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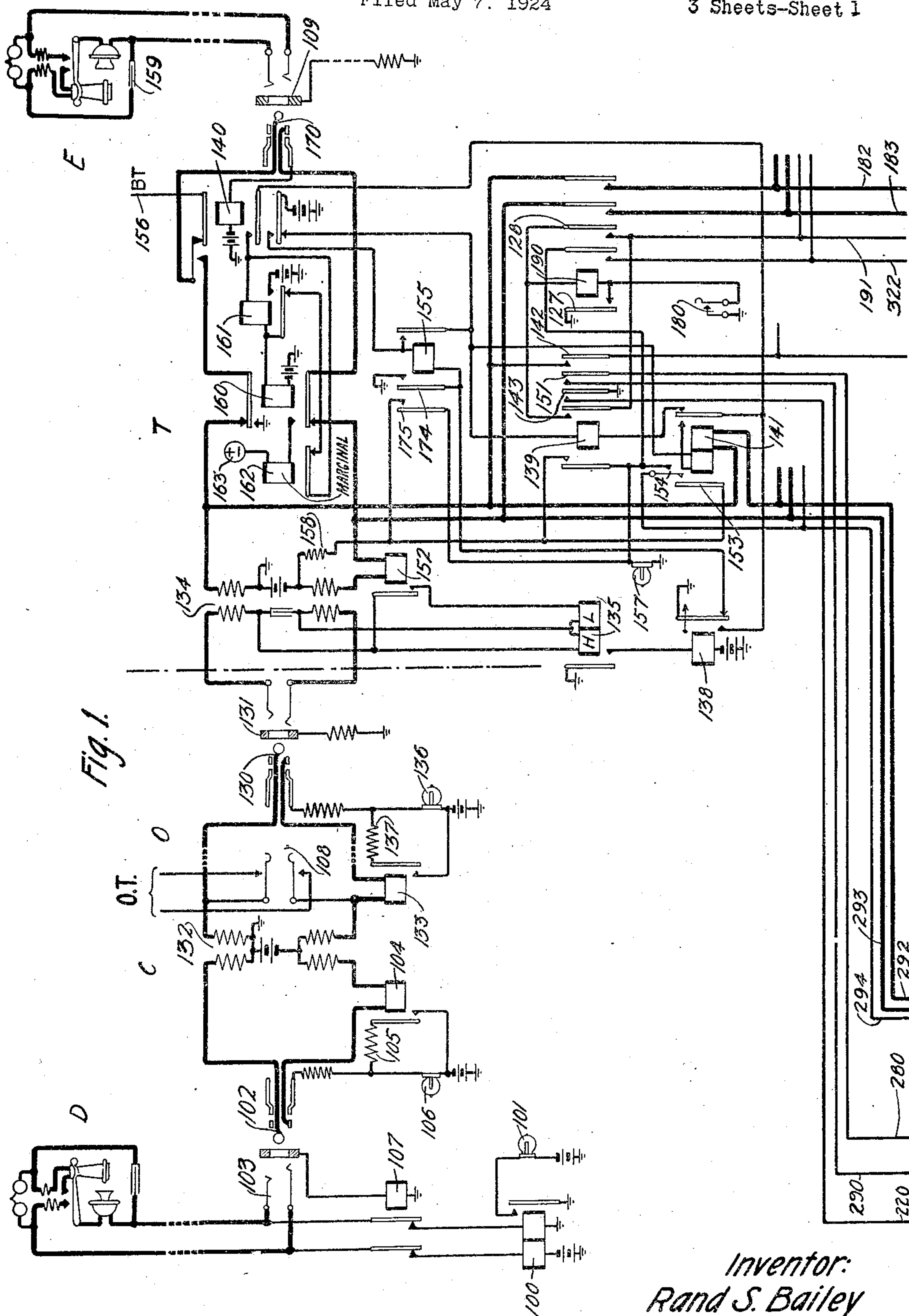
R. S. BAILEY

1,641,218

STRAIGHTFORWARD TRUNKING SYSTEM

Filed May 7, 1924

3 Sheets-Sheet 1



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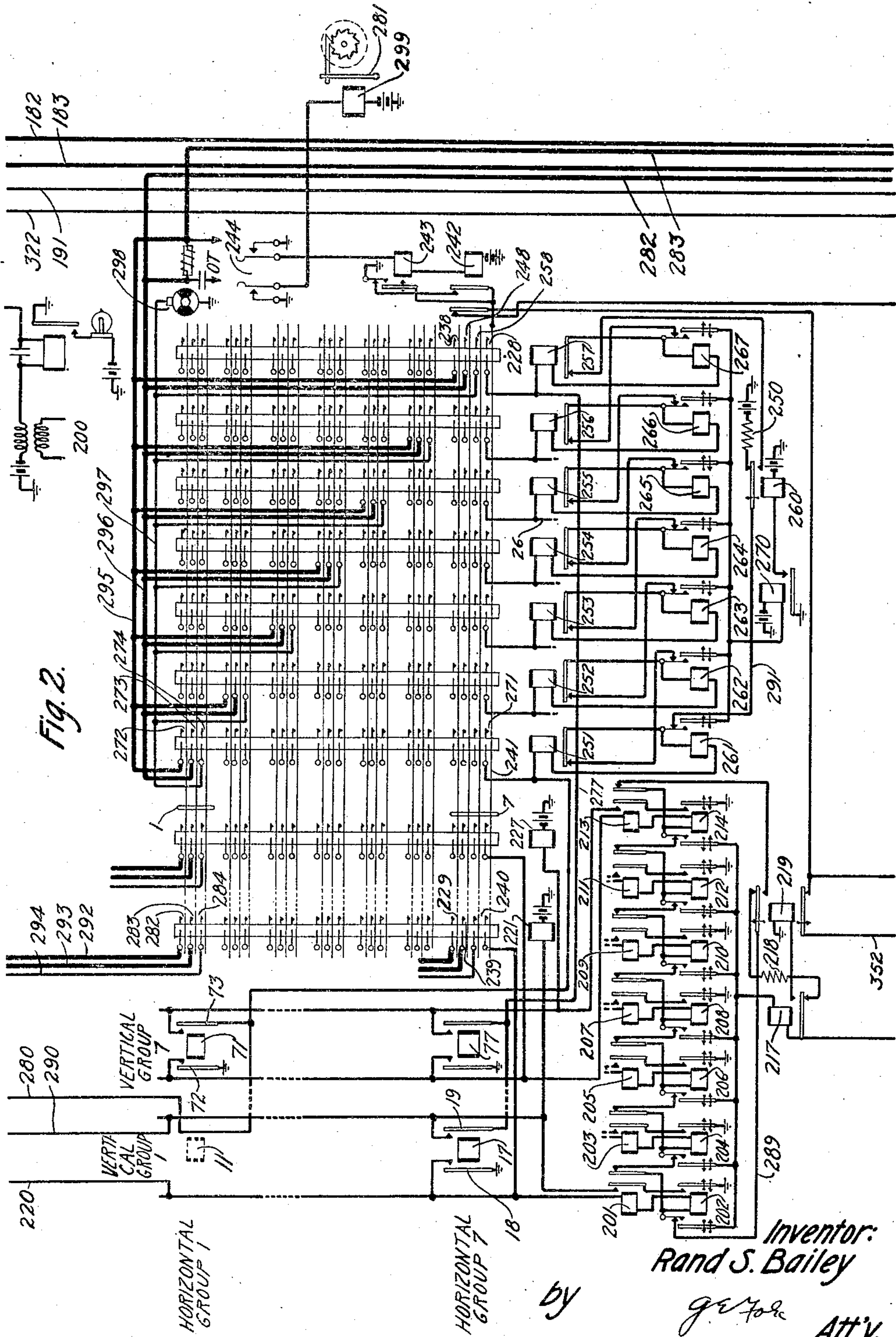
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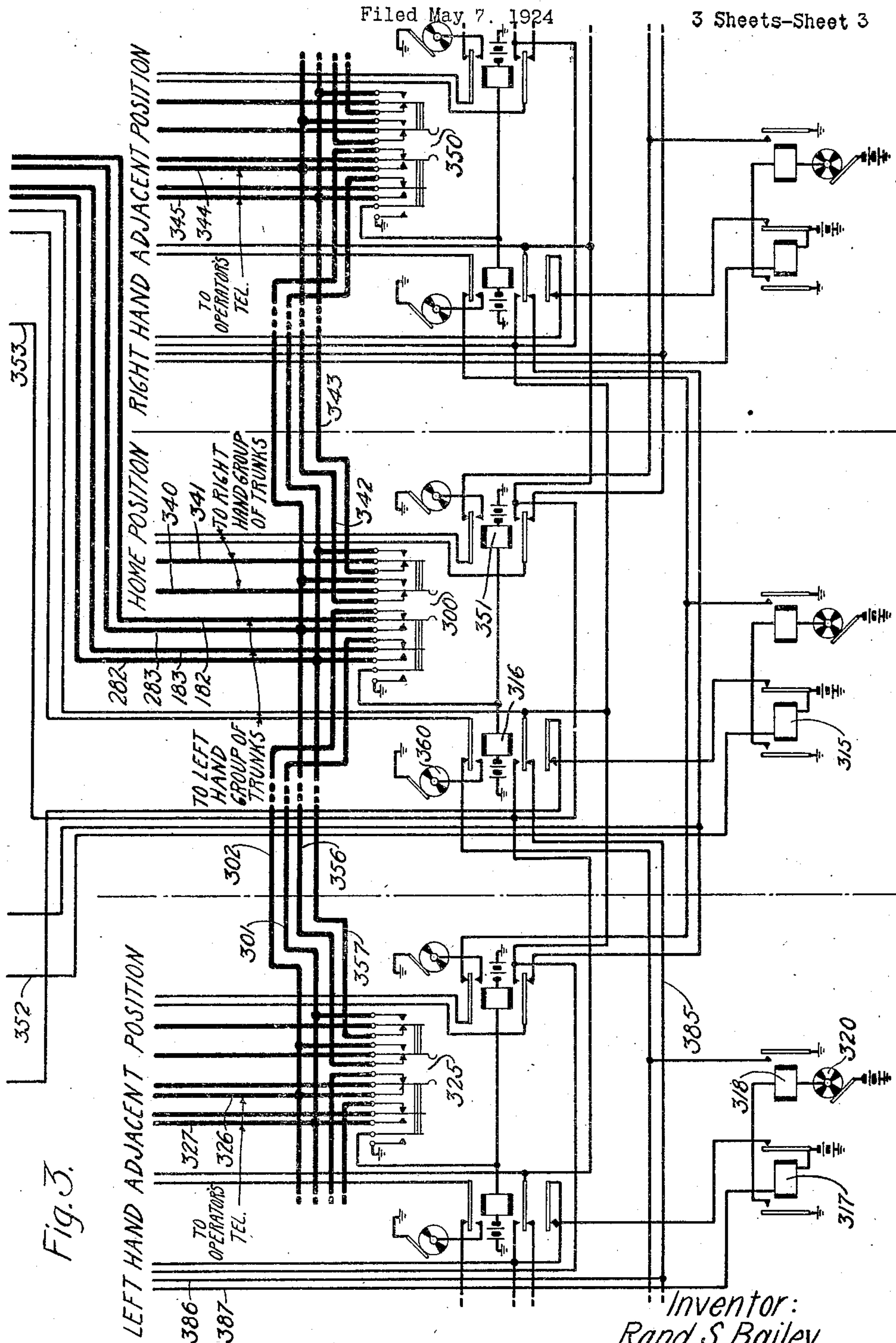


Fig. 3.

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per *[Signature]*

by

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UNITED STATES PATENT OFFICE.

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STRAIGHTFORWARD TRUNKING SYSTEM.

Application filed May 7, 1924. Serial No. 711,691.

This invention relates to telephone systems, and more particularly, to trunk circuits for establishing connections between manual telephone exchanges.

5 In manual telephone trunking systems as at present arranged, it is customary for the so-called B operator at a distant office to assign, by means of a separate order wire, a trunk to be used by the so-called A operator at the call originating office for the extension of a connection to the distant office, and keys are ususally provided whereby the B operator may connect her telephone set to the assigned trunk for the attention and supervision of the call.

15 It is an object of this invention to eliminate assignment of a trunk by the B operator by the provision of a so-called straightforward trunking system, whereby the A operator may seize any trunk leading to the desired distant office and whereby the B operator's telephone set is automatically connected to a trunk the moment it is seized.

25 Another object of the invention is to provide suitable supervisory signal indications during the establishing of a connection over a trunk in this manner as well as during the maintenance and release thereof.

30 Another object is the provision whereby preferential service in accordance with a certain system may be given to the trunks in the connection of the B operator's telephone set thereto.

35 Another object is the provision and means whereby if calls at a B operator's position are coming in at an excessive rate, the adjacent operators at either side may take over and attend to calls at such an operator's position when there are no calls awaiting attention at their own positions.

40 Another object is to provide an emergency arrangement whereby the B operator's set may be manually connected to the trunks if the automatic equipment is incapacitated.

45 To attain these objects in accordance with one feature of this invention, a multi-contact relay and circuit arrangement is provided whereby the B operator's set is automatically connected to a trunk the moment it is seized provided the set is not already engaged, in which case, the seized trunk is held ready to be connected when the set is free.

50 Another feature is the provision of a so-called group relay an unit relay arrangement

by means of which the trunks are divided into groups so arranged in cooperation with the multi-contact relay that the seized trunks are connected to the B operator's set in accordance with the value of the arbitrary numbers assigned thereto, that is, a seized trunk located in a group having a lower number would be attended to before a seized trunk located in a group having a higher number and so also would a lower numbered trunk in a group be attended to in preference to a higher numbered trunk in the same group.

55 Another feature is the provision of a so-called team key and a relay arrangement associated with each trunk, whereby if such a key is depressed the corresponding trunk is disconnected from the B operator normally assigned to attend to it and connected to an adjacent operator's set, that is, adjacent operators can at will attend to and dispose of incoming calls at each other's positions.

60 Another feature resides in the provision of a signal operating arrangement whereby a signal associated with a seized trunk is operated in one characteristic manner when the B operator normally attending to the trunk is connected thereto and in a different characteristic manner when an adjacent operator is attending to the trunk.

65 Other features reside in the operation of the signals associated with the trunks to indicate the progress of a call.

70 Another feature is the provision of an emergency key at each B operator's position by means of which, if the automatic equipment for connecting the B operator's set to a seized trunk should fail to function it would be cut completely out of service.

75 Another feature is the provision whereby the operation of the team key of any of the trunks will serve as an ordinary listening key to connect the operator's set to a seized trunk whenever the emergency key is operated.

80 One embodiment of the invention is disclosed in the accompanying drawings in which Figure 1 shows a calling subscriber's line, an ordinary A operator's cord circuit at one exchange and also a trunk line terminating in this exchange and extending to a B operator's position at a distant exchange where a called subscriber's line is also shown.

85 Fig. 2 illustrates a type of multi-contact

relay arrangement used in connecting the B operator's telephone set to trunks, such as the one shown in Fig. 1, and the associated group and unit relay arrangements for the preferential service.

Fig. 3 shows emergency keys and associated relay arrangements for three adjacent operator's positions. The drawing should be arranged together by placing Fig. 1 above and Fig. 3 below Fig. 2.

The system disclosed in the drawings is devised in such a manner that a B operator at the home position is capable of handling calls incoming to her position on 49 trunks, though it is obvious that, should conditions require it, the equipment may be readily adapted to handle a greater number of trunks.

The 49 trunks are divided into seven groups, each group having seven trunks therein. For descriptive purposes only, the trunks in the first group are numbered from 11 to 17, inclusive, the trunks in the second group from 21 to 27, inclusive, and so on to the last group, wherein the trunks are numbered 71 to 77, inclusive. Each of the groups of trunks, that is, all trunks bearing the same tens digit such as trunks 11, 12, 13 . . . 17 which hereinafter shall be referred to as the vertical groups, have allotted to them a pair of tens group relays, and these group relays are arranged in a chain circuit in such a manner as to effect a vertical group preferential circuit, and the system is so arranged that the lower number groups have preference over the higher number groups, that is, the trunks in the vertical group bearing the tens digit 1 have preference over the trunks in the vertical group bearing the tens digit 2, etc.

In like manner, each group (which will hereinafter be referred to as the horizontal groups) of trunks bearing the same unit digit such as trunks 11, 21, 31, etc., has allotted to it a pair of unit group relays, the unit relays of each group being also arranged in a chain circuit so as to effect a unit preferential circuit, and the system is designed so that the trunks in the horizontal groups bearing the lower unit digit have preference over the trunks bearing higher unit digits, that is, trunk 21 has preference over trunk 22, etc.

The multi-contact relays employed in the system disclosed and shown in Fig. 2, are in substance, relays which in operating close their contacts on stationary bus-bars, so that to handle the 49 trunks specified, only seven sets of such bus-bars are required, each set being common to the seven trunks in the same horizontal group, such as the trunks 11, 21, 31, etc., that is, the first set of bus-bars is assigned to the trunks 11, 21 31 . . . 71, the second set of bus-bars to trunks 12, 22, 32, . . . 72, etc., and all the sets are com-

mon to the B operator's telephone set at the home position. In this manner, by the joint operation of a set of tens group relays and a set of unit group relays, the B operator's telephone set may be connected to any one of the 49 trunks incoming at her position.

The invention will be readily understood from the following detailed description.

The first description will be directed to the establishment of a connection between a calling subscriber at station D and a called subscriber at station E, the connection to be established by way of an A operator's cord circuit C and the trunk T, which for descriptive purposes will be assumed to be trunk No. 11, that is, the first trunk in the first vertical trunk group.

The subscriber at station A upon removing the receiver from the switchhook, causes the line relay 100 to operate over an obvious circuit. Relay 100 in operating, causes the line lamp 101 to be lighted. The operator at position O at which the line lamp 101 is located, upon noting this lamp lighted inserts the answering plug 102 of a cord circuit C into the jack 103 associated with the illuminated line lamp 101. Upon the insertion of plug 102 into jack 103, the answering supervisory relay 104 operates from battery associated with the repeating coil 132 in a circuit including the closed subscriber's line loop and the answering end of the cord circuit C. Relay 104 operating in this circuit, connects the resistance element 105 in shunt of the answering supervisory lamp 106, preventing this lamp from lighting over the sleeve circuit which is now closed. The cut-off relay 107 operates in the closed sleeve circuit, disconnecting the line relay 100 from the calling subscriber's line. The line relay 100 thereupon releases, causing the line lamp 101 to be extinguished.

The A operator then actuates the key 108, thereby bridging her telephone set indicated at O. T. across the tip and ring conductors of the cord circuit. The operator then requests, of the calling party, the desired number. Upon learning that the desired party is located at station E, the A operator tests for an idle trunk leading to a B operator's position, at which the desired line terminates in the jack 109, in the well known manner and on finding the trunk T, which is assumed to be trunk number 11, idle, she inserts the plug 130 into the jack 131 of the selected trunk.

Upon the insertion of plug 130 into jack 131, a circuit is established which may be traced from grounded battery, through the lower right-hand winding of repeating coil 132, winding of supervisory relay 133, ring contacts of plug 130 and jack 131, lower left-hand winding of repeating coil 134, left-hand high resistance winding of relay 135, upper left-hand winding of repeating coil

134, tip contacts of jack 131 and plug 130, through the upper right-hand winding of repeating coil 132, to ground. Due to the high resistance of the left-hand winding of relay 135 included in this circuit, relay 133 does not operate at this time, so that the supervisory signal lamp 136 will light in an obvious manner through the sleeve circuit.

Relay 135, however, operates in the circuit just traced and causes relay 138 to operate over an obvious circuit. Relay 138 causes the trunk relay 139 to operate in a circuit extending from grounded battery, over the lower armature and back contact of relay 140, through the winding of relay 139, back contact and right-hand armature of cut-off relay 141, to ground over the front contact and armature of relay 138. Relay 139 in attracting its left-hand armature, causes the assignment lamp 157 to be lighted in a circuit which may be traced from grounded battery, through the resistance element 158, front contact and left-hand armature of relay 139, to ground through the filament of lamp 157. The assignment lamp 157 glows steadily in this circuit, indicating to the B operator that there is a call waiting on the trunk T. At its armature 142, relay 139 causes current from the tone source 200 to be connected to the tip conductor of the trunk T. The connection of this tone current to the tip conductor of the trunk causes a tone to be manifested in the A operator's head-set, indicating to the A operator that the B operator's telephone set is not yet connected to the selected trunk.

It is understood that the B operator's telephone set is assumed to be idle at this time. At its armatures 151 and 143, relay 139 closes through the common leads 280, 290 and 220. A circuit may now be traced from grounded battery, over the right-hand armature and back contact of relay 315, back contact and lower armature of relay 316, armature and back contact of relay 217, resistance element 218, back contact and upper armature of relay 219, normal make-before-break contacts of group relay 202, winding of relay 202, winding of group relay 201, common conductor 220, front contact and armature 143 of relay 139, to ground. The group relays 201 and 202 which are allotted to the first vertical group of trunks Nos. 11 to 17 inclusive, operate in this circuit. Relay 201 in attracting its outer armature, opens the shunt circuit including contacts of all other vertical group relays. At its inner armature, relay 201 prepares a circuit, the completion of which will presently be described.

Relay 202 at its right-hand armature, connects ground to the winding of the group relay 221, by way of the inner armature and front contact of relay 201. Relay 221 thereupon operates to close all its contacts on the

seven sets of bus-bars immediately above it for purposes which will hereinafter appear. At its left-hand armature, relay 202 opens the original energizing circuit for relays 201 and 202 and substitutes another circuit therefor, extending through the winding of relay 217. Relay 217 thereupon operates and in attracting its armature also opens at another point the original energizing circuit for relays 201 and 202 and causes relay 219 to operate in a circuit which is believed to be obvious. In attracting its upper armature, relay 219 transfers the start lead 289 to the back contact and outer armature of relay 213, which is one of the group relays assigned to the seventh vertical group of trunks (Nos. 71 to 77 inclusive). This transfer is effected in order to maintain the order of progression so long as there are calls waiting, as will be more fully described hereinafter. Relay 219 is made slow to release to further insure this order of progression. The closure of the contacts 282, 283, and 284 of the multi-contact relay 221, connects the conductors 292, 293 and 294, which are individual to No. 11 trunk T, to the set 1 of stationary bus-bars which set is individual to the horizontal group of trunks (Nos. 11, 21, 31, 41, 51, 61 and 71). At the contact 240, relay 221 causes relays 217, 201 and 202 to lock through the bus-bar 241 which is grounded at the contacts of the position release relays 242 and 243.

The unit relays 261 and 251 now operate in a circuit extending from grounded battery, through the resistance element 250, back contact and armature of relay 260, normal make-before-break contacts of relay 261, winding of relay 261, winding of relay 251, conductor 280, armature 151 and front contact of relay 139, conductor 290, front contact and inner armature of relay 201, to ground over the front contact and right-hand armature of relay 202. Relay 261 in operating, opens the original energizing circuit for relays 251 and 261 and connects relay 270 in series with these relays to battery and ground, causing relay 270 to operate and establish an obvious circuit for relay 260, which in operating transfers the start lead 291 to the back contact of relay 257, which is one of the unit relays allotted to the seventh horizontal group of trunks. In this manner the order of progression is maintained as hereinafter described. Relay 251 also closes all its upper contacts to the seventh set of stationary bus-bars. At the contacts 271, relay 251 causes relays 270, 261 and 251 to lock through on the bus-bar 241 which, as hereinbefore stated, is grounded by way of the armatures and contacts of the position release relays 242 and 243. At its contacts 272, 273 and 274, relay 251 causes the leads 295, 296 and 297, which lead to the B operator's telephone set, to be connect-

ed to the set 1 of the stationary bus-bars.

As a consequence of the operations heretofore described, the B operator's telephone set O. T. is now connected to the tip and ring conductors of the trunk circuit by way of the tip and ring leads 295 and 296, contacts 272 and 273 of relay 251, over the tip and ring bus-bars of set 1, contacts 282 and 283 of relay 221, conductors 292 and 293, and thence to the tip and ring conductors of the trunk T through the right-hand winding of the cut-off relay 141, so that the B operator is now in a position to converse with the A operator and learn the details of the connection.

Cut-off relay 141 now operates in a circuit extending from grounded battery, through the lower right-hand winding of repeating coil 134, through the winding of relay 152, conductor 293, contacts 283 of relay 221, ring bus-bar of set 1, contacts 273 of relay 251, conductor 296, through a bridge in the operator's telephone set, conductor 295, contacts 272 of relay 251, tip bus-bar of set 1, contacts 282 of relay 221, conductor 292, right-hand winding of cut-off relay 141, upper right-hand winding of repeating coil 134, to ground. Relay 141 in attracting its right-hand armature, opens the circuit for relay 139 and locks itself in a circuit extending from grounded battery, lower armature and back contact of relay 140, left-hand winding of relay 141, front contact and right-hand armature of relay 141, to ground at the front contact and armature of relay 138. At its left-hand armature, relay 141 closes its contacts 153 and 154, whereby a circuit is established which may be traced from grounded battery, through the resistance element 158, to the left-hand armature of relay 141 whence the circuit branches off in two parallel paths, one extending over the contacts 153 and 154 of relay 141 to ground through the filament of the assignment lamp 157, and the other extending over the contacts 153 of relay 141, conductor 294, contacts 284 of relay 221, lower bus-bar of set 1, contacts 274 of relay 251, conductor 297, to ground through the busy-back interrupter 298. By this arrangement, the assignment lamp 157 is intermittently shunted, causing it to be flashed in synchronism with the interruptions effected by the interrupter 298. The flashing of the lamp 157 at busy-back frequency, indicates to the B operator that her telephone set has been connected to the trunk circuit T to which the lamp 157 is individual.

Relay 139 in releasing as mentioned above, opens at its left-hand armature, the original circuit for the assignment lamp 157, which, however, as stated is now flashing at busy-back frequency. At its armature 142, relay 139 disconnects the tone signaling source 200 from the trunk, thereby indicating to

the A operator that the B operator's telephone set has been connected to the trunk circuit T. In releasing its armatures 143 and 151, relay 139 disconnects the common leads 220, 290, and 280 from the trunk T.

The A operator now passes the details of the call to the B operator who, upon learning that the desired party is located at station E, tests the sleeve of jack 109 of the called line in the well known manner and on finding the line idle, she inserts the plug 170 into the jack 109 and sleeve relay 140 operates over an obvious circuit. At its lower normal contacts, relay 140 opens the locking circuit for the cut-off relay 141, whereupon this relay will be prepared for a subsequent release as will hereinafter be described. In closing its lower alternate contacts, relay 140 prepares a circuit for relay 155, the purpose of which will be hereinafter described. In attracting its upper armature, relay 140 removes the busy test lead 156 from the tip conductor of the trunk circuit and renders the tip of the trunk continuous at that point.

When the B operator has thus completed her work in connection with the extension of a connection to the subscriber at E, she actuates the combined register and master release key 244. At its left-hand contacts, key 244 causes the message register magnet 299 to operate, preparing the position register for operation. At its right-hand contacts, key 244 causes the position release relays 243 and 242 to operate in an obvious circuit. Relay 242 is fast operating, whereas relay 243 is made slow-to-operate, so that for a brief interval the locking ground is removed from the bus-bar 241 so that, if no other calls are waiting, the group relays 201, 202, 221, and 217 and the units relays 251, 261, and 270 are released, thereby releasing the B operator's set from the trunk T. After the B operator's set is released, the circuit for relay 141 is open at contacts 282 and 283 causing this relay to release. The release of this relay opens the circuit for the assignment lamp 157 which is then extinguished. The locking ground is placed under the control of the release relay contacts instead of directly on the key, so that when there are calls waiting, the progressive order of connecting the B operator's telephone set to the trunk circuits will not be disturbed, as will hereinafter appear.

The subscriber at E will now be automatically rung as relay 140 in closing its inner lower alternate contacts, causes the ringing relay 160 to operate in a circuit extending from grounded battery, through the winding of relay 160, armature and back contact of relay 161, back contact and armature of relay 162, upper alternate contacts of relay 140, to ground at the front contact and armature of relay 138. It will be noted

that relay 161 is short circuited by its own normal contacts and by the normal contacts of relay 162, so that this relay does not operate at this time. Relay 160 in operating, causes ringing current from the source 163 to pass through the winding of the marginal tripping relay 162 over the front contact and lower armature of relay 160, ring contacts of plug 171 and jack 109, through the operating windings of the bells at the subscriber's station E, condenser 159, tip contacts of jack 109 and plug 170, alternate make-before-break contacts of relay 140, to ground at the upper armature and front contact of relay 160. The bells at the subscriber's station are actuated by this current to signal the called subscriber. Relay 162 being marginal, does not receive sufficient current at this time to operate.

When the called subscriber responds to this signal by removing the receiver from the switchhook, the condenser 159 is short circuited and the path for the ringing current is then through the subscriber's switchhook contacts and transmitter. With the condenser 159 short circuited, the resistance of the ringing circuit is sufficiently decreased to permit the tripping relay 162 to operate. Relay 162 in operating, opens the short circuit about the winding of relay 161, permitting this relay to operate in series with relay 160. Relay 161 in operating, connects battery to its own winding, causing it to be locked to ground at the front contact and armature of relay 138 and causing the ringing relay 160 to be shunted to disconnect the ringing current source 163 and the winding of the tripping relay 162 from the ring conductor of the trunk. Upon the release of the ringing relay 160, the supervisory relay 152 operates in a circuit extending from grounded battery, through the lower right-hand winding of repeating coil 134, winding of relay 152, back contact and lower armature of relay 160, ring contacts of plug 171 and jack 109, through the subscriber's closed line loop, tip contacts of jack 109 and plug 171, alternate make-before-break contacts of relay 140, upper armature and back contact of relay 160, to ground through the upper right-hand winding of repeating coil 134. Relay 152 in operating, connects the right-hand low-resistance winding of relay 135 in parallel with its left-hand high-resistance winding and in series with the left-hand windings of the repeating coil 134. Due to the shunting of the left-hand high resistance of relay 135, relay 133 now operates and thus short circuits the lamp 136 through the resistance 137 so that lamp 136 now becomes extinguished to indicate that the called subscriber has answered. The connection is now completed between the two subscribers and conversation may take place.

Assuming now that the period of conversation has terminated, the calling subscriber at station D replaces the receiver on the switchhook, thereby releasing the answering supervisory relay 104, which in turn removes the shunt from the filament of lamp 106, permitting this lamp to be lighted over the closed sleeve circuit. The illumination of lamp 106 at this time serves as a disconnect signal to the A operator, who then proceeds to take down the connection by removing the plugs 102 and 130 from jacks 103 and 131, respectively. The removal of plug 102 from jack 103 opens the sleeve circuit, causing the lamp 106 to be extinguished and the cut-off relay 107 to be released. Relay 107 in releasing, reconnects the line relay 100 to the tip and ring conductors of the calling line. When the A operator withdraws plug 130 from jack 131, relay 135 releases, which in turn causes the release of relay 138. Relay 138 in retracting its armature opens the locking circuit for relay 161 causing this relay to restore, and causes the disconnect relay 155 to operate in a circuit which may be traced from grounded battery, over the lower armature and front contact of relay 140, through the winding of disconnect relay 155, to ground at the back contact and armature of slow releasing relay 138. The disconnect relay 155 in attracting its armature 174, locks under the control of relay 140. In attracting its armature 175, relay 155 causes the assignment lamp 157 to be illuminated in a circuit extending from grounded battery, through the resistance element 158, front contact and armature 175 of relay 155, to ground through the filament of lamp 157. The illumination of lamp 157 at this time serves as a disconnect signal to the B operator. The operator thereupon proceeds to remove plug 170 from jack 109 which releases relays 140 and 155 causing lamp 157 to be extinguished.

With calls waiting.

It should be noted that in case the A operator attempts to connect with trunk T before the B operator has had time to complete the disconnecting operations, the fact that relay 155 is operated will not prevent the bringing in of this new connection as battery will be supplied through this relay at its right-hand armature and front contact from the lower armature and front contact of relay 140 for trunk relay 139. The energization of relay 139 will, therefore, maintain the assignment lamp 157 lighted and cause it to begin flashing as hereinbefore described after the B operator disconnects and releases relays 140 and 155, relay 139 being now maintained energized from the battery at the lower armature and back contact of relay 140 and the lamp again serv-

ing as an assignment signal for a new connection to be extended by the B operator.

It will, therefore, be assumed that the B operator has just completed a call on trunk No. 11, as described, and that calls are waiting to be answered on trunk No. 17, that is the last or seventh trunk in the first vertical group and trunk No. 71 or the first trunk in the seventh vertical group. The trunk relays 17 and 71 respectively of these trunks are shown to the left of Fig. 2 opposite the corresponding trunk bus-bars of the multi-contact relays, to simplify the description and to render the system more readily understandable. It is to be remembered that the relays 17 and 71 correspond in every detail to relay 139 of the No. 11 trunk T, the armatures 18 and 72 of these relays corresponding to armature 143 of relay 139 and the armatures 19 and 73 of these relays corresponding to armature 151 of relay 139. To assist in this comparison, the corresponding position, relay 139 would have occupied, is shown by a dotted outline of this relay marked 11. Another trunk relay 77, being assigned to trunk No. 77, the last trunk in the seventh group, has also been shown arranged in a corresponding position to give a further clear understanding of the relative arrangement of the trunks and the correspondence between them and the trunk relays.

Under the condition assumed, the group relays 201 and 202 and the units relays 251 and 261 are operated and locked to ground at the position release relays 242 and 243. The actuation of the master release key 244 releases the relays 251 and 261, but relays 201 and 202 cannot release at this time, since there is a parallel holding circuit to ground on the armature 18 of relay 17 which relay is individual to trunk No. 17 on which we have assumed a call to be waiting. Relays 201 and 202, therefore, remain operated and upon the release of relays 251 and 261, relays 257 and 267 operate in a circuit extending from grounded battery, through the resistance element 250, back contact and armature of relay 260, start conductor 291, over the chain circuit including the normal make-before-break contacts of relays 261 to 266, inclusive, and the back contacts and armatures of relays 251 to 256, inclusive, then over the normal make-before-break contacts of relay 267, winding of relays 267 and 257, conductor 277, armature 19 and front contact of relay 17, front contact and inner armature of relay 201 to ground at the front contact and right-hand armature of relay 202. Relays 257 and 267 which are allotted to the seventh horizontal group of trunks operate and lock to ground at the contacts of the position release relays 242 and 243 by way of the contacts 228 of relay 257.

It should be noted here that if the B op-

erator is slow in releasing the position key 244, she in no way affects the operation of the next call since the master ground is restored immediately, irrespective of the length of the interval during which the key 244 is actuated. This is accomplished by the contact arrangement and relative operating characteristics of the position release relays 242 and 243 as hereinbefore described.

Relay 257 in closing its contacts 238, 248 and 258, performs the same functions as described in connection with the closure of contacts 272, 273 and 274 of relay 251, so that the B operator's head set is now connected to trunk 17 by way of the conductors 295 and 296, contacts 238 and 248 of relay 257, tip and ring bus-bars of set 7, contacts 229 and 239 of group relay 221, and thence to the tip and ring conductors of the trunk No. 17 by way of conductors corresponding to the conductors 292 and 293 of No. 11 trunk T.

Had there been other calls waiting on trunks such as 15 or 16 of the first vertical group, these calls would have been completed before the call on trunk 17 was completed and the call on trunk 15 would have the preference over the call on trunk 16. This units preference is accomplished by virtue of the fact that after the unit relay 251 has released due to the actuation of the position release key 244, a circuit for relays 255 and 265, which relays are allotted to the fifth horizontal group of trunks containing trunks 15, 25, 35, 45, 55, 65 and 75, is established from grounded battery, winding of relay 270, armature and front contact of relay 261, armature and back contact of relay 251, normal make-before-break contacts and back contacts and armatures of relays 262, 263 and 264 and 252, 253 and 254, respectively, through the windings of relays 255 and 266, in series, and thence over the conductor 26 to the right-hand armature and front contact of the No. 15 trunk relay which relay corresponds to relays such as 139 and 17 and which armature corresponds to armatures such as 151 and 19 of these last mentioned relays, respectively, front contact and inner right-hand armature of relay 201 to ground at the front contact and right-hand armature of relay 202 which relays 201 and 202 are maintained operated as hereinbefore mentioned. When relays 255 and 265 operate, the chain circuit for relays 256 and 266, which relays are allotted to the sixth horizontal group of trunks (Nos. 16, 26, . . . 76) is opened preventing these relays from operating. In this manner the B operator's telephone set is connected to trunks 11 to 17, inclusive, of the first vertical group in sequence if calls are waiting on these trunks and not until there are no calls waiting in this group will the operator's telephone set be advanced to the second vertical group of trunks.

As has been assumed the only calls waiting when the call on trunk 11 was completed, were the calls on trunks 17 and 77 and it having been described how the call on the trunk No. 17 is taken care of, the next description will be directed to the completion of a call waiting on the trunk No. 77.

When the first vertical group has been satisfied and no other calls are waiting, relays 201 and 202 will release upon the actuation of the position release key 244 since there is now no parallel holding circuit for these relays, the relays 11 to 17 being now in their normal positions. Upon release of the relay 201, relays 213 and 214, which are allotted to the seventh vertical group of trunks (Nos. 71 to 77, inclusive) operate in a circuit extending from grounded battery, over the right-hand armature and back contact of relay 315, back contact and lower armature of relay 316, winding of relay 217, left-hand armature and front contact of relay 202, outer right-hand armature and back contact of relay 201, normal make-before-break contacts of relays 204, 206, 208, 210 and 212 and outer armature and back contacts of relays 203, 205, 207, 209 and 211, respectively, windings of relays 214 and 213, to ground on the front contact and left-hand armature of relay 77 which relay is operated due to the waiting call on trunk No. 77. Relay 227 now operates in a circuit extending from grounded battery, through the winding of relay 227, front contact and inner armature of relay 213 to ground at the front contact and right-hand armature of relay 214. In attracting its left-hand armature relay 214 opens the chain circuit to the other group relays and causes relay 217 to operate in series with relays 214 and 213, in a circuit which is now believed to be obvious. In this manner when relay 219 finally releases after all calls in the seventh vertical group have been completed the first vertical group of trunks will have the preference over all other vertical groups. The units relays 257 and 267 now operate in a circuit extending from grounded battery, through the resistance element 250, back contact and armature of relay 260, conductor 291, normal make-before-break contacts of relays 261 to 266, inclusive, and contacts of relays 251 to 256, inclusive, respectively, winding of relays 267 and 257, conductor 277, right-hand armature and front contact of relay 77 to ground over the armatures and front contacts of relays 213 and 214.

Relay 227 operating as hereinbefore described, connects the ground associated with the armatures and back contacts of the position release relays 242 and 243 to the lower bus-bar of set 7, whereupon relays 214, 213, 217 and 219 lock in the same manner as described in connection with relays 202 and

201 under the control of the position release relays 244 and 243. When relay 267 operates it opens the chain circuit in all other units relays and causes relay 270 to operate in series with relays 267 and 257. Relay 270 causes relay 260 to operate. When relay 257 closes its lowermost contacts it causes relays 260, 270, 267 and 257 to lock under the control of the position release relays 242 and 243.

With relays 227 and 257 operated as described the B operator's telephone set O. T. is connected to the No. 77 trunk in a circuit which is now believed to be obvious.

Had there been calls waiting on any other vertical groups of trunks such as the second or third vertical groups these calls would have been completed before the calls waiting in the seventh group and the calls in the second group would have preference over those waiting in the third group. This group preference is obtained in the same manner as hereinbefore described in connection with the units preference.

From the foregoing description it is apparent that the applicant has devised a system wherein the lower numbered trunks in each vertical group have preference over the higher numbered trunks and the lower numbered vertical groups of trunks have preference over the higher numbered vertical groups of trunks and the B operator's telephone set is not advanced to the next succeeding vertical group until there are no calls waiting in the vertical group wherein the last call was completed.

Teamwork.

If the B operator's telephone set is engaged at a time another call comes in on another trunk, the call will await its turn to be connected to the set as hereinbefore described. However, the circuit arrangements for the trunks at the various operators' positions are such that the adjacent operator on either side of a home operator's position, that is, the position at which a call or calls are waiting attention but cannot be immediately attended to, may take over and dispose of such calls. For this purpose, the trunks may be divided in two arbitrary groups, that is, those on the left half of a position are connected so that the operator on the left of this position may attend to the same, whereas those on the right of the position are connected so that the operator at the right thereof may attend to the same. In other words, the first twenty-five trunks beginning at 11 may be attended to by the operator on the left, while the remaining trunks may be attended to by the operator on the right. Therefore, should an operator at a position adjacent to the home operator's position, for example, the B operator on the

left, upon noting the steady illumination of an assignment lamp such as 157 of No. 11 trunk T desire to relieve the home operator of answering this call, she may do so by reaching over to the home operator's position and actuating the team key 180, that is individual to the trunk T. Upon actuation of this key a circuit is established from grounded battery through the winding of relay 317 associated with the equipment at this adjacent operator's position, conductor 387, lower armature and back contact of a relay at this position corresponding to relay 219 of the home position, conductor 386, conductor 385, inner lower armature and back contact of relay 316, conductor 191, inner right-hand armature and front contact of relay 139, winding of relay 190, key 180 to ground. Relay 190 operates and at its armatures 127 and 128 locks independent of the team key 180 and the trunk relay 139. At its two outer right-hand armatures and front contacts, relay 190 connects the tip and ring conductors 182 and 183 through the normal contacts of the emergency release key 300, conductors 301 and 302 which are strapped at the emergency release key 325 to the tip and ring conductors 326 and 327 leading to the telephone set of the B operator on the left of the home position as these conductors correspond to leads 202 and 203 of the home position. This particular trunk T at the home operator's position is now therefore directly connected to the telephone set of the B operator on the left.

On the other hand, if, for example, a B operator on the right should notice the steady illumination of a lamp, such as 157 of a trunk other than the trunk T in the group assigned for her attention she may depress the team key corresponding to 180 of that trunk and extend a connection to her set as follows: from this trunk to the tip and ring conductors 340 and 341 through normal contacts of emergency release key 300, conductors 342 and 343 strapped at the emergency release key 350 of the adjacent operator, tip and ring conductors 344 and 345 to the telephone set of this operator. It is thus seen that by this arrangement any operator may assist the operator on either side of her position and further, that the operator assisted is notified of this fact by the flashing of the assignment lamp in a manner different from the flashing established when her own set is connected to the seized trunk. This flashing is done as follows: when the circuit for relay 190 was closed, a relay 317 was also operated completing a circuit for relay 318 and the operation of relay 318, in accordance with interruptions produced by the interrupter 320 establishes a flashing shunt circuit for lamp 157 as follows: from ground at the armature and front contact of relay 318, upper armature and back con-

tact of relay 316, conductor 322, inner right-hand armature and front contact of relay 190 to the lamp 157.

Provision is also made in this invention, whereby an operator is prevented from assisting an adjacent operator as long as there are calls waiting at her own position. It will be noted that the energizing circuit for relays 190 and 317 passes through the lower armature and back contact of a relay corresponding to relay 219 and as this relay is always operated when a call at the corresponding position is awaiting attention, no circuit can therefore be established for assisting an adjacent operator, even though a particular team key may be accidentally or otherwise operated.

Emergency service.

In case the multi-contact relays or any part of the preferential relay arrangement should fail to operate there is provided in accordance with this invention a circuit arrangement including the emergency key and the team keys for establishing connection between any trunk and the operator's set, that is, these keys are used as ordinary trunk listening keys in the manual trunk circuits where the operator's set may be directly connected. Should, therefore, the circuit arrangement fail, the emergency key 300 is depressed and when a call comes in as signified by the lighting of an assignment lamp such as 157, the operator simply depresses the corresponding team key. The operation of the emergency key 300 closes an operating circuit for relays 316 and 351 and the operation of a team key such as 180 closes a circuit as follows: battery, winding of relay 315, conductor 352, lower armature and back contact of relay 219, outer armature and back contact of release relay 242, conductor 353, lower armature and front contact of relay 316, conductor 191, inner right-hand armature and front contact of relay 139, winding of relay 190, key 180 to ground. Relays 190 and 315 are operated in this circuit. The operation of relay 190 connects the operator's telephone set to the trunk T over conductors 282 and 283 through emergency release key 300 over conductors 182 and 183, armatures and front contacts of relay 190 to left side of repeating coil 134. The operation of relay 316 completes a flashing circuit for assignment lamp 157 from the busy-back interrupter 360 connected at the upper armature and front contact of relay 316 by way of lead 322, inner right-hand armature and front contact of relay 190 to lamp 157, to indicate to the operator that her set is connected to the trunk. It should be noted that at the operation of relay 316 the circuit for the group relays and relay 217 is opened at its lower armature and back contact to positively prevent the

operation thereof. As stated, the circuit for relays 190 and 315 passes through contacts of release relay 242 and the release of the operator's set from the trunk T is thereby accomplished by the operation of release key 244 the same as when the set was connected in the regular manner.

It should be observed that the operation of an emergency release key does not prevent the corresponding operator from assisting the operators at adjacent positions with the disposal of accumulated calls, although the adjacent operators cannot assist the operator having her emergency key operated. It is evident that with the emergency key at one position operated, the operation of a team key at an adjacent position cannot accomplish this result, for it will be noted that this operator is connected directly through leads, such as 356 and 357, to the adjacent operator's position, whereas leads, such as 301 and 302, for the adjacent operator are cut off at the contacts of this emergency key 300.

What is claimed is:

1. A telephone system comprising trunk lines divided into groups, an operator's telephone set, a multi-contact relay, a set of group relays for each group of trunks to cause the operation of the multi-contact relay to prepare a connection for any one of the trunk lines in said group to the operator's telephone set, a set of unit relays common to a group of trunks comprising a trunk line from each of said original groups to cause the operation of said multi-contact relay to connect any one of said trunk lines to the operator's telephone set but depending on which set of group relays are operated, means for seizing any one of said trunk lines, and means operative when a trunk line is seized to actuate the corresponding set of group and unit relays to cause the telephone set to be connected to said seized trunk provided no previously seized trunk is already connected to the operator's set, in which case the last mentioned trunk is held in readiness and connected as soon as the previously seized trunk is disconnected.

2. A telephone system comprising trunk lines, an operator's telephone set, means for seizing any one of said trunks, means operative when a trunk is seized for automatically connecting the operator's telephone set thereto, means for operating said connecting means to connect the operator's telephone set to subsequently seize trunks in a predetermined sequence, and signaling means for indicating in one characteristic manner to the operator that a particular trunk is seized and in another characteristic manner that the operator's telephone set is connected to said trunk.

3. A telephone system comprising trunk lines, an operator's telephone set, means for

seizing any one of said trunks, means operative when a trunk is seized for automatically connecting the operator's telephone set thereto, means for operating said connecting means to connect the operator's telephone set to subsequently seize trunks in a predetermined sequence, a signal for each trunk line, means for operating said signals in one manner when the corresponding trunk lines are seized, and means for operating said signals in a different manner when the operator's telephone set is connected to the corresponding trunk lines.

4. A telephone system comprising trunk lines, an operator's position at one end of said trunk lines, an operator's position at the opposite end of said trunk lines, means at said first operator's position for seizing any one of said trunk lines, means at said second operator's position operative when a trunk is seized for automatically connecting said operator's telephone set to a seized trunk, means for operating said connecting means to connect the second operator's telephone set to subsequently seized trunk lines in a predetermined order if said trunk lines are seized before the first mentioned trunk line is disconnected from the operator's set regardless of the order in which the trunks are seized, and signaling means for indicating to the second operator that a trunk line has been seized, signaling means for indicating to the second operator that her telephone set has been connected to said seized trunk, and signaling means for indicating to the first operator that the second operator has not yet been connected to a particular seized trunk.

5. A telephone system comprising trunk lines, an operator's position at one end of said trunk lines, an operator's position at the opposite end of said trunk lines, means at said first operator's position for seizing any one of said trunk lines, means at said second operator's position operative when a trunk is seized for automatically connecting said operator's telephone set to said seized trunk, means for operating said connecting means to connect the second operator's telephone set to subsequently seized trunk lines in a predetermined order if said trunk lines are seized before the first mentioned trunk line is disconnected from the operator's set regardless of the order in which the trunks are seized, a signal for each trunk line, each operated when the corresponding trunk line is seized to indicate to the second operator that such a seizure has taken place, means for operating any one of said signals in a different manner when the second operator's telephone set is connected to the corresponding trunk, a tone device, means for associating said tone device with any of said trunk lines when seized to indicate to the first operator that the second operator's set

is not yet connected to said seized trunks, and means for disconnecting said tone device from a seized trunk when the second operator's telephone set is connected thereto to indicate to the first operator that this connection has been made.

6. A telephone system comprising trunk lines, an operator's telephone set, means for seizing any one of said trunks, means operative when a trunk line is seized for automatically connecting the operator's telephone set thereto, means for disabling said automatic connecting means and manually operable means effective only upon the actuation of said disabling means for connecting the operator's telephone set to any one of said trunks when seized.

7. A telephone system comprising trunk lines, an operator's telephone set, means for seizing any one of said trunks, means operative when a trunk line is seized for automatically connecting the operator's telephone set thereto, means for preventing the automatic connecting means from functioning when a trunk line is seized, and manually operable means individual to each trunk line for connecting the operator's telephone set to any seized trunk, said means being effective only upon the actuation of said means for preventing the automatic means from functioning.

8. A telephone system comprising trunk lines, an operator's telephone set, means for seizing any one of said trunks, means operative when a trunk line is seized for automatically connecting the operator's telephone set thereto, means comprising a plurality of keys and a relay arrangement associated therewith whereby the depression of one key disconnects the automatic connecting means and whereby the depression of an individual key associated with each trunk line connects said trunk line to the operator's telephone set provided said trunk line has been seized.

9. A telephone system comprising trunk lines, an operator's telephone set, means for seizing any one of said trunks, means operative when a trunk line is seized for automatically connecting the operator's telephone set thereto, a key common to all trunk lines, a plurality of keys each individual to a trunk line, and means operated when the common key and a key individual to a seized trunk line are operated to disable the automatic connecting means and connect the seized trunk to the operator's telephone set.

10. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the corresponding operator's telephone set to each seized trunk terminating at said position, and means located at one position for manually connecting the operator's telephone set located at an adjacent position to

a seized trunk line terminating at said first mentioned position.

11. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the corresponding operator's telephone set to a seized trunk terminating at said position, and means individual to each trunk line at one position and located thereat for connecting the operator's telephone set located at an adjacent position to a trunk line at said first mentioned position if said trunk line is seized.

12. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the corresponding operator's telephone set to a seized trunk terminating at said position, means located at one position for manually connecting the operator's telephone set located at an adjacent position to a seized trunk line terminating at said first mentioned position, and means operated when an adjacent operator's telephone set is so connected for preventing the automatic connecting means at said adjacent operator's position from operating when a trunk line terminating thereat is thereafter seized.

13. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the corresponding operators' telephone set to a seized trunk terminating at said position, means at one position for manually connecting the operator's telephone set at an adjacent position to a seized trunk line terminating at said first mentioned position, and means at said adjacent position for preventing said manual connecting means at the first position from operating if a trunk circuit at an adjacent position is seized and connected to the operator's telephone set thereat.

14. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the corresponding operator's telephone set to a seized trunk terminating at said position, means at one position for manually connecting the operator's telephone set at an adjacent position to a seized trunk line terminating at said first mentioned position, and signaling means associated with said seized trunk line operative when so connected to indicate to the operator at the first mentioned position that the trunk is connected to an adjacent operator's set.

15. A telephone system comprising trunk lines, operators' positions, means for seizing any one of said trunk lines, means at each position for automatically connecting the

corresponding operator's telephone set to a seized trunk terminating at said position, means at one position for manually connecting the operator's telephone set at an adjacent position to a seized trunk line terminating at said first mentioned position, a signal associated with each trunk line, means for operating any one of said signals in one characteristic manner when the corresponding trunk line is seized, and means for operating any one of said signals in a different characteristic manner when the corresponding seized trunk line is connected to an adjacent operator's set to indicate to the first mentioned position that the trunk line is so connected.

16. A telephone system comprising trunk lines, an operator's telephone set, means for

seizing any one of said trunk lines, means operative when a trunk is seized for automatically connecting the operator's telephone set thereto, means for disabling said automatic connecting means and for manually connecting the operator's telephone set to any one of said trunks when seized, signaling means for indicating in one characteristic manner to the operator that a particular trunk line is seized and in another characteristic manner that the operator's telephone set is connected to the said trunk regardless of whether it has been connected automatically or manually.

In testimony whereof, I have signed my name to this specification this 6th day of May, 1924.

RAND S. BAILEY.