the line relay 55 and extends them, by way of wipers 66 and 68, bank contacts 69 and 71, and contact springs of relay 107, to the double wound line relay 100 of the frequency selector H.

The line relay 100 thereupon energizes over the previously traced circuit through substation A and completes a circuit from ground at G^{15} to the slow acting relay 306. Relay 306, upon energizing, completes a holding circuit for the line switching relay 61 of the selector F as follows: ground at G^{11}, contact springs 132, 131, and 130, bank contact 70, wiper 67, contact springs 84 and 85, and winding of line switching relay 61 to battery B.

The subscriber at substation A may now operate his dial in accordance with the final digit of the special number, resulting in this case in deënergizations of the line relay 100 of the frequency selector H. At each deënergization, the line relay sends an impulse to the slow acting relay 109 and the rotary magnet 103 in series over the following path: ground at G^{15}, contact springs 134 and 133, contact springs 128 and 129, winding of relay 109, winding of rotary magnet 103, and side switch wiper 111 in its first position to battery B. Since the calling and called substations, A and A′, require the selection of the upper group of ringing relays to ring their bells, the final digit to be called is one, and the rotary magnet receives one impulse, in response to which the wiper 113 is rotated into engagement with the bank contact 114. The slow acting relay 109, as previously stated, is energized in series with the rotary magnet and, upon attracting its armature, completes a circuit for the private magnet 108 as follows: ground at G^{14}, contact springs 123 and 124, and winding of private magnet 108 to battery B. At the end of the impulse or series of impulses, as the case may be, the slow acting relay 109

deënergizes, thereby breaking the private magnet circuit and allowing the side switch wipers to move to their second position in the well known manner.

It will be well to return here to the relays shown at E and note their operation during impulses. It is necessary of course that relay 35 remain energized continually but, since relay 35 is made slow acting, relay 37 might be allowed to vibrate during impulses without doing any harm so far as the holding circuit for line switch C is concerned. It is preferable, however, to make relay 37 slow acting also, for by so doing the ground at G^6 may be kept clear from the trunk conductor 51 during impulses.

Returning again to the frequency selector H, it has been explained how the wiper 113 was rotated into engagement with the bank contact 114, the side switch wipers being advanced to their second position immediately after this operation. The subscriber at substation A, having completed the dialing of the required special number, may now hang up his receiver, thereby breaking the circuit of the line relay 100 of the frequency selector H and the circuit of the relay 37 at the sub-exchange. Line relay 100, upon deënergizing, completes a circuit for relays 109 and 107 in series over the following path: ground at G^{15}, contact springs 134 and 133, contact springs 128 and 129, winding of relay 109, contact springs 125 and 126, winding of relay 107, and side switch wiper 111 in its second position to battery B. Relay 109, upon energizing, again closes the circuit of the private magnet 108. Relay 107, upon energizing, completes a new circuit for slow acting relay 306 as follows: ground at G^{12}, contact springs 136 and 137, and winding of relay 306 to battery. Relay 107 also shifts, by means of contact springs 138—143, inclusive, the incoming trunk conductors from the windings 102 and 101 of the line relay 100 to the relay 110 and the wiper 113, respectively. It is seen, therefore that the relays 109, 107, and 306, and the private magnet 108 remain energized after the receiver is hung up, the side switch wipers being held in the second position.

An instant after the above operations have been completed at the frequency selector the relay 37 at the sub exchange deënergizes, thereby completing a circuit for the relay 36 over a path which may be traced as follows: ground at G^6, contact springs 44 and 45, winding of relay 36, trunk conductor 51, contact springs 81 and 88, wiper 66, bank contact 69, contact springs 139 and 138, and winding of relay 110 to battery B. Relay 36 is of very high resistance and is effectively energized over the above circuit but relay 110, being of comparatively low resistance does not receive sufficient current for its operation when in series with relay 36. Upon attracting its armature the relay 36 completes a new circuit for relay 35 as follows: ground at G^5, contact springs 41 and 42, and winding of relay 35 to battery B^2. Relay 35, accordingly, remains energized and retains the holding circuit for line switch C intact.

The apparatus is now ready for the ringing operation which, in fact, begins as soon as relay 107 energizes for by that time the ringing relay M and interrupter N are already working. As soon as the frequency selector is seized ground at G^{11} is conne ted, by means of contact springs 132 and 131, to the common conductor 145, whence it extends by way of the normally closed switch S to the starting relay 166 and thence to battery B. Relay 166, upon energizing, completes an initial energizing circuit for double wound relay 170 as follows: ground at G^{18}, contact 189, contactor 181, contact 187, winding 172 of relay 170, armature 182, and contact 183 to battery B. Relay 170, upon energizing, completes an independent circuit for its winding 172 by means of armature 175 and contact 177, and also completes a circuit for the solenoid 180 as follows: ground at G^{18}, winding of solenoid 180, contact 174, armature 173, armature 182, and contact 183 to battery B. Upon energizing, the solenoid 180 raises the contactor 181, thereby short circuiting in succession each of the sets of opposite interrupter contacts, but without effe t at this time, however, for the multiple contacts 192 are dead. As the contactor 181 reaches its extreme upward position it connects contacts 184 and 188, thereby completing a circuit for the winding 171 of relay 170 as follows: ground at G^{18}, contact 188, contactor 181, contact 184, winding 171 of relay 170, contact 174, armature 173, armature 182, and contact 183 to battery B. Relay 170 is differentially wound and accordingly retracts its armatures thereby breaking the circuits of both its windings and also the circuit of the solenoid 180. Upon the cessation of current flow in the winding of solenoid 180, the contactor 181 descends again to its normal position. In passing contact 185 a circuit is completed momentarily for the ringing relays 161, 163 and 165 as follows: ground at G^{17}, armature 175, contact 176, multiple contacts 192, contactor 181, contact 185, and ringing relays 161, 163 and 165 in multiple to battery B. Upon energizing, relays 161, 163 and 165 supply ringing current to the bank contacts 114, 115 and 116, respectively. In this connection, however, only the ringing relay 161 is effective and completes a ringing circuit as follows: ground at G^{31}, generator R', contact 193, armature 194, bank contact 114, wiper 113, contact springs

141 and 142, bank contact 71, wiper 68, contact springs 89 and 82, trunk conductor 50, condenser 38 and relay 37 in parallel, contact 32, spring 28, line conductor 10, three parallel branches composed of ringer 5 and condenser 6, ringer 105 and condenser 106, and ringer 205 and condenser 206, line conductor 11, spring 25, contact 29, trunk conductor 51, contact springs 81 and 88, wiper 66, contact 69, contact springs 139 and 138, winding of relay 110, battery B, and ground G^{21} to ground G^{31}, the starting point. Ringer 105 responds to ringing current in the above circuit thereby signaling the subscriber at substation A'. As the contactor 181 passes contact 186, ringing relay 160 is energized momentarily, whereby the above ringing circuit is again completed, with the exception, however, that the generator R is substituted for the generator R'. In this latter instance the ringer 5 responds, thereby signaling the calling subscriber who is thus informed that the ringing operation is proceeding satisfactorily. When the contactor 181 reaches its normal position the circuit of winding 172 of relay 170 is again completed whereupon the entire ringing cycle is repeated.

We will consider now the effect of the ringing current upon the relays in or associated with the ringing circuit. Relay 37, being of very low resistance, in proportion to the rest of the circuit and being, furthermore, a sluggish relay, is not affected to any extent and does not attract its armature. Relay 36, it will be remembered, is energized by current from battery B in series with relay 110. During the ringing period relay 36 is in parallel with relay 110 and battery B in so far as the ringing current is concerned, whence it follows that in every half cycle the voltage of the battery B will be opposed by the voltage of the generator and relay 36 will vibrate its armature. This action is without any ill effect, however, since relay 35 is slow acting. As regards the relay 110 there are two conditions under which it will operate. If the receiver at the calling or called substation is removed during a ringing period direct current from battery B will flow in the winding of relay 110 over the previously described ringing circuit excepting that at the substation a path for direct current consisting of the receiver and transmitter is substituted for the ringer and condenser. Relay 110 is so adjusted that it will operate during that part of a ringing current cycle in which the battery and generator assist each other. In case the receiver is removed in the interval between rings direct current will flow as before over the ringing circuit as previously qualified, with the further exception, however, that the booster battery B' is substituted for the ringing current generator in a manner readily apparent. Battery B' is so connected that its voltage is added to that of battery B whereby sufficient current is made to flow in the winding of relay 110 to operate it.

Upon energizing, relay 110 breaks the circuit of relays 107 and 109. Upon the deenergization of relay 107, the previously described circuit of line relay 100, including the relay 37 and the subscriber's loop, is again completed, these relays attracting their armatures to perform the functions previously ascribed to them. Upon the deënergization of relay 109, the private magnet circuit is broken whereupon the side switch wipers are allowed to advance to their third position.

Assuming now that both subscribers have removed their receivers current is supplied to the transmitters at substation A and A' in parallel from the windings of the line relay 100 in the well known manner. A direct path for the talking currents is shown by the heavy lines and will require no further explanation.

Upon the completion of the conversation the subscribers will replace their receivers thereby breaking the circuit of line relay 100 and of relay 37. Line relay 100, upon deënergizing, breaks the circuit of slow acting relay 306, which relay, upon deënergizing, disconnects ground from the holding circuit extending to the selector F and from the common conductor 145, thereby stopping the interrupter N (in case no other frequency selector is in use) and allowing the selector F to be returned to normal position in the well known manner. Relay 306, also completes a circuit for the release magnet 104 as follows: ground at G^{15}, contact springs 134 and 133, contact springs 128 and 127, off normal contacts 120 and 121 (closed at first movement of shaft), and release magnet 104 to battery. Upon energizing, release magnet 104 withdraws the pawl from the shaft, allowing it to return to normal position, and also restores the side switch wipers to their normal position. To guard against the possibility of the shaft returning to normal position and opening contacts 120 and 121 before the side switch wipers are completely restored, the side switch wiper 112 and the extra off normal contact 122 are provided. When the shaft returns to normal position the contacts 121 and 122 are closed and in case the side switch wipers are still in their second or third position the release magnet will be kept energized by the ground connection at G^{13}. In this manner the complete restoration of the side switch wipers is assured.

At the sub-exchange the relay 37, upon deënergizing, breaks the circuit of relay

35, which relay, upon deënergizing in its turn, disconnects ground from the holding circuit extending to line switch C, thereby allowing line switch C to return to its normal position in the well known manner. It is plain that the relay 36 has its circuit completed only when the relay 37 is deënergized and when at the same time conductor 51 is connected to the ungrounded pole of battery. From the drawings and from the previous explanation it will be equally plain that these conditions can obtain only at the time specified, *i. e.*, after connection has been extended to a frequency selector whose side switch has been advanced to its second position, and the receiver has been replaced on the hook. Therefore relay 36 is prevented from interfering with the normal release of the substation switches except when such action is desired.

It will be seen from the foregoing that I have provided a simple and highly efficient means whereby a poly-station subscriber whose line terminates in a sub-exchange and who has extended a connection over a two conductor trunk to a reverting call switch, and has operated the said switch to select one of a number of ringing current combinations, is enabled to replace his receiver in order to allow the said ringing current to take effect without releasing the connection. Means are furthermore provided whereby upon the removal of a receiver or receivers on said poly-station line the ringing current is disconnected and a source of direct current is substituted therefor, after which, by replacing the said receiver or receivers the entire connection will be released.

While I have found it convenient, in explaining my invention, to describe a certain specific embodiment thereof, I do not wish to limit myself to the exact form shown herein, for the principles of my invention may obviously be extended to other types of apparatus and to a variety of usages. I desire, therefore, to include and have protected by Letters Patent all forms and modifications of my invention which may come within the scope of the appended claims.

What I claim as my invention is:

1. In a telephone system, a party line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism, means controlled over the two sides of said line in series for connecting said trunk line with said mechanism and for initiating the operation thereof, and means comprising a relay effective during the signaling operation to maintain said switch in operated position independent of said party line, said relay energized over a conductor of said trunk line.

2. In a telephone system, a line, a plurality of subscribers' stations in bridge of said line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism accessible to said trunk line, means controllable from one of said stations over the two sides of said line in series for operating said mechanism to signal another one of said stations, and means comprising a relay effective during said signaling operation for maintaining said switch in operated position independent of said first station, said relay energized over a conductor of said trunk line.

3. In a telephone system, a plurality of subscribers' stations, each station having a signal responsive to a different kind of current, a line for said stations, a trunk line, an automatic switch for connecting the two lines, sources of signaling currents of different kinds, means controllable from one of said stations over the two sides of said line in series for connecting said trunk line with any of said sources, and means comprising a relay effective during said connection for maintaining said switch in operated position independent of said stations, said relay energized over a conductor of said trunk line.

4. In a telephone system, a party line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism, means controlled over the two sides of said line in series for connecting said trunk line with said mechanism, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, and an auxiliary controlling relay for said holding circuit controlled jointly by said first relay and by means included in said mechanism.

5. In a telephone system, a line, a plurality of subscribers' stations in bridge of said line, a trunk line, an automatic switch for connecting the two lines, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, a selective signaling mechanism, means for making said mechanism accessible to said trunk line, said mechanism having a plurality of operating stages, means for rendering said relay inoperative in any one of said operating stages, and additional means then effective for maintaining said holding circuit.

6. In a telephone system, a line, a plurality of subscribers' stations in bridge of said line, a trunk line, an automatic switch for connecting the two lines, a source of current for said lines, a relay in one limb of said trunk line, a holding circuit for said switch normally controlled by said relay, a selective mechanism, means for making said mechanism accessible to said trunk line for signaling said substations, said substation line being insulated for direct currents at the substation end during the signaling operation, and means associated with the other limb of said trunk line for temporarily con-

trolling said holding circuit during said signaling operation.

7. In a telephone system, a party line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism, means for extending a connection from said trunk line to said mechanism, a battery in bridge of said line and having one of its terminals grounded, a holding circuit for said switch, a controlling relay for said circuit in the ungrounded limb of said trunk line, an auxiliary controlling relay for said circuit bridged from the other limb of said trunk line to ground, and means associated with said signaling mechanism for shifting the grounded limb of said trunk line to the other pole of said battery to operate said auxiliary controlling relay.

8. In a telephone system, a party line, a selective signaling mechanism, automatic switches for connecting the two, a battery in bridge of said line, a relay in series with said line, a holding circuit for certain of said switches controlled by said relay, means for reversing the current in one limb of said line, and an auxiliary controlling relay associated with said limb and controlled jointly through the reversal of the battery connection of its associated line limb and by said first relay.

9. In a telephone system, a party line, a selective signaling mechanism, automatic switches for connecting the two, a battery in bridge of said line, means for reversing the battery with regard to said line, a holding circuit for certain of said switches, a second holding circuit for other of said switches, means operated by direct current flow in said line for normally maintaining said circuits, means for rendering said means inoperative, means associated with one limb of said line and effective during an inoperative stage of said first means for maintaining said first circuit, said means being controlled by the reversal of the battery connection of its associated line limb, and means effective at the same time for maintaining said second circuit.

10. In a telephone system, a party line terminating in an automatic switch, a group of other lines, a trunk line accessible to said switch for extending a connection toward said other lines, a selective signaling mechanism, means for making said mechanism accessible to said trunk line, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, and an auxiliary controlling relay for said circuit controlled jointly by said first relay and by means included in said mechanism.

11. In a telephone system, a line, a plurality of subscribers' stations in bridge of said line, a trunk line, an automatic switch for connecting the two lines, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, a selective signaling mechanism, means for making said mechanism accessible to said trunk line, said mechanism having a plurality of operating stages, means for rendering said relay inoperative in any one of said operating stages, additional means then effective for maintaining said holding circuit, and a shunt path for talking currents around said relay.

12. In a telephone system, a line, a plurality of subscribers' stations in bridge of said line, a trunk line, an automatic switch for connecting the two lines, a source of current for said lines, a relay in one limb of said trunk line, a holding circuit for said switch normally controlled by said relay, a selective mechanism, means for making said mechanism accessible to said trunk line for signaling said substations, said substation line being insulated for direct currents at the substation end during the signaling operation, means associated with the other limb of said trunk line for temporarily controlling said holding circuit during said signaling operation, and a shunt path for talking currents around said relay.

13. In a telephone system, a party line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism, means controlled over the two sides of said line in series for connecting said trunk line with said mechanism, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, an auxiliary controlling relay for said holding circuit controlled jointly by said first relay and by means included in said mechanism, and a shunt path for talking currents around said first relay.

14. In a telephone system, a party line, a trunk line, an automatic switch for connecting the two, a selective signaling mechanism, means for extending a connection from said trunk line to said mechanism, a battery in bridge of said line and having one of its terminals grounded, a holding circuit for said switch, a controlling relay for said circuit in the ungrounded limb of said trunk line, an auxiliary controlling relay for said circuit bridged from the other limb of said trunk line to ground, means associated with said signaling mechanism for shifting the grounded limb of said trunk line to the other pole of said battery to operate said auxiliary controlling relay, and a shunt path for talking currents around said first relay.

15. In a telephone system, a party line, a selective signaling mechanism, automatic switches for connecting the two, a battery in bridge of said line, means for reversing the battery with regard to said line, a relay

in series with said line, a holding circuit for certain of said switches controlled by said relay, an auxiliary controlling relay associated with one limb of said line and controlled jointly through the reversal of the battery connection of its associated line limb and by said first relay, and a shunt path for talking currents around said first relay.

16. In a telephone system, a party line terminating in an automatic switch, a group of other lines, a trunk line accessible to said switch for extending a connection toward said other lines, a selective signaling mechanism, means for making said mechanism accessible to said trunk line, a relay in said trunk line, a holding circuit for said switch normally controlled by said relay, an auxiliary controlling relay for said circuit controlled jointly by said first relay and by means included in said mechanism, and a shunt path for talking currents around said first relay.

17. In a telephone system, a line, a trunk line, an automatic switch for connecting the two, a selective mechanism, means for making said mechanism accessible to said trunk line, said mechanism having a plurality of operating stages, a holding circuit for said switch, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuit, and means comprising a relay effective during one of the operating stages of said mechanism for maintaining said holding circuit independent of current flow in said line, said relay energized over a conductor of said trunk line.

18. In a telephone system, a line, a trunk line, a selective mechanism having a plurality of operating stages, automatic switching mechanisms for connecting said line with said mechanism via said trunk line, holding circuits for said switching mechanisms, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuits, and means comprising a relay effective during one of the operating stages of said mechanism for maintaining said holding circuits independent of current flow in said line, said relay energized over a conductor of said trunk line.

19. In a telephone system, a line, a trunk line, an automatic switch for connecting the two, a selective mechanism, means for making said mechanism accessible to said trunk line, a holding circuit for said switch, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuit, and means comprising a relay made effective in response to interruption of current flow in said line for temporarily maintaining said holding circuit, said relay energized over a conductor of said trunk line.

20. In a telephone system, a line, a trunk line, a selective mechanism, automatic switching mechanisms for connecting said line with said mechanism via said trunk line, holding circuits for said switching mechanisms, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuits, and means comprising a relay made effective in response to interruption of current flow in said line for temporarily maintaining said holding circuits, said relay energized over a conductor of said trunk line.

21. In a telephone system, a line, a trunk line, an automatic switch for connecting the two, a selective mechanism, means for making said mechanism accessible to said trunk line, a holding circuit for said switch, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuit, means made effective in response to interruption of current flow in said line for temporarily maintaining said holding circuit, and means comprising a relay actuated in response to renewed current flow in said line whereby said second means is prevented from responding to the next interruption of said current, said relay energized over a conductor of said trunk line.

22. In a telephone system, a line, a trunk line, a selective mechanism, automatic switching mechanisms for connecting said line with said mechanism via said trunk line, holding circuits for said switching mechanisms, a battery for supplying current, means dependent upon direct current flow in said line for maintaining said holding circuits, means comprising a relay made effective in response to interruption of current flow in said line for temporarily maintaining said holding circuits, and means actuated in response to renewed current flow in said line whereby said second means is prevented from responding to the next interruption of said current, said relay energized over a conductor of said trunk line.

23. In a telephone system, a line, a trunk line, an automatic switch for connecting the two, a second automatic switch for said trunk line, other lines accessible to said second switch, a selective mechanism having a plurality of operating stages also accessible to said second switch, a battery for supplying current, restoring means for said switches normally responsive to prolonged interruption of current flow in said first line, and means comprising a relay whereby after a connection has been established from said first line to said mechanism said restoring means is made irresponsive to cur-

rent interruption in said first line during one of said operating stages, said relay energized over a conductor of said trunk line.

24. In a telephone system, a line, a signal for said line, a two conductor trunk line, a switch for extending the line to the trunk line, means for releasing said switch, a source of current, means for connecting said source of current to the line over said trunk line to operate the signal, a relay for controlling said release means, said relay energized over the trunk line, another relay energized over the said trunk line only during the signaling operation for preventing said first relay from controlling said release means.

Signed by me at Chicago, Cook county, Illinois, this 16th day of February, 1916.

TALBOT G. MARTIN.