Aug. 6, 1946. J. W. DEHN ET AL 2,405,194

TELEPHONE SYSTEM

Filed July 20, 1943 4 Sheets-Sheet 1

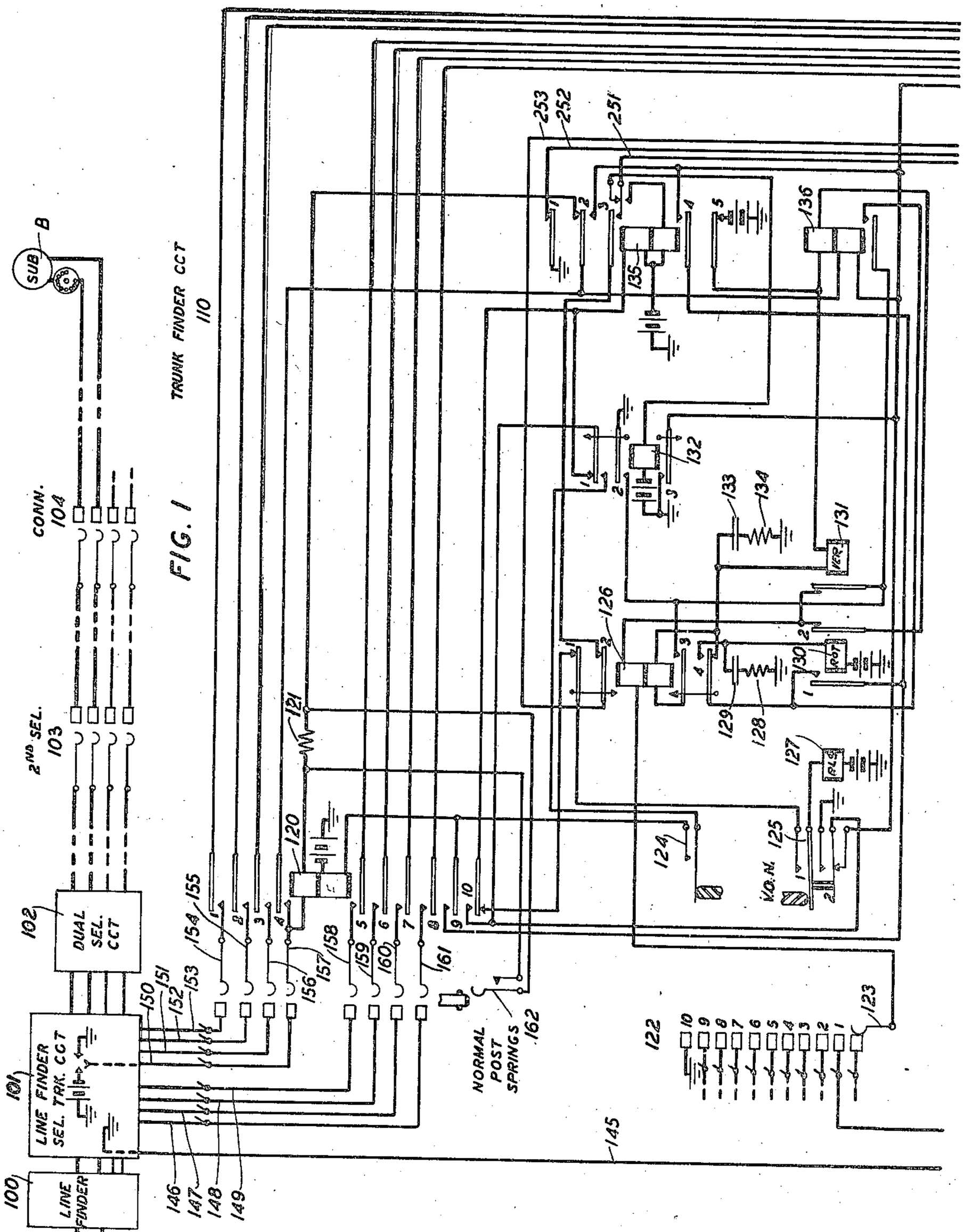

FIG. 1

FIG. 5

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

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TELEPHONE SYSTEM

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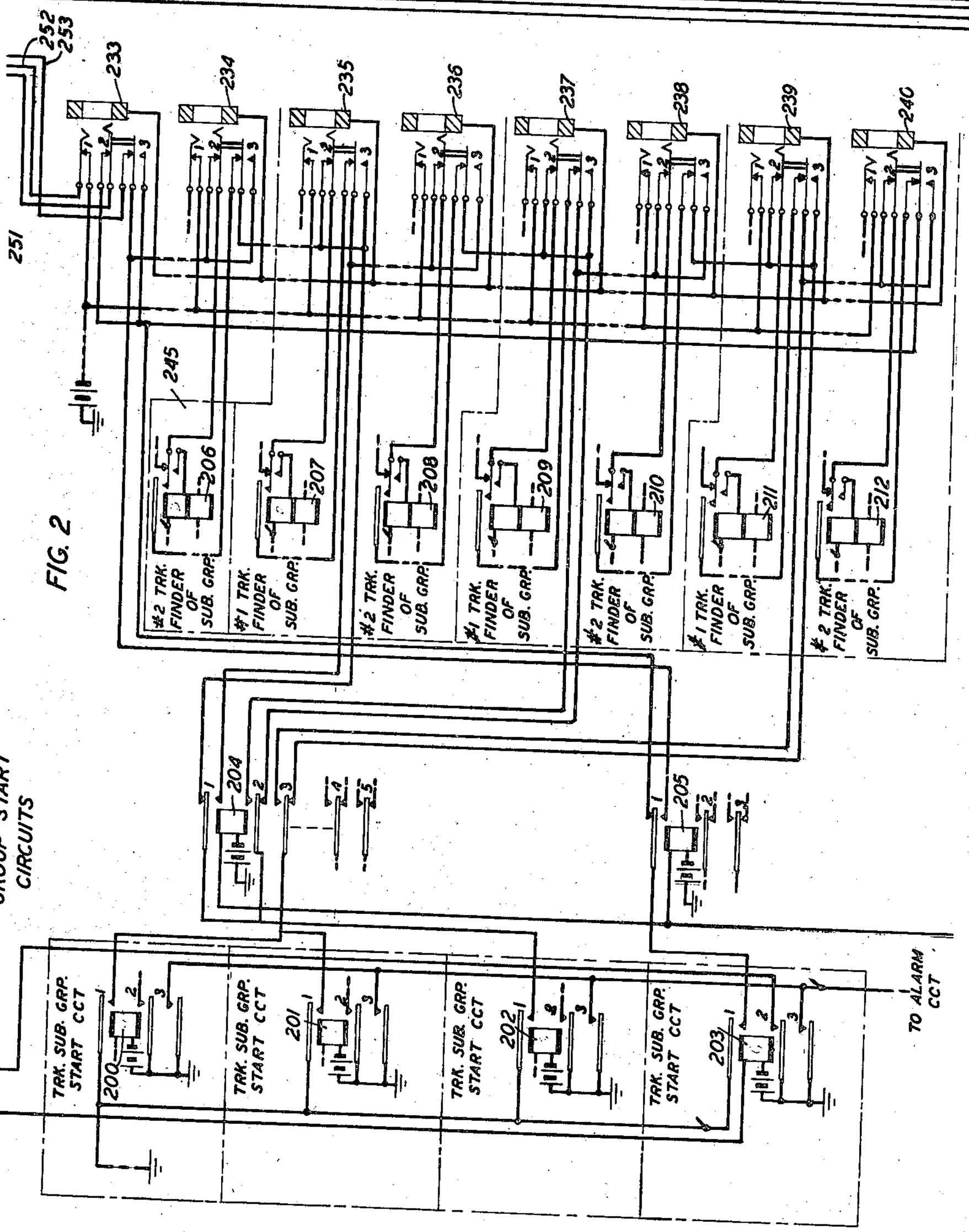

FIG. 2

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TELEPHONE SYSTEM

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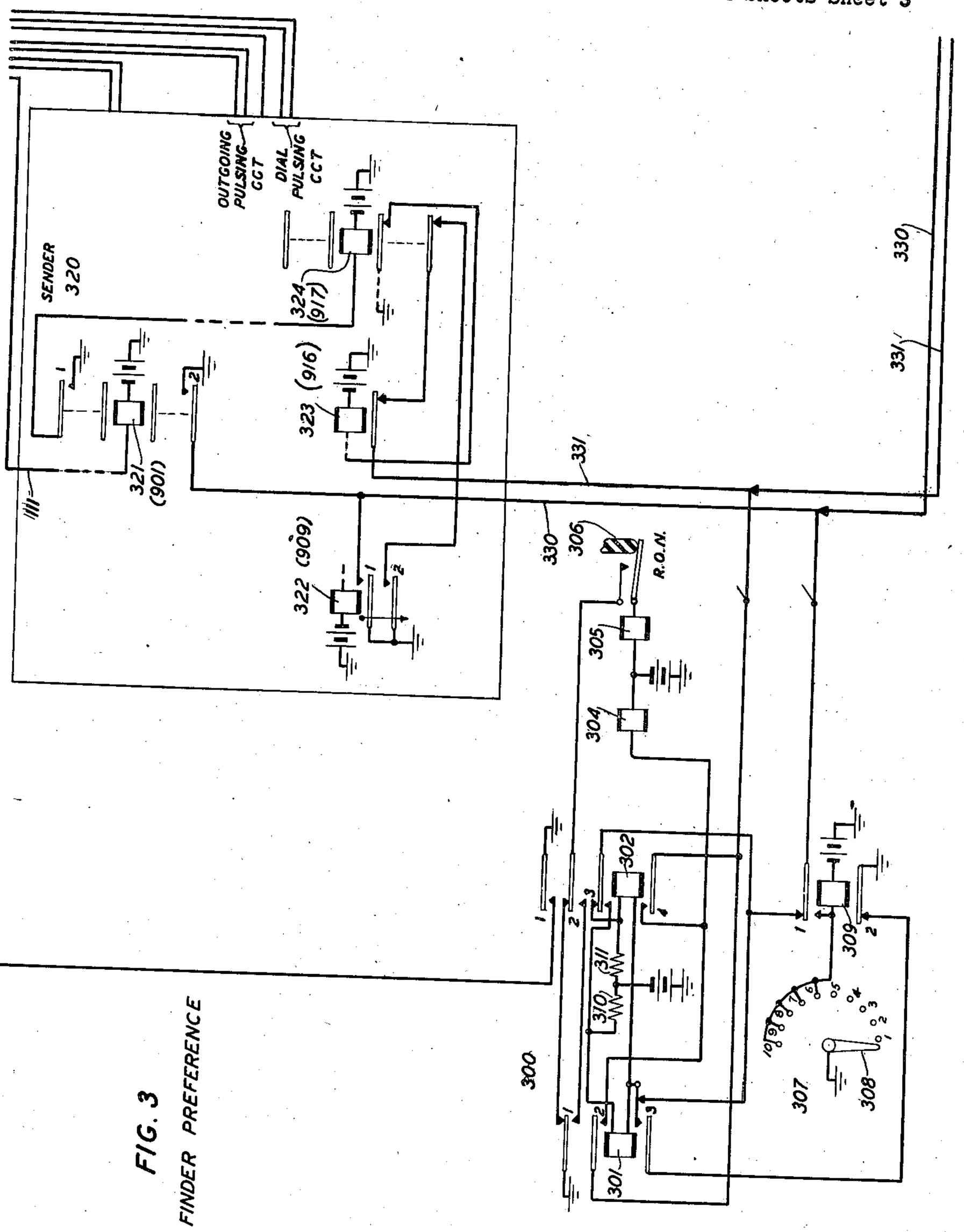

FIG. 3

FINDER PREFERENCE

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TELEPHONE SYSTEM

Filed July 20, 1943 4 Sheets-Sheet 4

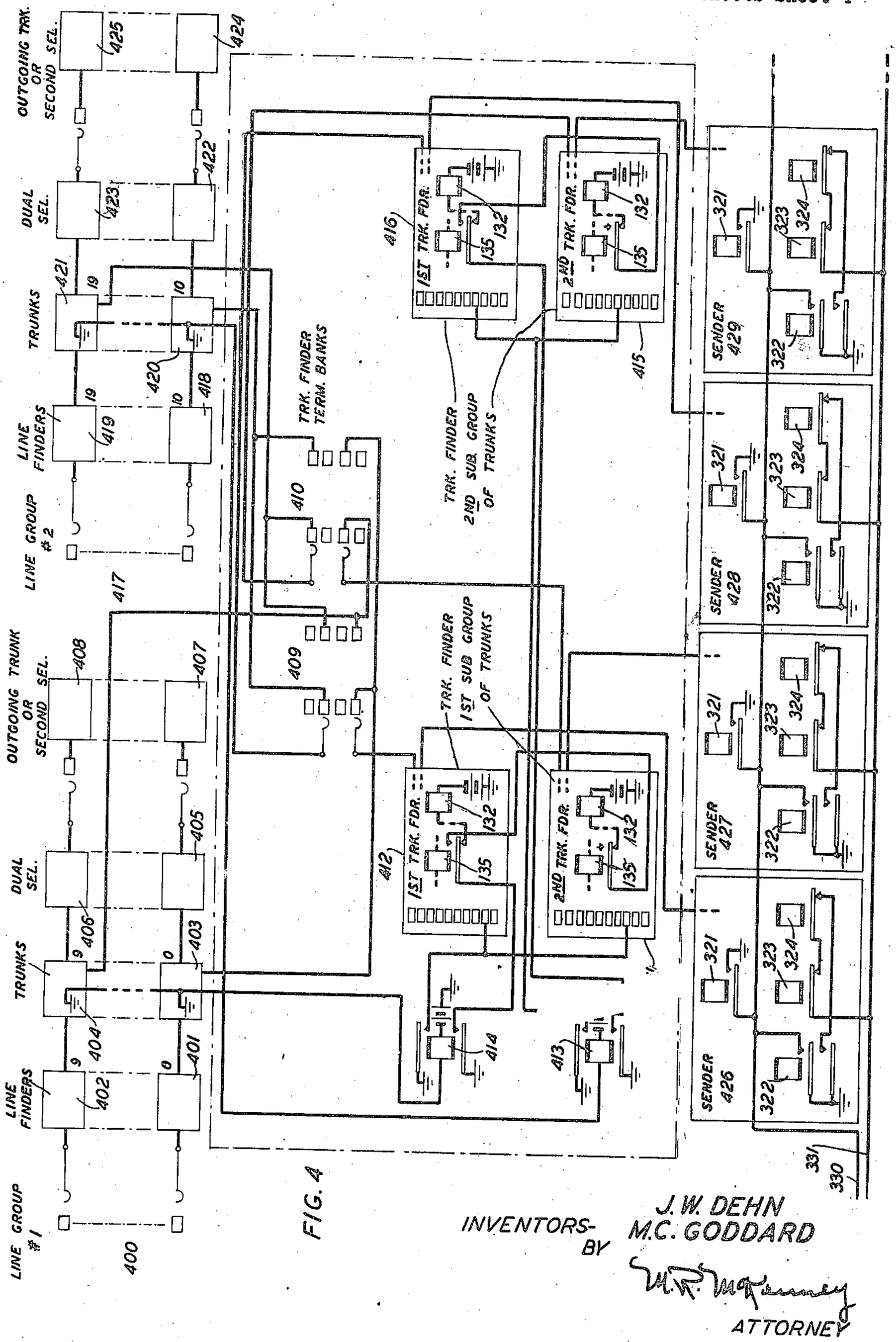

FIG. 4

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UNITED STATES PATENT OFFICE

2,405,194

TELEPHONE SYSTEM

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Application July 20, 1943, Serial No. 495,489

7 Claims. (Cl. 179—18)

1

This invention relates to telephone systems and particularly to those in which connections are established by automatic switches.

In automatic switching systems using line finders or trunk finders it is usual to have a plurality of such finders in groups serving groups of lines or trunks. Associated with each finder group is a start circuit actuated by a line or trunk over which a call has been initiated and this start circuit energizes a particular finder except when this finder is in use. When the first finder is in use it transfers the start lead to the next finder of the group. The start lead is thus transferred to the next in order finder in a group or subgroup in a sequential manner by the preceding finder as the finders are taken for use.

In the system disclosed herein both line finders and trunk finders are used, each having other mechanisms permanently connected thereto, the line finder having a trunk and a dual selector connected thereto and the trunk finder having a sender connected thereto. This arrangement is used as a matter of economy to obviate the use of links or connectors between the finders and the senders and for the sake of speed in operating these mechanisms. Both a line finder and a trunk finder are automatically energized by an incoming call, the line finder hunting for the calling line and the trunk finder hunting for the trunk permanently connected to the hunting line finder. Thus a sender is automatically connected with the calling line in a short space of time by the action of the line and trunk finders. The circuits from the sender dial tone mechanism and dial pulse responsive mechanism extend through the trunk finder, the trunk circuit, the line finder and over the line to the station mechanism of the calling subscriber.

One group of lines is served by a particular group of line finders and a plurality of groups of trunks connected to these line finders is served by a particular group of trunk finders. A start circuit for energizing the trunk finders is common to the trunks of a group and also common to the finders of this group which serve these trunks. The finders are operated in a set sequence during busy periods as the finders are taken for use. However, during non-busy periods if calls come into the office from a given group of lines over spaced periods and each call is disconnected before another call comes into the office the same finder would be used for all of these successive calls. In the case of the trunk finders which each have a sender permanently connected thereto this would mean that the same sender would be repeatedly connected to the calling lines of a group if the calls in the group were spaced apart so that each switching connection is completed and disconnected before another call from this group of lines enters the office.

The object of this invention is therefore to

2

improve the flexibility of group allotting arrangements in automatic switching systems in which there is a tendency to limit the operation of mechanism to a single channel during light load periods.

A feature of the present invention consists in automatically operable preference control mechanisms for shifting the preference for selecting finders arbitrarily during light load calling periods and in a sequential order during busy load calling periods.

Another and related feature of the invention consists in means associated with the preference control mechanism automatically operated by periodic switching operations in the office for determining when the order of preference for trunk finders and senders shall be normally advanced and when it shall be arbitrarily advanced.

These and other features will be discussed more fully in the following description as illustrated in the accompanying drawings in which:

Fig. 1 illustrates a line finder, a line-finder selector trunk, a dual selector, and associated selectors and illustrates in detail the mechanism of a trunk-finder circuit;

Fig. 2 illustrates the mechanism associated with a number of subgroups of trunks and trunk-finder circuits for shifting the preference of trunk-finder circuits in a sequential order as the finders are taken for use;

Fig. 3 illustrates an automatically operable arrangement for arbitrarily shifting the preference of trunk finders during light load calling periods and for placing the finder preference mechanism in the normal sequential order during busy load calling periods; and

Fig. 4 illustrates the grouping arrangement of line finders, trunks, selectors and the trunk finders and the senders.

General description

The grouping arrangement of the mechanism of an automatic switching system in a small telephone area for which this invention is used is shown in Fig. 4. Reference may be had to my copending application, Serial No. 495,487, filed July 20, 1943, for a complete description of different units of mechanism shown herein in diagrammatic form and also for a complete description of the organization and operation of these units of mechanism. Two groups of lines **400** and **417** are shown served by two subgroups of line finders each of which may comprise ten line finders. The ten line finders **401—402** have ten trunks **403—404** and ten dual selectors **405—406** permanently connected thereto. The same arrangement is used for each subgroup as shown for the ten line finders **418—419** which served the group of lines **417** and have ten trunks **420—421** and ten dual selectors **422—423** permanently connected thereto. The sequence of operation of

line finders in a subgroup of line finders is well known in the art and therefore only a general description of this operation need be given. The energization of line equipment responsive to an incoming call actuates what is known as a group start relay which energizes a line finder and marks a segment on the line-finder commutator to guide the line finder to a particular level of switch terminals where the calling line may be found. The line finders are allotted for use in a sequential order depending upon the busy condition of the line finders in the subgroup. This allotting is controlled by the transfer of the line-finder start circuit sequentially as the finders become busy which circuit is carried through contacts of a relay in each line finder.

In the present system the operation of a line finder such as **401** from its start circuit automatically energizes mechanism in its associated trunk **403** which establishes a start circuit for a trunk finder so that both the line finder and the trunk finder are hunting simultaneously. The line finder **401** hunting for the calling line and the trunk finder, Figs. 1 and 2, hunt for the trunk **403** connected to the hunting line finder **401**. The trunk-finder start circuit is common to the line finders and associated trunks of the line finder subgroup as shown and therefore any trunks in this subgroup will establish a start circuit for subgroup start relay **414**. Likewise any trunk in a second group **420—421** will establish a circuit for group start relay **413**. Each start relay controls a subgroup of trunk finders.

Trunk finders **411—412** are diagrammatically shown for serving the first subgroup of trunks and trunk finders **415** and **416** for serving the second subgroup of trunks, each of these trunk finders being the same as shown in Fig. 1 of the drawings associated with the sequence circuit and subgroup start circuits of Fig. 2. A shown diagrammatically in Fig. 4, the operation of subgroup start relay **414** will actuate trunk finder **412** if it is idle and if it is busy will actuate trunk finder **411** or another trunk finder in the subgroup and at the same time will mark a commutator segment for guiding the trunk finder. As previously stated each trunk finder has a sender permanently connected thereto and therefore the sender **426** is connected through the trunk to the calling line when the trunk finder **412** is actuated. Sender **427** may be connected through the trunk to the same calling line when trunk finder **411** is actuated because trunk finder **412** is in use. This may be any trunk of the group which actuates the trunk finder for associating a sender through the trunk to the line. The second and other groups of line finders, trunks, trunk finders and senders are operated and associated together as outlined for the first group.

From the foregoing it may be seen that the normal sequence of operating finders is economical for all automatic switching offices and would not require any auxiliary transfer devices in a large office in which more than one finder is normally in use. However, in smaller telephone areas there are periods when incoming calls over lines in a group are spaced apart and the first finder in a subgroup is taken for use on each incoming call over this period of light load. In the case of the present automatic switching system such as is fully described in copending patent application, Serial No. 495,487, filed July 20, 1943, and particularly to this system when used as an unattended office this normal procedure would overwork particular trunk finders and senders

permanently connected thereto. As an example, let it be assumed that during a light load period the first trunk finder **412** of a subgroup is energized repeatedly by successive calls because these calls are spaced so that there is only one call in the subgroup at any one time. Since a sender **426** is permanently connected to this trunk finder this sender will be continuously used to the exclusion of the other senders and if this sender becomes faulty in its operation it may prevent completing a number of telephone connections.

An auxiliary preference shifting mechanism is shown in Fig. 3 which is automatically responsive to light and heavy load conditions. During normal heavy load conditions this mechanism causes the regular sequence starting mechanism to function as described above but during light load periods when calls are spaced apart it alters the preference for the trunk finders after each call and thus alters the preference for senders connected to these trunk finders. This not only has the advantage of using different sender mechanism for successive calls but has the advantage of providing telephone service at all times even though a sender mechanism is faulty in an unattended office.

Detailed description

One of a group of lines is shown in Fig. 1 connected to a subscriber's station A which causes the energization of a line finder and line finder selector trunk circuit such as **100** and **101** respectively when the subscriber A removes the receiver from the switchhook. The line finder and line finder selector trunk circuit operate in a manner fully described in copending application Serial No. 495,487, filed July 20, 1943, and therefore need not be described herein. The energization of the line finder **100** by a subgroup start relay also causes the energization of the line finder selector trunk **101** which connects ground to the start lead **145** for energizing trunk finder subgroup start relay **203**. Four such relays are shown **200**, **201**, **202** and **203** for four subgroups of trunks and therefore for four subgroups of trunk finders. As shown in Fig. 4 the start lead **145** and therefore the start ground relay **203** are common to all trunks in a subgroup. The operation of relay **203** is shown for connecting ground to segment **1** of commutator **122** and for energizing relay **132** of the trunk finder which latter circuit may be traced from ground on contact **1** of the start ground relay **203**, contact **1** of relay **205**, contact **2** of jack **233**, lead **251**, contact **3** of relay **135** winding of relay **132** to battery. If this trunk finder is busy and relay **135** of this trunk finder is operated the ground from contact **1** of start relay **203** extends to the next sequential trunk finder **245** for operating a relay the same as relay **132** in the latter trunk finder. This circuit would extend from contact **1** of relay **203**, contact **1** of relay **205**, contact **2** of jack **233**, contact **3** of relay **135** operated, contact **2** of relay **126** thence over lead **253**, contact **3** of jack **233**, contact **2** of jack **234**, contact of relay **206**, to a relay such as relay **132** in trunk finder **245**. Relay **206** in this second trunk finder is the same as relay **135** in the first trunk finder of the subgroup.

The sequence circuit or preference circuit for other trunk finder subgroups is shown in Fig. 2. Relays **207** and **208** are in an intermediate subgroup of trunk finders and are the same as relay **135** shown in Fig. 1. Relays **209** and **210** are in another intermediate subgroup and relays **211** and **212** are in the end subgroup. Start ground relay

200 operates from a start circuit common to one subgroup of trunks and extends this start ground through the mechanism of the subgroups of trunk finders represented by relays 211 and 212. Relay 201 energized by the start circuit of another subgroup of trunks extends its start circuit through the group of trunk finders represented by relays 209 and 210. Relay 202 extends its start circuit to the subgroup of trunk finders represented by relays 207 and 208 as shown. Relay 203 extends its start circuit to the subgroup represented by the trunk finder in Fig. 1 and the trunk finder represented by relay 206. These relays 200 to 203 also connect ground to segments of commutators in the respective trunk finders depending upon which trunk finder is energized. By reference to diagrammatically grouped units shown in Fig. 4 it may be seen that the operation of start ground relay 414 representing a relay such as 203 may associate ground from its contact 1 with any commutator segment of the trunk finders in the group. When trunk finder 412 is energized by relay 414, the trunk finder is arrested in its motion when it reaches the first level of terminals. These terminals are indicated as terminals 409. When trunk finder 411 is energized by relay 414, it is arrested on the second row of terminals indicated at 410 since the ground from contact 1 of start relay 414 is connected to the second segment of the commutator of trunk finder 411.

The trunk finder shown in Fig. 1 operates in the following manner for connecting a sender to the calling line. For this connection it may be assumed that the trunk finder shown in Fig. 1 is used and that therefore the start circuit is extended by relay 203 through contact 3 of relay 135 and the winding of relay 132 operating the latter relay, and that segment 1 of the commutator 132 is connected with ground by the operation of relay 203. Relay 132 associates ground with the sleeve lead 111 extending to the sender and operates the stepping relay 136. The circuit for operating relay 136 may be traced from ground through contact 2 of relay 132, contact of vertical magnet 131, contact 2 of rotary magnet 130, upped winding of relay 136 to battery connected to contact 5 of relay 135. The stepping relay 136 establishes a circuit for the vertical magnet which steps the shaft up one step placing the commutator brush 123 on the first segment. The circuit for the vertical magnet may be traced from battery through contact 5 of relay 135, vertical magnet 131, contact 4 of relay 126, contact of relay 136 to ground on contact 2 of relay 132. The vertical off-normal springs 125 are closed and the circuit for relay 136 is opened by the contact of the vertical magnet 131. Relay 136 releases which causes the release of the vertical magnet which now recloses the circuit to relay 136. If brush 123 is not associated with ground on the first terminal, relay C and the vertical magnet continue to step the brushes of the trunk finder in an upward movement until the commutator brush reaches the segment which is grounded by the operation of the group start relay which in this case is relay 203. Since, for this example, segment 1 of commutator 122 is connected with ground, the brushes 154 to 161 of the trunk finder are arrested on the first level of terminals. A circuit for relay 126 is established through its upper winding in series with the upper winding of relay 136. This circuit may be traced from ground on contact 2 of relay 203, segment 1 of commutator 122, brush 123, upper winding of relay 126, contact 2 of the rotary magnet 130,

upper winding of relay 136 to battery on contact 5 of relay 135. This holds relay 136 in an operated position to prevent further stepping. Relay 126 is made slow in operating to give a short time interval between the last vertical step and the first rotary step which is brought about by the operation of relay 126. Relay 126 locks through its lower winding in series with the vertical magnet to battery on contact 5 of relay 135. This places relay 126 under the control of relay 135 and causes its release when relay 135 operates. The operation of relay 126 transfers the stepping circuit from the vertical to the rotary magnet. This circuit may be traced from battery through rotary magnet 130, contact 4 of relay 126, contact of relay 136 to ground on contact 2 of relay 132. The rotary magnet thus steps the shaft around until the sleeve wiper 157 reaches a terminal which is connected to battery through the winding of a cut-off relay in the trunk circuit connected to sleeve lead 150. This circuit extends from ground on contact 3 of relay 132, lower winding of relay 136, contact 2 of relay 135, resistance 121, upper winding of relay 120, sleeve brush 157 to battery through the cut-off relay winding in the trunk circuit. The trunk circuit cut-off relay operates in this circuit and in so doing connects ground with the sleeve lead 150 in place of battery. Relay 136 is thus held operated to prevent further stepping of the brushes in a rotary movement. Relay 120 is also sufficiently operated to close its contact 9. This energizes the lower winding of relay 120 over a circuit extending from battery through this winding and contact 9, contact 1 of the rotary magnet, contact of relay 136 to ground on contact 2 of relay 132. The operation of relay 120 connects leads 146 to 149 and 151 to 153 directly to the mechanism of sender 320 and establishes an operating circuit for relay 135. This operating circuit may be traced from battery through the upper winding of relay 135, contact 10 of relay 120 to ground on contact 2 of the off-normal contacts 125. The operation of relay 135 closes the sleeve lead ground from the trunk to the sender which may be traced from ground on sleeve lead 150, brush 157, contact 4 of relay 120, contact 2 of relay 135 to sleeve lead 111 extending through the sender. Relay 135 also closes a locking circuit for relay 120 traced from battery through its lower winding and contact 9 of relay 120, contact 4 of relay 135 to sleeve lead 111. Relay 135, as has been previously described, transfers the start lead 251 to the next in order trunk finder. The start lead extends from lead 251 through the associated armature, contact 2 of relay 126, lead 253, contact 3 of jack 233, contact 2 of jack 234, through the contact of relay 206 to a relay the same as relay 132 of the preceding trunk finder. The operation of relay 135 removes battery through its contact 5 from the upper winding of relay 136 and from the vertical magnet circuit and relay 126 and also releases relay 136 by short-circuiting its lower winding through its contact 2. This releases relay 126 so that the start circuit may extend through its contact 2. The circuit for relay 132 is opened through the continuity contact 3 of relay 135 and relay 132 is made slow to release so that ground is held on the sleeve lead extending to the dual selector and the sender until a short period of time has elapsed so that the mechanism of the associated circuits has had time to function.

The sleeve circuit in the trunk 101 has ground extended thereto, first, by the line finder and sec-

ond, by a relay in the dual selector 102. When this ground is initially connected from the line finder to the trunk circuit, a trunk start relay is operated which establishes the start circuit for the trunk finder and at the same time connects battery through the winding of the trunk cut-off relay with the sleeve lead 150 extending to the sleeve terminal of the trunk finder terminal bank. As previously described when the trunk finder finds this terminal, relay 120 is operated sufficiently to close its contact 9. This operation takes place through the upper winding of relay 120, lower winding of relay 136 to ground on contact 3 of relay 132 and when this circuit is established the cut-off relay in the trunk is operated in such a manner as to connect ground instead of battery with the sleeve lead 150 and relay 120 is locked through its lower winding as described. The ground extends over lead 150 through contact 4 of relay 120 and contact 2 of relay 135 after the latter relay is operated, thence over sleeve lead 111 to the sender for holding the off-normal ground sender relay 321 and as noted on the drawings the operation of relay 321 operates relay 324. The energization of relay 132 in the trunk finder causes the operation of off-normal relays 321 and 324 so that the sender is prepared to function as soon as it is connected to the trunk circuit and line finder. This automatically establishes the dial tone circuit and causes dial tone to be connected with conductors extending to the subscriber's line and thereafter establishes a connection between the calling subscriber's line and pulse responsive equipment in the sender for setting the sender according to dial pulses transmitted by the calling subscriber.

The finder preference control circuit 300 is shown connected to one sender circuit 320 and it is also shown that this control circuit is common to all senders of the telephone office. Since each trunk finder has a sender permanently connected thereto the device 300 is a sender preference control circuit as well as a trunk-finder control circuit but will be known hereinafter as the finder preference control circuit. Reference to the copending application, Serial No. 495,487, filed July 20, 1943, may be had for the detail operation of the senders shown diagrammatically in Figs. 3 and 4. For convenience in referring to the larger disclosure, relay numbers are shown in the sender 320 in brackets which are the same as the numbers given to these relays in the aforementioned copending patent application, the numbers which are not in brackets will be used in this description. The control features of the mechanism of the finder preference control circuit 300 depend upon the frequency with which senders of the office are taken for use by incoming calling lines. The energization of relay 321 when the sender is taken for use, establishes a circuit for relay 301 from ground on the contact of relay 321, contact 1 of relay 309, contact 3 and winding of relay 301, resistance 310 to battery. This ground places a shunt on relay 302 through its contact 3 so that relay 302 does not operate at this time. The operation of relay 324 opens a circuit at one point which is later established for the rotary magnet 304 of switch 307. Switch 307 is of the type which is moved one step when the rotary magnet 304 is energized and deenergized and requires the energization of release magnet 305 to return it to its normal position.

During normal busy load periods more than one sender is in constant use and therefore the ground from the contact 2 of relay 321 in the various senders maintains relay 301 constantly operated and the normal preference circuit shown in Fig. 2 for the trunk finders is in use so that when one finder is busy the next in order finder in the sequence is energized in the manner previously explained.

During light load periods when the incoming calls are spaced apart and only one sender is energized at a time the following procedure takes place in the finder preference control circuit as follows. During this period the first sender energized operates its relay 321 which connects ground through the winding of relay 301 which operates. Relay 322 is operated to release the sender. The latter relay holds ground through the winding of relay 301 until the sender has released which releases both relays 321 and 324. Relay 322 is slow to release after the other mechanism of the sender has been released and therefore the release of relay 324 causes a circuit to be established from ground through contact 2 of relay 322, contact of relay 324, contact of relay 323, contact 2 of relay 301, rotary magnet 304 to battery energizing the rotary magnet 304. The sender having released causes the release of relay 322 thus removing ground from rotary magnet 304, removing ground from the winding of relay 301 and contact 3 of relay 302. When ground is removed from the rotary magnet 304 the brush 308 steps from its normal position to terminal 1. The removal of ground from the winding of relay 301 and from armature 3 of relay 302 causes a circuit to be established for relay 302 from battery through resistance 311, winding of relay 302, contact 3 of relay 301 to ground on contact 2 of relay 309. Thus, both relays 301 and 302 are operated. The operation of relay 302 establishes a circuit to arbitrarily change the preference of all trunk-finder circuits by operating relays 204 and 205. It will now be apparent that if start ground relay 203 is energized the start circuit extends from ground on contact 1 of relay 203 through the inner contact 1 of relay 205, contact 2 of jack 234 to trunk finder 245 which is the second trunk finder in the sequence of the start circuit. Likewise if any of relays 200, 201 or 202 are energized the start circuit extends to the second trunk finder of the subgroup instead of the first trunk finder. By reference to Fig. 4 it will be seen that the second trunk finder 411 has sender 427 permanently connected thereto whereas the first trunk finder 412 has sender 426 permanently connected thereto. Therefore, in shifting the preference of the trunk finder arbitrarily as above outlined the preference is shifted to a different sender than would be used if this preference had not been altered. The rotary off-normal contact 306 is closed when brush 308 steps to the first terminal and with both relays 301 and 302 operated a circuit is established for release magnet 305 from ground on contact 1 of relay 301. This causes the brush 308 to restore to its normal position but does not cause the release of either relays 301 or 302.

When the next trunk finder and sender are taken for use relay 321 of this sender is operated which again connects ground to lead 330 which in this case short-circuits the winding of relay 301 causing its release. Relay 302 is, however, held operated from ground over lead 330, continuity contact 3 of relay 301 released, winding of relay 302, resistance 311 to battery. This trunk finder and sender are the second preference finder and sender since relays 204 and 205 are operated. Upon the operation of relay 322 for

the release of this sender and the release of relays **321** and **324** a circuit is again established over lead **331** for the rotary magnet **304**. In this case the circuit extends through contact **3** of relay **302**, rotary magnet **304** to battery. When relay **322** releases, the brush **308** again steps from its normal position to terminal **1** and, since the ground is removed from lead **330**, the circuit for relay **302** is opened and the latter relay releases. This constitutes the first cycle of preference shifting by relays **301** and **302**. The release of relay **302** returns the sequence circuit shown in Fig. 2 to normal by releasing relays **204** and **205** and thus the first trunk finder is the preferred finder for the next successive call. The third spaced call which is the next successive call again operates a sender relay **321** causing the operation of relay **301** and the release of this sender brings about the operation of relay **302** and the operation of the rotary magnet **304** causing the brush **308** to step forward. The operation of relay **302** again shifts the sequence circuit by the operation of relays **304** and **305** and the release of relays **301** and **302** by the subsequent operation and release of a sender again shifts sequence circuit of the trunk finders as explained. When the switch **307** moves away from its normal position, the rotary off-normal contact **306** is closed and therefore, at any time that relays **301** and **302** are both operated or both released, the release magnet **305** is energized through contacts **2** of relays **302** to ground on contact **1** of relay **301** and therefore this switch is released very often during calls which are spaced apart. In fact, this release occurs after each cycle of operation when relays **301** and **302** are both operated or both released for shifting the preference circuit of Fig. 2. However, when a busier period occurs the switch may advance a number of steps without having the trunk finder preference shifted.

Let it be assumed now that after a number of spaced operations of the switching equipment of the office including senders, when only one switching equipment is operating at one time, a busy period occurs and that there are a number of over-lapping calls and therefore that more than one sender is in operation at one time for completing switching connections. These overlapping operations hold ground continuously on lead **330** since a relay the same as relay **321** is operated in more than one sender and the operation of relay **321** in one sender overlaps the operation of relay **321** in another sender. If relays **301** and **302** are normal, the first sender operated during this busy period will operate relay **301** and place the shunt ground on contact **3** of relay **302** to prevent the operation of relay **302**. If relays **301** and **302** are operated, the first sender operated during the busy period will release relay **301** by placing a ground shunt through contact **3** of relay **302**. This will continue until such time as all of the senders in operation at any one time have released and the preference for the trunk finders and senders will be according to the position of the relays in the finder preference control circuit **300**, that is, with relays **204** and **205** operated, the second finder and associated sender are preferred and with relays **204** and **205** released the first trunk finder and associated sender are preferred. This, of course, depends upon whether relay **301** is held operated at the time or whether relay **302** is held operated.

During this temporary busy period each successive sender operated and released on overlapping calls associates ground with the stepping circuit for energizing rotary magnet **304** and the switch is advanced as each sender is released. The circuit for energizing the rotary magnet **304** is over conductor **331**. Assuming that relay **301** is operated this circuit extends from contact **2** of relay **322**, contacts of relays **324** and **323**, lead **331** to contact **2** of relay **301**, rotary magnet **304** to battery. Upon the release of each sender this circuit is closed and opened causing the switch to advance one terminal. Under this condition if the switch advances to terminal **6** responsive to the operation and release of six consecutive senders without any spaced periods in the operation of these senders, relay **309** is operated from ground connected to brush **308**. Relay **309** in operating establishes a locking circuit to ground on contact **1** of relay **321** of the energized senders so that the continuous overlap operation of senders maintains relay **309** locked in an operated position. Relay **309** in operating opens the circuit extending over lead **330** to relays **301** and **302** and opens the ground circuit from its contact **2** which is used to operate relay **302** as previously described. This causes the release of relay **301** establishing a circuit for restoring switch **307** to normal by energizing the release magnet **305** and prevents any further arbitrary shifting as long as there are overlap operations of the senders. If relays **204** and **205** were operated they are now released and the normal sequence operation as shown in Fig. 2 remains in use as long as this busy condition ensues. The next light load period when the last sender in use has released and no other sender of the office is in use for a switching connection removes ground from lead **330** and the locking circuit for relay **309** is thus open and this relay now releases. The next sender operated will thus operate relay **301** and if a spaced light load period follows the busy period, the arbitrary shifting of the preference again takes place under the control of relays **301** and **302** as operated by the spaced operation of the senders.

Frequently, during light load periods three or four calls may enter the office in an overlapping order and thereafter the calls may be again spaced apart. During this period when more than one sender is in operation at the same time, relay **301** or relay **302** would remain operated and the other relay of this pair would remain normal. Each of the four senders during this overlapping period would, upon releasing, advance switch **307** one step so that at the time the fourth sender released brush **308** would have reached the fourth terminal. Assuming that relay **301** had been operated during this overlapping period, relay **302** is operated at the time of releasing the fourth sender by removal of ground from lead **330** which removes the shunt from relay **302**. This operates relays **204** and **205** to arbitrarily shift the preference of the trunk finders and associated senders. On the other hand if relay **302** was operated during the overlapping period and relay **301** was released, then the release of the fourth sender would cause the release of relay **302**. In either case both of relays **301** and **302** would either be operated or released and consequently a circuit is established for the release magnet **305** to cause the switch **307** to restore to normal. Therefore at this time the normal shifting arrangement of preference shown in Fig. 2 is not used since the light load period of incoming calls continues even though for a

short period a small number of calls enter the office in overlapping order.

From the foregoing it is apparent that the auxiliary device **300** is common to and under control of the senders in the office for arbitrarily switching the order of preference of trunk finders and senders during light load calling periods on each occasion after the release of the sender when no sender in the office is in use for a switching connection so that the senders serving each group of lines are used in successive order during light load periods but automatically control the reversion to the normal preference shifting control shown in Fig. 2 during heavy load calling periods.

What is claimed is:

1. In an automatic switching telephone office, switches, groups of lines, a plurality of senders, a plurality of finders in groups each having one of said senders permanently connected thereto operable for connecting said senders to said lines, means responsive to a call over a line for operating a finder, the lines of each group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as said finders and senders are taken for use during busy load calling periods and an auxiliary device for arbitrarily advancing said order of preference during light load calling periods.

2. In an automatic switching telephone office. switches, groups of lines, a plurality of senders, a plurality of finders in groups each having one of said senders permanently connected thereto operable for connecting said senders to said lines, means responsive to a call over a line for operating a finder, the lines of each group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as said finders and senders are taken for use during busy load calling periods, an auxiliary device for arbitrarily advancing said order of preference during light load calling periods and a control mechanism automatically operated by periodic switching operations in said office for determining when the order of preference for finders and senders shall be normally advanced and when it shall be arbitrarily advanced.

3. In an automatic switching telephone office, switches, groups of lines, a plurality of senders, a plurality of finders in groups each having one of said senders permanently connected thereto operable for connecting said senders to said lines, means responsive to a call over a line for operating a finder, the lines of each group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as said finders and senders are taken for use during busy load calling periods, an auxiliary device for arbitrarily advancing said order of preference during light load calling periods on each occasion after a switching connection is completed and no other switching connection is in progress of completion and a control mechanism automatically operated by periodic switching operations in said office for determining when the order of preference for finders and senders shall be normally advanced and when it shall abitrarily be advanced.

4. In an automatic switching telephone office, switches, groups of lines, a plurality of senders, a plurality of finders in groups each having one of said senders permanently connected thereto operable for connecting said senders to said lines, means responsive to a call over a line for operating a finder, the lines of each group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as said finders and senders are taken for use during busy load calling periods, an auxiliary device for arbitrarily advancing said order of preference during light load calling periods on each occasion after the release of a sender when no other sender of the office is in use for a switching connection so that the senders serving each group of lines are used in a successive order during light load periods and a control mechanism automatically operated by periodic sender operations in said office for determining when the order of preference for finders and senders shall be normally advanced and when it shall be arbitrarily advanced.

5. In an automatic switching telephone office, groups of lines, a group of line finders serving each group of lines, each line finder having a trunk permanently connected thereto, senders, a group of trunk finders common to each group of line finders and trunks, each trunk finder having one of said senders permanently connected thereto, means responsive to a call over a line for operating a line finder and a trunk finder for connecting a sender to the calling line, said trunk finders and senders being operated in a preferred order, mechanism for normally advancing the order of preference sequentially as said trunk finders and senders are taken for use during busy load calling periods, an auxiliary device for arbitrarily advancing said order of preference during light load calling periods on each occasion after switching connection is completed and no other switching connection is in progress of completion and a control mechanism automatically operated by switching operations in said office for determining when the order of preference for trunk finders and senders shall be normally advanced and when it shall be arbitrarily advanced.

6. In an automatic switching telephone office, groups of lines, a plurality of finders in groups, means responsive to a call over a line for operating a finder, the lines of each finder group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as the finders are taken for use during busy load calling periods and an auxiliary mechanism for arbitrarily advancing said order of preference after each call when one finder completes a telephone connection and is released before another call requires the use of a finder.

7. In an automatic switching telephone office, groups of lines, a plurality of finders in groups, means responsive to a call over a line for operating a finder, the lines of each finder group preferring said finders in a particular order, mechanism for normally advancing the order of preference sequentially as the finders are taken for use during busy load calling periods, an auxiliary mechanism for arbitrarily advancing said order of preference after each call when one finder completes a telephone connection and is released before another call requires the use of a finder, and a control mechanism automatically operated by periodic switching operations responsive to each call for determining when the order of preference for finders shall be normally advanced and when it shall be arbitrarily advanced.

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