

Sept. 15, 1931.

A. C. POWELL

1,823,667

TRUNKING SYSTEM

Filed Sept. 30, 1930

4 Sheets-Sheet 1

FIG. 5.

FIG. 1.
FIG. 2.
FIG. 3.
FIG. 4.

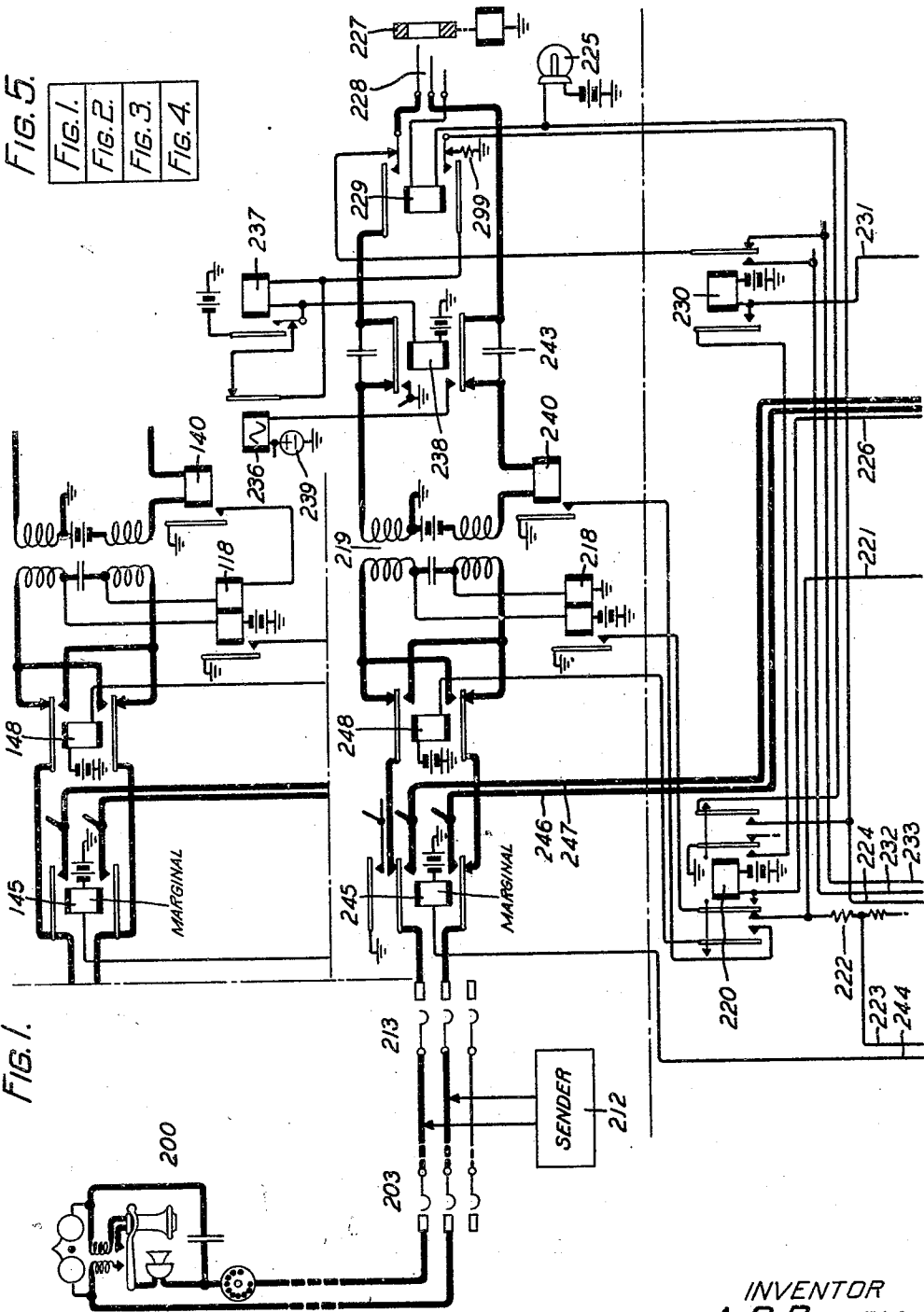


FIG. 1.

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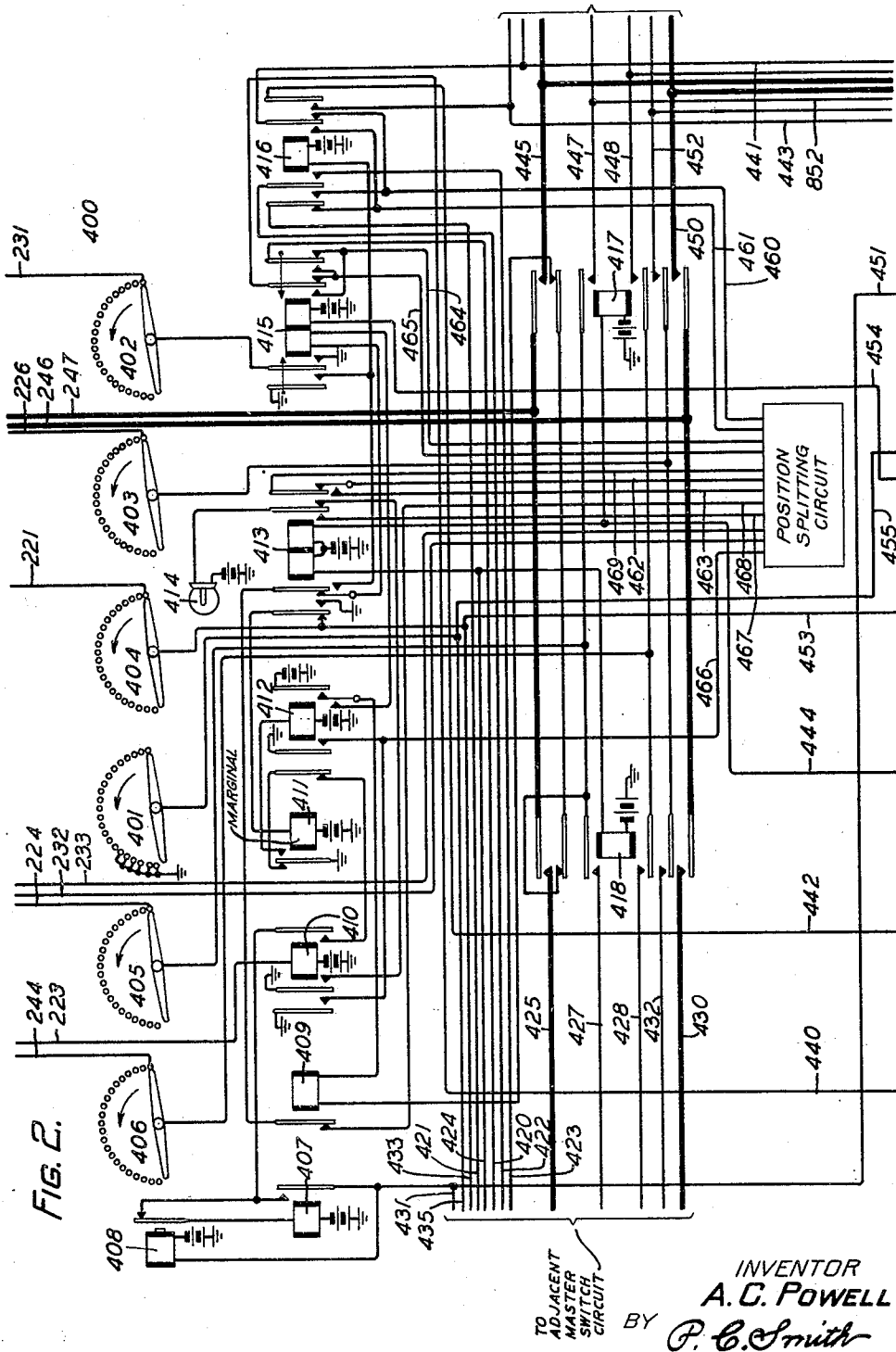
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4 Sheets-Sheet 2



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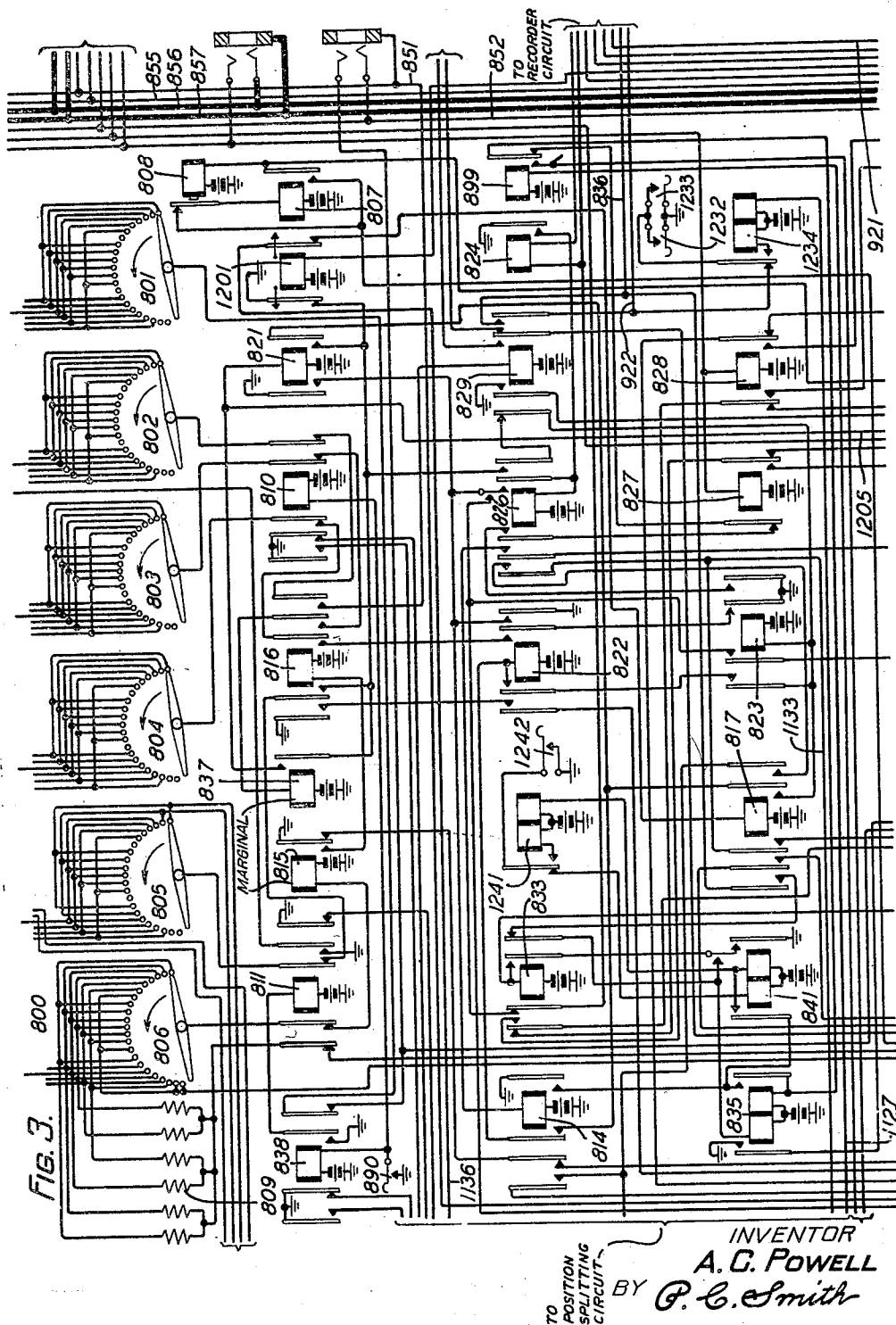
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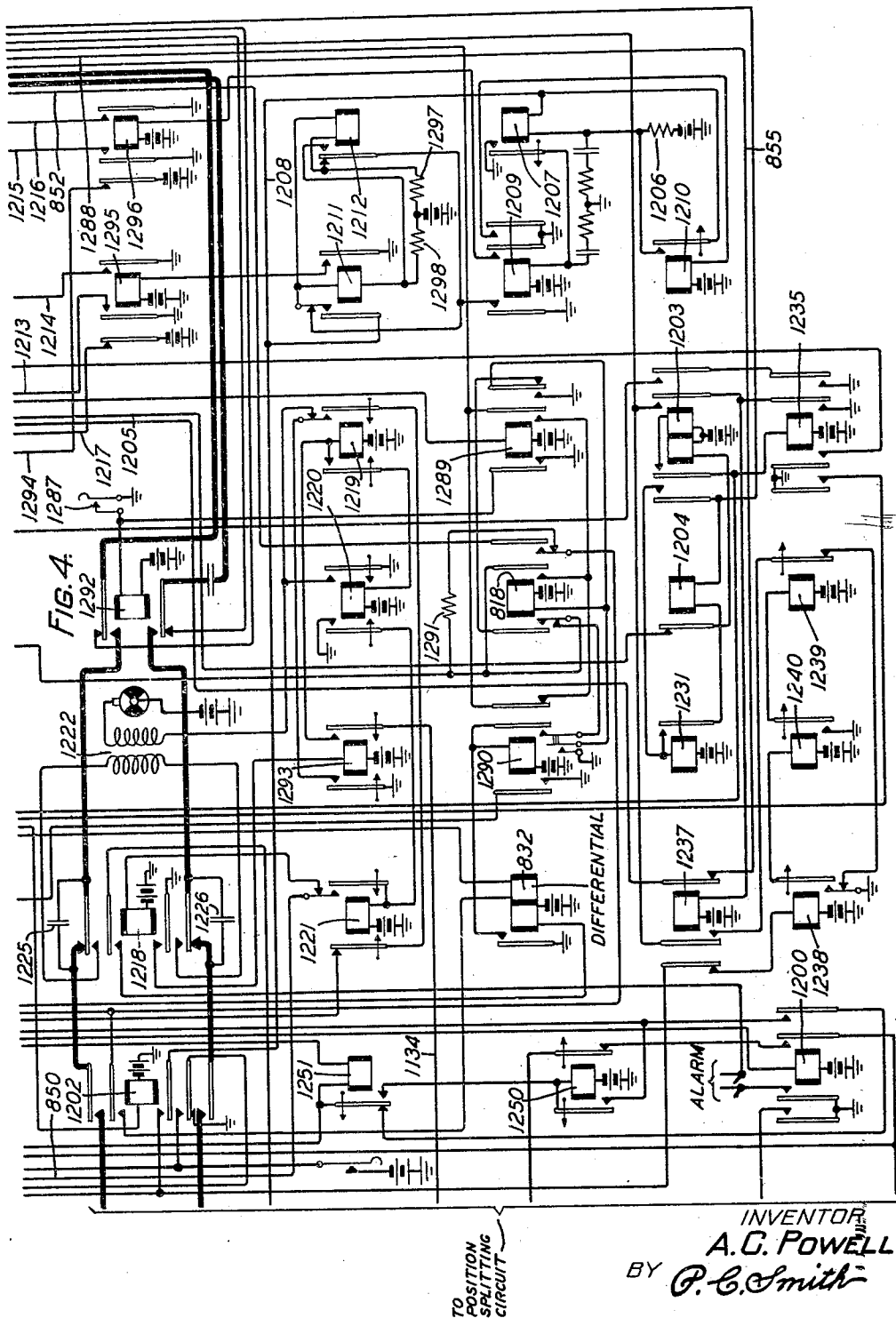
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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

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TRUNKING SYSTEM

Application filed September 30, 1930. Serial No. 485,423.

This invention relates to telephone systems in which connections are established under the control of operators and has for its object increased rapidity and efficiency in the direction of calls to an operator for extension.

The invention finds specific embodiment in a system in which calls incoming to an operator's position are automatically and successively connected to equipment for receiving the designation of the wanted line. In such systems if the circuit over which the designation is transmitted is not properly established, the "B" operator may disconnect her equipment from the trunk, but the calling subscriber or operator does not immediately receive an indication that the call has failed. In the case of a call from a dial subscriber the timing equipment of the sender frees the trunk after a measured length of time, while in the case of a connection extended by an "A" operator the trunk awaits the attention of that operator. Since the failure to establish this circuit may be due to transient conditions, in accordance with the present invention, when the "B" operator disconnects her equipment from the trunk following such a failure, the trunk is again marked as calling so that the automatic apparatus may subsequently make a second attempt to connect the trunk with the operator's equipment and thus permit the proper completion of the call. The same act which frees the trunk from the operator's equipment serves to prepare the ringing equipment of the trunk to signal the called subscriber but where the designation is not received, the disconnection is ineffective for this purpose. The switching apparatus is also arranged to discriminate between calls incoming from operators and calls incoming from dial offices and in the latter case delays the establishment of the circuit over which the designation is to be transmitted if the plug of the incoming trunk has not been removed from the jack with which it was used in connection with an earlier call.

This invention is in the nature of a modification of the system disclosed and claimed in Patent 1,746,793 to W. A. Rhodes et al., issued February 11, 1930 and reference is

hereby made to that patent for a more complete disclosure of the system as a whole. As far as possible the same reference numerals have been used in the present patent as were used in the Rhodes et al. patent.

In the call distributing arrangement of the Rhodes patent and the present patent, the trunks appearing in any position are divided into three groups. There is a group circuit individual to each group, and a position or master circuit individual to each position, which may associate itself through a group circuit with a trunk. Each position, which may serve trunks incoming from a machine switching office, is provided with a recorder for indicating the called line number. In addition each position is provided with keys by means of which operators' divisions of any desired size may be created. The equipment is so arranged that in general the operation of a key permits the group circuits at the ends of the operators' divisions to cause the automatic association of a trunk with either the master circuit of the position at which the trunk appears or with the master circuit of an adjacent position.

A call incoming over a trunk circuit causes the group circuit to which the trunk belongs to associate itself therewith and to summon a master circuit which locks up with the group circuit. The master circuit then determines whether it is connected with a trunk from a manual or a dial office since trunks of both kinds may appear in the same group. It now either associates a call indicator with the trunk causing the sender to send out impulses for operating the indicator in the well known manner, or it applies a tone to the trunk to indicate that the operator is ready to receive the number. As soon as the number has been received, either orally or visually, the operator depresses the release key, releasing the master circuit and group circuit from the trunk. She then tests the line in the usual manner and, inserting the plug in the line jack if the line is idle, causes ringing to take place and the connection to be completed. The operation of the release key advances the group circuit switch to the next trunk and the master circuit switch to the

next group, to distribute the handling of calls among the trunks. If the designation is not received the operator may release the master circuit by the use of an emergency release key whereupon the calling condition is restored to the trunk and it is reassociated with the group circuit and the master circuit for the purpose of making a second attempt at completing this connection.

A clearer understanding of the invention may be obtained from the following detailed description and the attached drawings in which:

Fig. 1 shows a subscriber's line and a plug ended trunk incoming from a dial office as well as a portion of a trunk incoming from a manual office;

Fig. 2 shows the group circuit serving the trunk of Fig. 1; and

Figs. 3 and 4 show the master circuits at the position to which the trunk of Fig. 1 and group circuit of Fig. 2 belong.

The establishment of a connection from the subscriber at machine switching substation 200 to the subscriber whose line jack is represented at 227 will first be described. The initiation of a connection by the subscriber at substation 200, the association of the sender 212 with the line and the selection of an idle trunk by district selector 213 under the control of the sender 212 takes places substantially as described in U. S. patent 1,589,402 granted to O. H. Kopp, June 22, 1926.

When the trunk has been selected, the sender connects a relay across the tip and ring conductors, completing a circuit from battery through the left winding of relay 218, upper left winding of repeating coil 219, upper back contacts of relays 248 and 245 through the district selector 213 to the sender relay, back through the district selector, lower back contacts of relays 245 and 248, lower left winding of repeating coil 219, right winding of relay 218 to ground. Relay 218 operates, closing ground at its front contact over the back contact of relay 220 to conductor 221 directly and through resistance 222 to conductor 223. Conductor 223 is common to all trunk circuits of the group, there being a resistance, like resistance 222, for each trunk. The grounding of conductor 223 completes a circuit through the winding of relay 410 to battery while the grounding of conductor 221, which is individual to the trunk, marks the terminal corresponding to the trunk in the bank of brush 404 of the group selector 400.

Relay 410 operates to initiate the association of the group circuit with the trunk circuit by connecting ground to conductor 466 and also closing a circuit from battery through the winding of relay 407, back contact of magnet 408, right contact of relay 410, back contact of relay 412, back contact of relay 411 to ground. Relay 407 closes a circuit from battery through the winding of

magnet 408, front contact of relay 407 to the operating ground for relay 407. Magnet 408 operates opening the circuit of relay 407, which releases, in turn opening the circuit of magnet 408 to release the magnet and step the brushes of switch 400 to the next terminal in search of the marked trunk. When group switch 400 finds the trunk over which the call is incoming, a circuit is completed from battery through the winding of relay 411, left back contact of relay 413, brush 404 to grounded conductor 221.

Relay 411 in operating disconnects ground from the circuit of relay 407 to prevent the advance of switch 400 from the terminals of the calling trunk. It also closes a circuit from battery through the winding of relay 412 to ground at the left front contact of relay 411. Relay 412 closes a substitute ground to conductor 466. Relay 412 also connects battery to the winding of relay 409 the other terminal of which is connected over back contacts of relays 417 and 418 through brush 405 to conductor 224 and through the winding of relay 229 to the sleeve terminal of plug 228 to test whether or not the plug is in the jack. Relay 409 is effective to prevent the call being directed to a team operator if the plug is in the jack since it holds open the circuit of relay 415 which is the teaming relay. Relay 412 also provides battery for the left winding of relay 415 the other end of which circuit extends to the position splitting circuit to determine whether or not the relay should be operated to direct the call to an adjacent position. Assuming that the call is not to be connected to an adjacent position the circuit of this relay will not be completed and this relay may be disregarded. The operation under team work conditions is fully set forth in the above mentioned patent to Rhodes et al.

Relay 410 in operating also closes a circuit from ground at its inner left front contact, inner right back contact of relay 413, through lamp 414 to battery. Lamp 414 lights indicating that a call is incoming in the group served by switch 400.

The connection of ground over the left front contact of relay 410 to conductor 466 completes a circuit extending through the splitting circuit to conductor 465, inner right back contact of relay 415, conductor 440 and thence in parallel through resistance 809 over the outer left back contact of relay 811 to battery through the winding of relay 1200, for the purpose of initiating the operation of master switch 800 and to the terminal of brush 806 corresponding to the group for the purpose of marking that group to the master switch. The operation of relay 1200 closes a circuit from battery through the winding of relay 807, back contact of magnet 808, outer right front contact of relay 1200, back contacts of relays 1251 and 814,

to ground on the back contact of relay 815. Relay 807 operates magnet 808 and this relay and magnet release in the same manner as relay 407 and magnet 408, advancing switch 800 to the terminal marked by the grounding of conductor 440. When brush 806 makes contact with conductor 440 a circuit is completed over the inner left back contact of relay 811, the winding of relay 815 and battery. Relay 815 in operating removes ground from the circuit of relay 807, preventing the advance of the master switch beyond the terminal connected to the conductor 440. It also closes a circuit from ground at its front contact through the winding of relay 816 to battery. Relay 816 in operating connects the winding of relay 837 over its middle right contact, inner right contact of relay 810, brush 803, conductor 453, brush 404 to conductor 221 and thence to ground over the back contact of relay 220 and the front contact of relay 218 thus operating relay 837 under the control of relay 218 which is in turn under the control of the sender 212. Relay 837 closes a circuit from battery through the winding of relay 821, front contact of relay 837 to ground at the left back contact of relay 1201. A circuit is closed in parallel with this through the left winding of relay 1203, back contact of relay 1204, conductor 1205 to the front contact of relay 837 so that relays 821 and 1203 are also under the control of relay 218. The operation of relay 1203 prepares a guard against ringing the wrong subscriber in case of abandoned calls. Relay 821 in operating closes a circuit from battery through the winding of relay 814, to ground at the left front contact of relay 821. With relay 814 operated a circuit is closed from battery through the winding of relay 822, inner left front contact of relay 814, right front contact of relay 821 to ground at the left back contact of relay 1201. Relay 822 in operating closes a holding circuit for relay 814 at its outer right front contact.

The operation of relay 1200 which started the master switch in search of the group switch also closes a circuit over the inner right front contact of relay 1200 and the back contact of relay 1250 to operate certain relays in the position splitting circuit which in turn connect ground to conductor 1136. This ground completes a circuit over the right back contact of relay 1201, winding of relay 817 and battery. With relay 817 operated, a circuit is closed from battery through the winding of relay 823, inner right front contact of relay 817, right front contact of relay 821 to ground at the back contact of relay 1201. The operation of relay 823, which is an indication that the operator is ready to handle the call in connection with this master switch, closes a cir-

cuit from ground at the inner right front contact of relay 823, inner right front contacts of relays 822 and 816, inner left back contact of relay 810, brush 804, conductor 444 through the windings of relays 417 and 413 in parallel to battery. The operation of relay 417 extends the conductors 445, 447, 448, 450 and 452 to the group circuit. With relay 413 operated relay 411 is held operated in a local circuit and a circuit is closed for flashing lamp 414 which will be described hereinafter. Relay 817 also closes a circuit from battery through the winding of relay 1202, inner left contact of relay 817 to ground in the splitting circuit over conductor 1133.

With relay 417 operated a circuit is closed to test whether or not the circuit for operating relay 245 is properly closed. This circuit may be traced from battery through the winding of relay 245, conductor 244, brush 406, contact of relay 417, conductor 448 and conductor 855, right back contact of relay 1237 through the winding of relay 824 to ground in the recorder circuit. If this circuit is properly completed relay 824 operates but relay 245 does not, due to the resistance of relay 824. The operation of relay 824 closes an obvious circuit for relay 826. Relay 826 locks over its middle right contact to ground at the front contact of relay 822. The operation of relay 826 closes a circuit from ground in the splitting circuit over conductor 1133, the outer left contact of relay 826, outer right contact of relay 817, outer left contact of relay 814, conductor 850, right normal contacts of relay 1221, winding of relay 1218 to battery. Relay 1218 disconnects the tip and ring conductors from the operator's telephone and extends them to the secondary winding of repeating coil 1222. Relay 826 also closes a circuit from ground at the outer right contact of relay 823, inner left contact of 826, left back contact of relay 827 back contact of relay 899 to conductor 1127 and thence to the splitting circuit to indicate that the home operator and equipment are busy with a call.

In addition, relay 826 closes a circuit from battery through the winding of relay 1238, left back contact of relay 1237, inner right contact of relay 826 to ground at the outer right contact of relay 822. Relay 1238 in turn operates relays 1240 and 1239. These relays remain operated under the control of relay 1237 until the release key is operated.

On calls incoming from dial offices the operation of relay 826 initiates operations which are effective to prevent calls from being displayed if the plug of the associated trunk is still in the multiple jack from a previous call. Relay 826 closes a circuit from battery through the left winding of relay 832, middle left contact of relay 817, right normal contact of relay 818, resistance 1291, inner left contact of relay 823, inner right

contact of relay 826 to ground at the left contact of relay 821. Relay 832 closes an obvious circuit for relay 1290 and relay 1290 in turn operates relays 818 and 833. Relay 818 closes a locking circuit for itself over the back contact of relay 1289, left alternate contact of relay 818 to the operating circuit of relay 832. If the call is incoming from a manual office relay 1289 will be operated as will be described hereinafter and the locking circuit of relay 818 will be opened so that this testing circuit is only completed in the case of calls incoming from dial offices. Relay 818 in operating disconnects the left winding of relay 832 from the contact of relay 826 and connects it over its right alternate contact to conductor 852 and thence over the inner upper front contact of relay 417, brush 405, conductor 224 to lamp 225 and through the winding of relay 229 to the sleeve of plug 228. If the plug has been left in the jack, ground will be connected to the winding of relay 229 and relay 832 will be held operated. If the plug is not in the jack the operation of relay 818 opens the circuit of relay 832 which releases in turn releasing relays 1290 and 833. With relay 818 operated and relay 1290 released a circuit is closed from ground at the left contact of relay 821, inner right contact of relay 826, inner left contact of relay 823, inner right contact of relay 818, back contact of relay 1290 to conductor 1288.

The connection of ground to conductor 1288 causes the operation of a relay in the recorder circuit which prepares the recorder for receiving the call indicator pulses. This relay also connects ground in shunt of the winding of relay 824 thus operating relay 245 and releasing relay 824. The operation of relay 245 disconnects the trunk from the windings of relay 218, causing relay 218 to release, in turn releasing relays 837, 821 and 1203 and thereby transmitting a signal to the sender 212 to cause it to send out the call indicator pulses. The operation of relay 245 connects the tip and ring conductors over conductors 247 and 246, contacts of relay 417, conductors 445 and 450, conductors 856 and 857, back contact of relay 1292 to the recorder circuit. The operation of the recorder is essentially the same as that described in U. S. Patent 1,464,084 granted to A. E. Lundell et al., August 2, 1923.

The release of relay 821 above described does not release relays 826 and 814 since these relays are locked to the front contact of relay 822 and relay 822 is held operated over the front contact of relay 823, back contact of relay 829, outer right front contact of relay 826 to ground at the left back contact of relay 1201, this ground also holding relay 823 operated.

The operation of relay 826 as above described initiates the operation of the relay

interrupter arrangement shown in the right hand side of Fig. 4. That is, the relay 826 closes a circuit from ground over the outer right contact of relay 822, inner right contact of relay 826, innermost lower contact of relay 1202, conductor 1208, winding of relay 1207, resistance 1206 to battery. Relay 1207 operates in turn operating relay 1209. Relay 1209 in turn operates relay 1210 and relay 1210 closes ground to resistance 1206 shunting relay 1207 and causing relays 1207, 1209, 1210 to release in succession. Relays 1207 and 1210 are slow to release to measure an interval before their release permits their reoperation. Relay 1209 also closes a circuit from ground at its left contact, normal contact and winding of relay 1211, resistance 1298 to battery. Relay 1211 operates and locks, and closes a circuit from grounded conductor 1208, alternate contact of relay 1211, winding of relay 1212, resistance 1297 to battery. Relay 1212 cannot operate being shunted by ground over the left contact of relay 1209. When relay 1209 releases this shunt circuit is opened and relay 1212 also operates. The next operation of relay 1209 closes a circuit from ground over its left contact, front contact of relay 1212, resistance 1298 to battery. This circuit is in shunt of the winding of relay 1211 and that relay releases but relay 1212 is held operative over the normal contact of relay 1211 to ground at the front contact of relay 1209. When relay 1209 releases the holding circuit of relay 1212 is opened and that relay releases so that on the next closure of the contact of relay 1209 the cycle of operations is repeated. Each time that relay 1209 operates ground is connected over its inner right contact to the winding of relay 1296. Each time that relay 1211 operates, which is half as often as relay 1209, ground is connected to the winding of relay 1295. At each operation of relay 1296 ground is connected to conductors 1215 and 1216 and battery is removed from conductor 1294 while at each operation of relay 1295 ground is connected to conductor 1213 and 1214 and battery is removed from conductor 1217. It will be apparent that this relay combination provides interrupted ground and battery at two rates, one twice as fast as the other. The operation of relay 817 which operates when the operator is ready to handle the call completes the flashing circuit for group lamp 414 which may be traced from battery through lamp 414, front contact of relay 413, conductor 467 through the splitting circuit to conductor 460, right back contact of relay 416, conductor 441, conductor 851, middle lower contact of relay 1202, right back contact of relay 828, conductor 1214 to ground at the right contact of relay 1295. It is therefore apparent that relay 414 will be intermittently lighted at the slow rate. At the same time a circuit is

closed from battery through lamp 225 which is individual to the trunk of Fig. 1, conductor 224, brush 405, contact of relay 417, conductor 447, conductor 852, outer right contact of relay 818, inner upper front contact of relay 1202, right winding of relay 832, left back contacts of relay 833 and 828, conductor 1213 to ground at the left front contact of relay 1295. The trunk lamp 225 is therefore flashed at the slow rate as well. The operator is therefore given a visual indication of the group and trunk over which the call is incoming. A circuit in parallel with lamp 225 extends from conductor 852 over the middle left front contact of relay 817, left winding of relay 832 to battery. The currents through the two windings of relay 832, due to its differential winding, neutralize one another and relay 832 remains unoperated.

The operation of relay 1218 above described in turn operates relay 1293. Relay 1293 closes a circuit from ground in the splitting circuit, over conductor 1134, right contact of relay 1293 to the winding of relay 1219. Relay 1219 extends its operating ground to the winding of relay 1220 and battery, while relay 1220 in turn operates relay 1221. Relays 1219, 1220 and 1221 are slow to operate thus causing a measured interval to elapse between the operation of successive relays. Relay 1221 in operating opens the circuit of relay 1218 and relays 1218, 1293, 1219 and 1220 successively release. However relay 1221 is held operated over its left alternate contact to ground over conductor 850 as previously traced. The operation of relay 1218 connects the secondary winding of tone coil 1222 to condensers 1225 and 1226 and over front contacts of relay 1212 to the operator's telephone set through the splitting circuit. Since relay 1292 is unoperated the tone circuit does not extend to the incoming trunk. The operation of relay 1293 closes a circuit through the primary of tone coil 1222, right normal contact of relay 1219 to ground at the left front contact of relay 1293. The operation of relay 1219 opens this circuit but the operation of relay 1220 recloses it over the front contact of relay 1220. The operation of relay 1221 by releasing relay 1218 and opening the secondary circuit of the tone coil 1222 terminates the second impulse of tone. In consequence two impulses of tone are transmitted to the condensers and through them to the operator's headset. This calls the attention of the operator to the fact that a call is awaiting her attention should she fail to observe the lighting of lamp 414 or of lamp 225.

Relays 827 and 828 when operated connect lamps 225 and 414 with the contacts of relay 1296 causing the lamp to be flickered at the higher speed. These relays are only operated if the operator handling the call

is the team operator and not the home operator.

Following the reception of the last pulse of the designation, the circuit of relay 245 is opened to cause the transfer of the tip and ring conductors back to the windings of relay 1218 and the sender 212 advances the district selector to talking position. A circuit is also prepared from the recorder circuit to conductor 836, outer left front contact of relay 817, back contact of relay 833, left winding of relay 835 to battery preparing for the operation of the release key. In addition a circuit is closed from ground in the recorder circuit over conductor 921 to the winding of relay 1204 and the armature of relay 1203.

When the district selector 213 has advanced to talking position, relay 218 reoperates in series with a relay in the selector circuit, again grounding conductor 221 and reoperating relay 837 which in turn reoperates relays 821 and 1203. If the call indicator circuit has grounded conductor 921 at the time that relay 1203 reoperates, a circuit is closed from battery through the winding of relay 1231, outer left contact of relay 1203 to conductor 921. Relay 1231 locks over its front contact through the winding of relay 1204 to conductor 921 but relay 1204 is inoperative since ground is connected to both terminals of its winding. The purpose of relay 1204 is to prevent ringing the wrong party if reselection takes place quickly after abandonment. If the call should be abandoned at this time, relay 1203 would release and remove ground from the second terminal of relay 1204 permitting that relay to operate in the locking circuit of relay 1231. With relay 1204 operated it is impossible for relay 1203 to reoperate and hence to complete the circuit for starting the ringing of the called party as described hereinafter.

Assuming that the call is not abandoned, the operator serving the called line number will close either release key 1232 or 1233 whichever is more convenient, one being located on the left and the other on the right side of the operating shelf. A circuit is thus completed over the release key, back contact of relay 1234, conductor 922 through the recorder circuit to conductor 836 and the winding of relay 835 as previously traced. Relay 835 locks in a circuit from battery through its right winding and right front contact to ground at the front contact of relay 814. It also closes a circuit from ground over its left contact to the winding of relay 1235 and to the inner left contact of relay 1203 providing a locking circuit for that relay. In addition, it extends its locking ground to the right winding of relay 1234 which relay locks through its left winding and left front contact under the control of the release key, rendering the release independent

of the length of time that the release key is held operated.

Relay 1235 in operating closes a circuit from battery through the winding of magnet 408, conductor 451, brush 801, right back contact of relay 838, outer left contact of relay 1235 to ground. It also closes a circuit from ground over its outer right contact, front contact of relay 1203, middle left contact of relay 826, inner left back contact of relay 833, conductor 452, contact of relay 417, brush 403, conductor 226, winding of relay 220 to battery. A third circuit extends from ground over its inner right contact, the winding of relay 1237 to battery, and in parallel therewith over the front contact of relay 1203 to the winding of relay 1201 and battery. A fourth circuit extends from ground over the inner left contact of relay 1235, winding of magnet 808 to battery.

Relay 1237 in operating opens the circuit of relay 1238 which releases, in turn releasing relays 1240 and 1239. Relays 1238 to 1240 release slowly, completing after an interval a circuit from ground over the normal contact of relay 1238, back contact of relay 1239, front contact of relay 1237 to the winding of relay 1201. An alternate circuit for operating relay 1201 is therefore provided in case the district selector is slow in closing the talking circuit thus delaying the operation of relay 1203.

The operation of relay 1201 opens the circuit of relays 817 and 821. Relay 817 releases relay 1202 thereby disconnecting the operator's telephone from this master circuit, opens the flashing circuit for lamp 414, the operating circuit for the relay interrupter and the operating circuit for relay 823. Relay 823 in turn releases relays 417 and 413 disconnecting the group circuit from the master circuit and releasing relays 815 and 816. Relay 823 also releases relay 822 and that relay in turn releases relay 814, which finally releases relay 835. The release of relay 835 releases relay 1235 which in turn releases magnet 808 and permits the advance of the master switch to its next terminals where it will serve any call which may exist in the corresponding group before advancing to other groups. The release of relay 1235 also releases magnet 408 to advance switch 400 to the next trunk thus definitely opening the connection between the trunk and the group circuit.

The master switch is now ready to serve a call in the next group. If such a call is waiting, it will hold relay 1200 operated and reoperate relay 815 to initiate the operation of the master switch circuit. If a call is waiting in some other group the operation of relay 815 will be delayed until the master switch has been advanced to the corresponding terminals.

Relay 220 when operated under the control of relay 1235 and 1203 as above described

locks to ground at the front contact of relay 218 and prepares for ringing the called subscriber. The operator tests the called line jack with the tip of the trunk plug, the test circuit extending from the sleeve of jack 227, tip of plug 228, upper back contact of relay 229, back contact of relay 230, conductor 233 to the operator's headset through the splitting circuit. If the called line is idle, the operator inserts plug 228 in jack 227, completing a circuit from ground through the cut-off relay of the subscriber's line, sleeve of jack 227 and plug 228, winding of relay 229, to battery through lamp 225. Lamp 225 does not light since relay 229 immediately operates closing a circuit from battery through the winding of relay 238, back contact of relays 237 and 236 in parallel with the winding of relay 237, lower front contact of relay 229, outer right contact of relay 220, winding of relay 229 to ground on the sleeve of the line. Relay 238 operated closes a circuit from source of ringing current 239, winding of relay 236, lower front contact of relay 238, ring of plug 228 and jack 227 through the ringer at the subscriber's substation over the tip of jack 227 and plug 228, upper front contact of relay 229, upper front contact of relay 238 to ground. The subscriber is signaled over this circuit. Relay 236 does not respond to ringing current, but when the called subscriber answers, the direct current circuit provided causes the operation of relay 236 which opens the shunt around the winding of relay 237. Relay 237 then operates locking to battery at its own front contact and shunting relay 238 which releases to connect the tip and ring of the subscriber's line through to the right windings of repeating coil 219. Relay 240 now operates closing a circuit from ground over its front contact, outer left front contact of relay 220, winding of relay 248 to battery. Relay 248 reverses the connection of battery to the tip and ring conductors to the district selector for supervisory purposes. Relay 220 remains locked to relay 218 as long as the calling subscriber keeps his receiver off the switchhook.

When the called subscriber hangs up, relay 240 releases in turn releasing relay 248 and restoring the direction of current in the trunk. When the calling subscriber disconnects, relays 218 and 220 release and the shunt around lamp 225 is opened, permitting that lamp to light in series with the winding of relay 229 as long as the plug 228 remains in the jack. If the operator should inadvertently remove the plug from the jack while conversation was in progress, lamp 225 would light in a circuit from battery through the lamp, outer right front contact of relay 220, lower back contact of relay 229 to resistance 299 and ground.

If the trunk should be reselected before the plug is removed from the jack, lamp 225 is

still lighted as above described in series with the sleeve relay 229. The operation of the group circuit and the master switch is the same as described above. However, when
 5 relay 826 operates and initiates the operation of the interrupter relays for the purpose of flashing lamps 414 and 225, a circuit is closed from battery through the left winding of relay 832, middle left contact of relay
 10 817, outer right contact of relay 818, conductor 852 and thence over conductor 447, contact of relay 417, brush 405, conductor 224 to the winding of relay 229. Ground is now connected to this winding and conductor
 15 224 from the sleeve of jack 227. At this time no current flows through the right winding of relay 832 since one side of this winding extends to ground over conductor 852 and the other to ground over the back contact
 20 of relay 833 as previously traced. The currents through relay 832 are therefore unbalanced and relay 832 operates, in turn operating relays 1290 and 833 as above described. Relay 833 in operating transfers the right
 25 winding of relay 832 from ground over conductor 1213 to battery over the back contact of relay 827 and the left back contact of relay 1211. Relay 1211 therefore intermittently connects battery through the right
 30 winding of relay 832 to conductor 224 in shunt of lamp 225, extinguishing that lamp at intervals to give a flashing signal to the operator. The direction of this intermittent current through the right winding of relay
 35 832 aids in holding the relay operated. It is impossible for the operator to disconnect the position equipment from the trunk without first removing the plug from the jack, since the operation of relay 833 opens the circuit from the release key to relay 835. The
 40 removal of the plug from the jack causes the release of relays 832, 1290 and 833 permitting the operator to release her position equipment and to complete the call in the usual manner. Since relay 835 and therefore relay
 45 1235 cannot be operated as long as the plug is in the jack relay 220 cannot be operated and it is impossible to ring the wrong subscriber.

If the sleeve of a trunk should become
 50 grounded, relays 832 and 833 cannot be released by the removal of the plug from a line jack, and the release keys are ineffective. In this case the emergency release key 1242 may be operated. This key closes a circuit
 55 from ground at the contact of key 1242, left back contact of relay 1241, left winding of relay 841 to battery. Relay 841 operates relay 835 which performs its releasing functions. Relay 841 locks to the contact of relay
 60 814 and operates relay 1241 which locks as long as key 1242 is held operated.

If neither the release key 1232 or 1233 nor the emergency release key 1242 will release the position equipment, the emergency key
 65 890 is operated. Key 890 closes obvious cir-

cuits for relays 838 and 810. Relay 838 in turn closes a circuit for relay 811. Relays 811, 838 and 810 prevent the association of the master switch with a group circuit and direct the group circuits to the adjacent master switches. 70

A trunk incoming from a manual office differs from a trunk incoming from a dial office only slightly, as indicated in the upper part of Fig. 1. The original operating circuit for relay 118 extends only through its left winding and the supervisory circuit controlled by relay 140 closes the circuit through the right winding of relay 118, instead of
 75 operating relay 148 which is ineffective and might have been omitted altogether. In addition the incoming tip and ring conductors are connected directly to the armatures of relay 148 instead of over the back contacts of relay 145 so that the operation of relay 145
 80 does not open the circuit of relay 118. 85

A call originating at a manual office will be extended by means of a cord circuit (not shown) to a trunk of the modified form of Fig. 1. Switch 400 and switch 800 will be associated with the trunk in the manner described for a call from a dial office. Trunks incoming from a manual office are marked in the bank of brush 401 by ground. As soon as
 90 relay 816 operates this ground extends over brush 401, conductor 455, brush 802, outer right contact of relay 810, outer right contact of relay 816, winding of relay 829 to battery. Relay 829 operates, in turn operating relay
 95 1289 and relay 1292. Relay 829 at its outer right front contact connects the release keys 1232 and 1233 to the winding of relay 835 under the control of relays 817 and 833. This renders the release key effective at any time
 100 following the operation of relay 823 which is operated over the splitting circuit immediately after the operation of relay 1200. Relay 829 also opens the circuit by which relay 823 is held operated in the case of an abandoned
 105 dial call under the control of the release key, so that an abandoned call from the manual office will release the master circuit automatically. 110

Relay 1289 operates relay 818 and together with relay 818 connects ground to conductor 1288, cancelling the test of the trunk plug. Relay 1292 transfers the tip and ring conductors from the recorder circuit to the armatures of relay 1218 and thence to the operator's telephone. The operations now proceed in the manner described for a call from a dial office except that the wanted number is passed orally from one operator to the other instead of by call indicator impulses. 120
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As soon as the operator has received the number she operates the release key, operating relay 835 and advancing the group and master circuits, and setting the ringing by operating relay 220 as above described. 130

Although the operation of relay 829 renders the release key effective at any time during straightforward calls, this key is ineffective whenever the trunk plug is in a multiple jack. It will be remembered that relay 818 is operated directly by relay 1289 or through the operation of relays 832 and 1290 in response to the test prepared by relays 826 and 823. With relay 818 operated the left winding of relay 832 connects over the middle left contact of relay 817, right alternate contact of relay 818, to conductor 852 and thence to lamp 225 and relay 229. If the plug is in the jack relay 832 either operates or is held operated from ground supplied from the sleeve of that jack and in turn either operates or holds operated relay 1290. With relay 1290 operated a circuit is closed for relay 833 which opens the operating circuit for relay 835.

If, on a dial call, the recorder fails to operate properly to bring about a complete display of the wanted number the release circuit is not closed and the position must be released by the operation of the emergency release key 1242. Before doing so however, the operator may obtain the number from the calling subscriber by operating key 1287 which operates relay 1292 directly, connecting the trunk through to the operator's telephone. The sender at the distant end, having finished transmitting the number, causes the district selector 213 to prepare the talking circuit and the operator is therefore connected through to the calling subscriber.

If for any reason the circuit of relay 245 fails to close, for example, because of a poor contact between brush 406 and the terminal connected to conductor 244, the number will not be displayed since no signal will be transmitted to the sender 212 to cause it to start transmitting the designation. Therefore if the number does not appear on the recorder in the usual length of time following the tone indicating that a call is incoming, the operator will release the master circuit by operating the emergency release key 1242. With the circuit of relay 245 open relay 824 cannot operate and in turn relay 826 fails to operate. The operation of emergency release key 1242 operates relay 835 which in turn operates relay 1235 and relay 1201. Relay 1203 has been held operated under the control of relay 837 which in turn was held continuously operated from relay 218. However, since relay 826 does not operate relay 220 can not be operated. The advance of the group switch 400 and the master switch 800 under the control of relay 1235 opens the circuit closed over conductor 221 and brush 404, restoring the calling condition to the trunk. After other calls waiting in the group have been served by the group circuit this trunk will be reselected and a second attempt made to complete the circuit of relays 245 and 824.

What is claimed is:

1. In a telephone system, an incoming trunk line, an operator's position, equipment at said position, automatic switching means for connecting said equipment with said trunk line, means to disconnect said equipment from said trunk line, and means to cause a second connection between said trunk line and said equipment if said first connection is not effective.
2. In a telephone system, incoming trunk lines, an operator's position, equipment at said position, switching means at said position, means responsive to the seizure of a trunk line to cause said switching means to connect with said trunk line, means responsive to said connection to establish a circuit between said trunk line and said equipment, means to disconnect said switching means from said trunk line, and means to cause said switching means to again connect with said trunk line if said circuit is not effectively established.
3. In a telephone exchange system, a trunk line, an operator's position, apparatus at said position, means responsive to the seizure of said trunk line for applying a calling condition to said trunk line, means responsive to said calling condition to associate said trunk line with said position apparatus and to remove said calling condition, and means to restore said calling condition to said trunk line if the association of said trunk line with said apparatus is not effective.
4. In a telephone exchange system, an operator's position, a trunk line appearing at said position, apparatus at said position, means responsive to a seizure of said trunk line to apply a calling condition thereto, means responsive to such calling condition to cause said apparatus to hunt for said trunk line, means to establish a circuit to inform the operator of the wanted subscriber's designation, operator controlled means to disconnect said apparatus from said trunk, and means effective if said circuit is not established and responsive to said operator controlled means to restore the calling condition to said trunk line.
5. In a telephone exchange system, an operator's position, a plurality of trunks appearing at said position, apparatus at said position, means responsive to the seizure of said trunk to apply a calling condition thereto, means responsive to the existence of said calling condition on any trunk to cause said apparatus to hunt for a trunk on which said condition exists, means to establish a circuit connecting the trunk found and said apparatus to inform the operator of the called line designation, operator controlled means to disconnect said apparatus from said trunk and cause said apparatus to hunt for another trunk on which a calling condition exists,

and means effective if said circuit is not established and responsive to said operator controlled means to restore the calling condition to said trunk.

a machine switching office, and means responsive to said discriminating means to prevent the connection of a trunk incoming from a machine switching office with said designation receiving means if the plug of the trunk is in one of said jacks. 70

5 6. In a telephone exchange system, an operator's position, a plurality of trunk circuits appearing at said position, a recorder at said position, means responsive to the seizure of said trunk circuits for applying 10 a calling condition thereto, switching means responsive to said calling condition to successively associate said recorder with trunk circuits to which said calling condition has been applied, means to establish a recording 15 circuit between said recorder and the trunk circuit with which it is associated, operator controlled means to disconnect said recorder from said trunk, and means effective if said recording circuit is not established to 20 restore said calling condition to said trunk.

10. In a call distributing system, an operator's position, a plurality of plug-ended trunks appearing at said position, a plurality of jacks to outgoing lines, a recorder at 75 said position, means responsive to the seizure of a trunk to establish a connection between said recorder and said trunk, means to delay the establishment of said connection as long as the plug of the trunk is in one of said 80 jacks, operator controlled means for preparing the signaling means of said trunk to signal the designated outgoing line, and means to render said operator controlled means ineffective to prepare said signaling means if 85 said connection is not established.

In witness whereof, I hereunto subscribe my name this 24th day of September, 1930.

ALBERT C. POWELL.

7. In a telephone exchange system, an operator's position, a trunk line appearing at said position, a called line recorder, means responsive to the extension of a call to said 25 trunk line to cause said recorder to associate itself with said trunk line, operator controlled means for disconnecting said recorder from said trunk line, means normally responsive to said operator controlled means 30 to prepare the trunk line for ringing the wanted subscriber, and means effective if the association of said recorder with said trunk line is not effective to prevent the preparation of ringing and to restore the calling 35 condition to said trunk line, whereby a subsequent attempt may be made to associate the recorder with the trunk line.

8. In a call distributing system, an operator's position, a plurality of plug-ended 40 trunks appearing at said position, a plurality of jacks extending to outgoing lines, a plurality of switching devices at said position, a recorder at said position, means responsive to the seizure of a trunk to cause a plurality 45 of said switching devices to associate themselves with said trunk, means automatically responsive to said association to connect said recorder with said trunk to receive the designation of an outgoing line, and means to 50 prevent the connection of said recorder with said trunk if the plug of the trunk is in one of said jacks.

9. In a call distributing system, an operator's position, a plurality of plug-ended 55 trunks incoming to said position from a manual office, a plurality of plug-ended trunks incoming to said position from a machine switching office, a plurality of jacks to outgoing lines, means at said position to receive 60 the designation of outgoing lines, means responsive to the seizure of a trunk to automatically associate said trunk with said designation receiving means, means to discriminate between said trunks incoming from a 65 manual office and said trunks incoming from

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