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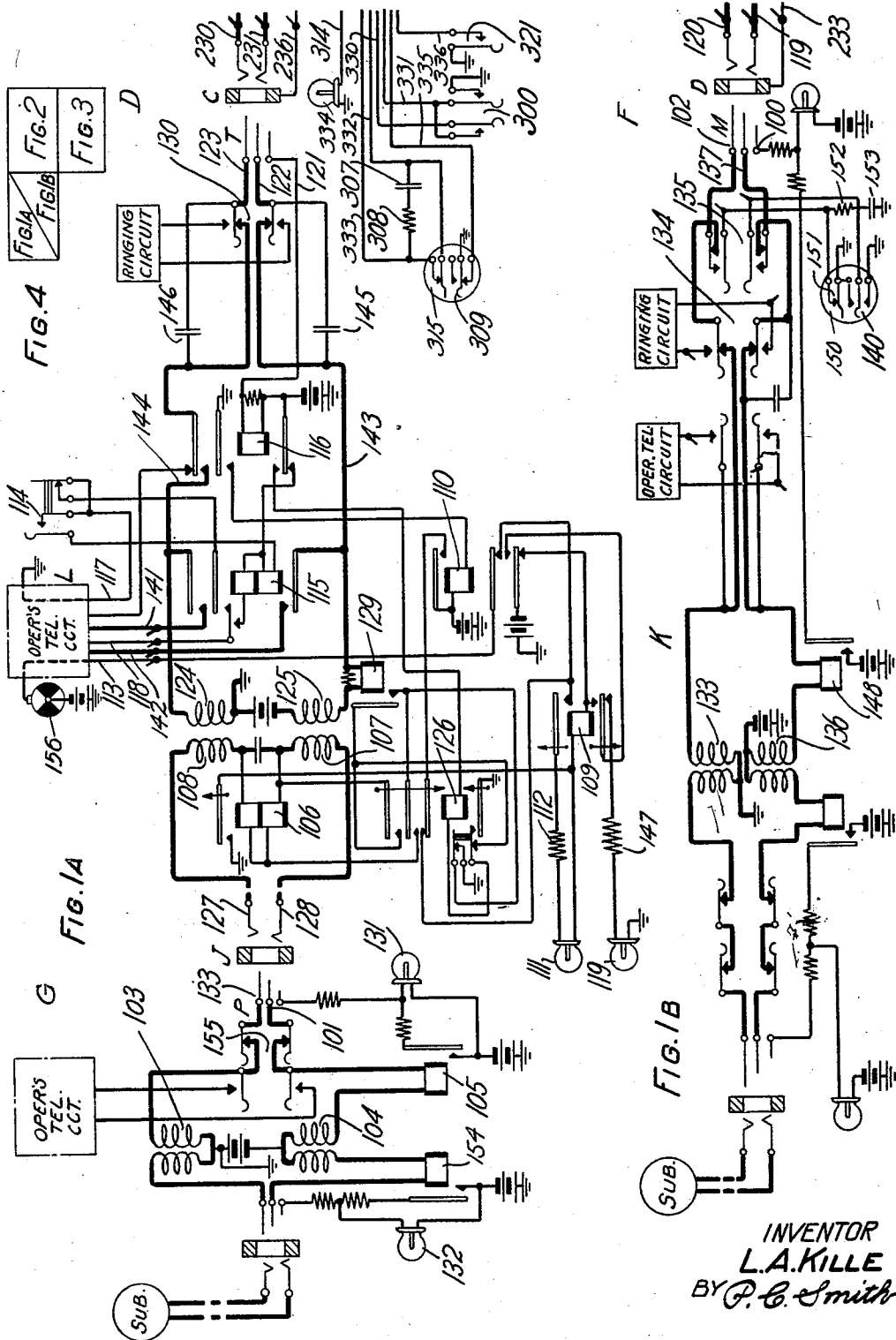
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1,832,306

SEMI-AUTOMATIC TELEPHONE SYSTEM

Filed April 30, 1930

3 Sheets-Sheet 1



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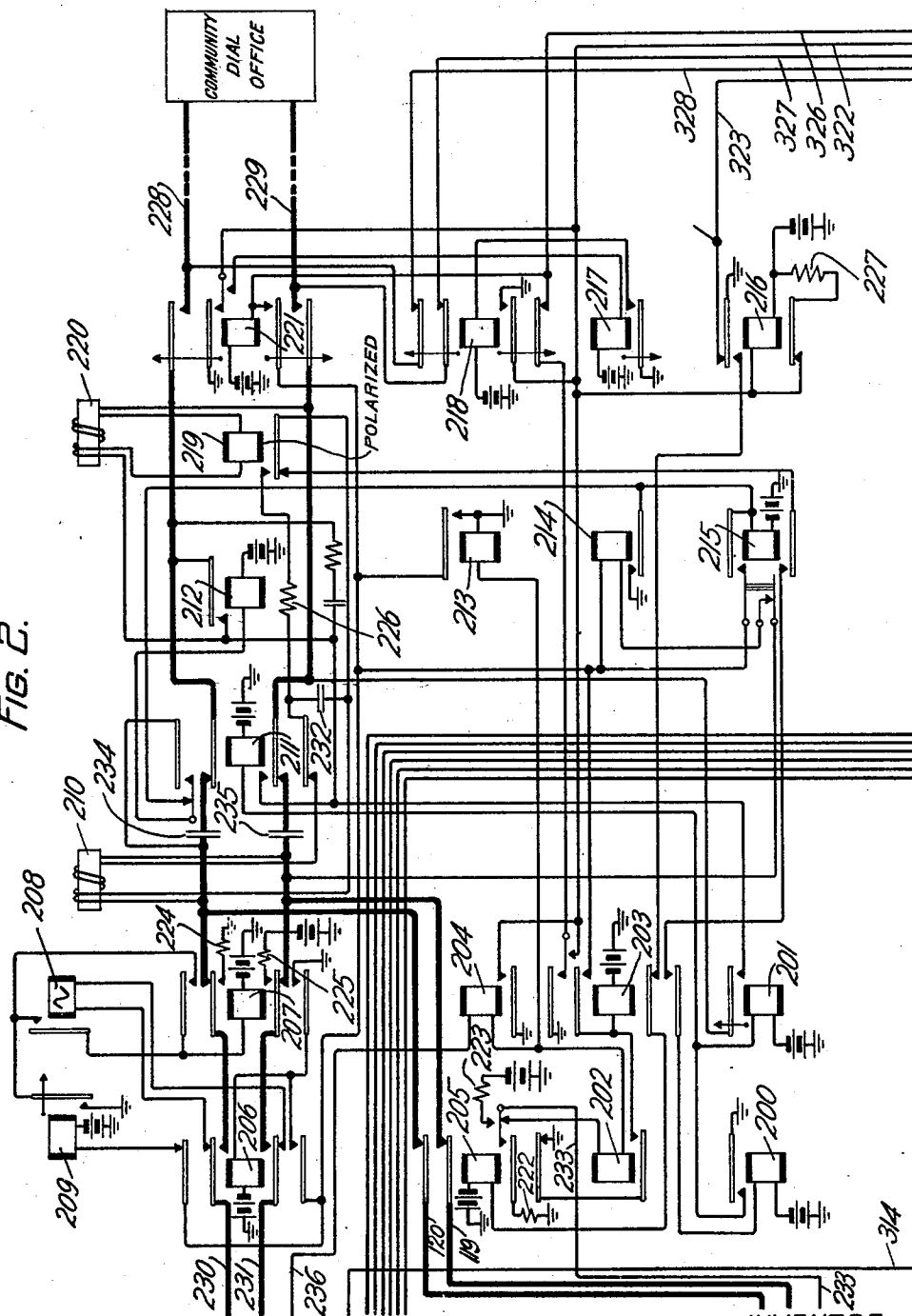
1,832,306

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3 Sheets-Sheet 2

FIG. C.



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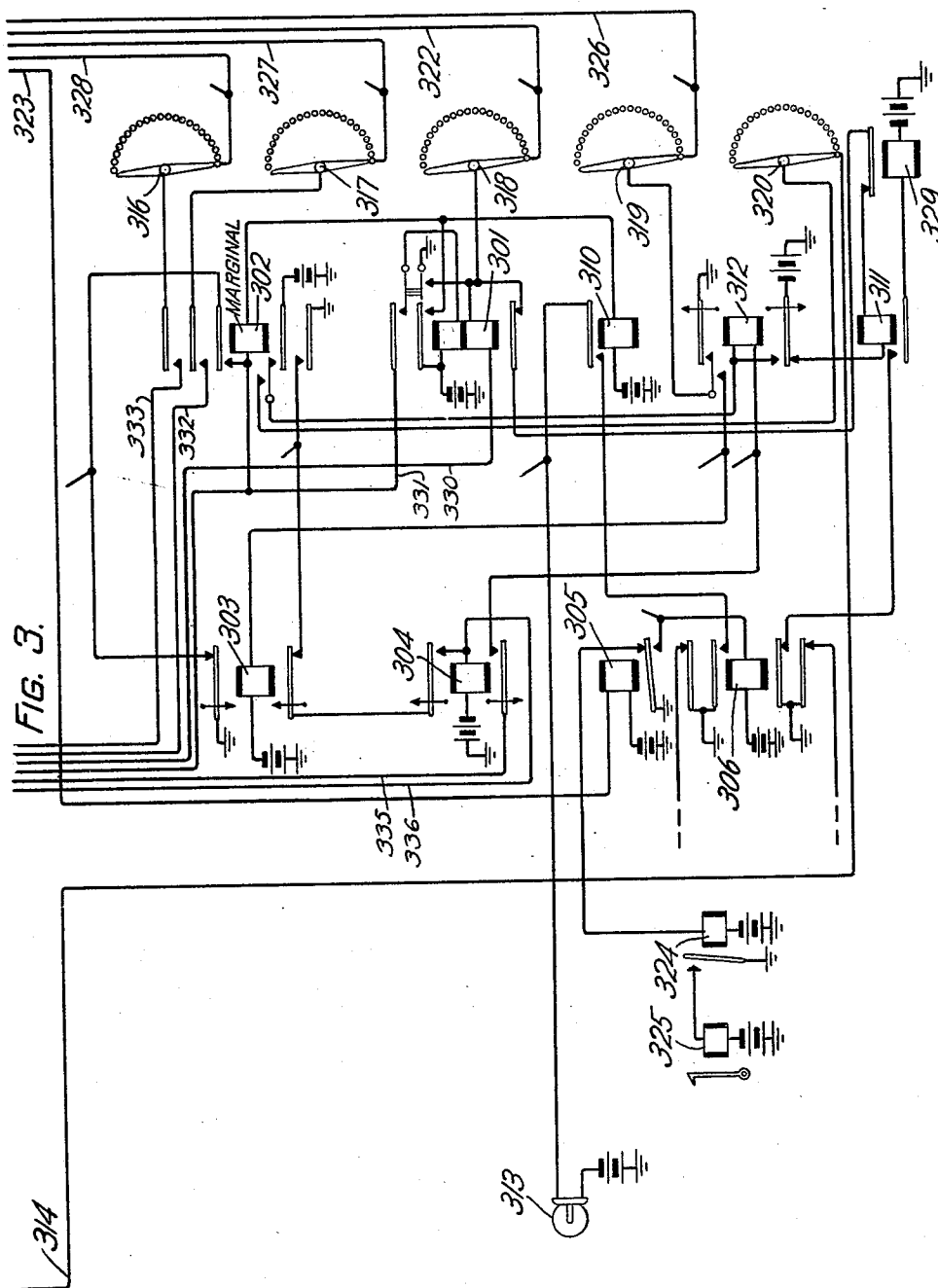
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3 Sheets-Sheet 3



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SEMI-AUTOMATIC TELEPHONE SYSTEM

Application filed April 30, 1930. Serial No. 448,488.

This invention relates to semi-automatic telephone systems and more particularly to a system for completing incoming calls to an unattended automatic satellite office at a dialing "B" switchboard position located in the terminating office to which the satellite is connected by direct trunks. The object of the invention is the provision of means whereby a call coming from a distant office for a wanted subscriber in a satellite can be dialed directly from the "B" position and completed thereto by connecting the incoming trunk with the trunk outgoing to the satellite office. Calls originating within the main office for the local satellite will be completed at the dialing "A" switchboard as at present.

More specifically, the invention contemplates the use of a preselecting trunking arrangement at the "B" position wherein the depression of a key designating the wanted satellite office causes the assignment of a preselected trunk to the position where the key is depressed, lights the associated trunk lamp thereat and connects the position dial to the assigned trunk. With the dialing of the wanted subscriber's number the connection is extended by automatic switches connected to the trunk at the satellite office. The operator completes the connection by inserting the plug-ended incoming trunk into the jack of the assigned trunk either before, during, or after dialing. When the operation of dialing the number is completed and the two trunks are thus joined, a dial release key is operated which causes the dial to be disconnected from the trunk taken into use.

At the present time most automatic offices are provided with dialing equipment only at the "A" switchboard positions for reaching wanted subscribers either within the exchange area, or to an unattended satellite office. Where a call originates in a distant office and is routed through a second office, in order to reach a particular satellite connected with the said second office it is necessary to supply connecting trunks between the "B" and "A" switchboards thereat in order to extend the incoming trunk to the "A" position which alone is provided with dialing facilities for further extending the con-

nection to the satellite. With the present invention the incoming trunks terminate at the "B" switchboard in accordance with common practice, but the auxiliary trunks between the "B" and "A" switchboards are eliminated and calls to unattended satellite offices will be dialed from the "B" switchboard directly. This arrangement, while facilitating the dispatch of incoming traffic, also has the additional advantage of leaving the "A" operator free to handle only those calls which arise within the main office itself.

In accordance with the present invention, one specific embodiment of which is disclosed herein by way of illustration, this is accomplished in the following improved manner: The trunks connecting the satellite with the main office are jack-ended at the "B" position and are multiplied and terminate in a similar manner at each of the "A" positions. Each "B" position is provided with a rotary trunk selector for each satellite to be reached and the trunks appearing at the "A" and "B" positions are also multiplied to the arcs of these selectors through a relay in the trunk which, when operated, closes the multiple to the "B" position equipment. The circuit of the rotary selector is arranged for the automatic preselection of a trunk so that, as soon as a preselected trunk is seized at any position or is otherwise made busy, the selectors serving that trunk group in all positions are stepped off the busy trunk and continue to rotate until another idle trunk is found. Should all the trunks be busy a circuit for stopping the selector is provided and a visual all trunks busy signal is given at each position. This signal persists until one trunk becomes idle whereupon all the selectors are stepped to that idle trunk and remain there until it is taken into use.

A dial, a dial release key, a key individual to each unattended satellite to be reached from the "B" position and a relay of association is provided thereat. The relay of association, together with inter-related circuits more particularly described hereinafter, serve to connect the dial with an assigned trunk after the depression of the satellite key.

When the operator receives a signal on an

incoming trunk that a call is awaiting and ascertains thereafter the name or number of the satellite together with the number of the wanted subscriber therein, she depresses the key of the wanted satellite office. Since the trunk is preselected, the depression of the key closes circuits to make the assigned trunk busy, operates the relay of association in order to connect the position dial with the assigned trunk and lights the assignment lamp of the trunk at the position. There is one trunk lamp in every "B" position for each trunk multiplied thereat, but since the lamp circuit is under the control of the operated relay of association and since, also, when a trunk is taken up at one position it is made busy at all others, the lamp is caused to light only at the position where the trunk is taken into use. The operator dials the number in the usual way and inserts the plug-ended calling trunk into the jack of the assigned trunk. The dial impulses are transmitted over the trunk through the wipers and wiper contacts of the selector and serve to step the automatic switches at the satellite office to the terminals of the wanted line. The dial release key is then depressed in order to disconnect the dial from the trunk. This key closes a circuit for stepping the selector off the trunk just used and the trunk is provided with an appropriate busy signal against interference either by the selectors at the "B" position, or by the operators at the "A" position as more particularly described hereinafter. It is to be noted in this connection that no restriction is imposed upon the operator as to when the plug-ended incoming trunk is to be inserted into the outgoing trunk jack other than the fact that it has to be inserted before depressing the dial release key. The trunk plug may be inserted into the jack either before, during, or after dialing.

The trunks which are thus used for extending connections to the satellite office are also multiplied to the dialing "A" switchboard where they are available to the "A" operator for completing similar calls arising within the office itself. In this case, however, the trunks are not provided with any preselecting equipment and therefore neither assignment lamps nor individual satellite keys are provided thereat. The operator makes a manual selection of a trunk by applying the ordinary sleeve test for a busy trunk and the dialing of the wanted subscriber's number takes place after the "A" cord plug has been inserted into the outgoing trunk jack, the dial impulses in this case being transmitted over the trunk through the tip and ring of the cord plug and tip and ring of the jack of the outgoing trunk. A trunk so taken into use by an "A" operator is, of course, made busy at the trunk selectors at the "B" positions causing such selectors to

be stepped off the busy trunk and on to an idle one.

The scope and purpose of the invention will be better understood by a consideration of the following detailed description taken in connection with the attached drawings in which:

Fig. 1—A shows a regular "A" cord circuit and subscriber's line at G, an interoffice trunk circuit at L, the outgoing trunk jack and B position dial and associated keys at D.

Fig. 1—B shows a subscriber's line, and dialing "A" cord at K and outgoing trunk jack at F.

Fig. 2 shows the outgoing trunk circuit extending from the terminating office to the community dial office.

Fig. 3 shows the terminating "B" position circuit.

Fig. 4 shows the manner in which the three drawing sheets should be arranged in order to disclose the invention completely.

The operation of the invention in connection with an incoming call established over the interoffice trunk line shown at L in Fig. 1—A will now be described. It is to be understood that only such parts of the interconnecting trunk between the two offices and the associated cord circuit will be described as is necessary for a complete understanding of the invention as both of these connecting circuits are well-known in the telephone art.

A call is extended over the interoffice trunk shown at L in Fig. 1—A by the "A" operator inserting the calling plug P of the regular "A" cord into the outgoing trunk jack J of the interoffice trunk leading to the terminating office. This operates relay 106 in the following circuit: Battery on winding 104 of the "A" cord repeating coil, winding of relay 105, lower contact of key 155, ring conductor 101 of calling plug P, ring contact 128 of outgoing trunk jack J, winding 107 of the interoffice trunk repeating coil, lower and upper windings in series of line relay 106, winding 108 of the interoffice trunk repeating coil, tip contact 127 of outgoing trunk jack J, tip contact 133 of the calling cord, top contacts of key 155, winding 103 of the "A" cord repeating coil, to ground. Relay 106 causes the operation of relay 109 over a circuit from ground on its front contacts, winding of relay 109 to battery on the bottom outer back contacts of relay 110. Relays 106 and 109 complete the circuit from ground on the contacts of relay 106, through the lamp 111 and resistance 112, top contacts of relay 109, bottom inner back contacts of relay 110, conductor 113 to battery through interrupter 156, controlled through the operator's telephone circuit, thereby flashing lamp 111 as an indication to the "B" operator that a call is waiting on the trunk associated with lamp 111. The call is then answered by operating key 114 which, over

its make contacts, operates relay 115 over a circuit from battery on the bottom back contacts of relay 116, lower winding of relay 115, make contacts of key 114 to ground on conductor 117 through the operator's telephone circuit. When key 114 is released, relay 115 locks over a circuit from battery on the bottom back contacts of relay 116, upper winding and top inner contacts, normally made contacts of key 114 to the same ground on conductor 117. This locking ground is also extended to the middle contact of the top inner contact combination of relay 115 to conductor 118 of the operator's telephone circuit. The operation of relay 115 connects the talking conductors 141 and 142 of the operator's telephone circuit across the trunk talking conductors 143 and 144 and thereby places the operator's talking circuit across the trunk in the well-known manner. The ground on conductor 118 causes a circuit associated with the operator's telephone circuit to function in the well-known manner and send two impulses of tone to the originating "A" operator to apprise her of the fact that the "B" operator is ready to receive the necessary information for completing the call. This information is then passed over the trunk line by the "A" operator in the well-known manner for straightforward trunking operation. When the "B" operator ascertains the number of the wanted subscriber and also the fact that this subscriber's line terminates in the community dial office, she depresses key 300 designating the wanted community dial office. The operation of key 300 causes a circuit to be closed from ground on key 300 through both of its contacts in series, conductor 330 lower winding of relay 301, selector brush 318 and associated contact, conductor 322, winding of relay 216 to battery and, through the bottom contacts of this relay in parallel with low resistance 227 to battery. Relay 301 is then energized in series with relay 216 of the trunk and in parallel with resistance 227. However, due to the fact that the winding of relay 216 is, at this time, shunted by the low resistance 227 and due, also, to the fact that relay 301 is made fast to operate, relay 301 will operate and connect direct ground from its top middle right contacts to conductor 322 before relay 216 can operate. When direct ground is thus placed on conductor 322, relay 216 operates, removing, at its bottom contacts, resistance 227 from the parallel path to its winding. It also removes a ground from its top contacts to conductor 323 and, on its front contacts, closes a circuit over the bottom inner back contacts of relay 203 winding of relay 205 to battery, causing this relay to operate. The operation of relay 205 opens, at its top contacts, the talking conductors 120 and 119 from the trunk jacks D at the dialing "A" positions while, at its

bottom inner front contacts it establishes a busy potential through resistance 223 to battery in parallel with resistance 222 to ground to the sleeve of these jacks, thus marking the trunk busy at all operator's positions to which it is multiplied. The back contact of the bottom inner contact combination of relay 205 opens the circuit of relay 202. The effect of removing ground from conductor 323 when relay 216 operates will be considered hereinafter in the consideration of circuit conditions prevailing when all trunks leading to the community dial office are busy.

When relay 301 operates, it closes a circuit to energize its own upper winding thru its top outer front contacts to ground on key 300, by way of conductor 331, opens the path to relay 311 at its bottom contacts, connects ground to conductor 322 as already described, short-circuits its own lower winding with ground from its top inner right front contacts, short-circuits relay 310 with battery at its top inner left front contacts and operates relay 302 over a circuit from battery at its top inner left front contacts, winding of relay 302, conductor 331 to ground on key 300. Relay 302 connects battery at its bottom inner front contacts to the winding of relay 312 and also to conductor 314 by way of selector brush 320 and associated contact. It also closes the trunk conductors 327 and 328 through to the position dial 315 by way of the two top outer front contacts of relay 302 and conductors 332 and 333 respectively. These two conductors, that is, 327 and 328, extend to the community dial office by way of the top back contacts of relay 218 where they connect with conductors 229 and 228 respectively. The battery connected to conductor 314 closes a circuit to light lamp 334 which is associated with the multiple jack of the trunk in the switchboard of the position where key 300 was operated, indicating thereby to the operator that the trunk which is assigned for extending the call to the community dial office is ready to receive dial impulses.

The ground connected to conductor 322 by the operation of relay 301 functions to clear conductors 326, 322, 327 and 328 of the trunk assigned to the "B" operator's position under consideration from the selector brushes of other "B" position trunk selectors having access to the same dial community office over the same trunk group. The brushes of the trunk selector associated with the position where dial key 300 has been operated remain connected to the associated contacts to which the conductors are wired. This is accomplished as follows:

The operation of key 300, while depressed, in addition to operating relay 301 supplies, as well, a temporary locking ground for this relay on conductor 331 through the top outer front contacts of the said relay to its upper

winding as already described. It also supplies an operating ground for relay 302 as already described, which relay operates to battery on the top inner left front contacts of relay 301 when this relay has operated.

After key 300 has been depressed, but before relay 301 is operated, relay 311 is connected to a momentary energizing circuit in series with the lower winding of relay 301 from ground on key 300, conductor 330, lower winding of relay 301, bottom back contacts of relay 301, interrupter contacts of trunk selector magnet 329, winding of relay 311 to battery on the bottom back contacts of relay 312. Since, however, relay 301 is made fast to operate, it will open the operating circuit of relay 311 at its bottom back contacts before relay 311 can operate sufficiently to close its front contact. The trunk selector 329 remains positioned, therefore, on the trunk assigned since its circuit is completed through the contacts of relay 311.

It was stated hereinbefore that the trunk selectors associated with all positions are of the preselecting type in that they automatically step off the terminals of a busy trunk and on to the terminals of an idle one as soon as the test terminal of a trunk to which a trunk selector or several trunk selectors are connected through their respective brushes, is made to test busy by the trunk being taken into use. Consequently, when ground is applied to conductor 322, the trunk, by virtue of its having been taken into use at the position where key 300 was depressed and relay 301 of the position circuit operated, relay 311 of some other position whose trunk selector is standing on the assigned trunk, is caused to operate since conductor 322 is multiplied to the corresponding terminals of the arcs of the other trunk selectors of the same trunk group. The ground on this conductor will close a circuit to relay 311 of this other position by way of the bottom back contacts of the associated relay 301 at that position, interrupter contact of trunk selector magnet 329, winding of relay 311 to battery on the bottom lower contacts of relay 312. Relay 311 of the other position, on operating, connects ground from the bottom inner back contacts of relay 306, its own front contacts, to the winding of the selector magnet 329 causing it to operate. When the selector magnet breaks its interrupter contacts relay 311 releases, in turn opening the circuit of the selector magnet 329. The selector switch then advances to the next set of trunk terminals and if the trunk connected thereto is idle there is no ground on the test conductor of the trunk corresponding to conductor 322 but battery through the winding of relay 216 of the idle trunk will be connected there instead, and relay 311 will, accordingly, not operate. The selector, therefore will remain on the terminals of the idle trunk. On the other hand, if the succeeding

trunk to which the trunk selector has been advanced is also busy, ground is connected to the test conductor thereof, relay 311 will operate again over the path previously described and the operating circuit for the selector magnet 329 is closed again to advance the selector brushes to the terminals of the next idle trunk.

Should the case be that several trunk selectors are standing on the terminals of the same idle trunk at the time when an operator depresses key 300, the ground connected to conductor 322 will operate the respective relays 311 in those other trunk group position circuits whose trunk selector brushes are connected to the terminals of the same trunk and cause each of the selectors to step off the busy trunk in the manner already described. The selector brushes of each trunk group position circuit, therefore, normally stand on the terminals connected to conductors 326, 322, 327 and 328 of an idle trunk. As already shown, any number of trunk group position selectors up to and including the total number of selectors may be standing on terminals associated with the same idle trunk and all but the one associated with the position where key 300 is depressed will step off the terminals of the trunk when the trunk is taken into use at the position by the depression of the said key.

Should it happen that, at the time the operator depresses key 300, all of the trunks leading to the community office are busy, lamp 313 at the position where the key is depressed is lighted as an indication of this fact, the trunk group busy register 325 is operated and the trunk selectors are prevented from any further hunting for idle trunks. This is accomplished as follows: Relay 305 is normally held in an operated position from ground on conductor 323 which is multiplied to the back contacts of all relays 216 of the trunk group. When these relays are normal, indicating that their respective trunks are idle, this ground serves to maintain relay 305 operated and which, in turn, maintains relay 324 operated over an obvious circuit. So long as there is one trunk idle, there will be a ground on conductor 323. When the last idle trunk is taken into use and its associated relay 216 operates as described, the last multiplied ground is removed from conductor 323 and relay 305 releases. Relay 305, when released, closes ground on its back contacts to operate relay 306. The release of relay 305 also releases relay 324 and when relay 324 makes its back contacts the trunk group busy register 325 operates its counting mechanism to register an all trunks busy condition. The operation of relay 306 removes, at its back contacts, the grounds leading to the front contacts of relays 311 in the various trunk groups so that, when the last trunk of the group becomes busy, all the trunk se-

lector circuits controlled by relay 306 or any number of similar relays connected in multiple, will be opened and the various trunk selectors will cease hunting for an idle trunk. If, at this time, key 300 is operated in any position, relay 301 will not operate since due to the operation of all relays 216 of the trunk group, no battery is available on conductor 322, and relays 310 and 302 will be energized in series over a circuit from battery on the winding of relay 310 and winding 302 in series to ground on conductor 331 to the contacts of key 300. However, since relay 302 is marginal, it will not operate in series with high resistance relay 310. Relay 310 however, does operate and connects ground from the top inner front contacts of relay 306, front contacts of relay 310 to lamp 313 at the position thereby lighting this lamp as an indication to the operator that no trunk to the community dial office is available. The conductor connecting to lamp 313 is multiplied to other trunk selector circuits in the same operator's position, should there be two or more of said circuits serving different community dial offices. In such cases, lamp 313 functions to indicate an all trunk busy condition for the particular trunk group whose associated key is operated. It is seen, therefore, that when all trunks in the group are busy, the preselecting feature is stopped, since no trunk is available to preselection, while lamp 313 is lighted at the position where key 300 was depressed to indicate the absence of an idle trunk and the message register 325 operated to register an all trunk busy condition.

In case key 300 is depressed while the associated trunk selector 329 at the position is hunting for an idle trunk, relay 301 will not operate since no battery is present on conductor 322 at the time, as it is assumed that the trunk selector is testing a busy trunk at the instant the operator depresses the key. The failure of relay 301 to operate prevents interference with any existing dial connections at other positions. Relays 310 and 302, however, will function in the manner described but lamp 313 will not be lighted due to the fact that, since all trunks are not busy, relay 305 is operated, relay 306 released, and there is no ground available on the contacts of relay 310 with which to close the circuit of lamp 313. If key 300 is still depressed when the selector brushes reach the terminals of an idle trunk circuit, relay 301 will operate, short-circuiting and releasing relay 310 by battery on its top left front contacts, open the path of relay 311 at its lower contact to prevent further operation of trunk selector and thereby causing it to stop on the terminals of the idle trunk.

Assuming that when key 300 is depressed a trunk is assigned at the position and trunk lamp 334 is lighted as an indication that the trunk has been assigned, the operator is ready

to dial the number of the wanted subscriber, as the position dial 315 is now connected in series with the pulsing circuit of the automatic switches at the community dial office over the trunk conductors 327 and 328 as already described.

When the position dial 315 is moved off-normal, contact 309 is opened and ground is removed from conductor 335 and hence from the bottom contacts of relay 304. As the dial restores to normal dial impulses are sent over the talking conductors and cause the automatic switches in the community dial office to follow the impulses in the well-known manner. These impulses are transmitted over the talking conductors by way of conductors 332 and 333, the top outer and middle contacts of relay 302, brushes 316 and 317 of the trunk selector 329, conductors 328 and 327, top contacts of relay 218, conductors 229 and 228 of the trunk line extending to the step-by-step switches in the community office and serve to operate these switches to reach the called subscriber's line. The protective circuit composed of resistance 308 and condenser 307 bridged across conductors 332 and 333 is for the purpose of protecting the pulsing contacts of dial 315.

As mentioned previously, no restriction is imposed on the "B" operator as to the time of inserting the calling trunk plug T into the jack C of the outgoing trunk to the community dial office. She may insert it either before, during or after dialing but before the depression of dial release key 321 as described below. When the trunk plug T is partially inserted into the jack, relays 204 and 213 of the outgoing trunk operate in series with relay 116 of the interoffice trunk over the following circuit: Battery on the winding of relay 116, winding of relay 116, sleeve conductors 121 and 236, winding of relay 204, winding of relay 213 to ground. The operation of relay 204 connects ground on its front contacts to conductor 322 which performs no useful function at this time. Relay 213 connects ground on its front contacts to a common ground conductor which connects to the locking contacts of relay 221, the winding of relay 214, the locking contacts of relay 215, the locking contacts of relay 206 and the winding of relay 209 through the top outer back contacts of relay 206 and to locking contacts of relay 203. Relay 209 operates. Relay 116 of the interoffice trunk also operates over the above traced circuit, closes through its top outer front contacts the tip talking conductor 144 to the tip conductor 123 of the trunk plug, disconnects battery from relay 115 which releases, operates relay 110 from ground on its top inner front contacts and prepares a circuit, on its bottom front contacts, to operate relay 126 when the called subscriber answers as more fully described hereinafter. The operation of relay 110 re-

moves battery from relay 109 which relay, however, being slow to release, holds over its locking contacts to battery on the bottom outer front contacts of relay 110. Relay 110 also disconnects conductor 113 and therewith disconnects battery through interrupter 156 from lamp 111 and replaces it with steady battery over the top inner back contacts of relay 126 and top front contacts of relay 110 for lighting this lamp as a ringing signal.

When the trunk plug T is fully inserted into the trunk jack, relay 208 is bridged across the talking conductors 230 and 231 at the top and bottom inner back contacts of relay 206. If the interoffice trunk shown in Fig. 1—A were equipped with machine ringing in the known manner, relay 208 would immediately operate from the ringing current circuit in the trunk. It is necessary, in a connection to a community dial office equipped with well-known step-by-step apparatus, to disconnect the ringing current circuit, normally a component part of such a trunk, when it is used to extend an incoming call directly to a wanted subscriber's line therein, since the step-by-step switches located therein have their own local ringing current supply which is used to ring the community dial office subscriber's line. In the embodiment of the invention here disclosed, the ringing circuit is controlled through key 130 and the operator may or may not depress the ringing key 130 before she has depressed the dial release key 321 as she chooses. Should she operate ringing key 130, however, before operating key 321, relay 208 operates over the ringing current circuit closed by the operated contacts of key 130. With the operation of relay 208 a path is closed to operate relay 207 from ground on the contacts of relay 209, contacts of relay 208, winding of relay 207 to battery. Relay 207 operated, locks over its top outer front contacts to the operating ground on the contacts of relay 209, operates relay 206 from ground over its bottom outer front contacts and connects grounded resistance 224 and battery through resistance 225 to the talking conductors 230 and 231, respectively. Relay 206 opens the circuit of relay 209 at its top outer back contacts and locks over its outer bottom front contacts to ground on the front contacts of relay 213. The ringing circuit in the interoffice trunk is now tripped in the well-known manner by the operation of a trip relay in the ringing circuit in series with the ringing current circuit and through a series path either to resistance 224 to ground or resistance 225 to battery. Relay 209 releases after a time interval and, in turn, releases relay 207. The release of relay 207 disconnects ground supplied through resistance 224 to conductor 230 and battery supplied through resistance 225 to conductor

231 and connects, through its top and bottom inner back contacts, conductors 230 and 231 respectively through to the windings of retard coil 210. Relay 209 is made slow to release in order that resistances 224 and 225 will be connected to conductors 230 and 231 for a length of time sufficient to operate the trip relay in the ringing circuit and thus insure the tripping of ringing current and the consequent disconnection of the ringing supply circuit from the talking conductors.

It will be observed that the operation hereinbefore described can be dispensed with insofar as it concerns the necessity of tripping the ringing circuit since such an operation depends entirely upon the operation of key 130 which, so far as a connection to a community dial office, is not necessary. The circuit can be revised to omit this feature if so desired. In the case of interoffice trunks arranged for automatic machine ringing the means described above are necessary since the ringing circuit is connected to the line without the operation of a ringing key. In order to make the traffic routine consistent, however, it is desirable to include the ringing feature so that an operator in using similar trunks on different types of connectors would be governed by the same traffic routine.

When the ring conductor 122 of the interoffice trunk is connected with the ring conductor 231 of the outgoing trunk, and when relay 207 has been released as already described, relay 214 operates over a circuit traced from battery in the interoffice trunk repeating coil winding 125, winding of relay 129, bottom normal contacts of ringing key 130, ring conductors 122 and 231, bottom inner front contacts of relay 206, bottom inner back contacts of relay 207, top back contacts of relay 215, winding of relay 214 to ground on the front contacts of relay 213. Relay 214 operates causing relay 215 to be operated over an obvious circuit and relay 212 to be operated over the top back contacts of relay 211. Relay 215 operated, locks over its top front contacts to ground on the front contacts of relay 213 and, at the same time, extends this ground to the winding of relay 212 over its operating path as previously described and opens, at its top back contacts, the operating circuit of relay 214 thereby causing this relay to release. Relay 214 is, therefore, disconnected from conductor 231 at the top back contacts of relay 215. Relay 212 operated, closes a circuit on its front contacts to connect a holding bridge consisting of the windings of retard coil 220 and relay 219 across the talking conductors 228 and 229 extending to the community dial office selector switches when relay 221 is operated by the operation of key 321 as described hereinafter.

The above described dependence of the

holding bridge across the trunk to the community dial office on the successful closure of the ring of the interoffice trunk plug with the ring contact of the outgoing trunk jack is made in order to avoid signalling the called subscriber in the community dial office unless the trunk plug has been fully inserted into the outgoing trunk jack and both talking conductors thus joined, which assurance is provided by the well-known mechanical structure of the trunk plug and jack wherein the successful contacting of the ring of the plug with the ring contact of the jack assures equally successful contacting between the tip of the trunk plug and the tip contact of the jack. In case the trunk plug has not been fully inserted, relays 214 and 215 do not operate, a holding bridge is not provided and the connection will be broken down as soon as key 321 is operated, due to the lack of the said holding bridge across the talking conductors to the community dial office after the loop over these conductors formed through the contacts of position dial 315 is opened by the release of key 321 as described hereinafter. If the trunk plug is fully inserted the removal of this short-circuit permits a current flow to be established over a circuit in series with the automatic equipment at the community dial office connected to conductors 228 and 229 through the winding of relay 219 and retardation coil 220. The current flowing through this circuit at this time is in such a direction as not to operate relay 219.

If the operator inserts the trunk cord into the outgoing trunk jack before dialing, or during dialing all the above described operations take place preparatory to placing the holding bridge across conductors 228 and 229. However, due to the fact that key 321 is not yet operated, relay 221 is not operated and no interference will take place with the dial pulses, which are transmitted over the parallel loop formed by conductors 228, 229, 328, 327, 333 and 332.

When the complete number has been dialed and the interoffice trunk plug has been inserted into the outgoing trunk jack as already described, key 321 is operated, thereby causing the operation of relay 304 by connecting ground to conductor 336. Relay 304 locks to ground on the lower front contacts of relay 302 over its own top contacts and the bottom contacts of relay 303. At its bottom contacts, relay 304 connects the ground from the normal contacts 309 of the dial 315, conductor 335, to the winding of relay 312. When the dial restores to normal, with key 321 operated, relay 312 operates over a circuit from ground on contacts 309, conductor 335, bottom contacts of relay 304, winding of relay 312 to battery on the bottom inner front contacts of relay 302. Relay 312 connects ground from its top outer front contacts to conductor

326 by way of selector brush 319 and associated contact causing relay 221 to operate and lock to ground over its own bottom front contacts, disconnects battery at its bottom back contacts from the winding of relay 311 and operates relay 303 by ground on its top front contacts. Relay 303 removes locking ground for relays 302 and 301 at its top contacts thereby causing these relays to release and, at its bottom contacts, unlocks relay 304 which also releases. The release of relay 302 disconnects conductors 327 and 328 from the position dial 315 over conductors 332 and 333, disconnects operating battery from relay 312 and battery to conductor 314 of the circuit of the trunk lamp 334, thus extinguishing it. Relay 301 released, disconnects operating battery from the winding of relay 302 and connects a ground supplied from relay 221 over conductor 322 to the winding of relay 311 by way of conductor 322, selector brush 318 and associated contact, the bottom back contacts of relay 301 and interrupter contacts of selector magnet 329. The release of relay 304 releases relay 312. Relay 312 released, disconnects ground from its top front contacts to conductor 323, releases relay 303 and operates relay 311 by battery on its bottom back contacts to ground on conductor 322 over a path already described. The operation of relay 311 operates selector magnet 329 over a path previously traced and the selector then functions to advance its brushes off the terminals of the busy trunk and on to the terminals of the first idle trunk encountered. Relay 303 is made slow to operate and relays 304 and 312 slow to release in order to insure that ground will be connected to conductor 326 for a length of time sufficient to properly operate relays in the trunk circuit as more particularly described hereinafter. Relay 303 is also made slow to operate for the additional reason of insuring holding the selectors in the distant community dial office while transferring the talking conductors 228 and 229 from the position dial 315 to the holding bridge composed of retardation coil 220 and relay 219 in the trunk circuit as already described.

Ground on conductor 326 operates relay 221 in the trunk circuit as already described which, in turn, connects direct ground from its top inner front contacts to conductor 322 to replace the busy ground removed therefrom by the release of relay 301. Relay 221 also cuts through, at its outer top and bottom front contacts, the talking conductors 228 and 229 towards the interoffice trunk circuit. Relay 221 also operates relay 217 over an obvious circuit and this relay, in turn, operates relay 218 also over an obvious circuit. Relay 218 disconnects, at its top back contacts, the conductors 327 and 328 from the talking conductors 229 and 228, respectively, connects another ground from its bottom

inner front contacts to conductor 322 and opens its bottom back contacts which connect with the top front contacts of relay 203.

If key 321 is operated before the plug of the interoffice trunk is inserted into the outgoing trunk jack, the operation of key 321 connects ground to conductor 336 ultimately resulting in operating relays 221, 217 and 218 as already described. When relay 221 operates, however, the switches in the community dial office will be released due to the fact that relay 212 is not operated and therefore no holding bridge is placed across the talking conductors 228 and 229. The operation of relay 218 connects direct ground to conductor 322 as already described. When key 321 is released, the selector magnet 329 is operated over the circuit previously described and causes it to step off the terminals of the trunk. Ground is thereby removed from the conductor 326 thereby releasing relays 221, 218 and 217 in turn disconnecting ground from conductor 322, releasing relay 216 and restoring the circuit to normal. Relays 221, 218 and 217 are made slow to release to insure that ground on conductor 322 will remain connected thereto for a length of time sufficient to operate the selector magnet 329 and prevent the preselection of the trunk circuit before the automatic switches in the community dial office have restored to normal.

The called subscriber is signalled by the ringing current circuit of the automatic switches at the community dial office and when the receiver is removed from the switch-hook the circuits in the community dial office function to reverse the current through relay 219 and retardation coil 220, and to thereby operate relay 219. Relay 219, on closing its front contacts, connects resistance 226 in series with the retardation coil 210 which, by the closure of the contacts on relay 219 closes a loop across the talking conductors 230 and 231. This circuit extends from battery on the winding 125 of the interoffice trunk repeating coil winding of relay 129, ring conductors 143, 122 and 231, bottom inner front contacts of relay 206, bottom inner back contacts of relay 207, one winding of retardation coil 210, front contacts of relay 219, resistance 226, bottom outer back contacts of relay 211, other winding of retardation coil 210, top inner back contacts of relay 207, top inner front contacts of relay 206, tip conductors 230, 123, 144, repeating coil winding 124, to ground, operating supervisory relay 129 in the interoffice trunk circuit.

The operation of relay 129 when the called subscriber removes his receiver from the hook, operates relay 126 over a circuit from battery on bottom front contacts of relay 116, winding of relay 126, bottom normally made continuity contacts of relay 126, front contacts of relay 129 to ground on inner bottom back

contacts of relay 126. Relay 126 short-circuits the bottom high resistance winding of relay 106 through its top front contacts and causes thereby a greater flow of current over the talking conductors 127 and 128 and the cord supervisory circuit connected thereto. This increase of current flow operates the supervisory relay 105 of the "A" cord in the well-known manner and extinguishes lamp 131, thereby indicating to the "A" operator at the originating office that the called subscriber has answered. Relay 126 locks to ground on its own bottom outer front contacts. Relay 126 also extinguishes lamp 111 by opening its circuit at its top inner back contacts as an indication to the "B" operator that the called subscriber has answered.

In case the called subscriber's line is busy at the community dial office current reversals at suitable intervals are sent back over the talking conductors from the community dial office in the well-known manner. Relay 219 follows these reversals, in turn causing the supervisory relay 129 in the interoffice trunk circuit to flash, which on its first operation, operates relay 126 as already described, and this relay, in cooperation with relay 129 alternately short circuits the high resistance winding of relay 106 which effects the supervisory relay 105 in the "A" cord and causes it to intermittently operate and flash lamp 131 also, resulting in an indication to the "A" operator that the line is busy. At the same time a tone is supplied from the community office and is transmitted back over the talking conductors and condensers 145 and 146 to the calling subscriber's station in the well-known manner to indicate to him that the called line is busy.

When the receiver is replaced on the switch-hook in the community dial office battery is reversed over the talking conductors 228 and 229 causing the release of relay 219. The release of relay 219 removes, at its front contacts, the bridge consisting of retard coil 210, and resistance 226 in series from across the talking conductors 230 and 231 on the incoming side of the trunk. Relay 129 thereby releases which, in turn, opens the short-circuit around the high resistance winding of relay 106. The decrease in current in the trunk conductors releases the supervisory relay 105 in the "A" cord circuit and causes the supervisory lamp 131 to burn steadily in the well-known manner as an indication that the called subscriber has restored. When the calling subscriber restores, lamp 132 in the "A" cord circuit is caused to light in the well known manner by the release of relay 154. The removal of the "A" cord plug P from the trunk jack J releases relay 106. Relay 106, in turn, releases relay 109. Relay 109 now supplies battery from the front contacts of relay 110 through its bottom back contacts, resistance 147, and lights lamp 119 as a disconnect sig-

nal to the "B" operator. When the trunk plug is removed from the outgoing trunk jack relay 116 releases, releasing relays 126 and 110 and extinguishing lamp 119. Relays 213 and 204 in the outgoing trunk also release and, in turn, release relays 221, 217, 218, 212 and 215. The release of relay 218 releases relay 216 which restores the circuit to normal.

When it is desired to establish a connection between a calling subscriber in the same office in which the community dial office terminates, the same trunk can be used and the connection is established at the dial "A" position to which the said trunk is multipled. We will now proceed to describe such a connection in which Figure 1B shows the connecting circuits at the dial "A" position.

When a calling subscriber signals the "A" operator, she obtains from him the number of the wanted subscriber in the well-known manner. She proceeds thereafter to manually select an idle trunk extending to the community dial office by the well-known method of testing the sleeve of the outgoing trunk jack with the tip 102 of the "A" cord. If the trunk is busy because of a connection set up at a "B" position relay 205 is operated as already described and a battery potential is present on the sleeve conductor 233 from the inner front contacts of relay 205 thereby causing the trunk to test busy. The absence of battery potential then, indicates the idle condition of the trunk and the cord plug M is inserted into outgoing trunk jack D at the "A" board. If the trunk is idle relay 205 is normal and conductor 233 is connected through the bottom inner back contact of relay 205 to the winding of relay 202 which relay is also connected in series with the winding of relay 213. The insertion of the cord plug M into the outgoing trunk jack D causes the operation of relays 202 and 213 in series from battery supplied over the sleeve conductor 100 of the "A" cord in the well-known manner, to ground on the winding of relay 213. Relay 202 causes the operation of relay 203 from ground on the bottom back contacts of relay 205, front contacts of relay 202 to the winding of relay 203. Relay 203, in turn, operates relay 221 by connecting ground on its front outer top contacts to the winding of relay 221 by way of the bottom back contacts of relay 218 and, at the same time, extending this ground over another top outer contact to conductor 322 to make the trunk busy at the "B" position trunk selectors. Relay 216 is also operated by this ground but performs no function other than to remove ground from conductor 323 for registering purposes as already described. When the plug of the cord circuit is fully inserted in the trunk jack, relay 214 operates from battery on the "A" repeating coil winding 136, winding of relay 148, normally made bottom contacts on ringing key 134, normally made bottom contacts

of dial key 135, ring conductors 137 and 119, top inner back contacts of relay 205, top normally made contact of relay 215, winding of relay 214 to ground on the front contacts of relay 213. Relay 214 operates relay 215 as already described. Relay 215 locks to ground on the front contacts of relay 213, and operates relay 212 as already described. The operation of relay 212 closes a bridge composed of the windings of retard coil 220 in series with relay 219 across the talking conductors 228 and 229 to the community dial office, causing the switches in that office to prepare for dial pulses. The talking conductors 120 and 119 are associated with the subscriber operator's position dial 150 by the operation of key 135 in the cord circuit. Moving the position dial off normal to dial the first digit operates relay 200 over a circuit from ground on the off normal contacts 140 of dial 150, bottom make contacts of key 135, ring conductors 137 and 119, top inner back contacts of 205, one winding of retard coil 210, back contacts of relay 219, lower front contacts of relay 215, lower front contacts of relay 203, winding of relay 200 to battery. The operation of relay 200 operates relays 201 and 211 in parallel over an obvious circuit. Relay 211 operated disconnects the talking conductors 228 and 229 extending to the community dial office from the condensers 234 and 235 respectively, connects the extension of conductor 120 over the top outer front contacts of relay 211 to the winding of relay 212, and, at its lower inner front contacts short-circuits the bridge composed of the retard coil 220 and relay 219, thus providing a direct loop from conductor 228 to conductor 229 of the trunk to the community dial office through the contacts of relay 212. Relay 201 operated provides an additional short-circuit for the bridge composed of the windings of retard coil 220 and relay 219.

Relay 212 is thus connected to ground in the pulsing contacts of dial 150 through the tip conductors 120 and 102, top make contacts of key 135, contacts 151 of dial 150, while its contact is looped across conductors 228 and 229 so as to furnish open circuit impulses to the automatic switches at the community dial office. As the subscriber operator's position dial 150 restores to normal the circuit of relay 212 is opened at contact 151 of the dial a number of times corresponding to the number dialed. Relay 212 releases and reoperates on these impulses and transmits, in turn, open circuit pulses over the talking conductors 228 and 229 to control the switches in the community dial office. When the dial has restored to normal the circuit of relay 200 is opened at dial contacts 140. Relay 201 is made slow to release and will not release between the dialing of successive digits. When the complete number has been dialed, relay 200 releases and causes relay 201 to start to

release. Relay 200 also releases 211. The release of relay 211 reconnects the talking conductors 228 and 229 to the community office through condensers 234 and 235, transfers the holding path for relay 212 from conductor 120 back to ground on the contacts of relays 213 and 215, reconnects condenser 232 and resistance 226 to conductor 120 and disconnects the short-circuit around the bridge composed of relay 219 and retard coil 220. This bridge however remains short-circuited by the contacts of relay 201 until this relay releases. Relay 201 is made slow to release so as to maintain the short-circuit sufficiently long to allow the automatic switch pulsing relay sufficient time to operate before placing it in series with the high impedance bridge of retardation coil 220 and relay 219. Otherwise the slow reoperation of the pulsing relay in the switches in the community office would result in the pulse relay contacts remaining open on the final pulse for a length of time which might be sufficient to cause the switch in the community dial office to be released and thus cause the connection to be lost.

The operation of the ringing circuit as well as the various switchboard signals when the called subscriber answers, or is busy or does not answer is the same as previously described for the connection set up at the "B" position.

What is claimed is:

1. In a telephone system, a main office, a switchboard position equipped with a dial in said main office, an automatic satellite office connected by trunk lines to said main office, said trunk lines terminating at said switchboard position, a key at said switchboard position designating said satellite office, a dial release key at said switchboard position, means for assigning one of said trunk lines to said switchboard position when said key designating said satellite office is operated, means for associating said position dial with said assigned trunk when said key is operated, and means for disconnecting said dial from said assigned trunk when said dial release key is operated.

2. In a telephone system, a main office, a switchboard position equipped with a dial at said main office, a selector switch in said switchboard position, an automatic satellite office connected by trunk lines to said main office, said trunk lines terminating at said switchboard position and multiplied to terminals of said selector switch, a key at said switchboard position designating said satellite office, means for stepping said selector switch off respective terminals of each of said trunks when busy, a relay operatively responsive to operation of said key, and means for operatively associating said position dial through contacts of said operated relay with the idle trunk on which said selec-

tor switch is standing at the time said key is operated.

3. In a telephone system, a main office, a switchboard position equipped with a dial at said main office, a selector switch in said switchboard position, an automatic satellite office connected by trunk lines to said main office, said trunk lines terminating at said switchboard position and multiplied to terminals of said selector switch, a key at said switchboard position designating said satellite office, a dial release key at said switchboard position, means for stepping said selector switch off respective terminals of each of said trunks when busy, a relay operative responsive to the operation of said first key for operatively associating said position dial with the idle trunk on which said switch is standing, and means controlled by said dial release key for releasing said relay to disconnect said position dial from said trunk.

4. In a telephone system, a main office, a plurality of switchboard positions at said main office, a selector switch in each of said positions, an automatic satellite office connected by trunk lines to said main office, said trunk lines terminating at and multiplied to each of said switchboard positions and also multiplied to terminals of each of said selector switches, a lamp at each of said switchboard positions for each of said trunks multiplied thereat, a key at each of said switchboard positions designating said satellite office, a relay in each of said switchboard positions operative responsive to the operation of said key, means for stepping said selector switch off respective terminals of each of said trunks when busy, and means for lighting the lamp of the trunk on which said selector switch is standing through contacts of said operated relay at that one of said switchboard positions where said key is operated.

5. In a telephone system, a main office, a switchboard position at said main office, a selector switch in said switchboard position, an automatic satellite office connected by trunk lines to said main office, said trunk lines terminating at said switchboard position and multiplied to terminals of said selector switch, a lamp at said switchboard position, a key at said switchboard position designating said satellite office, a relay operatively responsive to operation of said key, means for stepping said selector switch off respective terminals of each of said trunks when busy, means for stopping further operation of said selector switch when all trunks are busy, and means controlled through contacts of said operated relay for lighting said lamp when all trunks are busy at the time said key is operated.

6. In a telephone system, a calling line, a switchboard position equipped with a dial, an automatic community office, a trunk having a holding and signaling bridge, said trunk extending from said switchboard posi-

tion to said community office, a key in said switchboard position designating said community office, a dial release key in said switchboard position, means for assigning said trunk to said switchboard position when said key designating said community office is operated, a cord circuit for interconnecting said calling line with said trunk, means for associating said position dial with said assigned trunk when said key is operated, and means responsive to the connection of said cord circuit with said trunk for connecting said holding and signaling bridge across conductors of said trunk after said dial release key is operated.

7. In a telephone system, a first office, a calling line in said first office, a second office, a switchboard position equipped with a dial in said second office, an automatic community office, a first trunk having a holding and signaling bridge, said trunk extending from said switchboard position to said community office, a key in said switchboard position designating said community office, a dial release key in said switchboard position, means for assigning said first trunk to said switchboard position when said key designating said community office is operated, a second trunk for interconnecting said calling line in said first office with said assigned first trunk, means for associating said position dial with said assigned first trunk when said key is operated, means for disconnecting said dial from said assigned first trunk when said dial release key is operated, and means responsive to the connection of said second trunk with said first trunk for connecting said holding and signaling bridge across conductors of said first trunk after said dial release key is operated.

8. In a telephone system, a first office, a calling line in said first office, a second office, a switchboard position in said second office, a community office, a first trunk extending from said switchboard position in said second office to said community office, a key in said switchboard position designating said community office, means for assigning said first trunk to said switchboard position when said key is operated, a second trunk for interconnecting said calling line with said first trunk, a ringing circuit, means for connecting said ringing circuit to said second trunk, means in said first trunk responsive to the connection of said second trunk with said first trunk for extending said ringing circuit to said first trunk, and means in said first trunk responsive to said ringing circuit for disconnecting said ringing circuit from said first and second trunks respectively.

9. In a telephone system, a first office, a calling line in said first office, a second office, a switchboard position equipped with a dial in said second office, an automatic community office, a first trunk extending from said

switchboard position to said community office, a key in said switchboard position designating said community office, a dial release key at said switchboard position, means for assigning said first trunk to said switchboard position when said key designating said community office is operated, a second trunk for interconnecting said calling line in said first office with said assigned first trunk, a ringing circuit, means for connecting said ringing circuit to said second trunk, means in said first trunk responsive to the connection of said second trunk with said first trunk for extending said ringing circuit to said first trunk, and means in said first trunk responsive to said ringing circuit for disconnecting said ringing circuit from said first and second trunks respectively.

10. In a telephone system, a calling line, a switchboard position equipped with a dial, an automatic community office, a trunk line extending from said switchboard position to said automatic community office, a key in said switchboard position designating said community office, a dial release key at said switchboard position, means for assigning said trunk to said switchboard position when said key designating said community office is operated, a cord circuit for interconnecting said calling line with said trunk, a ringing circuit, means for connecting said ringing circuit to said cord circuit, means in said trunk responsive to the connection of said cord circuit with said trunk for extending said ringing circuit to said trunk, and means in said trunk responsive to said ringing circuit for disconnecting said ringing circuit from said cord circuit and said trunk respectively.

11. In a telephone system, a switchboard position, a selector switch in said switchboard position, trunk lines, an automatic community office connected by said trunk lines to said switchboard position, said trunk lines terminating at said switchboard position and multiplied to terminals of said selector switch, a registering device, means for stepping said selector switch off respective terminals of each of said trunks when busy, means for stopping further operation of said selector switch when all of the said trunks are busy, and means for operating said registering device when all trunks are busy.

12. In a telephone system, a plurality of switchboard positions each equipped with a dial, a selector switch in each of said positions, an automatic community office, automatic switches in said community office, trunk lines extending from said switchboard positions to said community office, said trunk lines terminating in manual connection terminals at each of said switchboard positions designating said community office, a dial release key in each of said switchboard positions, means responsive to the operation of said key at one of said switchboard positions for assigning one

of said trunks to said position, means for marking said assigned trunk as busy to all of said selector switches, means for stepping said selector switches off the terminals of said assigned trunk at all of said switchboard positions except at the position where said key is operated, means for associating said position dial with said assigned trunk at said position where said key is operated, means for extending a connection from said position to said community office over said selector switch at said position, said assigned trunk and said automatic switches, means for disconnecting said dial from said assigned trunk when said release key is operated and means for keeping said trunk line busy until said automatic switches in said community office have restored to normal.

13. In a telephone system, a calling line, a switchboard position equipped with a dial, an automatic community office, a trunk extending from said switchboard position to said community office, a key in said switchboard position designating said community office, means for assigning said trunk to said switchboard position when said key is operated, a dial release key, a relay operatively responsive to the operation of said key and means controlled by said relay for disconnecting said dial from said trunk when said release key is operated and said dial is normal.

14. In a telephone system, a calling line, an operator's position equipped with a dial, an automatic community office, a trunk extending from said switchboard position to said community office, means for connecting said calling line to said trunk, a key in said switchboard position designating said community office, means in said switchboard position for associating said dial with said trunk and means responsive to the operation of said key for operating said means to operatively associate said dial with said trunk.

15. In a telephone system, a calling line, an operator's position equipped with a dial, an automatic community office, a called line in said community office, a trunk extending from said switchboard position to said community office, means for connecting said calling line to said trunk, means controlled by the operator for operatively associating said dial with said trunk, automatic switches in said community office responsive to said dial for extending said trunk circuit to said called line, and means controlled by the operator for operatively disassociating said dial from said trunk.

16. In a telephone system, a calling line, an operator's position equipped with a dial, an automatic community office, a trunk extending from said switchboard position to said community office, a key in said switchboard position designating said community office, a dial release key, means for connecting

said calling line to said trunk, means responsive to operation of said key for operatively associating said dial with said trunk, and means responsive to operation of said dial release key to operatively disassociate said dial from said trunk and to prevent their operative reassociation while said calling line remains connected with said trunk.

17. In a telephone exchange system, a calling line, a switchboard position, an automatic community office, automatic switches in said community office, a trunk extending from said switchboard position to said automatic switches in said community office, a cord circuit for interconnecting said calling line with said trunk, a dial, means for operatively associating said dial with said cord circuit, a pulsing relay in said trunk, means for operatively connecting said pulsing relay to said dial over one conductor of said cord and one conductor of said trunk, and means controlled by said pulsing relay for operatively controlling said automatic switches in said community office.

In witness whereof I hereunto subscribe my name this 28th day of April, 1930.

LINDLEY A. KILLE.