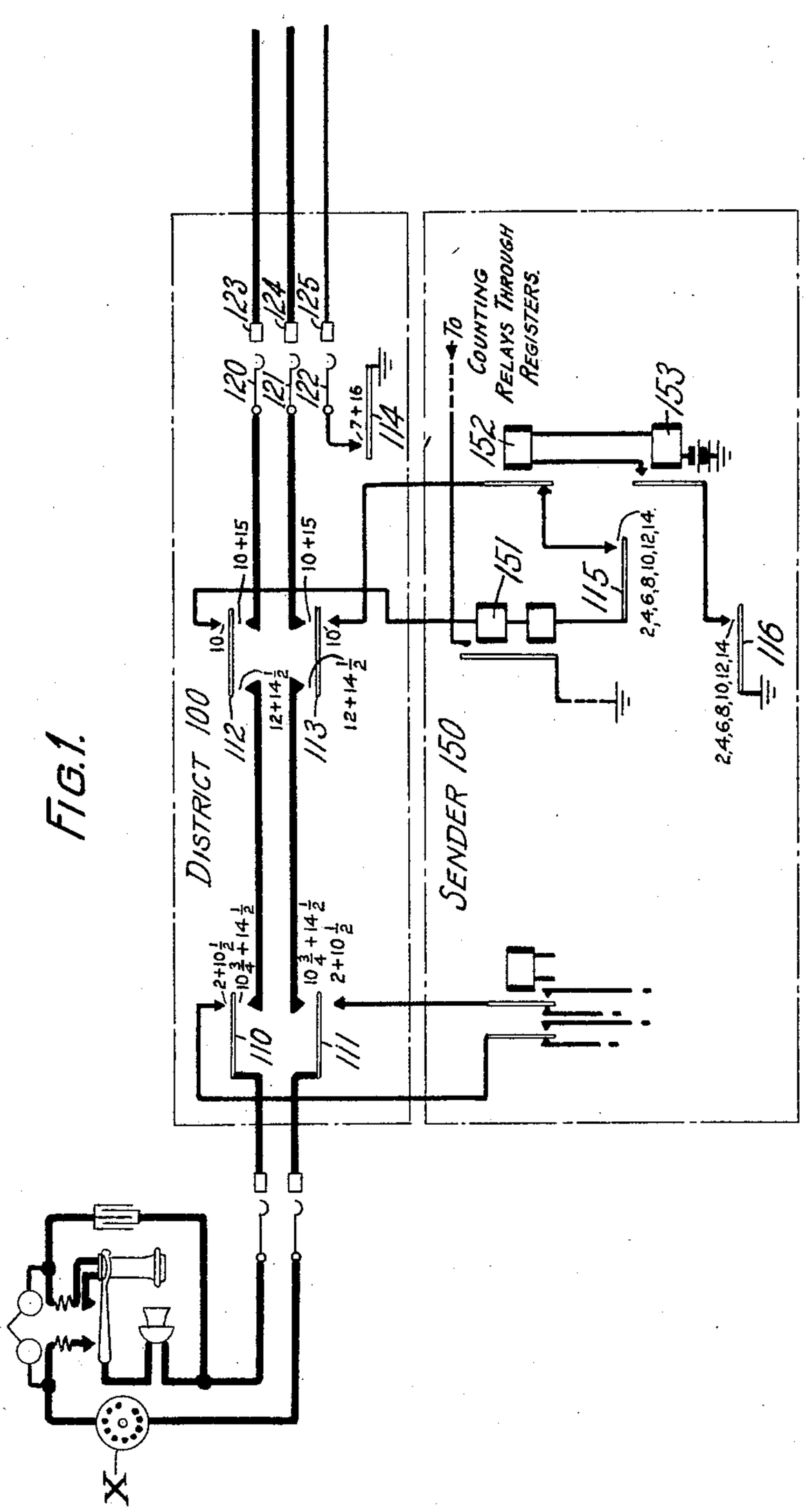
Oct. 14, 1930. J. N. WALTERS ET AL 1,778,407

SELECTIVE SWITCH

Filed July 29, 1927 2 Sheets-Sheet 1

FIG. 1.



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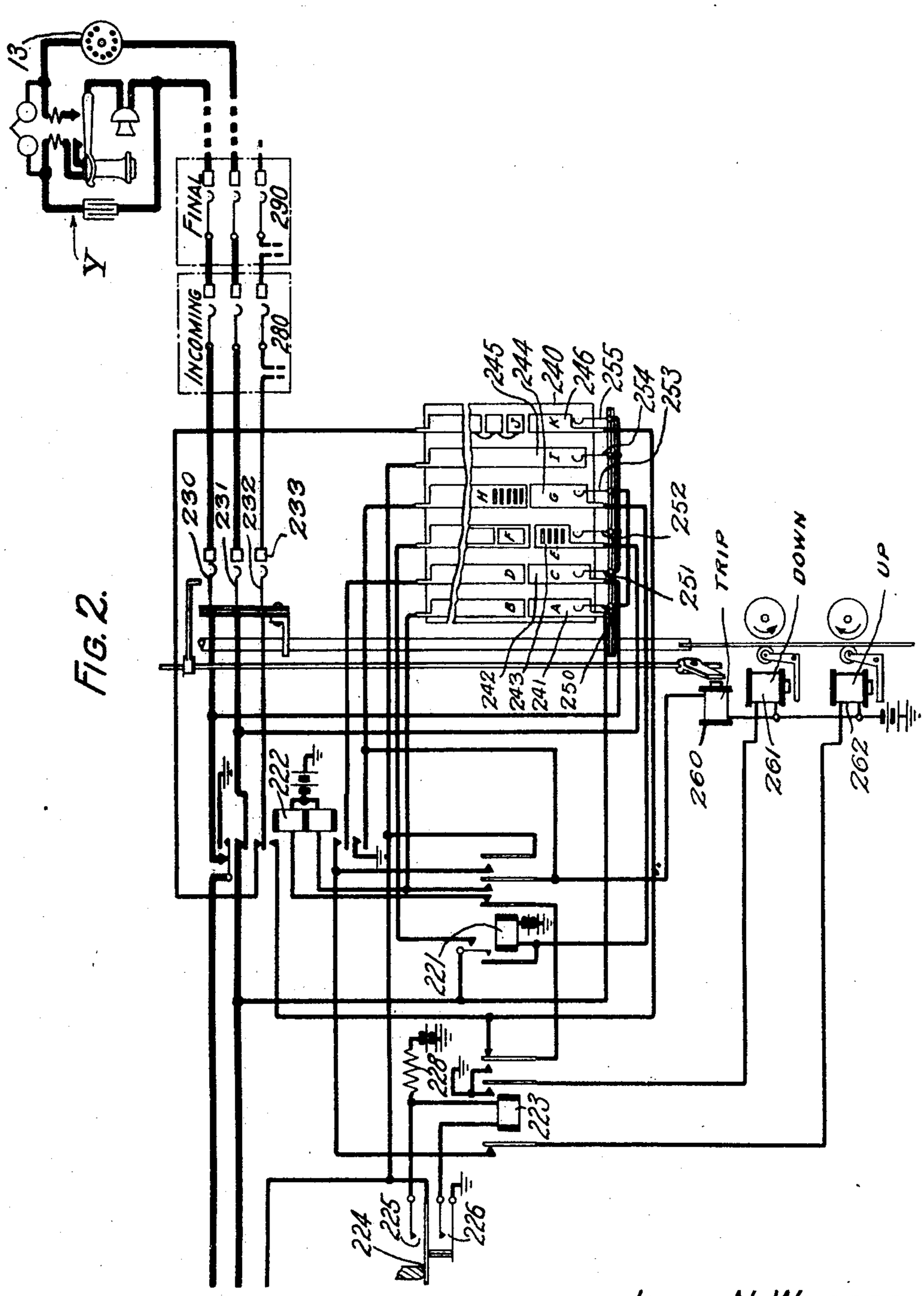

FIG. 2.

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UNITED STATES PATENT OFFICE

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SELECTIVE SWITCH

Application filed July 29, 1927. Serial No. 209,219.

The present invention relates to a selective switch in a machine switching telephone office. More specifically it relates to a selective switch of the revertive impulse type comprising relays and commutators operable for full control of the switch driving mechanism for positioning the switch brushes.

Selective switches for panel type machine switching systems ordinarily include a progression switch of the rotary type. This progression switch is operable for making circuit changes which are necessary for the various movements of a selective switch. The operation of this progression switch as a separate unit in a selective switch is a factor to be considered in the operating time for completing telephone connections. Any time required for the operation of switching apparatus is material because of the number of switches required in a telephone office. The removal of such apparatus from a selective switch therefore would effect considerable economy both in apparatus required for switches and in the number of switches required for a telephone office. The removal of such apparatus from a selective switch would also reduce maintenance work. Apparatus such as a progression switch normally has a number of adjustments to be maintained for satisfactory operation of the switch. Incorrect adjustments of such a progression switch may result in incorrect telephone connections.

In accordance with the present invention movable brushes are associated with commutators to act both as a progression switch and as an interrupter. A pair of relays are variably operable in accordance with the position of the brushes associated with the progression switch commutators for controlling the selective movements of the switch. Full control of the driving mechanism of the switch is accomplished with this combination of relays and commutators in the manner that has been heretofore accomplished with relays, commutators and a rotary power driven progression switch.

In carrying out this invention a pair of off normal contacts have been associated with the commutator brushes. These off normal contacts are closed when the brushes are driven in an upward movement. A circuit is established upon the closure of these contacts for the actuation of a relay to restore the switch mechanism to normal when the calling line is disconnected. The continued connection of the calling line to this switch causes the association of a busy potential with one of the switch terminals. This busy potential maintains the operating circuit for the restoring relay ineffective. On the disconnection of the calling line this busy potential is removed allowing the restoring relay to operate.

Referring to the drawings in which one embodiment of the invention is disclosed:

Fig. 1 shows a calling line and a diagrammatic representation of a subscriber's individual line switch, a district selector and a common sender;

Fig. 2 shows in detail the circuits of an office selector in accordance with the present invention, the diagrammatic representation of incoming and final selectors and a called line.

The illustrated embodiment represents a complete telephonic connection between two subscribers' stations X and Y. The arrangement of the selective switches and apparatus is similar to the disclosure in Patent 1,550,377, issued to A. E. Lundell, August 18, 1925. The district selector and sender shown in Fig. 1 operate the same as the district selector, and sender of the aforementioned patent to Lundell and therefore need not be described in detail in this application. The selective switch shown in detail in Fig. 2 represents a selective switch arranged to perform functions the same as Fig. 9 of the aforementioned patent to Lundell. The incoming and final selectors diagrammatically shown in Fig. 2 are the same as Figs. 12 and 13 of the aforementioned patent.

In accordance with the present invention the apparatus individual to the switch, Fig. 2, is of the type shown and described in Patent 1,123,696, issued to E. B. Craft and J. N. Reynolds January 5, 1915. This switch has a vertically disposed switch shaft provided

with a plurality of sets of brushes, each brush set having access to a bank of terminals. For driving the switch shaft upwardly an up drive magnet is provided which when energized presses the switch shaft against a constantly driven power drum and for driving the switch shaft to normal position a down drive switch magnet is provided which when energized presses the switch shaft against a second constantly driven power drum. For determining the particular set of brushes on the switch shaft to be employed, a tripping spindle is provided as described in the patent to Craft et al. A plurality of commutators are provided similar to those disclosed in the aforementioned patent. Brushes are driven over these commutator surfaces by the vertically disposed switch shaft hereinbefore mentioned for driving the brushes having access to the bank terminals. The commutators disclosed herein are arranged to act as a progression switch in addition to acting as an interrupter. The top portion of the commutator is therefore separated from the bottom portion of the commutator for the establishment of different circuit conditions during the progression of the brushes over the commutator surfaces. Off normal contacts are mounted in any suitable manner below the commutator brush assembly. The weight of the brush assembly and shaft maintains the contacts open during the time that the brush assembly is resting in its normal position. The upward movement of the brush assembly permits the off normal contacts to be closed by the movement of spring contacts. The relays disclosed as part of the apparatus for controlling this switch are of a type well known in the art.

It is believed that the invention will be better understood from the following detailed description taken together with the illustrated embodiment.

Assuming that the subscriber at station X desires a telephone connection with station Y, the receiver is removed from the switchhook and the dial manipulated in the well known manner. The district selector and sender are associated with subscriber's station X in response to the removal of the receiver from the switchhook as described in the aforementioned patent to Lundell. The manipulation of the dial sets a plurality of registers in the sender for the control of the selective switches for the association of station X with station Y.

The district selector is operated in accordance with the settings of the sender registers for positioning brushes 120, 121 and 122 on the trunk terminals 123, 124 and 125 in the manner described in the aforementioned patent to Lundell. The sequence switch cams 112, 113 and 114 are rotated into position 10 for the control of other selector switches. With the apparatus of the district and sender thus positioned, a busy potential is associated with terminal 125 through brush 122 and cam 114 to prevent the seizure of the same terminals by other district selectors. A bridge circuit known as the fundamental circuit is established in the sender for energizing the apparatus of the selective switch, Fig. 2. This fundamental circuit may be traced from battery through the winding of relay 221, section "G" of commutator 244, brush 253, brush 250, section "A" of commutator 241, thence over the tip conductor of the trunk extending to terminal 124, brush 121, right upper and lower contacts of cam 113, normal contact of counting relay 152, cam 115, winding of stepping relay 151, right upper and lower contacts of cam 112, brush 120, terminal 123, thence over the ring trunk conductor, uppermost normal contact of relay 222, section "C" of commutator 242, brush 251, brush 254, commutator 245, terminal 125, brush 122 to ground through cam 114. Relay 221 is operated over the fundamental circuit as traced.

The operation of relay 221 establishes a circuit for the up drive magnet 262 which may be traced from battery, through the winding of the up drive magnet, left normal contact of relay 223, right outermost contact of relay 221, to ground through terminal 125, brush 122 and cam 114. Since all of the brushes associated with the commutators 240 are assembled in a brush set and associated with the drive shaft as well as the brushes 230, 231 and 232 they are driven upward by the movement of this shaft under the control of the up drive magnet. The initial upward movement of the commutator brushes and contact brushes is for making brush selection as will be hereinafter described.

Preceding the upward movement of the brushes the off normal contacts 225 and 226 are maintained open by the pressure of the brush assembly against the contact spring assembly 224. Upon the upward movement of the brush assembly the off normal spring assembly is released allowing the contacts 225 and 226 to be closed. An operating circuit is thus established for relay 223 from battery, through resistance 228, winding of relay 223 to ground through contact 226. This circuit is, however, maintained ineffective for operating relay 223 by the ground shunt associated therewith through cam 114. Relay 223 therefore cannot operate until brush 122 is disconnected from terminal 125.

The usual practice in selective switches of this type is to operate the return to normal relay when the switch is seized for a telephone connection and to release the relay for restoring the switch to normal when the busy ground is removed. It will be recognized that such a practice necessitates circuit paths through a progression switch for energizing the restore to normal apparatus such as the

down drive magnet. Otherwise the relay in its non-operated position would maintain the restore to normal apparatus operated. The usual practice is therefore to establish the restore to normal circuits through a progression switch after the sleeve relay, such as 223, is operated so that when this relay is released the restore to normal circuits will be completed. In this circuit the restore to normal relay 223 is maintained in its non-operated position in order to obviate the necessity of preparing the restore to normal circuits through a progression switch commutator. The unusual circuit arrangement for relay 223, however, eliminates the necessity for such a progression switch circuit.

It will be remembered that the up-drive magnet 262 was energized, by the operation of relay 221, for brush selection. Let it be assumed that the sender is set for the selection of a terminal in the third bank of terminals. The brushes will be elevated to a point where the brush associated with the third bank will be tripped. As brush 252 is driven over section "E" of commutator 243, impulses are intermittently transmitted to the sender. This impulse circuit may be traced from ground through cam 114, brush 122, terminal 125, commutator 245, brush 254, brush 252, section "E" of commutator 243, upper middle contact of relay 222 to the tip conductor for establishing a shunt to release the stepping relay 151 of the sender. The relay 221 is not released by this shunt circuit since a circuit is established through its left contact and winding to battery for maintaining it in an operated position. Since the sender is set for selecting the third brush it necessarily follows that three counting relays in the sender must be operated to open the fundamental circuit for arresting the movement of the up-drive magnet. Each time the stepping relay 151 is caused to operate and release a set of counting relays is operated. The brush 252 is driven over conducting and non-conducting segments of section E of commutator 243. Each conducting segment of the commutator associates the shunt ground with the tip trunk conductor for causing the release of the stepping relay 151. Upon the third connection of the shunt ground to the tip conductor a terminating counting relay shown as relay 152 is operated to open the fundamental circuit. The circuit for relay 221 is thus opened when the brush 252 is driven onto the next non-conducting segment of the commutator. The release of relay 221 opens the energizing circuit for the up-drive magnet to arrest the upward movement of the brushes.

It will be noted that the brush 255 is normally disassociated from section "K" of commutator 246. This brush is, however, associated with the commutator during brush selection. Upon the release of relay 221 a circuit is established through this brush for the operation of relay 222. This circuit may be traced from battery, through the upper winding of relay 222, right innermost contact of relay 221, right normal contact of relay 223, section "K" of commutator 246, brush 255, brush 254, commutator 245 to ground through terminal 125, brush 122 and cam 114. The operation of relay 222 establishes an energizing circuit for the trip magnet 260 from battery through its winding to ground through the lowermost contact of relay 222.

The operation of relay 222 further prepares a path for the reestablishment of the fundamental circuit for the reoperation of relay 221. As soon as the sender sequence switches have been advanced for the control of the switch Fig. 2 for group selection, this fundamental circuit is completed by the release of the counting relays. The fundamental circuit may now be traced from battery, through the winding relay 221, section "G" of commutator 244, brush 253, brush 250, section "A" of commutator 241, thence over the tip trunk conductor, terminal 124, brush 121, right upper and lower contacts of cam 113, normal contact of counting relay 152, cam 115, winding of the stepping relay 151, right upper and lower contacts of cam 112, brush 120, terminal 123, to ground through the uppermost contact of relay 222. The operation of relay 221 establishes a locking circuit for relay 222 before the contact is opened through which its operating circuit is established. This locking circuit may be traced from battery, through the lower winding of relay 222, right middle contact of relay 221, to ground through the lowermost contact of relay 222.

The operation of relay 221 further establishes a circuit for the up drive magnet 262 from battery, through its winding, left normal contact of relay 223, right outermost contact of relay 221 to ground through terminal 125, brush 122 and cam 114. Upon the upward movement of the switch shaft the tripping of the brushes associated with the third bank terminals takes place. A detailed description of the tripping mechanism and its operation is given in the aforementioned patents to E. B. Craft et al., and A. E. Lundell. It is therefore thought unnecessary to include a detailed description of the tripping mechanism in this application.

The upward movement of the brushes carries brush 252 over the remaining conducting and non-conducting segments of section "E" of commutator 243. These interruptions are, however, not effective for transmitting impulses to the sender since the conductor connected to commutator 243 has been opened at the upper middle contact of relay 222. When the brush 252 is associated with section "F" of commutator 243 a ground is then connected to the tip conductor to release

the sender stepping relay 151 by shunt. This shunt circuit may be traced from cam 114 through brush 122, terminal 125, commutator 245, brush 254, brush 252, section "F" of commutator 243, left contact of relay 221 to the tip conductor. The relay 221 is maintained in its operated position by a circuit through its left contacts and winding to battery. The number of impulses transmitted to the sender for shunting the stepping relay 151 depends upon the terminal group to be selected. Let it be assumed that the sender apparatus is set to cause the selection of the second group in the third bank. Two ground impulses are transmitted to the sender for causing the operation of two counting relays including relay 152 for opening the fundamental circuit after the second ground impulses. The operation of counting relay 152 opens the energizing circuit for relay 221.

The release of relay 221 opens the energizing circuit for relay 222 that was established through its lower winding. The brush 232 is now associated with the first terminal of a group of trunks. If this first trunk is busy the brush 232 will be associated with a busy ground connected to terminal 233. This ground maintains an energizing circuit for relay 222 over the upper inside contact of relay 222, right outer normal contact of relay 223, right inner normal contact of relay 221, upper winding of relay 222 to battery. The energizing circuit for the up drive magnet 262 is now extended from battery, through its winding, left normal contact of relay 223, lower inside contact of relay 222, section "D" of commutator 242, brush 251, brush 254, commutator 245, to ground through the terminal 125, brush 122 and cam 114. A circuit for the up drive magnet 262 is thus maintained to drive the brushes upward in search of an idle trunk. Ground is not associated with terminal 233 of an idle trunk. Therefore when an idle trunk is encountered the energizing circuit for relay 222 is opened to cause its release. The release of relay 222 opens the circuit for the up drive magnet to arrest the upward movement of the switch shaft. The release of relay 222 now connects the tip and ring trunk conductors from the sender to brushes 230 and 231 for actuating the incoming selector switch 280 as described in the aforementioned patent to Lundell.

It will be noted that the commutator brushes have been progressively moved upward and are now associated with sections of the commutator that do not include relay 221 in any circuit. This relay cannot be energized when the fundamental circuit is established for operating the incoming selector switch 280. Certain of the commutator segments and associated brushes therefore act in the capacity of a progression switch for functions similar to those accomplished by the sequence switch in the ordinary type of selector switch.

It will be remembered that an operating circuit has been continuously established for relay 223 which operating circuit in ineffective because of the ground shunt associated with terminal 125. Let it be assumed now that the sender has operated to associate the incoming selector switch 280 with the final selector switch 290 and the final selector switch with subscriber's station Y and also that upon the completion of a telephone conversation the subscriber at station X has replaced the receiver upon the switchhook. After the replacement of the receiver on the switchhook at station X the district selector 100 is automatically restored to its normal position, thus disconnecting brush 122 from terminal 125. The shunt preventing the operation of relay 223 is thus removed and this relay is caused to operate over the circuit previously traced through off normal contact 226. The operation of relay 223 associates an energizing circuit through its right inner contact with the down drive magnet 261. The operation of relay 223 further establishes a circuit to energize relay 222 from ground through the right outer contact of relay 223, right inner normal contact of relay 221, upper winding of relay 222 to battery. The energization of the down drive magnet restores the switch shaft and brushes to their normal position. During the restoring period of the switch terminal 125 is held busy to other selectors by the ground through the winding of relay 223. The operation of relay 222 at this time is for the purpose of energizing the trip magnet 260. This circuit may be traced from battery through the winding of the tripping magnet to ground through the lowermost contact of relay 222. The energization of the trip magnet maintains the trip lugs in an angular position with respect to the trip fingers in order to eliminate the possibility of trouble during the downward movement of the switch shaft.

A type of selector known as an office selector has been used for the description of this invention. It is not the intention, however, that the invention shall be limited to this particular type of selector switch.

What is claimed is:

1. In a selective switching system, a selective switch having a plurality of stationary contacts and movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over the stationary contacts in a primary and a secondary selective movement, a branched circuit extending through the winding of said clutch magnet, and means in said switch controlled by the primary movement thereof to shift the control of the said clutch magnet from one branch of said circuit to another.

2. In a selective switching system, a se-

lective switch having a plurality of stationary contacts and movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over the stationary contacts in a plurality of selective movements, a branched circuit extending through the winding of said clutch magnet, and means in said switch controlled by the movements thereof for organizing the branches of said circuit.

3. In a selective switching system, a selector switch having a plurality of stationary contacts and movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over said stationary contacts, a branched circuit extending through the winding of said clutch magnet selectable for governing a plurality of progressive selective movements of said contacts, and a circuit changer operated by said driving means for selecting the branches of said circuit.

4. In a selective switching system, a selector switch having a plurality of stationary contacts and movable contacts associable therewith, a progression switch having movable brushes, a common means including a clutch magnet for driving said movable contacts and brushes in a plurality of selective movements, a branched circuit extending through the winding of said clutch magnet, and means controlled by said progression switch for shifting the control of said clutch magnet from one branch of said circuit to another.

5. In a selective switching system, a selector switch having a plurality of stationary contacts and movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over said stationary contacts, a branched circuit extending through the winding of said clutch magnet selectable for governing a plurality of progressive selective movements of said contacts, electrically operable apparatus for shifting the control of said clutch magnet from one branch of said circuit to another, and a device controlled by said clutch magnet for variably operating said apparatus.

6. In a telephone exchange system, a first switch, a second switch, means operable for causing said first switch to select said second switch, means for operating said second switch, an electro-magnetic device operative for restoring said second switch, an operating circuit for said electro-magnetic device, means for establishing said operating circuit during the operative movements of said second switch, and means maintained by the connection of said first switch to said second switch for causing said operating circuit to be ineffective.

7. In a telephone exchange system, a first switch, a second switch, means operable for causing said first switch to select said second switch, means for operating said second switch, an electro-magnetic device operative for restoring said second switch, an operating circuit for said electro-magnetic device, means for establishing said operating circuit during the operative movements of said second switch. means maintained by the connection of said first switch to said second switch for causing said operating circuit to be ineffective, and means whereby said circuit is made effective for operating said electro-magnetic device by the disconnection of said first switch from said second switch.

8. In a telephone exchange system, a first switch, a second switch, means operable for causing said first switch to select said second switch thereby associating a busy potential with a terminal of said second switch, an electromagnetic device in said second switch operative for restoring said second switch, an operating circuit for said electro-magnetic device established during the operative movements of said second switch, means for associating a busy potential with said operating circuit to maintain said operating circuit ineffective, and means for disassociating said busy potential from said operating circuit for causing the operation of said electro-magnetic device to restore said second switch.

9. In a telephone exchange system, a first switch, a second switch, means operable for causing said first switch to select said second switch, said second switch comprising stationary commutators with movable brushes associable therewith arranged to act as both a progression switch and an interrupter for variably governing the selective movements of said switch, means for moving said brushes for switch selections, an electro-magnetic device operative for restoring said second switch, off normal contacts closed by the movement of said commutator brushes for establishing an operating circuit for said electro-magnetic device, and means maintained by the connection of said first switch to set second switch for causing said operating circuit to be ineffective.

10. In a selective switching system, a selective switch having a drive shaft, a driving means for said shaft, a branched control circuit extending through the winding of said driving means, stationary contacts variably selectable by movable contacts attached to said shaft, brushes attached to said shaft for controlling the extent of movement of the shaft, and a progression switch with movable brushes attached to said shaft for sequentially closing the branches of said control circuit for actuating a plurality of movements of said switch.

11. In a selective switching system, a selective switch having a drive shaft, a driving means for said shaft, a branched control circuit extending through the winding of said driving means, stationary contacts variably

selectable by movable contacts attached to said shaft, an interrupter driven by said shaft for controlling the extent of shaft movement, and a progression switch driven by said shaft for sequentially closing the branches of said control circuit for actuating a plurality of movements of said shaft.

12. In a selective switching system, a selective switch having a drive shaft, a drive for said shaft, a plurality of stationary contacts and movable contacts associable therewith, an electromagnet for coupling said shaft and said drive for moving said movable contacts over said stationary contacts in a plurality of selective movements, a branched control circuit extending through the winding of said electromagnet, and means for shifting from one branch of said circuit to another according to the position of said drive shaft.

13. In a selective switching system, a selective switch having a drive shaft, a driving means for said shaft, a plurality of stationary contacts, movable contacts attached to said shaft for association with said stationary contacts, a branched control circuit extending through the winding of said driving means for driving said movable contacts over said stationary contacts in a plurality of selective movements, and a switching mechanism operable by the movement of said shaft for sequentially changing the control of said driving means from one branch of said circuit to another and for controlling the extent of each selective movement.

14. In a selective switching system, a selective switch having a drive shaft, a driving means for said shaft, a plurality of stationary contacts, movable contacts attached to said shaft for association with said stationary contacts, a branched control circuit extending through the winding of said driving means for driving said movable contacts over said stationary contacts in a plurality of selective movements, a plurality of electromagnetic devices for establishing the branches of said circuit, and a switch mechanism operable by the movement of said shaft for sequentially controlling the energization of said electromagnetic devices for changing the control of said driving means from one branch of circuit to another.

15. In a telephone exchange system, a selector switch having a plurality of groups of stationary contacts and sets of movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over said stationary contacts in a plurality of selective movements, a branched control circuit extending through the winding of said magnet, stationary commutators, a set of movable brushes associable therewith and operable by said magnet, and means controlled by the movement of said set of brushes over said commutators for sequentially establishing the branches of said circuit and for governing the selective movements of said switch.

16. In a telephone exchange system, a selector switch comprising a plurality of stationary terminals arranged in groups and sets of movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over said stationary terminals to select any group of terminals and an idle terminal in the selected group, a branched control circuit extending through the winding of said magnet, stationary commutators, a set of movable brushes associable therewith and operable by said magnet, and means controlled by the movement of said set of brushes over said commutators for sequentially establishing the branches of said circuit and for governing the selective movements of said switch.

17. In a telephone exchange system, a selector switch comprising a plurality of stationary terminals arranged in groups in a single plane and sets of movable contacts associable therewith, means including a clutch magnet for driving said movable contacts over said stationary terminals to select any group of terminals and an idle terminal in the selected group, a branched control circuit extending through the winding of said magnet, stationary commutators, a set of movable brushes associable therewith and operable by said magnet, and means controlled by the movement of said set of brushes over said commutators for sequentially establishing the branches of said circuit and for governing the selective movements of said switch.

18. In a telephone exchange system, a selector switch comprising a plurality of stationary banks of terminals arranged in groups and sets of movable contacts associable respectively with said banks of terminals, means including a clutch magnet for driving said movable contacts first for selecting a set of movable contacts and then in group and terminal selection movements to select any group of terminals in any one of said banks and an idle terminal in the selected group, a branched control circuit extending through the winding of said magnet, stationary commutators, a set of movable brushes associable therewith and operable by said magnet, and means controlled by the movement of said set of brushes over said commutators for sequentially establishing the branches of said circuit to control said selections and for governing the selective movements of said switch.

19. In a telephone exchange system, a selector switch comprising a plurality of groups of stationary contacts and movable contacts associable therewith, means includ-

ing a clutch magnet for driving said movable contacts over said stationary contacts in a plurality of selective movements, a branched control circuit extending through the winding of said magnet, stationary commutators, a set of movable brushes associable therewith and operable by said magnet, a sender for directing the selective movements of said switch, and means controlled by the movement of said set of brushes over said commutators for sequentially establishing the branches of said circuit and for transmitting revertive control impulses to said sender.

In witness whereof, we hereunto subscribe our names this 22nd and 26th days of July, A. D. 1927.

EDGAR H. CLARK.
JAMES N. WALTERS.