Aug. 23, 1927. 1,640,157

R. G. RICHARDSON ET AL

PARTY LINE AUTOMATIC TELEPHONE SYSTEM

Original Filed Feb. 1, 1923 3 Sheets-Sheet 1

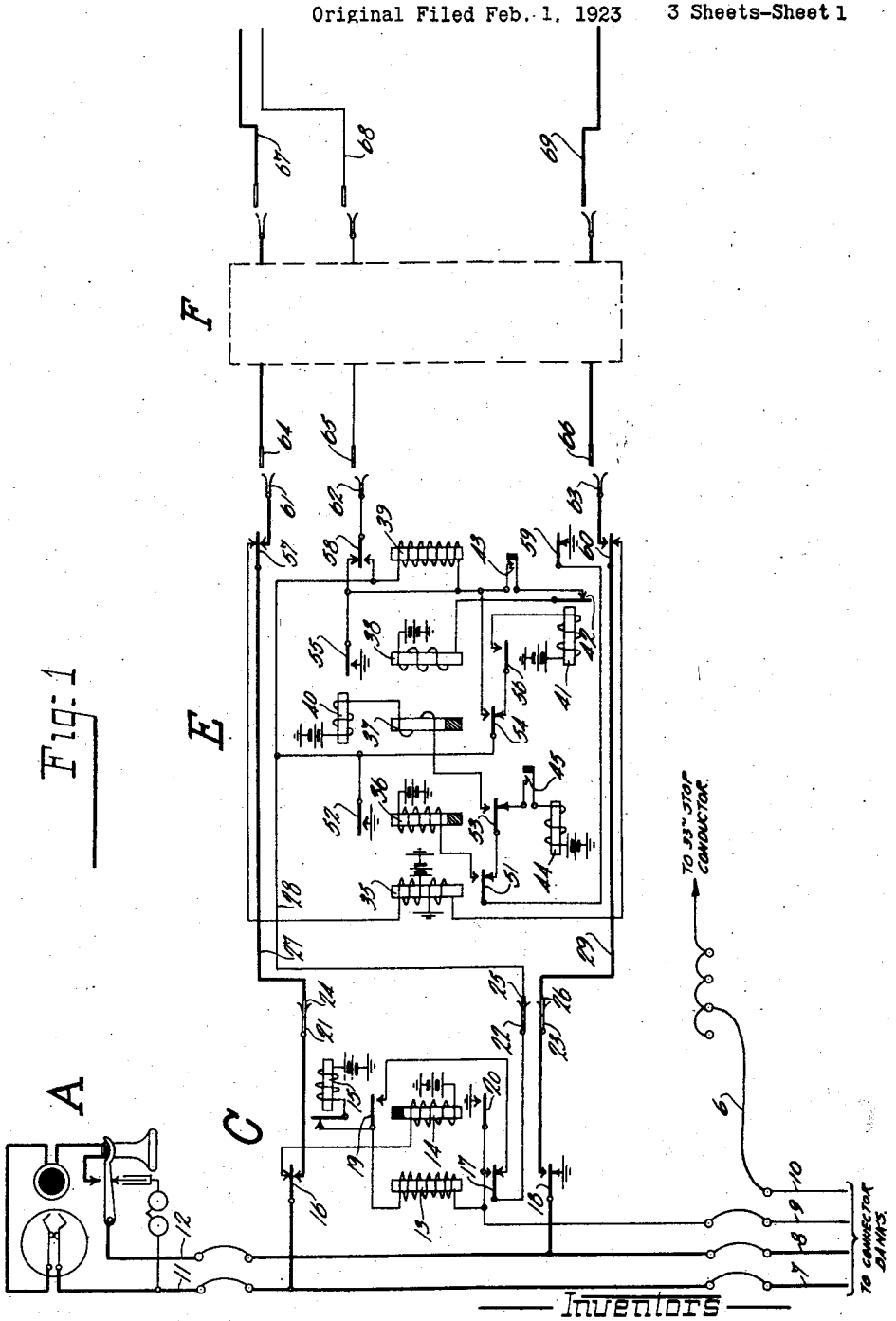

Fig. 1

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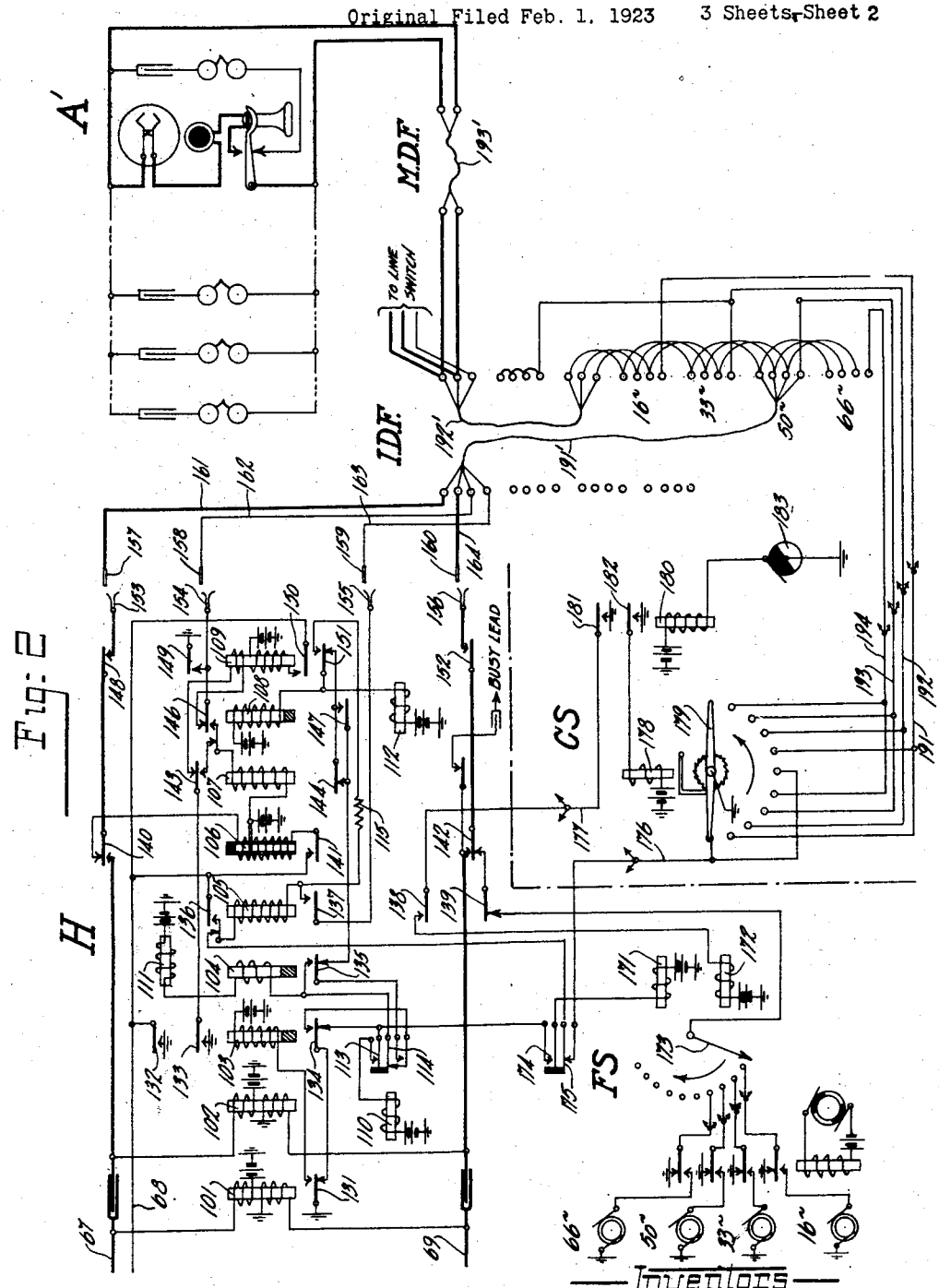

Fig. 2

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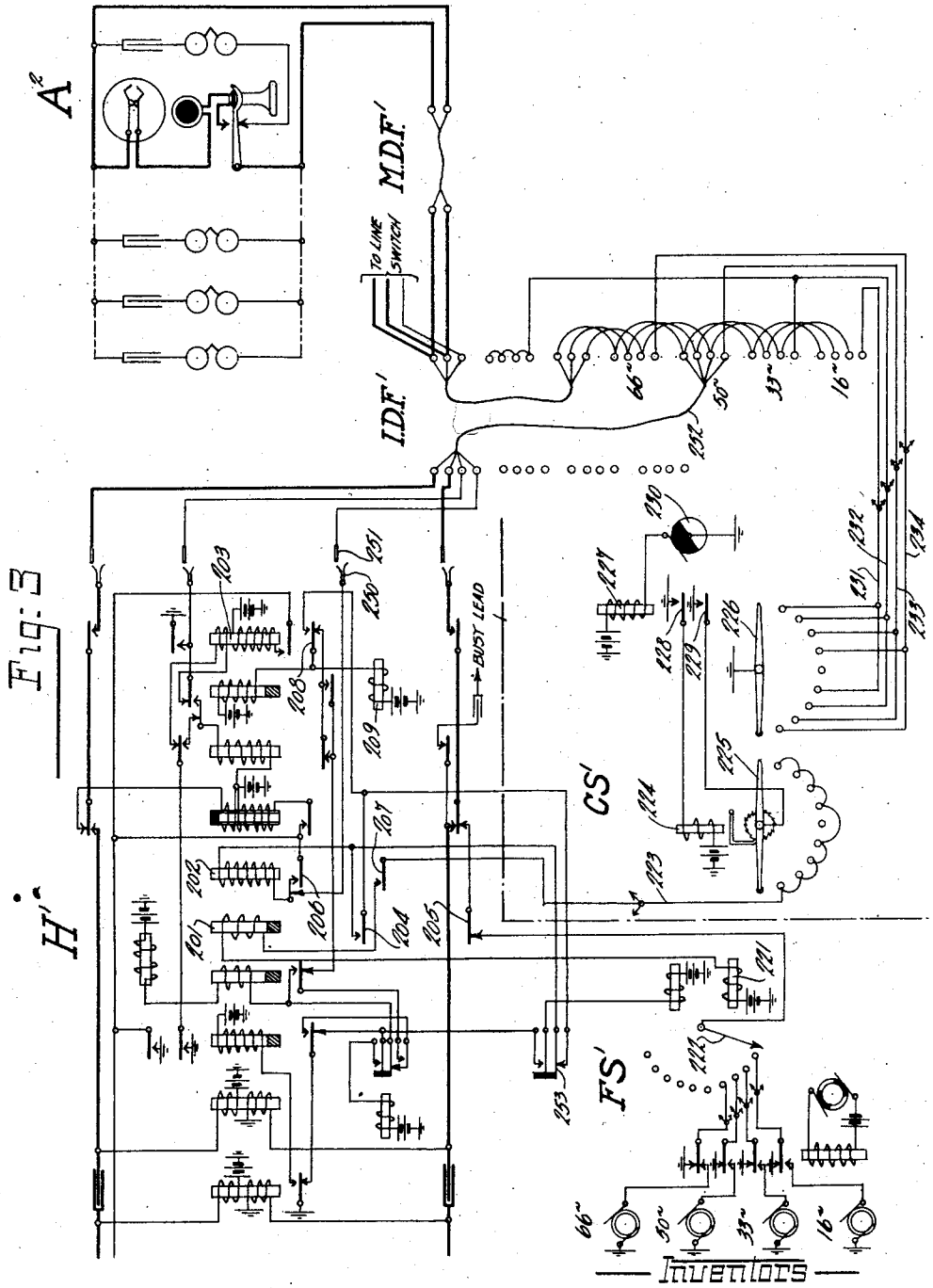

Fig. 3

H'

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Patented Aug. 23, 1927. 1,640,157

UNITED STATES PATENT OFFICE.

RODNEY G. RICHARDSON, OF CHICAGO, AND JOHN I. BELLAMY, OF BROOKFIELD, ILLINOIS, ASSIGNORS, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

PARTY-LINE AUTOMATIC TELEPHONE SYSTEM.

Application filed February 1, 1923, Serial No. 616,429. Renewed January 5, 1927.

The present invention relates to party line automatic telephone systems in general, but is concerned more particularly with systems of the above kind in which the character or the nature of application of the ringing current for signalling a called party line subscriber is determined by a terminal individual to each station, reference being had to the co-pending application of Owen et al., Serial No. 246,643, filed July 25, 1918; and the main object, briefly stated, is the production of new and improved circuit arrangements whereby the amount of equipment used in a system of the above character to select the ringing current to be applied to a called party line is reduced to a minimum; whereby the operation of the system from the standpoint of the wire chief and his assistants is simplified; and whereby the marginal features found in prior systems of the same nature are removed.

Another object incidental to the carrying out of the main object is the provision of circuit arrangements whereby a simple single-motion switch individual to each connector in the system picks out the ringing current in accordance with the connection of the individual ringing current selecting terminal of the called station.

Other objects which are concerned mainly with the circuit details will be met with and fully explained during the course of the specification.

The drawings, comprising Figs. 1–3, inclusive, which accompany this specification show by means of the usual circuit diagrams a sufficient amount of apparatus in a system of the type to which the invention relates to enable the invention to be understood and its utility appreciated.

Fig. 1 of the drawings shows the substation A of which the line terminates at the exchange in the line switch C; the first selector E accessible to the line switch C; and also the second selector F (denoted by the dotted rectangle bearing that reference character) accessible to the first selector E.

Fig. 2 shows the connector H accessible to the second selector F, Fig. 1, and having access to a number of lines. One of these lines is the party line on which the substation A′ is located. This drawing shows also the frequency selecting switch FS which is individual to the connector H, and the common controlling switch CS which is common to all the connectors in the exchange. Also, the intermediate distributing frame I. D. F. and the main distributing frame M. D. F are shown.

Fig. 3 discloses a modification and may be substituted for Fig. 2. This drawing shows an alternate method for setting the frequency selecting switch FS′ and the slightly different control switch CS′ which is necessarily different on account of the different scheme utilized in setting the frequency selecting switch.

Referring now particularly to Fig. 2, the invention will be described generally with reference thereto. The line of substation A′ terminates as usual at the line side of the main distributing frame M. D. F., and is connected by the two-wire jumper 193′ to the protector or switchboard side of the M. D. F. The protector side of the M. D. F. is connected by switchboard cables to the line switch side of the intermediate distributing frame I. D. F. The three conductors for the line switch are taken off the line switch side of the I. D. F., as shown. Since the line of substation A′ is a party line, the associated contacts on the line switch side of the I. D. F. are not jumpered directly to the connector bank side of the I. D. F., but are connected by means of the jumper 192′ to a so-called "idler-block," one of these being used for each four-party line.

The idler block shown has five sets of terminals. One of these sets of terminals is used up by the jumper 192′, leaving the other four sets of terminals for use in running jumpers, such as 191′, between the idler block and the connector bank side of the I. D. F. The idler block shown, it may be stated, is representative of the others.

The contacts of the connector banks are cabled over to the connector bank side of the I. D. F. and are there connected up in order. Each set of connector bank contacts represents a station which may be a station on an individual line or a station on a party line, depending upon to where the associated jumper, such as the jumper 191′, is connected. Any four sets of terminals, in the same group or in different groups of connectors, may be assigned to any party line. For instance, in the drawing the fifty cycle station on the party line shown has been as-

signed the set of terminals 157—160, and the other stations, sixty cycle, thirty three cycle, etc., may have assigned to them any of the ninety nine other sets accessible to the same connector or sets accessible to other groups of connectors, merely by running the proper jumpers.

When a party line station is signalled, it is necessary that the signalling be done in such a manner that the other stations on the line are not signalled. In this particular case, it has been chosen to use the so-called harmonic system of ringing. The four generators which supply the harmonic ringing current are shown diagrammatically in the lower left-hand corner of the drawing, and they furnish ringing current of the proper frequencies to selectively operate the tuned ringers on the party lines.

In order to choose between the four sources of ringing current when any particular station is called, the frequency selector FS is provided for the connector H and is operated over the common impulse conductor 177 after the associated connector has been set on the called line. The frequency selecting switch FS is guided to pick out the particular frequency desired under the control of relay 105 of the connector H, which relay, in turn, is controlled in accordance with the cross connection of the bank contacts engaged by the ringing current wiper 155 of the connector H.

The contacts in the bank of wiper 155, of which one is provided for each station called by way of the connector H, are cabled to the left-hand side of the I. D. F. along with the line and test contacts as shown. Since there are four connector bank contacts in each set, the jumpers, such as 191′, are four-conductor jumpers and the fourth conductor of each connects with one of the four stop conductors 191–194, inclusive, which are connected to the idler blocks, as shown. The correct stop conductor is, therefore, connected back to the ringing current terminal of each station, and provides for controlling the frequency selecting relays, such as relay 105 of the connector H, in such a manner that the frequency selectors, such as the frequency selector FS, are set for any one of the four frequencies of ringing current, depending in any one case upon which of the four sets of terminals on the idler block the terminals of the selected station are connected to.

The line switches of the system, of which only the line switch C, Fig. 1, is shown, are mechanically of the well-known rotary type of which the wipers have no normal position and move in a forward direction only. The selectors and connectors, such as E, F, and H, Figs. 1 and 2, and H of Fig. 3, are of the usual vertical and rotary type and, accordingly, their bank contacts are arranged in horizontal rows or levels.

The frequency selecting switches, such as the frequency selecting switch FS, Fig. 2, and the frequency selecting switch FS′, Fig. 3, are of a simple type of single-motion switch, being operated in a forward direction by their respective operating magnets and restored to normal by their respective release magnets.

The control switches CS, Fig. 2, and CS′, Fig. 3, have wipers which are moved in a forward direction only by their respective stepping magnets. These switches are of the type of which the wipers are advanced upon the deenergization of the associated stepping magnet rather than on the energization of said magnet.

Throughout the drawings, the relays which have slow acting characteristics are denoted by the shading on the lower ends of their cores or else by the solid black portion on the upper ends of their cores. The relays which have cores shaded on the lower end are the usual so-called "slow acting" relays and are slow to fall back but not noticeably slow to pull up. On the other hand, the relays which have the upper ends of their cores shown solid black are slightly slow to pull up, in addition to being slow to fall back.

In order to explain the operation of the system, it will be assumed that the subscriber at substation A desires to converse with the subscriber at the party line substation A′, Fig. 2.

When the receiver is removed at substation A, line relay 14 energizes over line conductors 11 and 12. Upon energizing, line relay 14 places ground on private normal conductor 9 at armature 20, thereby making the calling line busy, and closing a circuit for switching relay 13 and stepping magnet 15 in series. As a further result of the energization of line relay 14, it connects test wiper 22 to the junction of switching relay 13 and stepping magnet 15 at armature 19.

In case the trunk upon which the wipers of the switch are standing is idle, switching relay 13 energizes immediately. Assuming the trunk to be busy, however, switching relay 13 is short-circuited by the ground potential encountered by test wiper 22 on the busy test contact and does not energize, and the wipers are rotated step by step by the buzzer-like action of stepping magnet 15, which is operated through test wiper 22. When an idle trunk is reached, which trunk it will be assumed is the one terminating in bank contacts 24–26, inclusive, switching relay 13, being no longer short-circuited, energizes in series with stepping magnet 15. Stepping magnet 15, however, does not energize at this time on account of the high resistance of switching relay 13. Switching relay 13, upon energizing, opens a point in the test circuit and prepares the holding cir-

cuit at armature 17, and at armatures 16 and 18 disconnects line conductors 11 and 12 from the winding of line relay 14 and ground, and extends them by way of wipers 21 and 23, bank contacts 24 and 26, conductors 27 and 29, armatures 57 and 60 and their resting contacts, to the upper and lower windings of line relay 35 of the selector E.

Line relay 35 now energizes over the calling subscriber's loop and closes at armature 51 a circuit for release relay 36. Upon energizing, release relay 36 opens a point in the circuit of release magnet 44 and prepares a circuit for vertical magnet 40 at armature 53, and at armature 52 places ground on release trunk conductor 28, thereby closing the usual holding circuit for switching relay 13 of the line switch C before quick-acting line relay 14 has had time to deenergize.

When the calling subscriber operates his calling device in accordance with the first digit in the desired number, the circuit of line relay 35 is opened a corresponding number of times. Each time line relay 35 deenergizes in response to one of the interruptions thereby produced, it closes a circuit for vertical magnet 40 as follows: from ground by way of the resting contact of armature 59 and said armature, armature 51 and its resting contact, armature 53 and its working contact, relay 37, and vertical magnet 40 to battery. By the operation of vertical magnet 40, the wipers 61–63, inclusive, are raised opposite the desired level of bank contacts. Relay 37 is energized in series with vertical magnet 40 and, being slow-acting, retains its armature attracted throughout the vertical movement. As a result of the energization of relay 37, a circuit is closed at armature 54 for stepping relay 38 by way of off normal contacts 43 (which close upon the first vertical step) and interrupter contacts 42. Stepping relay 38, upon energizing, closes a locking circuit for itself at armature 55, and at armature 56 prepares a circuit for rotary magnet 41.

At the end of the vertical movement, slow-acting relay 37 deenergizes and completes the circuit of rotary magnet 41 at armature 54. Rotary magnet 41, upon energizing, advances the wipers 61–63, inclusive, into engagement with the first set of bank contacts in the selected level, and, near the end of its stroke, opens the circuit of stepping relay 38 at interrupter contacts 42. Stepping relay 38, upon deenergizing, opens the circuit of rotary magnet 41 at armature 56, whereupon rotary magnet 41 deenergizes also and closes its interrupter contacts 42 again. In case the trunk terminating in the first set of bank contacts is idle, switching relay 39 energizes immediately. Assuming the trunk to be busy, however, switching relay 39 is short-circuited by the ground potential encountered by test wiper 62, and stepping relay 38 energizes from this same ground potential and closes the circuit of rotary magnet 41 again, whereupon the switch wipers are rotated into engagement with the next set of bank contacts. This alternate operation of stepping relay 38 and rotary magnet 41 continues until an idle trunk is reached, which trunk it will be assumed is the one terminating in bank contacts 64–66, inclusive whereupon switching relay 39, being no longer short-circuited, energizes in series with stepping relay 38. Stepping relay 38, however, does not energize at this time on account of the high resistance of switching relay 39. Switching relay 39, upon energizing, opens a point in the test circuit and prepares the holding circuit at armature 58; disconnects ground from armature 51 of line relay 35 at armature 59, thereby opening the circuit of release relay 36; and at armatures 57 and 60 disconnects conductors 27 and 29 from the windings of line relay 35, and extends them by way of wipers 61 and 63 and bank contacts 64 and 66 to the windings of the line relay (not shown) of the selector F.

When the subscriber operates his calling device in accordance with the second digit in the desired number, the selector F raises its wipers opposite the desired level of bank contacts and, upon the initiation of the trunk selecting movement, selects an idle trunk, which trunk, it will be assumed, is the one comprising conductors 67–69, inclusive, and extending to the connector H Fig. 2. In response to the seizure of this trunk, line relay 101 of the connector H energizes over the calling line and closes a circuit for release relay 103 at armature 131. Release relay 103, upon energizing, prepares a circuit for vertical magnet 111 at armature 134; prepares a circuit for relays 107 and 109 at armature 133; and at armature 132 places ground on release trunk conductor 68, thereby establishing the usual holding circuit for the switching relays of the line switch C and the selectors E and F.

When the calling subscriber operates his calling device in accordance with the next digit in the desired number, the circuit of line relay 101 of the connector H is opened a corresponding number of times and, upon each of the resulting deenergizations of line relay 101, a circuit is closed for vertical magnet 111, the circuit at the time of the first closure being as follows: from ground by way of armature 131 and its resting contact, armature 134 and its working contact, contact of off normal spring 114 and said spring, relay 104, and vertical magnet 111 to battery. By the operation of vertical magnet 111, the wipers 153–156, inclusive, of the connector H are raised step by step

until they stand opposite the desired level of bank contacts, which in this case is the level in which the line of substation A' terminates. Relay 104 is energized in series with vertical magnet 111 and, being slow-acting, is maintained energized throughout the vertical movement. Relay 104 serves at armature 135 to maintain its own circuit and that of vertical magnet 111 intact after the off normal springs have shifted as they do upon the first vertical step. At the end of the vertical movement, slow-acting relay 104 deenergizes and transfers the operating circuit to rotary magnet 112.

When the calling subscriber operates his calling device in accordance with the next and last digit in the desired number, an impulse of current is sent to rotary magnet 112 upon each of the resulting deenergizations of line relay 101, the first impulse of current being sent over the following circuit: from ground by way of armature 131 and its resting contact, armature 134 and its working contact, normally open contacts controlled by off normal spring 114, armature 135 and its resting contact, resting contact of armature 144 and said armature, resting contact of armature 151 and said armature, and rotary magnet 112 to battery. By the operation of rotary magnet 112, the wipers 153–156, inclusive, are rotated step by step into engagement with the terminals 157–160, inclusive, of the desired line. Relay 108 is energized in multiple with rotary magnet 112 and, being slow-acting, is maintained energized throughout the rotary movement. Upon energizing, relay 108 disconnects test wiper 154 from the upper winding of switching relay 109 and connects it with busy relay 107 at armature 146, and at armature 147 places a shunt around armature 144 and its resting contact of busy relay 107 so as to guard its own circuit and that of rotary magnet 112 from being opened prematurely by busy relay 107, in case that relay energizes during the rotary movement, due to test wiper 154 passing over busy test contacts.

Assuming the called line to be busy, test contact 158 is grounded and busy relay 107 is accordingly energized when the switch wipers come to rest on the desired set of contacts, and relay 108, upon deenergizing at the end of the rotary movement, completes a locking circuit for busy relay 107 as follows: from ground by way of the working contact of armature 133 and said armature, armature 143 and its working contact, normally closed contacts controlled by armature 146, and busy relay 107 to battery. Also, since busy relay 107 is energized, slow relay 108, upon falling back, disconnects itself and rotary magnet 112 from the operating circuit so as to prevent any further operation of the switch wipers and any further operation of relay 107 in case the calling subscriber should again operate his calling device. Busy relay 107 at its lower armature connects the busy lead to the lower heavy talking conductor, thereby sending back the usual busy tone to the calling subscriber to inform him that he cannot obtain the desired connection for the time being. Upon hearing this tone, the calling subscriber replaces his receiver, whereupon the partly established connection is released in the usual manner.

Assuming now that the line of substation A' is idle when substation A' is called as hereinbefore described, test contact 158 is not grounded and busy relay 107 is consequently not energized when the switch wipers come to rest on the terminals of the desired line, and slow-acting relay 108, upon deenergizing, completes a circuit for the upper winding of switching relay 109 in series with the switching relay of the line switch (not shown) associated with the called line as follows: from ground by way of the working contact of armature 133 and said armature, armature 143 and its resting contact, upper winding of switching relay 109, resting contact of armature 146 and said armature, test wiper 154, test contact 158, private normal conductor 162, and thence to battery by way of the switching relay of the line switch associated with the called line. The switching relay of the called line switch, which relay corresponds to switching relay 13 of the line switch C, Fig. 1, energizes only part way at this time owing to the usual mechanical interlocking arrangement between its armature and that of the associated line relay. Consequently, this switching relay disconnects the normal battery and ground connections of the called line but does not connect up the associated wipers.

In the connector H, switching relay 109, upon energizing in series with the switching relay of the called line switch, first closes a locking circuit for itself at its lightly adjusted armature 150, and then places direct ground on test wiper 154 at armature 149; connects up the line wipers at armatures 148 and 152; and at armature 151 disconnects rotary magnet 112 and relay 108 from the operating circuit and connects them to pick-up relay 105 through resistance 115. As soon, after this occurs, as wiper 179 arrives upon its first or sixth contact under the control of stepping magnet 178, ground is placed on the common pick-up conductor 176, thereby closing a circuit for pick-up relay 105 as follows: from ground by way of wiper 179, pick-up conductor 176, off normal contacts 175 of the frequency selector FS, normally closed contacts controlled by armature 136 of relay 105, relay 105, resistance 115, working contact of armature 151 and said arma-

ture, and rotary magnet 112 to battery. Relay 105 energizes over this circuit, but neither stepping magnet 112 nor relay 108, which is in multiple with it, energizes on account of the high resistance 115. Relay 105, upon energizing, locks itself to release trunk conductor 68 and disconnects its own winding from the pick-up conductor at armature 136; connects up wiper 155 at armature 137; disconnects wiper 173 of the frequency selector FS at armature 139; and at armature 138 connects up stepping conductor 177.

Upon the next energization of control relay 180, the usual circuit is closed for stepping magnet 178 of the control switch at armature 182, whereupon magnet 178 energizes and moves the associated pawl into engagement with the next notch on the ratchet wheel but does not advance wiper 179. As a further result of the energization of relay 180, ground is placed on the common stepping conductor 177 at armature 181, thereby closing a circuit for stepping magnet 172 of the frequency selector. Stepping magnet 172 now energizes and advances the wiper 173 into engagement with the first associated bank contact.

Upon the subsequent deenergization of relay 180, the circuit of stepping magnet 178 of the control switch CS is opened and ground is removed from stepping conductor 177. Upon the deenergization of stepping magnet 178, the wiper 179 is advanced into engagement with the bank contact in which the first stop conductor 191 terminates, thereby placing a ground on said stop conductor 191. This, however, does not have any effect as regards the connector H. The wiper 173 is advanced again upon each of the subsequent energizations of control relay 180 until said wiper 173 comes into engagement with the third associated bank contact or the one which is associated with the fifty-cycle generator. This occurs, of course, while control relay 180 is energized and while wiper 179 of the control switch CS is on the bank contact in which the second stop conductor 192 terminates.

Upon the next deenergization of control relay 180, stepping magnet 178 deenergizes and advances wiper 179 into engagement with the bank contact in which the third stop conductor 193 terminates. Since the jumper 191′ is connected with the fourth set or the fifty-cycle set of terminals on the idler block, ground is placed on ringing current terminal 159 of the called station A′ by way of the control switch CS, the fifty-cycle stop conductor 193, a conductor of jumper 191′, and conductor 163 to bank contact 159. This ground potential is extended through wiper 155 and armature 137 and its working contact to the junction of relay 105 and resistance 115, thereby short-circuiting relay 105. Relay 105 accordingly deenergizes; disconnects the common stepping conductor 177 from stepping magnet 172 of the frequency selector at armature 138; and at armature 139 connects up wiper 173, whereupon ringing current from the selected source is intermittently projected out on the called line, returning by way of the upper talking conductor and the upper winding of ring-cut-off relay 106. Relay 105 is not operated again when pick-up conductor 176 is next grounded, for the reason that off normal contacts 175 of the frequency selector FS are now open. As is well-known, the ringing current projected out on the called line passes through the four bridged bells in multiple. However, only the bell at substation A′ responds because it is the only one tuned to the frequency of ringing current that is being sent out.

When the subscriber at substation A′ responds to the ringing of his bell by removing his receiver, a direct current bridge is closed across the conductors of the called line, whereupon ring-cut-off relay 106 energizes through its upper winding; closes a locking circuit for itself at its lightly adjusted armature 141; and at armatures 140 and 142 disconnects the line wipers from its own upper winding and the source of ringing current and extends them to the windings of battery feed impedance 102. The calling and called subscribers may now converse with each other as desired over the talking circuit which is outlined by the heavy conductors and, when the conversation is terminated, they replace their receivers.

When the receiver is replaced at the called substation A′, the direct current bridge is removed from across the line conductors, and talking battery ceases to flow.

When the receiver is replaced at the calling substation A, the circuit of line relay 101 of the connector H is opened and line relay 101 accordingly deenergizes and opens the circuit of release relay 103. Slow-acting release relay 103 now deenergizes in response to the prolonged opening of its circuit; removes ground from release trunk conductor 68 at armature 132, whereupon relays 106 and 109 deenergize; and at armature 134 closes a circuit for release magnet 110 by way of off normal contacts 113. Upon the energization of release magnet 110, the wipers 153–156, inclusive, of the connector H are restored to normal position in the usual manner, and the circuit of release magnet 110 is opened at off normal contacts 113 when the wipers reach their normal position.

As a further result of the deenergization of release relay 103, a circuit is closed for release magnet 171 of the frequency selector

FS in multiple with release magnet 110 and through off normal contacts 174. Wiper 173 is restored to normal position upon the energization of release magnet 171, and the circuit of release magnet 171 is again opened at off normal contacts 174 when wiper 173 reaches its normal position.

As a further result of the ground potential being removed from release trunk conductor 68, the switching relays of the line switch C and the first and second selectors E and F deenergize. The deenergization of switching relay 13 of the line switch C restores conditions in that switch to normal. The deenergization of switching relay 39 of the selector E closes a circuit for release magnet 44 at armature 59 by way of armatures 51 and 53 and off normal contacts 45. Upon the energization of release magnet 44, the wipers of the selector E are restored to normal position in the usual manner, and the circuit of release magnet 44 is opened at off normal contacts 45 when the wipers reach their normal position.

The selector F is restored to normal in the same way as the selector E.

Referring now particularly to Fig. 3, the operation of the modification will be described. It will be understood, of course, that the interrupter 230 is constantly operating with the result that the control switch CS′ is being constantly driven around in a manner similar to the control switch CS as above described. It may be pointed out also that whereas the control switch CS, Fig. 2, has, for each cycle of operations, a definite position (the position at which the common pick-up conductor 176 is grounded) at which it starts the waiting frequency selectors, and has a plurality of positions at which it stops the operating frequency selectors (the positions at which the four stop conductors 191–194, inclusive, are grounded), the control switch CS′ has, for each cycle of operations, a definite stop position at which it stops the frequency selectors which are being operated, the frequency selectors such as FS′ being picked up or started at the correct position by the four pick-up or start conductors 231–234, inclusive.

Assuming now that the substation A^2 is being called; that the wipers of the connector H′ have been set on the terminals of the line of substation A^2; and that the called line is idle, switching relay 203 energizes in the usual manner and prepares a circuit for pick-up relay 202 in series with rotary magnet 209 at armature 208. After this occurs, a circuit is closed for pick-up relay 202 when wiper 226 arrives upon the bank contact at which pick-up conductor 233 terminates. This circuit is as follows: from ground by way of wiper 226, pick-up conductor 233, a conductor of jumper 252, bank contact 251, wiper 250, normally closed contacts controlled by armature 206, pick-up relay 202, off normal contacts 253 of the frequency selector FS′, working contact of armature 208 and said armature, and rotary magnet 209 to battery. Pick-up relay 202 energizes over this circuit, but neither rotary magnet 209 nor the relay which is in multiple with it energizes at this time on account of the high resistance of relay 202. Upon energizing, pick-up relay 202 closes a locking circuit for itself and opens its initial circuit at armature 206, and at armature 207 connects up impulse conductor 223 to rotary magnet 221 of the frequency selector FS′ by way of the slow-acting series relay 201.

The above mentioned energization of pick-up relay 202, it will be observed, occurs in response to the advance of the wipers 225 and 226 of the control switch CS′ and, consequently, occurs during the time that relay 227 is deenergized, the wipers of the control switch CS′ as pointed out above, being advanced upon the deenergization rather than the energization of the associated stepping magnet 224. Accordingly, since relay 227 is deenergized at this time, impulse conductor 223 is not grounded and stepping magnet 221 of the frequency selector FS′ is not energized immediately.

Upon the next energization of control relay 227, magnet 224 is energized, upon armature 228 being attracted, and prepares to step the wipers upon its subsequent deenergization. As a further result of the energization of relay 227, the common impulse conductor 223 is grounded at armature 229 by way of wiper 225 and the bank contact upon which it is standing.

This closes a circuit for stepping magnet 221 by way of armature 207 and its working contact and relay 201. Relay 201, upon energizing in series with magnet 221, places a shunt around off normal contacts 253 at armature 204 so as to maintain the circuit of pick-up relay 202 intact after off normal contacts 253 have been opened. As a further result of the energization of relay 201, wiper 222 of the frequency selector FS′ is disconnected at armature 205 so as to prevent any ringing current from being projected out on the called line while wiper 222 is being operated. Stepping magnet 221, upon energizing, advances the wiper 222 into engagement with the first associated bank contact. Upon the subsequent deenergization of relay 227, ground is removed from the common impulse conductor 223 at armature 229, and the circuit of stepping magnet 224 is opened at armature 228. Upon deenergizing, stepping magnet 224 advances the wipers 225 and 226 into engagement with the next set of bank contacts.

Upon the next energization of relay 227, stepping magnet 224 is again energized and

ground is again applied to the impulse conductor 223, thereby closing the circuit of stepping magnet 221 and series relay 201 the second time. When this occurs, the wiper 222 is advanced into engagement with the second set of bank contacts. Relay 201, being slow-acting, is not deenergized between successive impulses.

Upon the next deenergization of relay 227, the wipers 225 and 226 are again advanced and impulse conductor 223 is again ungrounded.

Upon the next energization of relay 227, which is the third energization of this relay after the energization of pick-up relay 202, magnet 221 energizes the third time and advances wiper 222 into engagement with the third associated bank contact, which is the bank contact with which the desired frequency of ringing current is connected.

Upon the subsequent deenergization of relay 227, the common impulse conductor 223 is ungrounded again, and the wipers 225 and 226 are advanced into engagement with one of the dead sets of bank contacts. Accordingly, impulse conductor 223 is not grounded upon the next energization of relay 227. This produces an extra long interval between the impulses of current delivered over impulse conductor 223, and allows time for the slow-acting relay 201 in series with magnet 221 to energize. Upon deenergizing, relay 201 removes the shunt from around off normal contacts 253 at armature 204, thereby opening the circuit of pick-up relay 202. Upon deenergizing, pick-up relay 202 disconnects the impulse conductor 223 from the stepping magnet of the frequency selector at armature 207. As a further result of the deenergization of slow-acting relay 201, it connects up wiper 222 at armature 205, whereupon ringing current from the selected source is projected out over the called line to ring the desired bell. The remaining part of the operation is as described in connection with Fig. 2.

It is very evident that the frequency selector FS′ may be set for any of the four frequencies when the wipers of the connector H′ are set on the terminals shown, by merely connecting the jumper 252 to any one of the four sets of terminals of the idler block, the pick-up relay 202 being operated sooner or later during the cycle of operations of the control switch CS′, depending upon which of the four pick-up conductors 231–234, inclusive, is used.

Regarding the signalling of substations on individual lines, it may be said that the ringers at these substations do not ordinarily have harmonic bells and are signalled with the thirty-three cycle generator, that being the one to which these bells respond most readily. For example, the substation A, Fig. 1, which is reached as a called substation by way of the normal conductors 7–10, inclusive, is signalled by the thirty-three cycle generator as is indicated by the single wire jumper 6 which is run to the thirty-three cycle stop conductor bus-bar. It will be noted in this connection that it is not necessary to use four conductor jumpers for the individual lines, the ringing current selection being taken care of for these lines by a short single wire jumper run to a nearby bus-bar.

Although certain forms of the invention have been described in detail, it is understood that we do not wish to be limited to the precise constructions shown herein, but desire to include and have protected by Letters Patent all modifications which come fairly within the scope of the appended claims.

What is claimed is:—

1. In a telephone system, party lines, a set of terminals at the exchange associated with each station on each line, each station being called by way of its associated set of terminals, connector switches for extending connections to the desired lines by way of said terminals, a step by step ringing current selecting switch associated with each connector, and means controlled in accordance with the set of terminals on which a connector is set for operating said selecting switch to select the correct ringing current to signal the called station.

2. In a telephone system, party lines, a connector switch having wipers for extending connections to said lines, a ringing current selecting switch individual to said connector switch, and means controlled according to the setting of said wipers for subsequently operating said selecting switch.

3. In an automatic party line telephone system, a connector switch for completing connections to called party lines, a plurality of branches for each line over which connection thereto may be completed, and an auxiliary progressively movable ringing current selecting switch associated with said connector and controllable over the particular branch in use when any line is connected with.

4. In a party line telephone system, a link circuit for completing connections to called party lines, a plurality of branches for each line over which connection thereto may be completed, and a progressively movable ringing current selecting switch associated with said link circuit and controllable over the particular branch in use when any line is connected with.

5. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be com-

pleted, each branch corresponding to a particular station on said line, ringing current generators equal in number to the number of said stations, and a progressively movable switch controlled over the branch in use when said line is connected with to select the proper generator for signalling the desired station.

6. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a particular station on said line, ringing current generators equal in number to the number of said stations, each generator being adapted to operate the bell at a particular station only, and a progressively movable switch controlled over the branch in use when the line is connected with for selecting the generator corresponding to such branch and to the station which it is desired to signal.

7. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a different station on said line, different ringing current generators equal in number to the number of said stations, a switch and means for operating it to select one of said generators, and means controlled over the particular branch in use when the said line is connected with for determining which generator is selected by said switch.

8. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a different station on said line, different ringing current generators equal in number to the number of said stations, a switch for selecting the proper generator to signal the desired station when said line is connected with, step by step mechanism for operating said switch to select said generators in order, and means controlled over the branch in use for determining the number of steps taken by said switch.

9. In a selective ringing system, a ringing current selecting switch, a plurality of control conductors, means for associating said switch with any conductor, means for grounding said conductors successively, means for generating an operating impulse to move said switch each time a conductor is grounded, and means controlled over the particular conductor with which the said switch is associated for determining the number of impulses which become effective.

10. In a selective ringing system, a ringing current selecting switch, a plurality of control conductors, means for associating said switch with any conductor, means for grounding said conductors successively, means for stepping said switch ahead each time a conductor is grounded, and means controlled over the particular conductor with which said switch is associated when the same is grounded for preventing further stepping of said switch.

11. In a selective ringing system, a ringing current selecting switch, a plurality of control conductors, means for associating said switch with any conductor, a device for advancing said selecting switch and for successively grounding said control conductors, and means responsive when the conductor with said switch is associated is grounded for stopping further advance of said switch.

12. In a selective ringing system, connector switches for connecting with called lines, a ringing current selecting switch individual to each connector, a common control switch for operating all said selecting switches, control circuits for determining the extent of movement of said selecting switches, and means in each connector for selecting a control circuit whenever a called line is connected with.

13. In a selective ringing system, connector switches for connecting with called lines, a ringing current selecting switch individual to each connector, a continuously operating transmitting device for operating said selecting switches, a plurality of control circuits for determining the extent to which said selecting switches are operated by said device, and means in each connector for selecting a control circuit whenever a called line is connected with.

14. In a telephone system, a party line, a connector having access to said line over a plurality of branches, a frequency selector individual to said connector, and means individual to each branch for controlling said frequency selector.

15. In a telephone system, a party line, a connector having access to said line over a plurality of branches, a frequency selector individual to said connector, a relay in said connector for controlling said selector, and a conductor individual to each branch for controlling said relay.

16. In a telephone system, a party line, a connector having access to said line over a plurality of branches, a frequency selector individual to said connector, means for starting the operation of said selector automatically when the connector connects with any branch, and means controlled over a conductor of the branch in use for stopping said selector at a particular point.

17. In a telephone system, party lines, a connector switch having wipers for directly connecting with said lines, a ringing current selecting switch individual to said connector

switch, and means controlled according to the setting of said wipers for operating said selecting switch.

18. In a telephone system, party lines, a set of terminals at the exchange associated with each station on each line, each station being called by way of its associated set of terminals, connector switches for extending connections to desired lines by way of said terminals, a circuit closing device, a plurality of sources of ringing current, and means in each connector controlled by said device in accordance with the set of terminals on which the connector is set for connecting the correct source of ringing current to the called line to signal a desired station thereon.

19. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a particular station on said line, ringing current generators equal in number to the number of said stations, a circuit closing device, and means in said link circuit controlled by said device over the branch in use when the line is connected with to connect the proper generator to the line for signalling the desired station.

20. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a particular station on said line, ringing current generators equal in number to the number of said stations, each generator being adapted to operate the bell of a particular station only, a circuit closing device, and means in said link circuit controlled by said device over the branch in use after the line is connected with for connecting to the line the generator corresponding to the station which it is desired to signal.

21. In a party line telephone system, a link circuit for completing connections to a called party line, a plurality of branches over which connections to said line may be completed, each branch corresponding to a particular station on said line, different current generators equal in number to the number of said stations, a constantly rotating mechanism, and means operable after said line is connected with and controlled by said mechanism over the branch in use for determining which generator is used to signal a desired station on said line.

22. In a telephone system, party lines, a connector switch having wipers for directly connecting with said lines, a progressively movable ringing current selecting switch, and means controlled according to the setting of said wipers for operating said selecting switch.

23. In a telephone system, a connector switch, a party line, branches of said party line accessible to said connector, each branch including a control conductor, means for operating said connector to connect with said line via one of its branches, a plurality of ringing generators, means for grounding the control conductors successively, and means in said connector operative when the control conductor associated with the branch in use is grounded for connecting the proper generator to the line to signal a particular station thereon.

24. In a telephone system, connector switches, party lines, branches of each party line accessible to said connectors, a control conductor associated with each branch, means for operating one of said connectors to connect with one of said lines via one of its branches, a plurality of sources of ringing current, means for connecting a source of potential to the branches of each of said party lines successively, and means in the operated connector operative when said source of potential is connected to the control conductor associated with the branch in use for connecting the proper source of ringing current to the connected line to signal a particular station thereon.

25. In a telephone system, connector switches, party lines, branches of each party line accessible to said connectors, each branch comprising talking conductors, a test conductor, and a selective ringing conductor, means for operating one of said connectors to connect with one of said lines via one of its branches, and means common to said lines and controlled over the selective ringing conductor of the branch in use for signalling the particular station on the line which corresponds to the branch in use.

26. In a telephone system, a connector, a party line, branches of said party line accessible to said connector, each branch comprising talking conductors, a test conductor, and a selective ringing conductor, means for operating said connector to connect with the line via any branch, and means individual to said connector and controlled over the selective ringing conductor of the branch in use for signalling the particular station on the line which corresponds to the branch in use.

Signed at Chicago, Illinois, this 29th day of January, 1923.

RODNEY G. RICHARDSON.

Signed at Chicago, Illinois, this 29th day of January, 1923.

JOHN I. BELLAMY.