Nov. 17, 1931. A. B. STERN 1,831,931

TELEPHONE SYSTEM

Filed Feb. 7, 1930 3 Sheets-Sheet 1

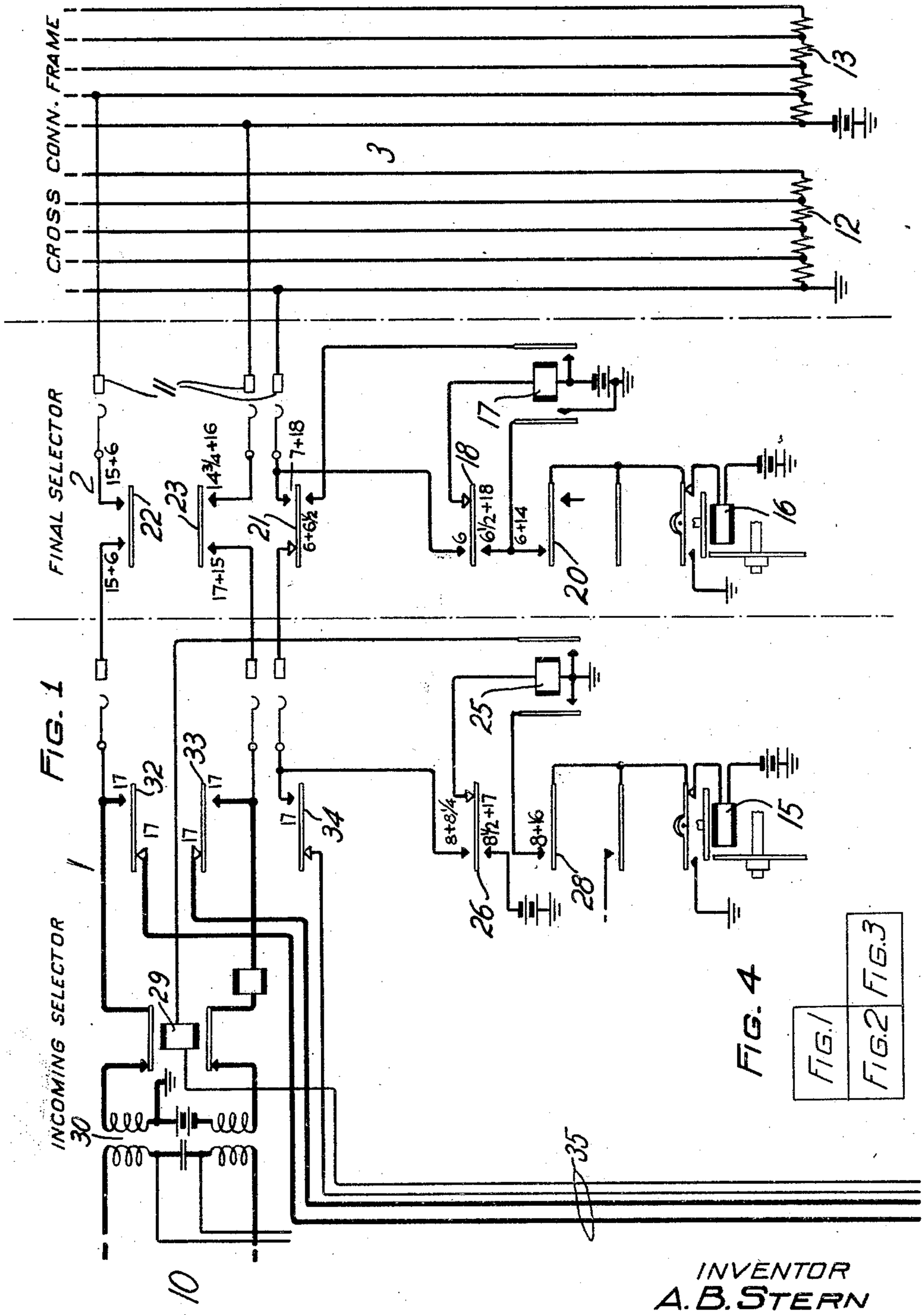

FIG. 1

FIG. 4

FIG. 1	FIG. 3
FIG. 2	

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TELEPHONE SYSTEM

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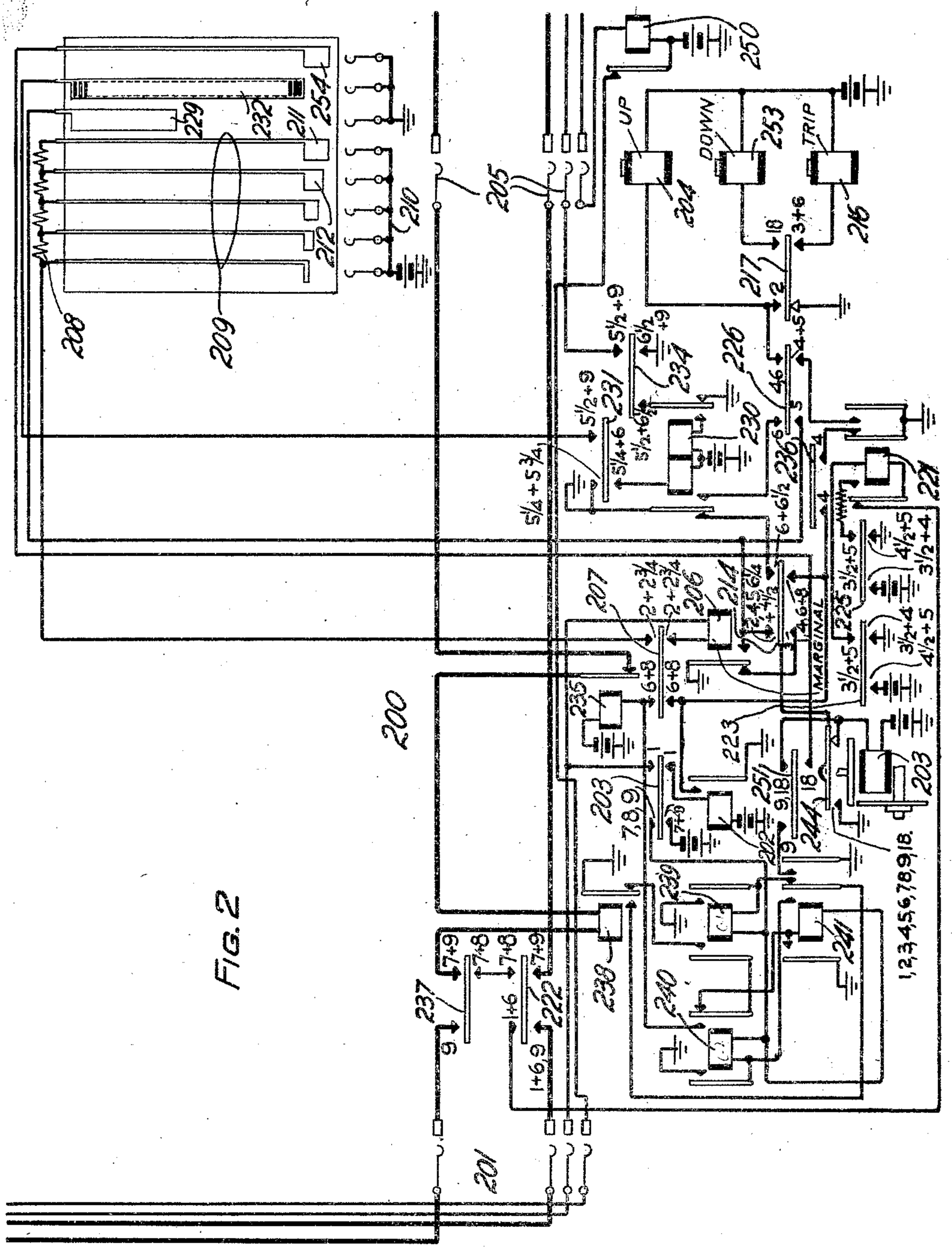

FIG. 2

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TELEPHONE SYSTEM

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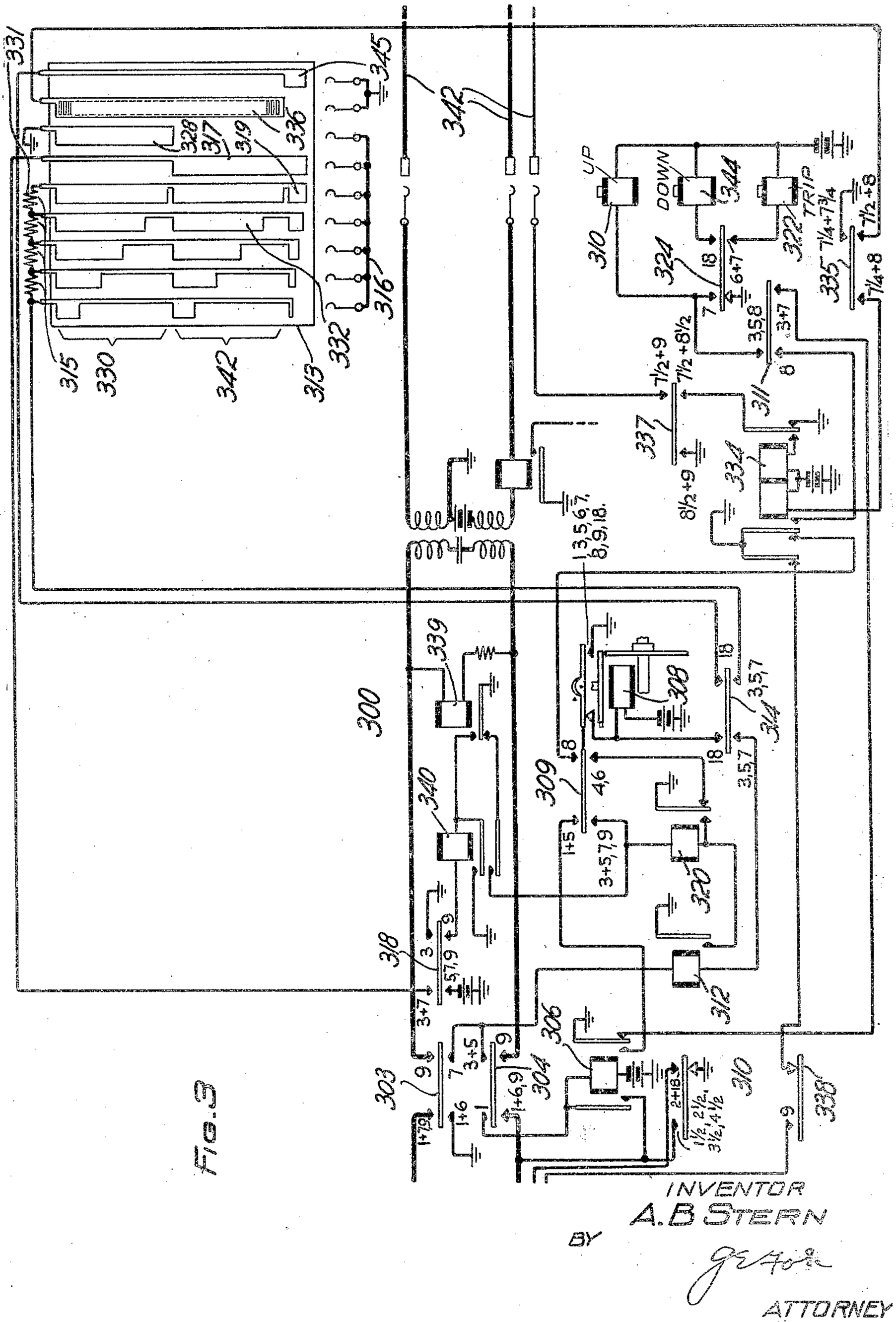

FIG. 3

Patented Nov. 17, 1931 1,831,931

UNITED STATES PATENT OFFICE

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TELEPHONE SYSTEM

Application filed February 7, 1930. Serial No. 426,604.

This invention relates to telephone systems and particularly to machine switching systems.

The object of the invention is to improve service from a central office to private branch exchanges by enabling the increase of lines to private branch exchanges without disturbing existing facilities for handling such traffic.

Heretofore, systems have been provided in which connections from a calling line have been extended over automatic switches in one exchange to mark a certain point or terminal and then, due to this marking, an idle trunk leading to a desired exchange has been connected to the calling line over another path.

A feature of this invention is a system of this general character in which a connection may be established over switches to mark sets of terminals where each set represents a certain group of lines outgoing from an exchange and in which, due to this marking, auxiliary switches are controlled to extend the connection to an idle line in the marked group.

Another feature is a system in which each set of terminals representing a group of lines is variously connected to current sources to establish characteristic potential conditions on these terminals. These conditions are employed for the guiding of the auxiliary switches to establish connections to the marked groups of outgoing lines and to cause said switches to hunt for idle lines in said group and connect them when found to calling lines.

This invention has been illustrated in the accompanying drawings in which Fig. 1 shows the switches for marking the connection to be established and Figs. 2 and 3 show the circuits of two line selecting auxiliary switches.

In establishing a connection to an idle trunk in a group leading to a distant private branch exchange, the connection is first set up over the incoming selector 1 and the final selector 2, to a cross-connecting frame 3 where a set of terminals representing the desired group of lines is selected. These sets of terminals are provided with various electrical characteristic potential conditions which serve to guide the auxiliary switches, such as the auxiliary incoming selector 200 of Fig. 2 and the auxiliary final selector 300 of Fig. 3, to the desired group of trunks outgoing to a distant office. All of these switches may be of any well known type employed in panel type automatic systems and in general the circuit arrangements for controlling them may also be of any well known type, such for example as are disclosed in the Patent No. 1,395,977, to F. A. Stearn et al., of November 1, 1921. The operation of these switches to select a connection will therefore not be described in the succeeding text in any further detail than is necessary for the full understanding of the application of the present invention to a standard panel type automatic telephone system.

If it is now assumed that in setting up a connection of this kind guiding impulses have been received over line 10 and the incoming selector 1 and the final selector 2 have been actuated to select for example the set of terminals 11, this selection determines the desired group of outgoing lines. The electrical conditions on the various sets of terminals at the cross-connecting frame 3 that guides the selections may be arranged as follows: The sleeve terminals may be connected to ground through various resistances and the resistance between a terminal and ground determines the brush selection in the auxiliary incoming selector 200. This resistance may be inserted as shown at 12 between cross-connecting bars which are then connected to the sleeve terminals in accordance with a predetermined plan or arrangement of terminals on the final selector. The tip and ring terminals may be connected either to ground or battery through various resistances. The polarity of the current on the ring terminal determines the group selection in the auxiliary incoming selector 200 and the resistance inserted between the ground or battery on the ring terminal determines the brush selection in the auxiliary final selector 300. The resistances for these purposes may be connected as shown at 13 between the source and the cross-connecting

bars for the terminals which are connected to these bars as desired. The polarity applied to the tip terminal determines whether the desired group of trunks is in the upper or lower half of an auxiliary final selector bank and the resistance on the tip terminal determines which of the five groups in the selected half is the one over which hunting for an idle trunk shall take place. The various combinations of conditions on the terminals at the final selector 2 may be as follows: The sleeve terminals may be connected to ground directly or through the succeeding resistances as shown at 12. The combinations of conditions on the tip and ring terminals may be as follows: ground on the ring and battery on the tip either directly or through resistances as exemplified at 13; ground on the ring and ground on the tip either directly or through resistances; battery on the ring and battery on the tip either directly or through resistances, or battery on the ring and ground on the tip either directly or through resistances.

The arrangement of terminals at the auxiliary selectors may be as follows, although it should be understood that any other suitable arrangement may be made. In the auxiliary incoming selectors the banks may contain 500 sets of terminals divided in 5 banks of 100 sets each. These banks may be selected by the brush selection, to wit, by the tripping of one out of five sets of brushes. The next selection will be that of the lower or upper half of the determined bank of 100 sets of terminals and the trunk hunting for an idle auxiliary incoming selector may therefore take place over a group of 50 sets of terminals with each set of terminals connecting to an auxiliary final selector. In the auxiliary final selectors the banks may also contain 500 sets of terminals divided in 5 banks of 100 sets each. These banks may be selected by the brush selection through the tripping of one out of 5 sets of brushes. The next selection will be that of the lower or upper half of 50 sets of terminals each in the determined bank, while the succeeding selection will be one out of five groups of 10 sets of terminals each and the hunting may take place over the selected group of 10 sets of terminals for an idle trunk leading to the desired private branch exchange.

It is assumed that the connection has been established to the terminals 11, the selectors 1 and 2 will have their respective sequence switches 15 and 16 located in positions 8 and 6 respectively. With sequence switch 16 in position 6, a circuit is now established for the operation of relay 17 from battery, winding of this relay, sequence switch cam 18 over the sleeve brush and terminal to ground at 12. Relay 17 in operating closes a circuit through sequence switch cam 20 for the advancing of the sequence switch to position 15. The sequence switch will now remain in this position until the switch is released. Relay 17 will also remain in operated position until the switch is released through a circuit over cam 18 to ground at the left hand armature and front contact of relay 17. It should be noted that when sequence switch cam 21 passes from 6 to 6½ after the operation of relay 17, a connection from battery through the right-hand armature and front contact of relay 17 is momentarily extended over the sleeve conductor leading to the sleeve terminal of the incoming selector 1. When the sequence switch passes into 7 and to position 18, the sleeve brush of the final selector 2 is connected through to the sleeve terminal of selector 1, so that the ground at 12 will then be connected through to the incoming selector 1. The tip and ring conductors are also connected through to the incoming selector when position 15 is reached by meane of cams 22 and 23.

This momentary connection to battery for the sleeve conductor to the incoming selector 1 cause the operation of relay 25 over a circuit from this battery and the sleeve connection, through the sequence switch cam 26 position 8, winding of relay 25 to ground. Relay 25 in operating closes a connection to ground at its left-hand armature and front contact and cam 28 to advance the sequence switch 15 to position 17, in which position the switch will remain until the connection is released. Relay 25 closes a locking circuit for itself to battery over cam 26. Relay 25 also prepares a circuit for the operation of relay 29 which causes the talking connection for the incoming line 10 over the repeating coil 30 to be disconnected from the auxiliary switches. This circuit is closed as hereinafter described when the auxiliary incoming selector 200 has been seized. In this position the tip and ring and sleeve conductors from the final selector are now extended through cams 32, 33 and 34 respectively, to conductors 35 leading to the auxiliary switches and the electrical conditions encountered at terminals 11 will now control the auxiliary switches to select the desired group of trunk and hunt for and connect the incoming line 10 to an idle trunk in a manner to be hereinafter described.

Conductors 35 extend through switch 201 to the auxiliary incoming switch 200. Switch 201 has merely been indicated in diagrammatic form as its use is not essential to the full understanding of this invention. It may be employed for automatically associating a common equipment of auxiliary incoming and final switches with lines such as 10 for example in small exchanges where it would not be economical to provide independent auxiliary switches for each incoming line as would be the case in larger exchanges. Regardless

of whether this switch is used or not the first effect after the conductors 35 have been connected to the auxiliary incoming switch 200 will be that relay 29 is operated from battery at relay 250 and also that the ground at 12 on the sleeve conductor will cause the operation of relay 202 over a circuit from battery winding of this relay, cam 203 in position 1, to the sleeve conductor over switches 1 and 2 to ground at 12. Relay 202 in operating closes a circuit at its right-hand armature and front contact for the operation of sequence switch 203 to cause it to advance to position 2. In this position relay 202 is released and the circuit closed for the up drive magnet 204 to advance the brushes 205 of selector 200 for brush selection. In position 2 a connection is established for relay 206 over cam 207 to the brush selecting commutators 209. The brush selection is controlled by the condition on the sleeve conductor as determined at 12. Relay 206 is marginal and operates only when a condition has been established whereby only four of the resistances at 12 or at 208 or at both these points are included in the sleeve conductor circuit. If, as shown in Fig. 1, the sleeve circuit is connected directly to ground at 12, relay 206 will operate through all four of the resistances at 208 as soon as the brushes 210 of commutator 209 have advanced to connect with the commutator segment 211. On the other hand, if the sleeve circuit at 12 were grounded through the first or one resistance only thereat, relay 206 will not operate until the first resistances of the group at 208 have been eliminated. This takes place when the brushes 210 have advanced to connect with the commutator segment 212. In a similar manner if the sleeve circuit is connected through succeeding resistances at 12, relay 206 will not operate until the corresponding resistances in group 208 have been eliminated by the brushes 210 advanced to the corresponding commutator segment in the group 209. When therefore relay 206 does operate a circuit is completed from ground at its armature and front contact through cam 214 for advancing the sequence switch 203 to position 3. In this position relay 206 is released by the opening of the circuit therefor at cam 207 and the up-drive magnet 202 is also released to stop the upward movement of the switch. In position 3 the trip magnet 216 is operated over cam 217 to trip the proper set of brushes determined by the distance traveled by the selector shaft in a manner well known in the art. In this particular case it will be the first set of brushes so that selection will take place in the first of the five banks of terminals in this selector. With relay 206 released a circuit will now be completed for advancing sequence switch 203 to position 4 by a circuit from ground at the armature and back contact of relay 206 through cam 214. With the sequence switch in position 4 the operations of the circuits from this time on will be controlled by the conditions on the tip and ring terminals at 11.

The next controlled movement of the incoming auxiliary selector will be the selection of the upper or lower half of the terminals in the selective bank. The condition on the ring terminal at 11 will now determine this selecting movement of the auxiliary incoming selector 200. If there is battery on the tip conductor the upper half will be selected and with ground on the tip conductor the lower half will be selected. With battery connected to the tip conductor as shown at 13 the upper half will be selected and in this case it will be observed that while the sequence switch passed through position 3½ into position 4 relay 221 operated over a circuit as follows. Battery at 13 over the ring conductor, cam 222 in position 3½, left-hand armature and back contact and winding of relay 221, cam 223 in position 3½, to ground. Relay 221 in operating provides a locking circuit for itself from battery at cam 225 independent of the battery on the ring conductor at 13. A circuit is now closed at the outer right-hand armature and front contact of relay 221 for reclosing the circuit of the up-drive magnet 204 through cam 226. The up-drive magnet will now again drive the brushes upward and thereby cause the first set of brushes to be tripped and when the brushes have been advanced half way up the selected bank the brush of the commutator 229 connects this commutator to ground. When this takes place a circuit is established for advancing of the sequence switch from position 4 into position 6 over cam 214, positions 4 and 5. Relay 221 is now released as its locking circuit over cam 225 is open when the sequence switch leaves position 4. The up-drive magnet 204 is therefore stopped when the sequence switch leaves position 4.

In position 5½ relay 230 is operated over a circuit through its left-hand winding and cam 231. In position 5½ to 6, relay 230 is held operated over a circuit from battery through the left-hand winding of this relay, cam 231, commutator 232 to ground at the brush for this segment. The up-drive magnet 204 is now again operated over a circuit completed through cam 226, position 6, left-hand armature and front contact of relay 230 to ground. Relay 230 is now held operated through its right-hand winding to a ground over cam 234 encountered over the sleeve brush from the sleeve terminals of busy trunks leading to busy final selectors. As stated relay 230 is also held operated over cam 231 by the ground on the commutator 232. These ground connections, however, alternate to hold the relay 230 operated. When therefore an idle trunk is found identified by the absence of the ground on the

sleeve terminal, the relay 230 releases and opens the circuit of the up-drive magnet 204. The hunting movement of the selector 200 is thereby stopped and the corresponding idle final selector seized. A busy ground is immediately placed on the sleeve terminal of this selector from the left-hand armature and back contact of relay 230 through cam 234 in order to guard this trunk and associated selector against seizure by another auxiliary incoming selector. The release of relay 230 also closes a circuit for the operation of relay 235 over a circuit from battery, winding of this relay, cams 207 and 214 in position 6, to ground at the left-hand armature and back contact of relay 230. The sequence switch 203 is also advanced by the release of relay 230 to position 7 from a circuit established over cam 214 to this ground at the left-hand armature and back contact of relay 230. Sequence switch 203 is then advanced to position 8 over cam 214 to the ground at the commutator 229.

It should be observed at this time that in case the ring conductor had been connected to ground instead of to battery as shown at 13, relay 221 would not have operated until the sequence switch 203 had passed into position 4½ as the battery connection would not have been completed at cam 223 until position 4½ had been reached. The sequence switch 203 would therefore be passed into position 5 from position 4, due to this relay failing to operate at position 3½, by a circuit closed to ground therefor at the inner right-hand armature and back contact of relay 221 and cam 236. In position 5, with relay 221 operated, a circuit is closed for advancing the sequence switch to position 6 from ground at the outer right-hand armature and front contact of relay 221 and cams 226 and 214. The up-drive magnet 204 will therefore not in this case be operated in position 4 and consequently the hunting will take place in the lower half of the selected group of terminals. The operation of the circuits in the selector 200 are the same as hereinbefore described in connection with the hunting for an idle trunk to an idle final selector. The only exception and an important one is that the sequence switch 203 is only advanced to the position 7 when trunk hunting ceases and relay 230 releases. This is due to the fact that there will be no connection to ground at the commutator for the sequence switch in position 7 as the lower half of the bank of terminals was selected in this case.

With the sequence switch in position 8, as hereinbefore described when the upper half of the bank was selected, relay 235 releases and a connection is now closed to complete a loop for the tip and ring conductors over cams 237 and 222 towards the auxiliary final selector 300. This loop extends over cams 303 and 304 in position 1 to battery and ground, with the tip connection completed through the winding of relay 238 and the ring connection completed through the winding of relay 306. Relays 238 and 306 operate in this circuit.

The operation of relay 306 closes a circuit for sequence switch 308 over cam 309, positions 1 to 5. It will be observed however that the sequence switch will be stopped in position 3 as the release of relay 306 occurs before the switch reaches this position, as will hereinafter be described. Relay 306 is locked through its own left-hand armature and front contact over the ring and tip conductors through the loop at the incoming selector to ground at cam 303 at the succeeding positions and between the positions it will be locked directly to ground at cam 310. Due to the grounding of the ring conductor between the positions by cam 310, relay 238 will be alternately shunted and thus caused to alternately release and operate as the sequence switch 308 passes from one position to another. This alternate operation and release of relay 238 is recorded by relays 239, 240 and 241 as follows. On the first operation of relay 238, relay 239 operates and locks to battery at cam 203. At the release of relay 238, relay 241 operates and locks to ground from battery at cam 203. At the next operation of relay 238 relay 240 operates and locks to cam 203. When relays 239, 240 and 241 are operated and on the next release of relay 238 relay 235 will operate over an obvious circuit and sequence switch 203 will be advanced to position 9 over a circuit through cams 214 and 207 in position 8, right-hand armature and front contact of relay 240, left-hand armature and front contact of relay 239 to ground at the right-hand armature and back contact of relay 238. This operation of the sequence switch causes the release of relays 239, 240 and 241 and the release of relay 240 causes the release of relay 235. The tip and ring conductors are now extended through to the final selector over cams 237 and 222. As these effects are produced by the second release of relay 238 sequence switch 308 will stop in position 3. This is due to the fact that on the operation of relay 235 the locking circuit for relay 306 is opened and is not again closed as the loop circuit through the incoming selector to ground at cam 303 will now be opened. Relay 306 in releasing opens the circuit for sequence switch 308 and with the switch in position 3 the final selector is in condition for brush selecting operation with battery on the ring conductor.

The operation of the final auxiliary selector will now be described under conditions where there is a battery connection on the ring at the terminals 11. With the sequence switch in position 3 and relay 306 released the up-drive magnet 310 will be operated over a circuit from battery winding of this

magnet, cam 311 in position 3, right-hand armature and back contact of relay 306 to ground. Depending now on the resistance condition at the cross connecting frame on the ring conductor, the relay 312 will operate when the resistance conditions have been met in the circuit completed through the commutator 313 in the same manner as the conditions were satisfied in the commutator 209 auxiliary incoming selected circuit. That is, a circuit will be established for relay 312 from the battery supplied over the ring conductor from 13 through cam 304 in position 3, winding of relay 312, cam 314 in position 3, resistances at 315, one of brushes 316, commutator 317, cam 318 in position 3, to ground. As the ring terminal at 13 is connected directly to battery, the relay 312 will operate as soon as the brushes have been advanced to connect with the commutator segment 319, thus selecting the first set of brushes to be tripped in the switch. Relay 312 in operating closes an obvious circuit for the operation of relay 320 over cam 309, positions 3 to 5. Relay 320 locks through its own armature and front contact and the sequence switch 308 is advanced to position 6. When position 6 has been reached relay 320 is released by the opening of the circuit therefor at cam 309. It should be noted that relay 312 releases as soon as the sequence switch left position 3 as the circuit therefor is open at cam 314 after position 3. The up-drive magnet is also stopped after position 3 by the opening of the circuit therefor at cam 311. The trip magnet 322 is operated over cam 324 in position 6 to be ready to trip the first set of brushes when the next up-drive occurs and the sequence switch 308 is advanced on the release of relay 320 to position 7 from a circuit completed at the armature and back contact of this relay and cam 309 in position 6. In position 7, the up-drive magnet 310 is again energized through a circuit completed through cam 324.

If on the other hand the ring terminal at 11 had been connected to ground instead of the battery it will be remembered that the sequence switch 203 of selector 200 will remain in position 7 after the selections have been completed in this selector. Consequently when the loop circuit is closed to selector 300 and when the cam 310 causes the alternate operation and release of relay 238, the control by relays 239, 241, 240 and 235 over the selector 300 will be different. In this case when relay 235 operates the sequence switch 203 will be advanced from position 7 to position 8 over the obvious circuit through cam 214. This causes the release of relays 239, 241, 240 and 235, but as the sequence switch is only in position 8 the loop circuit to selector 300 will be closed a second time. Consequently relay 306 will not be released at position 3 but maintain the circuit for the sequence switch 308 to cause it to continue to position 5. Relay 238 will therefore again be alternately operated and released under control of cam 310 and the cycle of operation of relay 239, 241, 240 and 235 repeated a second time. At the end of the second cycle of operation the sequence switch 203 will be advanced to the position 9 as hereinbefore described and with the sequence switch 308 in position 5. The up-drive magnet 310 will now be operated in the same manner as before, but relay 312 operates in this case from battery supplied at the cam 318 in position 5, through commutator segment 317, brushes 316, the commutators in the group 313, through resistances 315, cam 314, winding of relay 312, cam 304, ring conductor to ground at the cross connecting frame. Depending on the resistance conditions encountered at 13 the relay 312 will operate to select the proper set of brushes to be tripped. Relay 312 closes the circuit for relay 320, which relay in operating causes the sequence switch to advance to position 6 and stop the up-drive magnet 310. When this position is reached the trip magnet 322 is operated in position 6 and on the release of relay 320 the sequence switch is advanced to position 7.

The selection of the upper or lower group of terminals in the group selected by the tripping brushes will now take place and if there is battery connected on the tip at the cross connecting frame, the effect will be that the selection will take place in the upper part of the bank instead of the lower part. This is taken care of entirely by the commutators 317 and 328. As stated the up-drive magnet 310 will again be energized in position 7 and in view of the fact that relay 312 cannot operate until a ground connection is encountered for its circuit at this selector, the up-drive magnet will continue to drive the brushes over the lower half of the terminal bank until commutator 328 is reached by the commutator brushes 316. This takes place at the beginning of the second half of the bank and the circuit for the relay 312 will now be completed from battery over the tip conductor cam 303 in position 7, winding of relay 312, cam 314, through the commutators of the group 313, brushes 316 to ground at the commutator 328.

If ground had been connected to the tip conductor instead of battery the circuit for relay 312 would have been completed as soon after the brush selection as the brushes 316 of the commutator had reached the lower group of cummutator segments 342. This circuit would have been completed from battery cam 318 in position 7, commutator 317, commutator 342, resistance 315, cam 314, relay 312 and from there to the ground on the tip conductor at cross connecting frame at 13. In this case the selection of the desired private branch exchange group of trunks

will have taken place in the lower half of the selected main group in the same manner as hereinafter described for the selection in the upper half.

Depending now on the resistance conditions at cross connecting frame between the tip conductor and the battery at 13 relay 312 will operate when the proper circuit conditions have been established. The up-drive magnet will therefore now immediately be stopped by the operation of relay 312, if the first group of trunks are to be selected or continue to operate until the desired group is selected as determined by the resistance condition in the circuit for relay 312. As shown in the drawings the battery at 13 is connected through one resistance unit to the tip conductor and consequently the relay 312 will not operate until the second group has been reached, that is until the first resistance unit 331 has been eliminated from the circuit by the brushes 316 coming in contact with the second segment 332 of the upper group 330 of commutator segments. The trunk hunting following this selection will therefore take place in the second group of the upper half of the bank selected by the tripped brushes.

When relay 312 operates causing relay 320 to operate the sequence switch 308 will be advanced to position 8 over a circuit through cam 309. In this position the up-drive magnet will again operate over a circuit closed by the operation of relay 334. This relay operates in position 7¼ over a circuit from battery, through its left-hand winding, cam 335 to ground. Relay 334 is held operated through its right-hand winding through cam 337 to ground supplied at the sleeve terminals of busy trunks alternately with the ground supply through commutator 336. The brushes of the switch therefore advance over these busy trunks until an idle trunk is found when the holding ground for relay 334 is removed causing it to release and stop the up-drive magnet 310. The sequence switch 309 is now advanced to the ninth position from the circuit completed at the left-hand armature and back contact of relay 334 and cam 309 and a busy ground connection is placed on the sleeve through cam 337.

In position 9 a circuit is closed for the operation of relay 250 in the auxiliary incoming selector 200 over cam 338. Relay 250 opens the circuit for relay 29 in the incoming selector 1 and thereby causes this relay to release to connect the incoming line 10 through the repeating coil 30 to the tip and ring conductors extended to the auxiliary final selector 300. It is evident that due to the release of relay 29 at this time any suitable arrangement may be made to move the sequence switch 16 for example to open the connections to leads 35 from the battery and ground connections at the cross connecting frame 3, in fact the final selector may be entirely restored to normal at this time without interference with the talking connection established from trunk 10 to a trunk to a private branch exchange.

Relay 339 is now operated over a circuit completed through the winding of relay 339, cams 303 and 304, armature and back contact of relay 235, winding of 238, cams 237 and 222, cams 32 and 33, armatures and back contacts of relay 29, to ground and battery through the right-hand winding of repeating coil 30. Relay 339 in operating closes an obvious circuit for relay 340. Relay 340 is held operated through a circuit completed through its inner lower armature and front contact to battery at cam 318. The purpose of the operation of this relay will presently become apparent. The connection is now completed from the incoming line 10 through the auxiliary switches 200 and 300 to an idle trunk such as 342 of the selected group and the ringing equipment (not shown) will be actuated to call the selected private branch exchange. The called operator at this exchange may then answer the call and the connection to the desired subscriber extended in the usual manner.

When disconnection is desired the opening of the connection over the trunk 10 causes the release of the incoming and final selector in the usual manner. On the advance of the sequence switch 15 to normal the loop through the repeating coil 30 is opened causing the release of relay 339. The release of this relay closes a circuit for the advancing of the sequence switch 308 to position 18 over the circuit completed at the lower outer armature and front contact of relay 340 and cam 309. In this position the down-drive magnet 344 is operated from a circuit completed at cam 324 to return the switch 300 to normal position where a circuit is completed through commutator 345 to return the sequence switch 308 to normal position through cam 314. Auxiliary incoming selector 200 is returned to normal at the releasing of relay 238. The release of this relay causes the operation of relay 241 from battery supplied at cam 203. Relay 239 was operated when the relay 238 was operated and on the release of this relay, relay 241 operates as hereinbefore described. The operation of relay 241 now causes the sequence switch 203 to be advanced to position 18 over a circuit completed from battery, sequence switch 203, cam 251, outer right-hand armature and front contact of relay 241 to ground. The down-drive magnet 253 is now operated through the circuit completed at cam 217 and when the switch 200 has been returned to normal position a circuit is completed through commutator 254 and cam 251 for the return of the sequence switch 203 to normal position.

It should be understood that while the invention has only been illustrated in connection with a single system it may readily be applied to a number of other arrangements without departing from the spirit thereof.

What is claimed is:

1. In a telephone system, a calling line, groups of lines, switching means responsive to impulses received over said calling line for marking a group of lines, auxiliary switching means, and means responsive to said marking for directing said auxiliary switching means to select the marked group of lines and to connect the calling line with an idle line in the selected group.

2. In a telephone system, a calling line, a group of lines, switching means responsive to impulses received over said calling line for marking said group of lines, auxiliary switching means, and means responsive to said marking for directing said auxiliary switching means to select the marked group of lines and to hunt for an idle line in said selected group and to connect said calling line to an idle line in said selected group when found.

3. In a telephone system, a calling line, called lines, groups of lines, switching means responsive to impulses received over the calling line, for selecting a called line, or for marking a group of lines, auxiliary switching means, means responsive to said marking for controlling said auxiliary switching means to connect the calling line with an idle line in the marked group of lines over a path excluding said first mentioned switching means.

4. In a telephone system, a calling line, groups of lines, switching means responsive to impulses received over the calling line for marking a group of lines, auxiliary switching means, means responsive to said marking for controlling said auxiliary switching means to select the marked group and hunt for and connect said calling line with an idle line in the marked group over a path excluding said first mentioned switching means.

5. In a telephone system, a calling line, groups of lines, a switch, means for selecting a certain set of terminals to said switch, representing a certain group of lines, another switch in which said groups of lines terminate, means responsive to the selection of said sets of terminals for actuating said other switch to select a group of terminals thereon corresponding to the group of lines represented by the selected terminals on said first mentioned switch, for hunting for the terminals of an idle line in said group and for connecting the calling line and said idle line exclusive of said first mentioned switch.

6. In a telephone system, a calling line, groups of lines, sets of terminal points comprising various combinations of potentials and representing particular groups of lines, means for selecting any set of terminal points representing a particular group of lines, switching means, means responsive to said selection for actuating said switching means to connect the calling line with an idle line in the group of lines represented by the selected set of terminal points.

7. In a telephone system, a calling line, groups of lines, sets of terminal points, connections from said sets to ground or battery through various combinations of resistances, means for selecting any set of terminals; switching means, means responsive to the selection of said terminals for actuating said switching means to connect the calling line to a particular group of lines corresponding to the characteristic combination encountered at the selected set of terminals.

8. In a telephone system, a calling line, groups of lines, sets of terminal points, connections from said sets to ground or battery through various combinations of resistances, means for selecting any set of terminals, a plurality of switches, means responsive to the electrical conditions encountered at certain of the terminals in a selected set for controlling the setting of certain of said switches and responsive to the electrical conditions encountered at certain other terminals in the selected set for controlling the setting of other switches for the establishing of a connection from the calling line to a certain corresponding group of lines.

In testimony whereof, I have signed my name to this specification this 6th day of February, 1930.

ARTHUR B. STERN