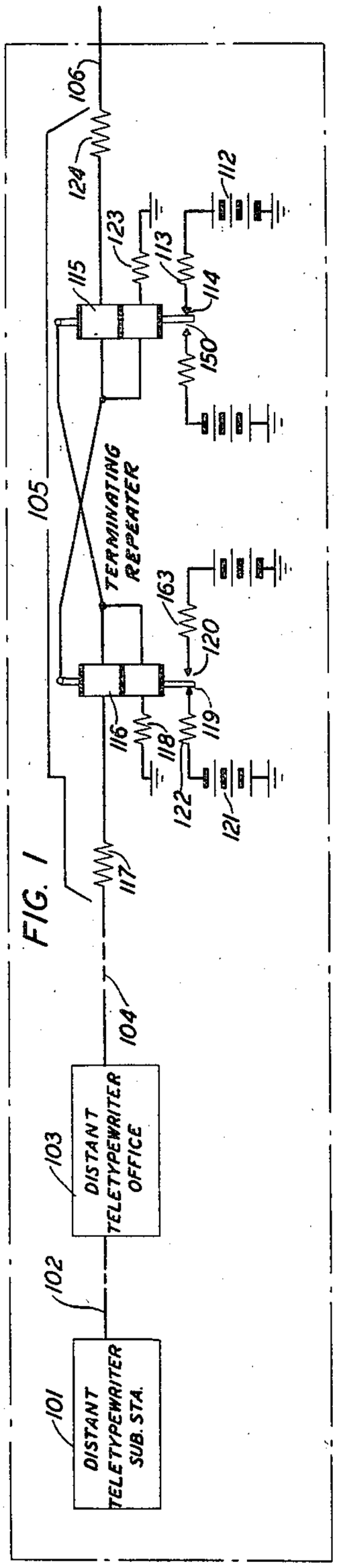
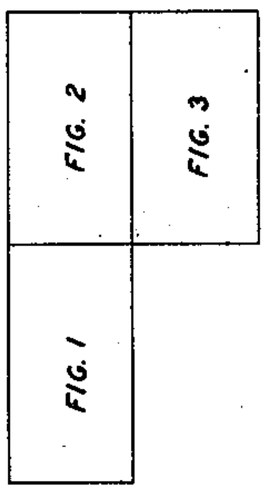
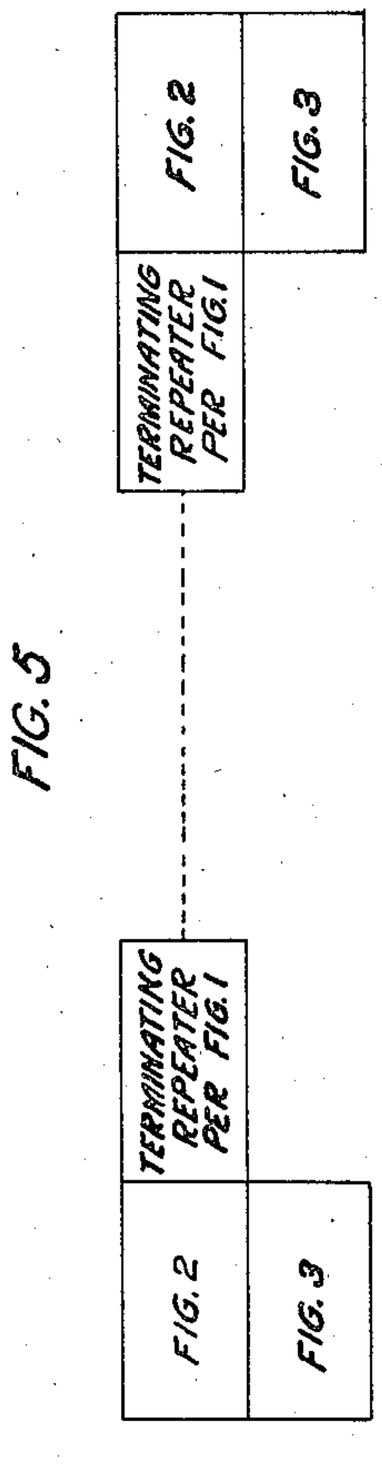
Feb. 11, 1947. C. A. DAHLBOM 2,415,420

TELEGRAPH TRUNK CIRCUIT

Filed Dec. 22, 1943 3 Sheets-Sheet 1







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TELEGRAPH TRUNK CIRCUIT

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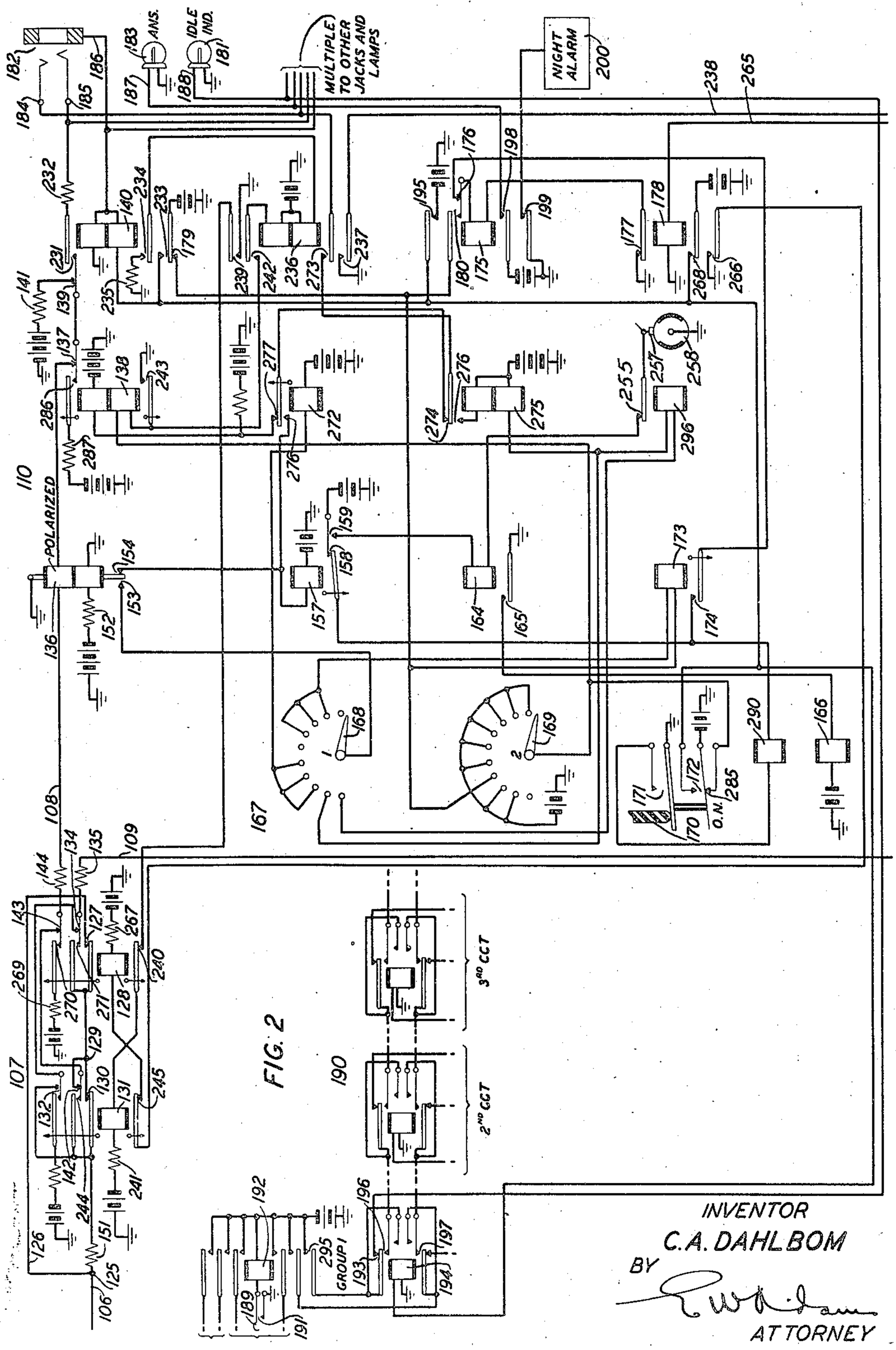

FIG. 2

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TELEGRAPH TRUNK CIRCUIT

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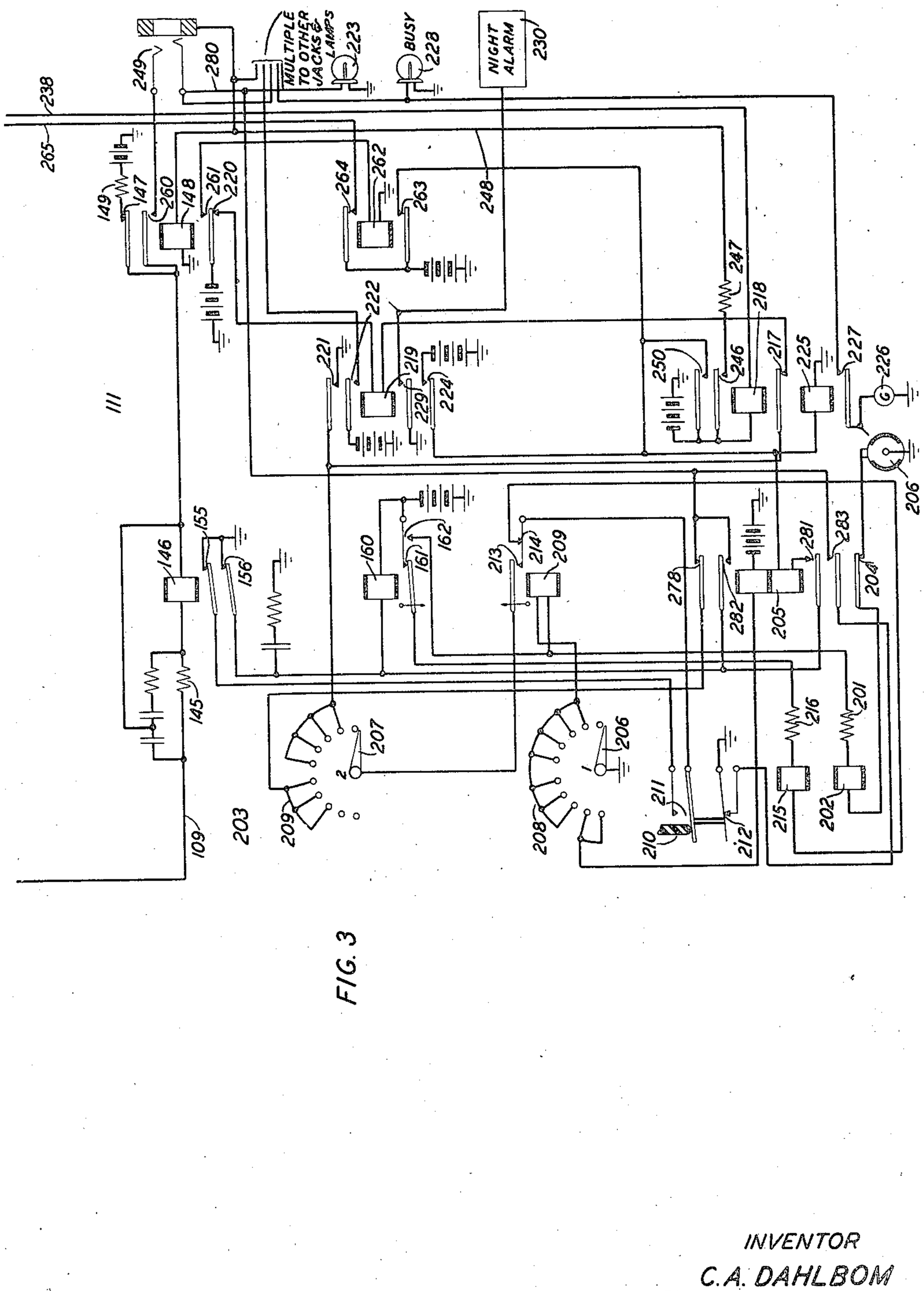

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UNITED STATES PATENT OFFICE

2,415,420

TELEGRAPH TRUNK CIRCUIT

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27 Claims. (Cl. 178—2)

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This invention relates to teletypewriter line circuits and more particularly to arrangements for terminating one end of such circuits in or at two different switchboards in different offices, for example, in the same city; such two terminations are functionally equivalent to and operate as one terminal in cooperation with the opposite end. In the general case the opposite end may have a multiple terminal of the type of the present invention or a terminal of some more usual type of the prior art.

A specific and exemplary embodiment disclosed comprises a trunk between central offices commonly known as a toll trunk which is of the ring-down type and arranged so that it may be terminated at either or both ends in two different switchboards in two different offices in the same city, each of which provides access to the same end of the intertoll trunk extending to a distant city. The two switchboards in the same city will ordinarily be located in different buildings but may be located in the same building. They may be separated by a considerable distance. Calls may be answered or originated at either one of the switchboards in the same city. The exemplary circuit includes the supervisary features required for use with toll line circuits used as ring-down intertoll trunk circuits and provides for the termination of the trunk at each of two different types of switchboards in the same city.

An object of the invention is the improvement of teletypewriter switching systems.

A more particular object is the improvement of intertoll telegraph trunk circuits.

Another object is the arrangement of a telegraph trunk circuit so that it includes supervisory features to provide for its termination in two different offices in the same city.

A feature of the invention is means for answering an incoming call at either one of two teletypewriter switchboards in two different offices in the same city.

A further feature is a calling-in signal in the form of a break signal of two to four seconds duration which controls means for operating call and busy lamps at each of two switchboards in the same city.

A further feature is means in the trunk terminations for extinguishing the call lamps at each switchboard when the call is answered at one of the switchboards.

A further feature is means for impressing a busy condition on the jack of the trunk in one of the switchboards in the same city when an

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incoming call is answered at the other switchboard.

A further feature is means at either one of the switchboards at which an incoming call has been answered for momentarily grounding a supervisory lead in the trunk termination to control a supervisory signal in the cooperating cord circuit in response to a recall signal from the distant end of the line in the form of a seven-second break signal.

A further feature is means in the trunk termination at the switchboard where the call has been answered for applying a permanent ground to the supervisory lead extending to a connecting cord circuit to control a supervisory signal to indicate a disconnect signal in response to a ten-second break applied at the distant end of the trunk.

The manner of accomplishing the above and other objects and the manner of accomplishing the above and other features will become apparent from the following description when read with reference to the associated drawings in which:

Fig. 1 shows a distant teletypewriter subscriber's station connected to a distant teletypewriter central office which is in turn connected to a terminating repeater which is located at the same office in which the trunk termination per Fig. 2 appears;

Fig. 2 shows the telegraph trunk termination at one of the switchboards in one of the offices in a particular city;

Fig. 3 shows a telegraph trunk termination in a second switchboard in a second office located in the same city as that in which the facilities per Fig. 2 are located;

Fig. 4 is a diagram indicating the manner in which Figs. 1, 2 and 3 are arranged each in relation to the other to form a complete system with terminations of a trunk in two offices in the same city; and

Fig. 5 is a diagram indicating the manner in which Figs. 2 and 3 and the terminating repeater per Fig. 1 are arranged each in relation to the other to form a complete system with terminations in two offices at each end of the channel.

Refer now to Figs. 1, 2 and 3. At the left of Fig. 1 is a rectangle 101 which represents a distant teletypewriter subscriber's station. It may be any one of a large number of such stations each of which is connected by an individual telegraph channel such as 102 to a teletypewriter switching office in the distant city represented by rectangle 103. From the distant teletypewriter of-

fice 103 an intertoll trunk channel 104 extends to the trunk terminating repeater 105. From the terminating repeater 105 which is located in the same city as that in which the facilities per Fig. 2 and Fig. 3 are assumed to be located, a telegraph channel 106 extends to a trunk termination switch 107. From the trunk termination switch 107 two branches 108 and 109 under control of switch 107 extend to telegraph trunk terminating equipment 110 which is located in one switchboard and 111 which is located in another switchboard in the same city. In the idle condition the transmission paths of the two ring-down intertoll trunk circuits are held in a marking condition. A circuit may be traced from battery 112 in Fig. 1 through resistance 113, contact 114 of relay 115 to the apex of relay 116. From the apex of relay 116 one branch extends through the top winding of relay 116, resistance 117 and channel 104 to the distant teletypewriter office 103 where it terminates in negative battery. From the apex of relay 116 the second branch extends through the lower winding of relay 116 and resistance 118 to ground. The effect of the current flowing through the top winding of relay 116 which tends to operate the armature of relay 116 toward the left to engage contact 119 is dominant over the effect of current flowing through the bottom or biasing winding of relay 116 which is tending to operate the armature of relay 116 toward the right to engage contact 120. The armature of relay 116, therefore, engages its marking contact 119. A circuit may then be traced from negative battery 121 through resistance 122 and contact 119 to the apex of relay 115. From the apex of relay 115 one branch of the circuit extends through the bottom winding of relay 115 and resistance 123 to ground to provide biasing current for relay 115. From the apex of relay 115 a second branch extends through the top winding of relay 115, resistance 124 and channel 106 to point 125 where parallel branches are formed. One branch extends through conductor 126 and contact 127 of relay 128 to another parallel branch at point 129. One of the parallel branches extending from point 129 leads through contact 142 of relay 131, contact 143 of relay 128, resistance 144, conductor 108, top winding of relay 136, contact 137 of relay 138, contact 139 of relay 140 and resistance 141 to positive battery. From point 129 the second branch extends through contact 130 of relay 131, contact 132 of relay 131, contact 134 of relay 128, resistance 135, conductor 109, resistance 145, winding of relay 146, contact 147 of relay 148 and resistance 149 to positive battery.

Attention is called to the fact that both of the transmission branches 108 and 109 at this time are terminated in positive battery connected to resistances 141 and 149, respectively. The current flowing through the top winding of relay 115 which is tending to actuate the armature of relay 115 to engage its marking contact 114 is dominant over the effect of current flowing through the bottom winding of relay 115 which is tending to actuate the armature of relay 115 to engage its spacing contact 150 and the armature of relay 115 is, therefore, maintained in engagement with its marking contact 114. It was pointed out in tracing the circuit above that parallel branches are formed at point 125. A circuit was traced through the upper branch 126. The lower branch may be traced from point 125 through resistance 151 and contact 130 to junction point 129 where it joins the path which extends through conductor 126. The path through conductor 126, therefore, forms a shunt around resistance 151 while the relays 128 and 131 are in the condition shown in Fig. 2. A circuit may be traced from battery through resistance 152 and the bottom winding of relay 136 to ground. This supplies biasing current to the bottom winding of relay 136 which tends to actuate the armature of relay 136 towards the left to engage its contact 153. The effect of current flowing through the top winding of relay 136 over the path traced above tends to actuate the armature of relay 136 toward the right to engage its marking contact 154 and the effect of this current is dominant over the effect of the biasing current so that the armature of relay 136 engages contact 154. The winding of relay 146 in Fig. 3 is energized by the effect of current flowing through conductor 109 in the path traced above so that contacts 155 and 156 are closed.

When contact 154 of relay 136 in Fig. 2 is closed, a circuit may be traced from ground through contact 154 and the winding of relay 157 to battery actuating the armature of relay 157 to maintain contact 158 closed while contact 159 is open. When contact 156 of relay 146 in Fig. 3 is closed, a circuit may be traced from ground through contact 156 and the winding of relay 160 to battery energizing relay 160 which closes contact 161 and opens contact 162.

The above is the condition of the circuits per Figs. 1, 2 and 3 at the start of operations. Other relays in Figs. 1, 2 and 3 at such time are in the released condition as shown on the drawings.

Incoming call

When a call is incoming from the distant teletypewriter office 103 a spacing signal of from two to four seconds duration is impressed on channel 104 extending from the distant office 103 to the terminating repeater 105. In response to this the effect of the current in the top winding of relay 116 is reduced so that the effect on the current in the bottom winding of relay 116 becomes dominant and the armature of relay 116 is actuated to engage its spacing contact 120. As a result of this positive battery is connected through resistance 163 and contact 120. Since positive battery is connected also through resistance 141 and resistance 149 at the opposite ends of this circuit, no current will flow through the top winding of relay 136 or through the winding of relay 146. The armature of relay 136 will be actuated to close its spacing contact 153 and the contacts of relay 146 will be opened. The description of the sequence of events in Fig. 2 in response to the spacing signal for the incoming call will first be described.

The opening of contact 154 releases relay 157. Contact 159 is closed. This establishes a circuit from battery through contact 159, winding of relay 164 and contact 255 of relay 296 to brush 257 of interrupter 258 which closes a circuit to ground sixty times per minute. Relay 164 will be operated and released, closing and opening contact 165 once per second while the spacing signal from office 103 persists. When contact 165 is closed a circuit may be traced from ground, through contact 165 and the winding of rotary stepping magnet 166 of the two-bank selector switch 167 to battery, energizing and de-energizing rotary stepping magnet 166 once per second. The rotatable arms 168 and 169 associated with banks 1 and 2 of selector 167, respectively, are in the positions indicated when in the

released condition. Each time rotary steppng magnet 166 is energized, rotatable arms 168 and 169 are stepped in unison in a counter-clockwise direction to engage successive terminals on their respective banks. The off-normal spring assembly 170 is actuated to close contacts 171 and 172. Contacts 171 and 172 remain closed while arms 168 and 169 are in any other than their normal released positions. Arms 168 and 169 will be stepped from one to four steps, dependent upon the duration of the spacing signal.

When arm 168 engages its second, third or fourth terminals a circuit may be traced from ground, through contact 153, arm 168, terminals 2, 3 or 4 of bank 1 of selector 167, winding of relay 173 and contact 179 to battery, operating relay 173 and closing contact 174. Upon completion of the spacing signal, contact 119 of relay 116 will be reclosed. The top winding of relay 136 will be reenergized, closing contact 154 and reoperating relay 157. This, in turn, recloses contact 158. A circuit may then be traced from battery through contact 158, winding of release magnet 290 of selector 167 and contact 171, of off-normal spring assembly 170, to ground, energizing release magnet 290 which immediately restores arms 168 and 169 to their original positions. The circuit through the winding of relay 173 is thus opened and relay 173 releases, opening contact 174. Relay 173 is a slow-to-release relay so that contact 174 remains closed once relay 173 is operated for an interval long enough to permit relay 175 to operate over a circuit which may be traced from battery, through contact 158, contact 174, contact 176 of relay 175. winding of relay 175 and contact 177 of relay 178 to ground. When relay 175 operates it locks over a circuit which extends from battery, through contact 179 of relay 140, contact 180 of relay 175, winding of relay 175 and contact 177 to ground.

During the interval while the trunk terminating circuit per Fig. 2 is idle, the idle indicator lamp 181 associated with jack 182 of the trunk is lighted. It is pointed out that the trunk termination per Fig. 2 has a plurality of terminations in the switchboard in which the trunk per Fig. 2 is terminated. The tip, ring and sleeve connections 184, 185 and 186 of jack 182 are connected in parallel to jacks at a number of positions of the switchboard. Similarly, the answering lamp conductor 187 is connected in parallel through the filament of an answering lamp, such as lamp 183, to ground at each of the positions where jack 182 appears. Similarly the idle indicator lamp conductor 188 is connected through a lamp filament of a lamp, such as lamp 181, to ground at each of the appearances of jack 182. Whenever the switchboard in which jacks 182 are located is being operated, key 189 of the idle indicator relay chain circuit 190 is operated to close contact 191. This establishes a circuit from ground through contact 191 and the winding of relay 192 to battery, energizing relay 192 and closing all of its associated contacts. Relay 192 controls a number of relay chain circuits, such as the one shown in Fig. 2.

While the trunk termination per Fig. 2 is idle, a circuit may be traced from ground, through the filament of idle indicator lamp 181, contact 193 of relay 194 and contact 295 of relay 192 to battery, lighting idle indicator lamp 181. Since the trunk termination per Fig. 2 is now engaged to receive an incoming call lamp 181 is extinguished. This is performed by the closing of contact 172 of the off-normal spring assembly 170.

When contact 172 is closed, a circuit may be traced from battery, through contact 172 and the winding of relay 194 to ground, operating relay 194 which extinguishes lamp 181 by opening contact 193. Relay 175 is operated before contact 172 is reopened. This maintains relay 194 operated over a circuit which may be traced from battery, through contact 195 of relay 175 and the winding of relay 194 to ground. The operation of relay 194 also transfers the idle indicator circuit to the next relay in the chain by closing contacts 196 and 197. The operation of relay 175 also establishes a circuit from battery, through contact 198 and the filament of answering lamp 183 to ground, lighting answering lamp 183 as an indication that a call incoming from jack 182 is waiting to be answered.

The operation of relay 175 also establishes a circuit from ground, through contact 199 and the night alarm circuit 200 to battery, not shown, to operate night alarm circuit 200.

The closing of contact 195 of relay 175 also establishes a circuit from battery, through contact 195 and the bottom and top windings of relay 140 in series to ground. Relay 140 is wound differentially, that is to say, when current flows through both windings of relay 140 in series as in the present instance, the effects of the current in the two windings oppose each other so that relay 140 remains in the released condition as shown. Attention is called, however, to the fact that the sleeve conductor 186 of jack 182 is connected to the junction of the top and bottom windings of relay 140. As a result of this, when negative battery is connected through contact 195 the negative potential between the junction of the two windings of relay 140 and ground is impressed on the sleeve of jack 182. This serves as a busy indication at the multiple appearances of jack 182.

The description of the operation of Fig. 3 will now be resumed. The opening of contact 156 deenergizes the winding of relay 160, opening contact 161 and closing contact 162. The closing of contact 162 establishes a circuit from battery, through contact 162, resistance 201, winding of rotary stepping magnet 202 of two-bank selector 203, contact 204 of relay 205, through interrupter 206 to ground. Interrupter 206 is arranged to break the circuit to ground at the rate of sixty times per second. The rotary stepping magnet 202 will be energized and deenergized once per second. Brush arms 206 and 207 are normally in the positions indicated. Each time rotary magnet 202 is energized rotatable brush arms 206 and 207 are stepped in unison, one step, in a counter-clockwise direction. When arm 206 engages the second terminal of its bank a circuit may be traced from ground, through arm 206, second terminal of bank 208, winding of relay 209 and contact 162 to battery, operating relay 209. In response to the reclosure of the line from the distant station at the termination of the breaking interval within the interval of two to five seconds relay 146 will be reoperated. This, in turn, reoperates relay 160. When the selector brush arms 206 and 207 are stepped off-normal the off-normal spring assembly 210 of selector 203 is actuated to close contact 211 and open contact 212. A circuit may then be traced from ground, through contact 155, contact 211, contact 214, release magnet 215 of selector 203, resistance 216 and contact 161 to battery. This restores arms 206 and 207 to normal.

Relay 209 is a slow-to-release relay. During the interval after relay 146 operates and before relay 209 releases, a circuit may be traced from ground through contact 155, contact 211, contact 213, switch arm 207, contact 217 of relay 218, winding of relay 219 and contact 220 of relay 148 to battery operating relay 219. When relay 219 operates, it locks over a circuit from battery through contact 220, winding of relay 219, contact 217 of relay 218 and contact 221 of relay 219 to ground. Relay 219 will remain locked until the operator at the switchboard where Fig. 3 is terminated responds to the call. When relay 219 operates, a circuit may be traced from battery through contact 222 of relay 219 and filament of lamp 223 as well as through the filaments of other lamps in parallel with lamp 223 at all switchboard positions to ground. The operation of relay 219 also establishes a circuit from battery through contact 224 and the winding of relay 225 to ground operating relay 225. A circuit may then be traced from ground through a source of alternating current 226, contact 227 of relay 225 and the filament of lamp 228, as well as the filaments of other lamps connected in parallel with the filament of lamp 228 at other positions in the switchboard, to ground. It is pointed out that one relay such as 225 and one source of alternating current such as 226 are connected so as to serve a plurality of trunks. The left-hand terminal of relay 225 is connected in parallel to a contact such as 224 in each of a number of different trunks. The right-hand terminal of contact 227 is connected in parallel to a number of conductors which extend to groups of lamps such as lamp 228. Relay 225 and alternating current source 226 constitute an alternating current supply circuit for busy lamps such as 228 in the office where Fig. 3 is located. The object of the use of this busy lamp circuit is to reduce the drain on the direct current batteries in the office.

The operation of relay 219 also establishes a circuit from ground through contact 229 of relay 219 through the night alarm circuit indicated by rectangle 230. If the night alarm circuit is closed a signal will be operated to attract the operator's attention. The night alarm circuit 230 is connected in parallel to the right-hand terminal of a number of contacts such as 229 so that the single night alarm circuit 230 will serve a large number of trunk terminations such as Fig. 3 in a well understood manner.

The call lamps and busy indications are now displayed at both switchboards. When the operator at either switchboard answers the call, the jack appearance at the unanswered switchboard is made to test busy for the duration of the call.

The circuits which cooperate with the trunk circuit herein at the two central offices located in the city where Figs. 2 and 3 are terminated are disclosed in detail in Patent 2,220,931, J. A. Krecek, November 12, 1940, and in allowed application Serial No. 424,436, C. A. Dahlbom et al., filed December 26, 1941, respectively. The cord circuit per Fig. 2 in Patent 2,220,931 may be connected to Fig. 2 herein to extend the connection through the system disclosed in Patent 2,220,931. The cord circuit per Fig. 2 of application Serial No. 424,436 may be connected to Fig. 3 herein to extend the connection through the system disclosed in the application Serial No. 424,436. Patent 2,220,931 and application Serial No. 424,436 are incorporated herein by reference as though fully set forth herein.

Answering an incoming call through Fig. 2

The manner in which the trunk termination per Fig. 2 herein responds when the answering end of the cord circuit disclosed in Patent 2,220,931 is connected to jack 182 will now be described. In this description the conditions imposed on jack 182 by the cooperating cord for the different operations will be described. The manner in which the cord circuit in Patent 2,220,931, responds may be understood from reference to Patent 2,220,931.

When the answering end of the cord circuit is inserted in jack 182, negative battery will be impressed on the sleeve connection 186 of jack 182 of the same magnitude as the negative battery connected through contact 195 of relay 175. A circuit may be traced from the sleeve of jack 182 through conductor 186 to the junction of the windings of relay 140. One path extends from the junction through the bottom winding of relay 140 and contact 195 to negative battery. The lower winding of relay 140 will be deenergized. A second path may be traced from the junction of relay 140 through the top winding of relay 140 to ground. Relay 140 will be energized to close its make contacts. When relay 140 is operated, the transmission path incoming from the distant office 103 in Fig. 1 which formerly extended through contact 139 and resistance 141 to positive battery will be opened at contact 139 and extended through contact 231, resistance 232 and the ring connection 185 of jack 182 through the ring of the connecting cord circuit. The closing of contact 233 of relay 140 establishes a circuit from battery through contact 233 and the winding of relay 194 to ground to maintain the idle indication. The opening of contact 179 of relay 140 releases relay 175. The closing of contact 234 of relay 140 establishes a circuit from ground through resistance 235, contact 234 and the bottom winding of relay 236 to battery operating relay 236. The closing of contact 237 of relay 236 establishes a circuit from ground through the contact 237 and conductor 238 which extends between the offices where the trunk terminations per Fig. 2 and Fig. 3 are located, through the winding of relay 218 to battery operating relay 218 in Fig. 3. The closing of contact 239 establishes a circuit from ground through contact 239, contact 240 of relay 128, winding of relay 131 and resistance 241 to battery operating relay 131. The closing of contact 242 of relay 236 will prepare a holding path extending from battery through the top winding of relay 236 and contact 242 to contact 243 of relay 138, which is open, for use at a later time. The release of relay 175 extinguishes the answer lamps such as 183 by opening contact 198. The opening of contact 199 of relay 175 disconnects the night alarm circuit. The operation of relay 131 by closing contact 132 applies a holding termination to the unanswered trunk termination per Fig. 3. The operation of relay 131 also removes the short-circuit which extended through conductor 126 around resistance 151 by opening contacts 130 and 142. Removal of this short-circuit provides the correct loop current. The operation of relay 131 by opening contact 245 opens the operating path of relay 128. This removes the danger of transmission circuit interruption should the operator at the switchboard where the trunk terminal per Fig. 3 is located accidentally connect a cord to the jack in Fig. 3. This will be understood from the description below.

The operation of relay 218 in Fig. 3 by opening contact 217 will release relay 219. The release of relay 219 will in turn extinguish the lamps such as 223 by opening contact 222. The opening of contact 229 of relay 219 will disconnect the night alarm circuit 230. The closing of contact 246 of relay 218 will establish a circuit from negative battery through contact 246, resistance 247, conductor 248 to the sleeve of jack 249 and and to the sleeve of other jacks in parallel with jack 249 at all positions in the switchboard where Fig. 3 is terminated. The closing of contact 250 of relay 218 will establish a circuit from battery through contact 250 and the winding of relay 225 to ground to maintain all of the busy lamps such as lamp 228 lighted.

Answering an incoming call through Fig. 3

If the plug of the cord circuit is inserted in jack 249, battery on the sleeve of the plug will be connected through the winding of relay 148 to ground operating relay 148. The closing of contact 260 of relay 148 will connect the transmission path in Fig. 3 to the transmission path of the connected cord circuit. The opening of contact 220 of relay 148 will release relay 219. The opening of contact 222 of relay 219 will extinguish all of the answering lamps such as lamp 223. The opening of contact 229 of relay 219 will release night alarm circuit 230. The closing of contact 261 of relay 148 will establish a circuit from battery through contact 261 and the winding of relay 262 to ground operating relay 262. The operation of relay 262 will establish a circuit from negative battery through contact 263 and the winding of relay 225 to ground to maintain the busy lamp such as lamp 228 lighted. The operation of relay 262 will establish a circuit from battery through contact 264, conductor 265 into Fig. 2 through the winding of relay 178 to ground operating relay 178. The operation of relay 178 will establish a circuit from ground through contact 266, contact 245 of relay 131, winding of relay 128, and resistance 267 to battery operating relay 128. The operation of relay 178 will establish a circuit from negative battery through contact 268 and the top and bottom windings of differential relay 140 in series so that negative potential is impressed on the sleeve of jack 182 over conductor 186 from the junction of the windings of relay 140. This will provide a busy indication on all jacks such as jack 182 in the switchboard where Fig. 2 is terminated. The operation of relay 178 by opening contact 177 will release relay 175. This in turn will extinguish the lamps such as lamp 183 by opening contact 198. The opening of contact 199 of relay 175 will disconnect the night alarm 200. The operation of relay 128 will apply a holding termination to the unanswered trunk termination per Fig. 2 by connecting battery through resistance 269, contact 270 and resistance 144 to conductor 108. The operation of relay 128 by opening contact 127 will remove the shunt around resistance 151 and by closing contact 271 will connect resistance 151 in the transmission path to the transmission channel through Fig. 2. This provides the proper loop current. The operation of relay 128 by opening contact 240 will break the path extending through the winding of relay 131 so that relay 131 cannot be operated accidentally should a cord circuit plug be inserted in jack 182. The operation of relay 178 by closing contact 268 operates relay 194 to maintain the idle indicator circuit in operation.

Receiving recall signals

The manner in which recall signals are transmitted through the trunk terminations per Fig. 2 and Fig. 3 will now be described. First, the manner in which they are transmitted through Fig. 2 will be described. A recall signal is received by means of a spacing signal of approximately seven seconds in duration. In response to the spacing signal as has been shown the armature of relay 136 will be operated to engage a spacing contact 153. This in turn releases relay 157 in the manner described. In response to this the selector arms 168 and 169 will be operated in the manner described to approximately the seventh terminal on each bank. When brush arm 168 engages the sixth terminal of its bank a circuit may be traced from ground through contact 153, brush arm 168, sixth terminal of the selector bank associated with brush arm 168 and the winding of relay 272 to battery operating relay 272. A circuit may then be traced from the tip conductor of jack 182 through conductor 184, contact 273 of relay 236, contact 274 of relay 275, contact 276 and contact 154 of relay 136 to ground. The path through contact 154 to ground is available as soon as the recall spacing interval is ended. When the armature of relay 136 engages contact 154, relay 157 is reoperated. This restores selector 167 to its normal position. Relay 272 is a slow to release relay. Ground through contact 154 is connected momentarily prior to the release of relay 272 to the tip conductor 184 of jack 182 and through the tip of the connected cord circuit to actuate a flashing recall signal in the connected cord. When relay 272 releases battery is connected through contact 277 to the tip conductor. The flashing recall signal transmitted from Fig. 2 therefore consists in replacing battery normally connected to the tip conductor of jack 182 with ground momentarily and then reconnecting battery to the tip conductor.

The manner in which a recall signal is transmitted through Fig. 3 will now be described. When a recall signal in the form of a spacing condition of approximately seven seconds duration is received by the trunk termination of Fig. 3 brush arms 206 and 207 of selector 203 will be advanced to their sixth, seventh or eighth contact. Relay 209 is operated in response to this in a manner which has been described. When relay 146 reoperates at the end of the spacing period relay 160 will be reoperated as described heretofore to deenergize the rotary magnet and relay 209. Relay 209 is a slow to release relay. During the releasing time of relay 209 ground is connected to a circuit which extends through contact 155, contact 211 of the off-normal assembly 210, contact 213 of relay 209, selector arm 207, sixth terminal of bank 209 and contact 278 of relay 205 to the ring conductor 280 of jack 249 and through the ring of the connected cord circuit plug into the cord circuit. When relay 209 finally releases ground will be disconnected from the ring. This momentary grounding of the ring lead will cause the connected cord circuit to register a flashing recall signal. The flashing recall signal will be retained until the operator responds and will be retired by the action of the operator as a function of the cord circuit entirely independent of any further operation of the intertoll trunk circuit.

Receiving disconnect signals

The manner in which disconnect signals are received through the trunk termination per Fig. 2 and Fig. 3 will now be described. First, the manner in which the disconnect signal is received through Fig. 2 will be described.

A disconnect signal transmitted from the distant operator or station opens the line circuit for approximately ten seconds to operate the armature of relay **136** to engage contact **153**. This releases relay **157** in a manner heretofore described. This in turn operates relay **164** in a manner which has also been described. Selector brush arms **168** and **169** will be stepped until they engage the tenth terminals on their respective banks. When brush arm **168** engages its ninth terminal a circuit may be traced from ground through contact **153** of relay **136**, brush arm **168**, ninth terminal on the corresponding selector bank, and the bottom winding of relay **275** to battery operating relay **275**. The operation of relay **275** connects ground through the upper or holding winding of relay **275**, contact **276**, contact **273** of relay **236** and conductor **184** to the tip of jack **182** and through the tip of the plug of the connected cord circuit to operate the disconnect signal in the cord. In this case the reopening of the line circuit at the distant end will not change the disconnect signal into a flashing recall signal.

The closing of the line at the completion of the ten-second open reoperates the armature of relay **136** to close its marking contact **154**. Relay **157** reoperates and restores selector **167** to normal in the manner which has been described. When the selector reaches step 10 the conductor from the interrupter is opened.

The manner in which a disconnect signal is transmitted through the trunk termination per Fig. 3 will now be described.

When a disconnect signal in the form of a spacing condition of approximately ten seconds duration is received over conductor **109**, relay **146** is released. Relay **209** will be operated during the interval while the selector brush arm **206** engages with its fifth, sixth, seventh and eighth contacts but will be released when brush arm **206** is advanced to its ninth contact. When brush arm **206** engages its ninth contact a circuit may be traced from ground through brush arm **206** and the top winding of relay **205** to battery operating relay **205**. The operation of relay **205** will prepare a locking path for this relay over a circuit which may be traced from battery through contact **263** of relay **262**, bottom winding of relay **205**, contacts **281**, **282** and **283** of relay **205** to open contact **212** of the off-normal spring assembly **210**. Contact **212** will close when selector **203** returns to normal. The operation of relay **205** by opening contact **204** will disconnect ground through interrupter **206** from rotary magnet **202** of selector **203**. The object of opening contact **204** is to prevent excessive wear of the rotary selector in the event that a trouble condition causes a spacing condition of longer than nine seconds. When the disconnect spacing period is ended and selector **203** is released, contact **212** will be reclosed, locking relay **205** operated through its bottom winding. The reoperation of relay **146** at the end of the disconnect interval establishes a circuit from ground through contact **156** of relay **146**, contact **282** of relay **205** to ring conductor **280** of jack **249** and through the ring of the plug of the connected cord circuit to light the cord circuit supervisory lamp steadily as a disconnect signal. When relay **146** is operated at the end of the disconnect signal relay **160** will also reoperate. This in turn restores selector **203** to normal. Since ground is supplied through contact **212** of the off-normal spring assembly **210** through the contacts of relay **205** to the ring conductor of the jack, subsequent release of relay **146** cannot remove ground from the ring lead or from the locking winding of relay **205**. Even though relay **146** is released for a period normally sufficient to release relay **160** selector **203** will not be stepped since the lead from interrupter **206** is open at contact **204** of relay **205** and relay **160** is locked to the selector ground. Relay **205** will remain locked to hold ground on the ring conductor **280** until the operator removes the cord and releases relay **148**.

Sending a recall signal from the switchboard through Fig. 2 toward the distant office

The manner in which a recall signal is transmitted from the switchboard at which Fig. 2 is located will now be described. In order to transmit a recall signal through Fig. 2 a key in the cord circuit is operated to apply positive battery to tip conductor **184** of jack **182** and a circuit may then be traced through contact **273** of relay **236**, contact **274** of relay **275**, contact **277** of relay **272** and the top winding of relay **138** to negative battery operating relay **138**. When relay **138** operates it locks over a circuit which may be traced from ground through contact **243**, bottom winding of relay **138**, contact **285** of off-normal spring assembly **170** to negative battery. When relay **138** is operated contact **137** is opened which opens the transmitting path to the distant office. Contact **286** is closed. This connects negative battery through resistance **287**, contact **286**, contact **231** of relay **140** and resistance **232** to transmitting ring conductor **185**. This holds the cord circuit repeater in the marking condition during the open circuit period of the recall signal. The opening of the circuit through the top conductor of relay **136** permits contact **153** to close. This in turn releases relay **157**. The release of relay **157** operates relay **164**. This in turn steps the selector. These operations have been described heretofore. Contact **285** of the off-normal spring assembly is open but since a parallel path to battery is closed through brush arm **169** of selector **167** to battery relay **138** is maintained locked in operated position. This locking condition is maintained until brush arm **169** engages terminal No. 7. The paths extending from terminal No. 7 are open at this time. Relay **138** is therefore released to close the transmitting channel through Fig. 2. Relay **136** thereupon closes contact **154**. This results in the transmission of a seven second open line signal toward the distant office **103** as a flashing recall signal. When brush arm **168** engages its sixth terminal relay **272** is operated over a circuit heretofore traced. This connects ground through contacts **154**, **276**, **274** and **273** to tip conductor **184** of jack **182** and through the tip of the plug of the connected cord circuit to actuate the flashing recall signal in the home cord after relay **136** engages contact **154**.

Sending a disconnect signal from the switchboard through Fig. 2 to the distant office

The manner in which a disconnect signal is transmitted from the switchboard through Fig. 2 to the distant office will now be described.

A disconnect signal is transmitted by operating

a key in the cord circuit to connect positive battery to tip conductor 184 of jack 182. This operates relay 138 in a manner which has been described. Relay 138 in turn opens the transmission circuit toward the distant office and locks through contact 285 over a circuit which has been traced. The lock is maintained when selector 167 is stepped in response to the open signal, in a manner which has been described, from negative battery connected to terminals of the selector bank associated with brush 169. The operator removes the cord from jack 182. This releases relay 140. A circuit may then be traced from negative battery through contact 179 of relay 140, terminal No. 7 of bank 2 of selector 167, brush arm 169, bottom winding of relay 138, and contact 243 to ground to maintain relay 138 operated. This maintains relay 236 operated over a circuit from ground through contact 243, contact 242 and the top winding of relay 236 to battery. This in turn maintains the busy condition on the sleeves of jacks such as 249 in the switchboard where Fig. 3 is located until the disconnect signal is completed.

Sending recall and disconnect signals from the switchboard through Fig. 3 toward the distant office

In transmitting recall and disconnect signals from the switchboard in which Fig. 3 is terminated toward the distant office in Fig. 1 the transmission circuit extending through Fig. 3 is not opened in the terminating trunk as was the case for the trunk termination per Fig. 2. Recall and disconnect signals are transmitted from the operator's position circuit connected to the cord circuit which cooperates with Fig. 3 and does not involve the operation of apparatus in Fig. 3. These operations will therefore not be described.

Outgoing calls

In the case of a call originating either in the switchboard to which Fig. 2 is connected or to which Fig. 3 is connected the calling cord of the cord circuit is connected to jack 182 or to jack 249. In either case the calling signal is transmitted by the operation of a key in the cooperating cord to send an open signal of from two to five seconds. The answering lamps in the corresponding trunk termination will not be lighted as relay 175 in Fig. 2 and relay 219 in Fig. 3 are not operated on calls originating in the switchboards where they are located.

Out-of-service feature

When the termination circuit disclosed in Fig. 2 is out of service due to the opening of the path through the line winding of relay 136, as a result of a trouble condition, further operation of selector 167 is avoided, once the selector arm 168 reaches terminal 10, by the operation of relay 296. Relay 296 operates in series with relay 275 on step 10 of selector bank 1 of selector 167 over a circuit from ground through contact 153, arm 168, terminal 10 and the windings of relays 296 and 275 to battery. This disconnects interrupter 258 by opening contact 255. The arms 168 and 169 of selector 167 will thereafter remain on the tenth terminal of their respective banks until the trouble is cleared.

An out-of-service feature is included also in the termination circuit disclosed in Fig. 3. In Fig. 3 the interrupter is disconnected when ground in connected through brush 206 and contact 10 of bank 1 through the top winding of relay 205 to battery opening contact 204 after an open signal of ten seconds or more in duration.

Termination in two offices at each end of channel

As mentioned in the second paragraph on page 1 the double-ended trunk of the present invention may be located in two different switchboards in two different cities interconnected by a single channel. The figures are then arranged, as would be obvious to one skilled in the art, as shown in the diagram per Fig. 5 and the operation of the trunk circuit at each end is the same as described in the foregoing.

What is claimed is:

1. In a telegraph switching system, a telegraph trunk circuit, a first telegraph central office connected to one end of said trunk, a second and a third telegraph central office connected in parallel to the other end of said trunk, means in said trunk for transmitting a trunk calling signal from said first office to both said second and said third offices simultaneously, means in said trunk for transmitting communication signals from said first office to either one of said second and third offices, and means in said trunk circuit for transmitting supervisory signals from said first office to either one of said second and third offices.

2. In a telegraph switching system, a telegraph trunk circuit, a first telegraph central office connected to one end of said trunk, a second and a third telegraph central office connected in parallel to the other end of said trunk, means in said trunk for transmitting a trunk calling signal from said second or said third office to said first office, means in said trunk for transmitting communication signals from said second or said third office to said first office, and means in said trunk for transmitting supervisory signals from said second or said third office to said first office.

3. In a telegraph switching system, a telegraph channel, a telegraph repeater in said channel, a first and a second telegraph central office connected to one end of said channel, means in each of said central offices for transmitting a channel calling signal over said channel, means in each of said central offices for transmitting communication signals over said channel, and means in each of said central offices for transmitting supervisory signals over said channel.

4. In a telegraph switching system, a telegraph channel, a telegraph repeater in said channel, a first telegraph central office connected to one end of said channel, a second and a third telegraph central office connected in parallel to the other end of said channel, means in said channel for transmitting a calling signal over said channel from said first office to said second and third offices simultaneously, means in said channel for transmitting communication signals over said channel to said second office or to said third office, and means in said channel for transmitting supervisory signals over said channel from said first office to said second or said third office.

5. In a telegraph switching system, a first manual central telegraph subscriber's switchboard, a second and a third manual central telegraph subscriber's switchboard, a telegraph channel connecting said first switchboard to said second and third switchboards in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first switchboard to said second or said third switchboard, and means in said system for transmitting a calling signal from said first

switchboard to said second or said third switchboard.

6. In a telegraph switching system, a first manual central telegraph switching office, a second and a third manual central telegraph switching office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, and means in said system for transmitting a recall signal from said first office to said second or said third office.

7. In a telegraph switching system, a first telegraph office, a second and a third telegraph office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, and means in said system for transmitting a disconnect signal from said first office to said second or said third office.

8. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, means in said system for transmitting a calling signal from said first office to said second or said third office, and means in said system for transmitting a disconnect signal from said first office to said second or said third office.

9. In a telegraph switching system, a first telegraph office, a second and a third telegraph office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, means in said system for transmitting a calling signal from said first office to said second or said third office, and means in said system for transmitting a recall signal from said first office to said second or said third office.

10. In a telegraph switching system, a first telegraph office, a second and a third telegraph office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, means in said system for transmitting a recall signal from said first office to said second or said third office, and means in said system for transmitting a disconnect signal from said first office to said second or said third office.

11. In a telegraph switching system, a first telegraph office, a second and a third telegraph office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means in said system for transmitting communication signals from said first office to said second or said third office, means in said system for transmitting a calling signal from said first office to said second or said third office, means in said system for transmitting a recall signal from said first office to said second or said third office, and means in said system for transmitting a disconnect signal from said first office to said second or said third office.

12. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, and means in said system for transmitting supervisory signals from said second or said third office to said first office.

13. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, and means at either said second or said third office for transmitting channel calling signals from said second or third office to said first office.

14. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, and means in said second and said third office for transmitting recall signals from said second or said third office to said first office.

15. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater, in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, and means at said second or third office for transmitting disconnect signals from said second office to said first office.

16. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, means in said second and said third office for transmitting calling signals from said second office to said first office, and means in said second and third office for transmitting recall signals from said second office to said first office.

17. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, means in said second or said third office for transmitting channel calling signals from said second or third office to said first office, and means in said system for transmitting disconnect signals from said second or third office to said first office.

18. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third

offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, means in said second office for transmitting recall signals from said second office to said first office, and means in said second office for transmitting disconnect signals from said second office to said first office.

19. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph repeater in said channel, means at either said second or said third office for transmitting telegraph communication signals over said channel to said first office, means in said system for transmitting channel calling signals from said second office to said first office, means in said system for transmitting recall signals from said second office to said first office, and means in said system for transmitting disconnect signals from said second office to said first office.

20. In a telegraph switching system, a first telegraph central switching office, a second and a third telegraph central switching office, a telegraph channel connecting said first office to said second and third offices in parallel, a telegraph trunk termination connected to said channel at each of said second and said third offices, means in each of said terminations for discriminating between a telegraph calling signal and a telegraph supervisory signal transmitted from said first office over said channel to said second and third offices, and means responsive to the answering of said calling signal at said second office for effectively disconnecting said trunk termination from said third office.

21. In a telegraph switching system, a first telegraph central office, a second and a third telegraph central office, a telegraph channel connecting said first office to said second and said third offices in parallel, a telegraph repeater in said third offices for operating an indicator to said channel, means at each of said second and indicate that a call is incoming over said channel from said first office, and means responsive to the answering of said call at said second office for restoring said indicator at said third office to its original condition.

22. In a telegraph switching system, two separate telegraph switching trunk terminations, a telegraph calling signal control and a telegraph cord switching circuit supervisory signal control in each of said telegraph trunk terminations, said terminations in two separate central telegraph switching offices, said terminations connected in parallel to one end of a long distance telegraph trunk circuit, a telegraph repeater in said long distance telegraph trunk circuit, and means in said terminations, responsive to a signal transmitted over said circuit, for registering a calling signal at each of said two terminations substantially simultaneously.

23. In a telegraph switching system, a telegraph channel including a repeater, a first telegraph trunk termination connected from a first end of said channel to a first telegraph central office, a second telegraph trunk termination connected from said first end of said channel to a second telegraph central office, separate cord circuit supervisory signal controls in each of said terminations, means at either of said offices for answering a call incoming over said channel, and means at either of said offices responsive to said answering for disabling a telegraph communication path between the other of said offices and said channel.

24. In a telegraph switching system, a telegraph channel, a telegraph repeater in said channel, a first telegraph trunk termination connecting a first end of said channel to a first central telegraph switchboard, a second telegraph trunk termination connecting said first end of said channel to a second central telegraph switchboard, separate cord circuit supervisory signal controls in each of said terminations, and means responsive to the answering of a call incoming through said termination at said first switchboard for impressing a busy condition on said trunk termination in said second switchboard.

25. In a telegraph switching system, a telegraph channel, a telegraph repeater in said channel, a first and a second telegraph trunk termination, at a first and a second manual central office telegraph switchboard, each of said switchboards being at a different office, said terminations connected in parallel to each end of said channel, separate cord circuit supervisory signal controls in each of said terminations, and means for transmitting a calling signal from either of said switchboards at one end of said channel to both of said switchboards at the other end of said channel.

26. A system in accordance with the preceding claim including means for responding to said signal at either switchboard in which it appears.

27. A system in accordance with claim 25 including means for effectively disconnecting the communication path to one of said switchboards in which said signal appears when the call is answered at the other of said switchboards in which said signal appears.

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