

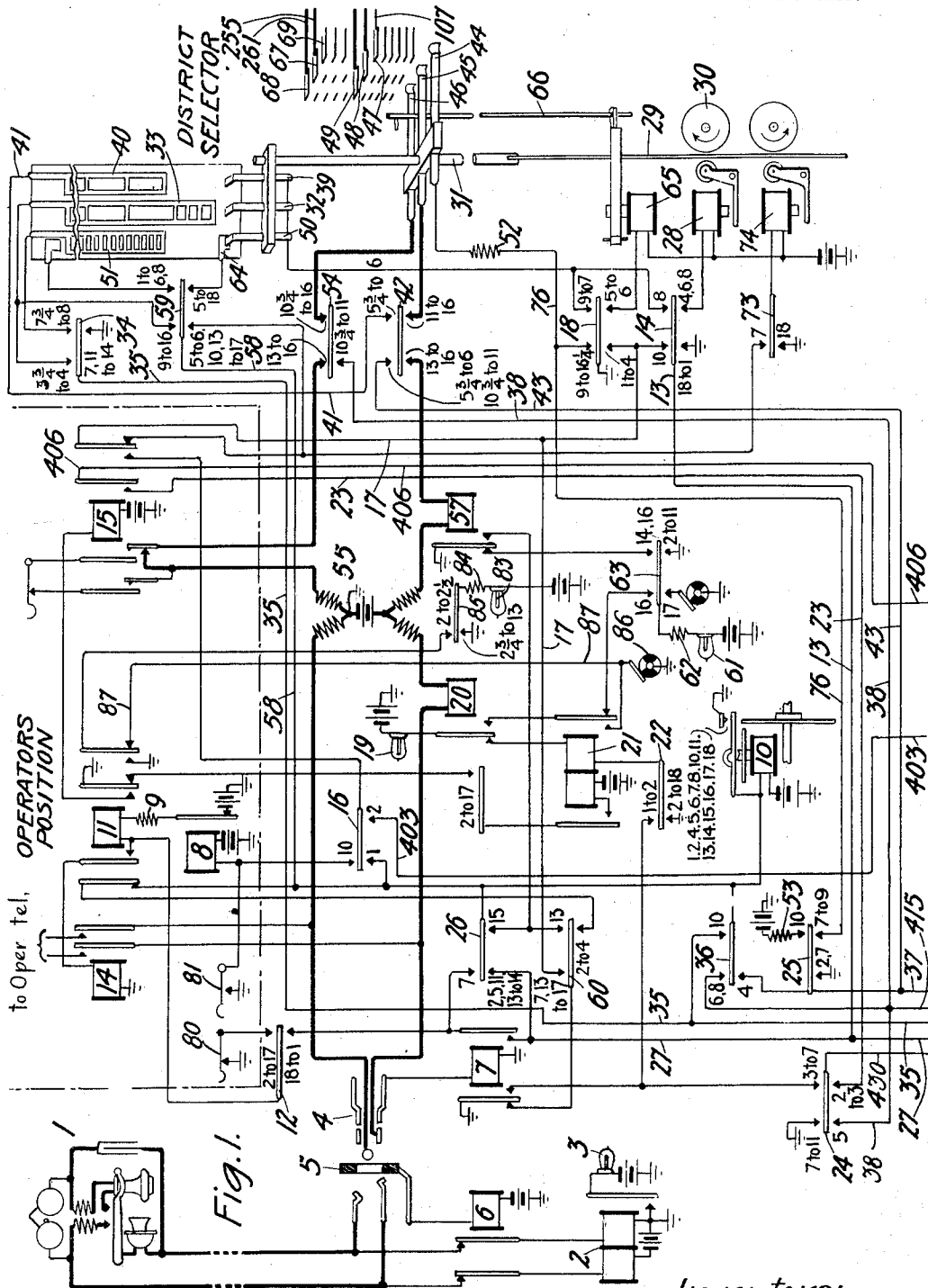
A. E. LUNDELL AND F. A. STEARN.
TELEPHONE SYSTEM.

APPLICATION FILED JULY 22, 1918.

1,345,016.

Patented June 29, 1920.

16 SHEETS—SHEET 1.



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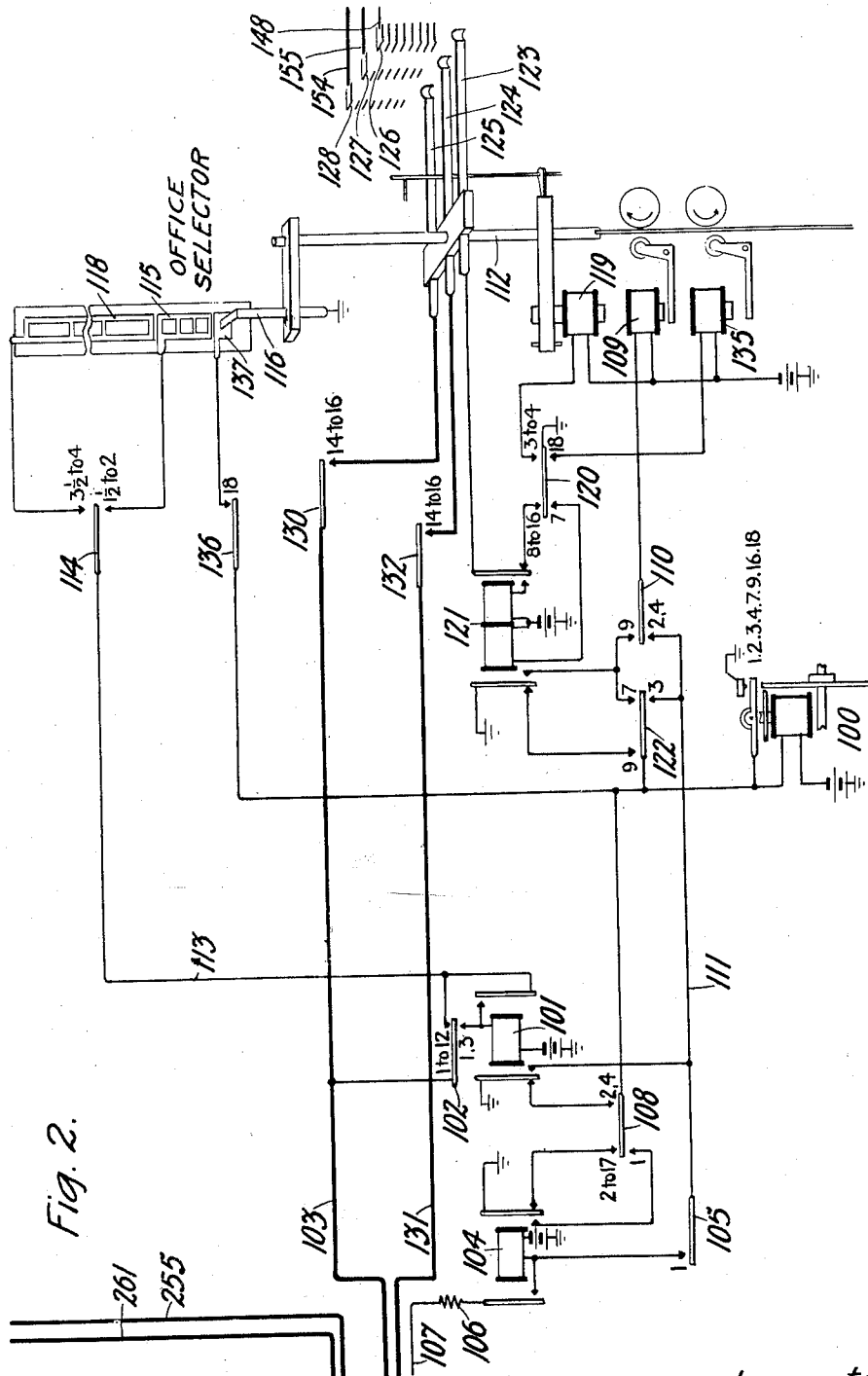
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16 SHEETS—SHEET 2.

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16 SHEETS—SHEET 3

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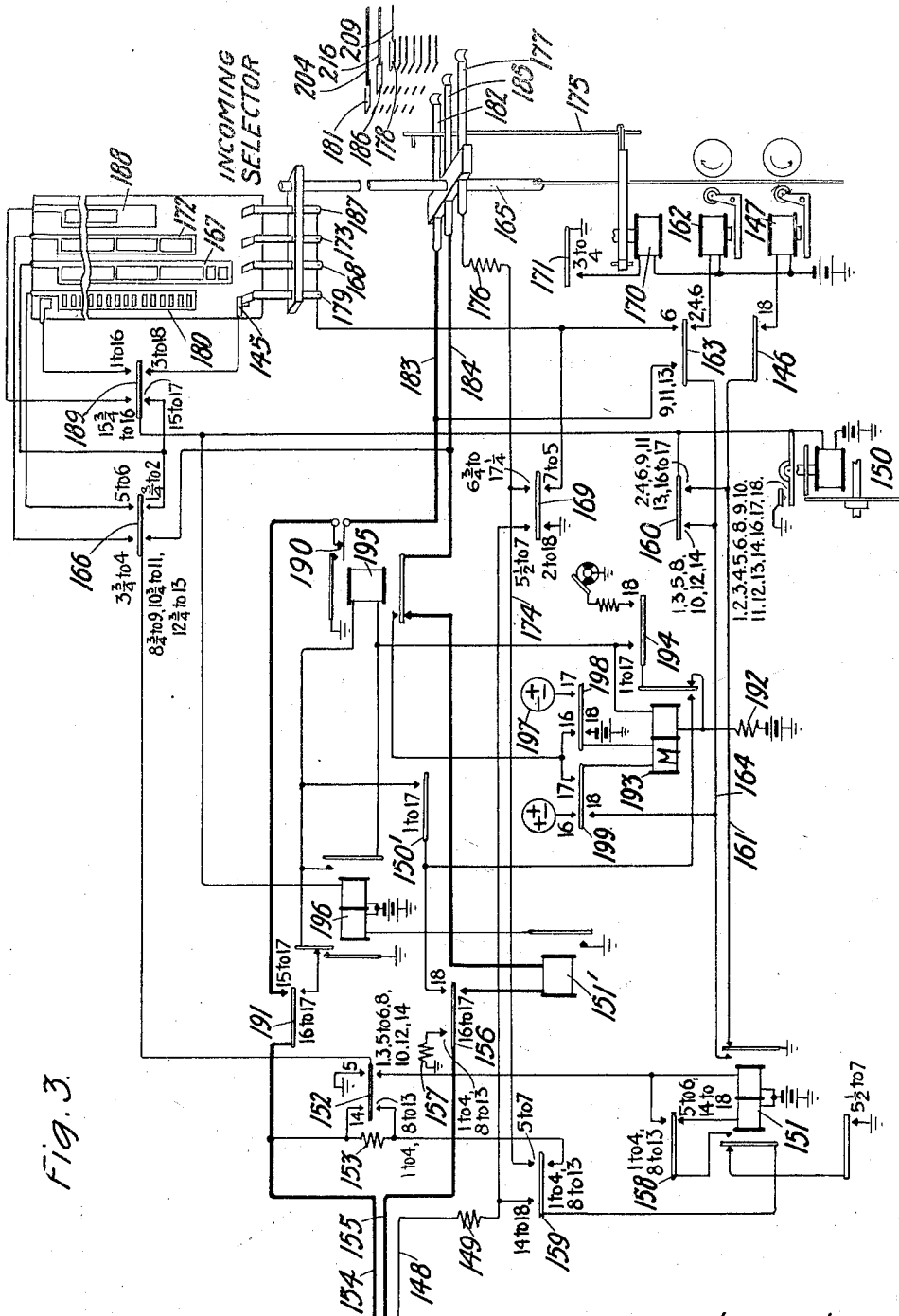


Fig. 3.

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16 SHEETS—SHEET 4.

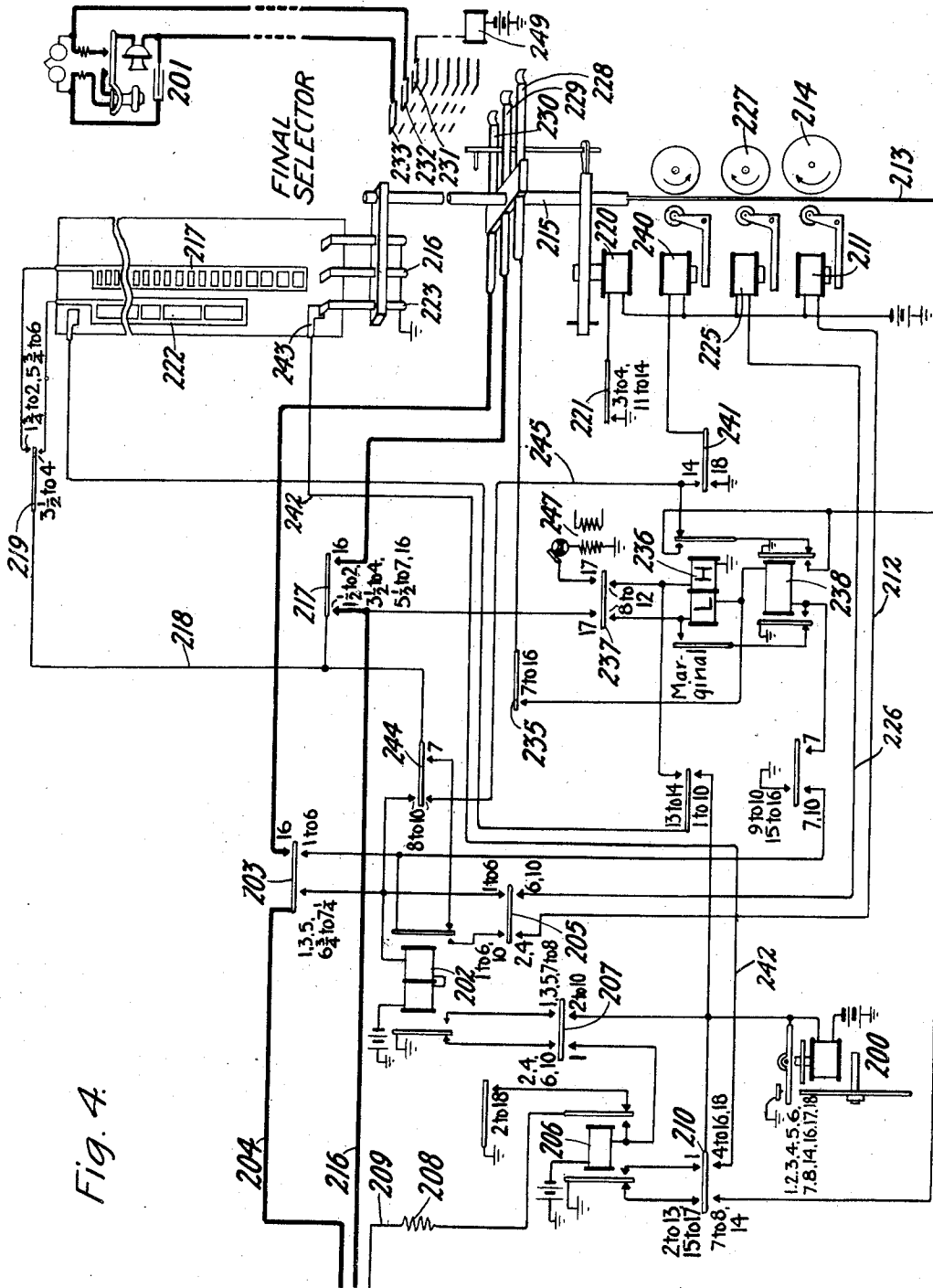


Fig. 4.

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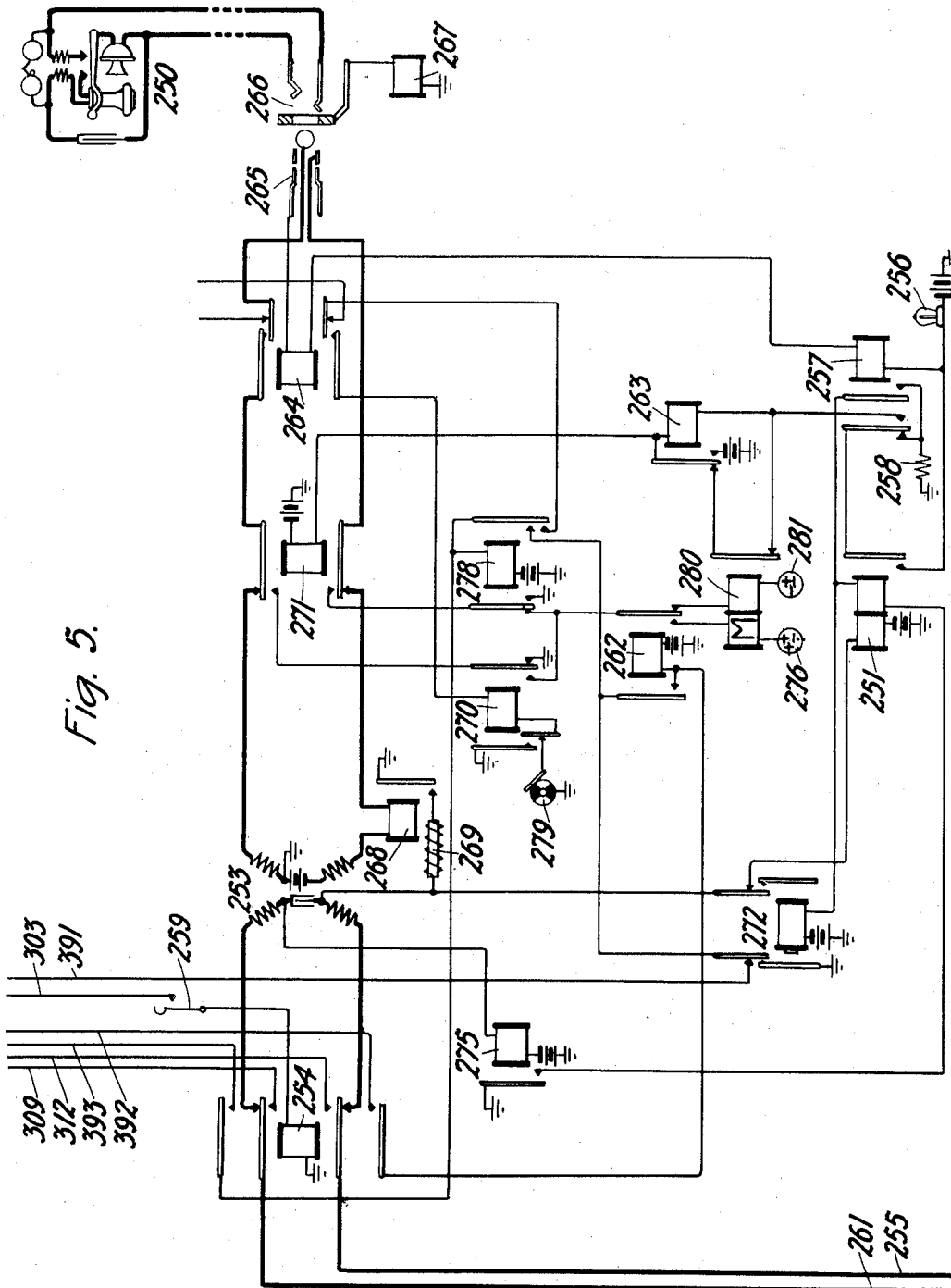
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16 SHEETS—SHEET 5.



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16 SHEETS—SHEET 6.

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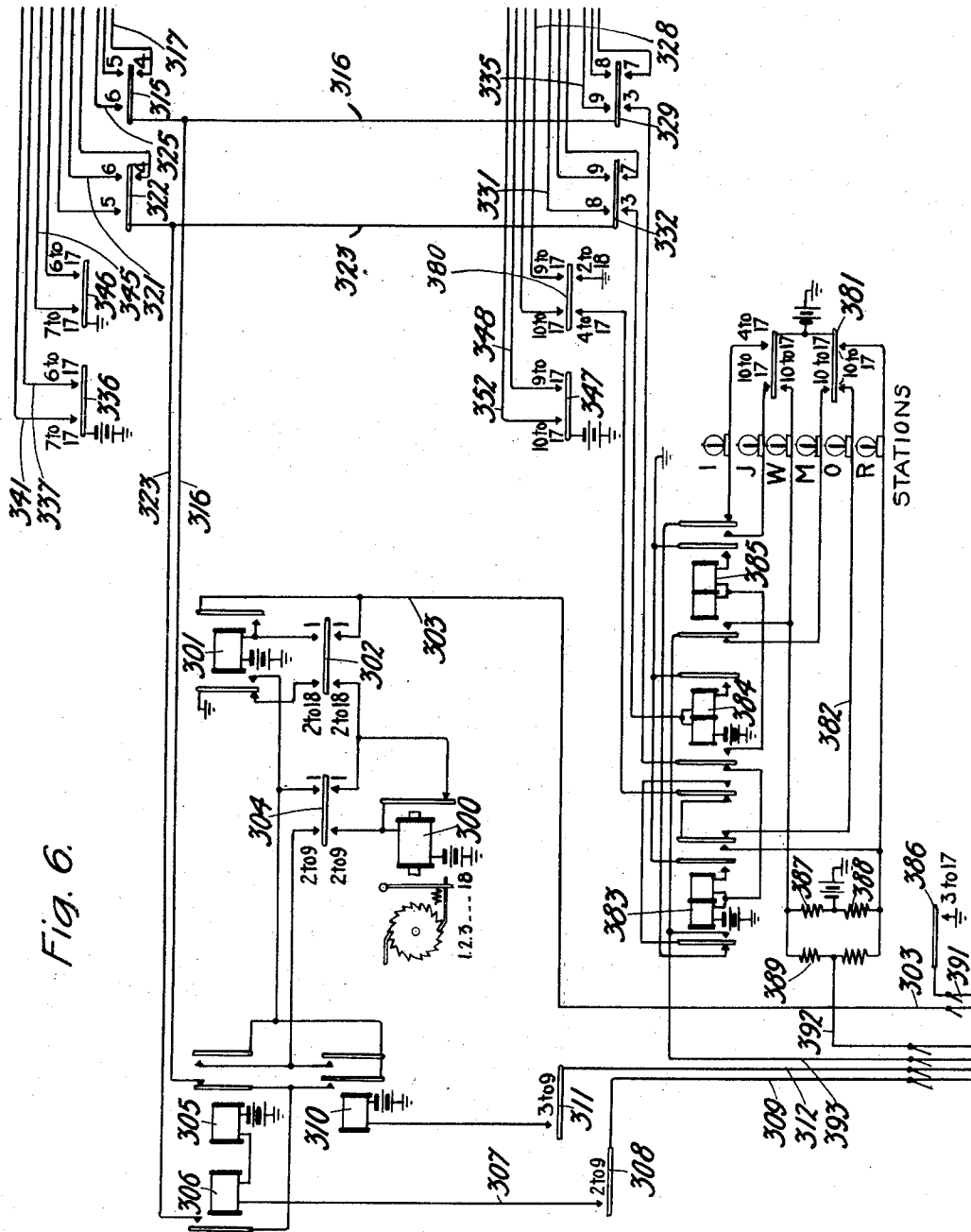


Fig. 6.

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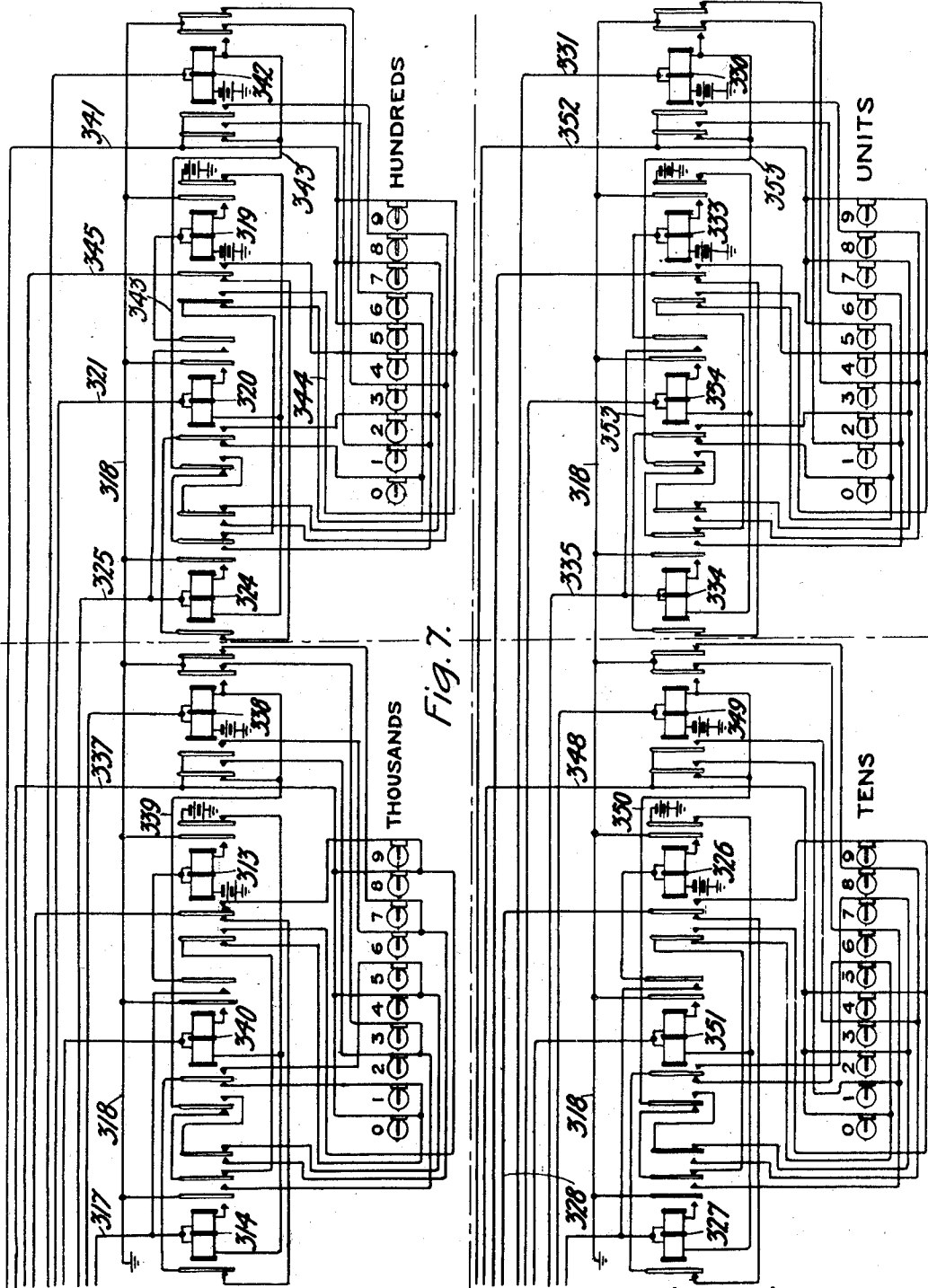
A. E. LUNDELL AND F. A. STEARN.
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16 SHEETS—SHEET 7.



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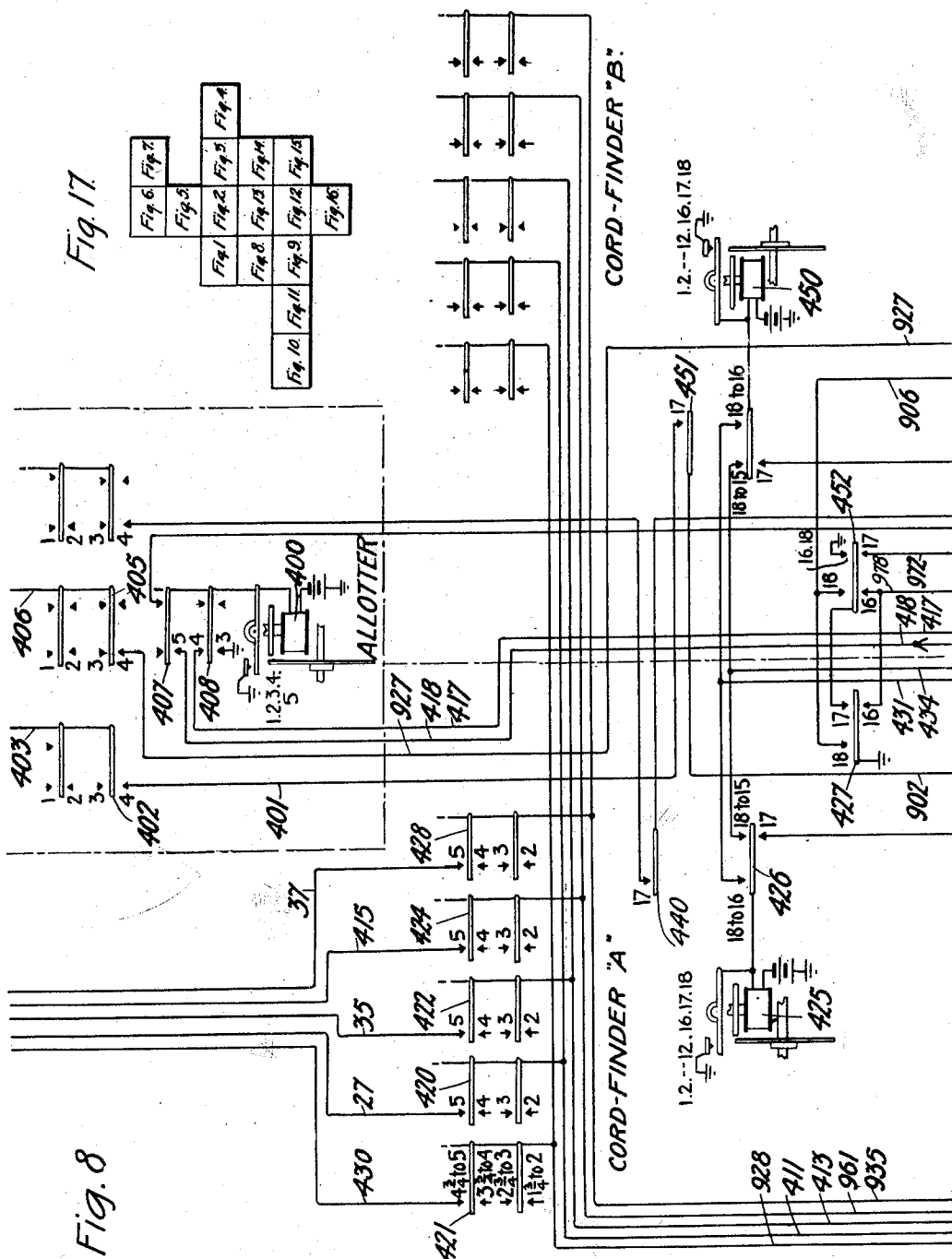
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16 SHEETS—SHEET 8.

1,345,016.



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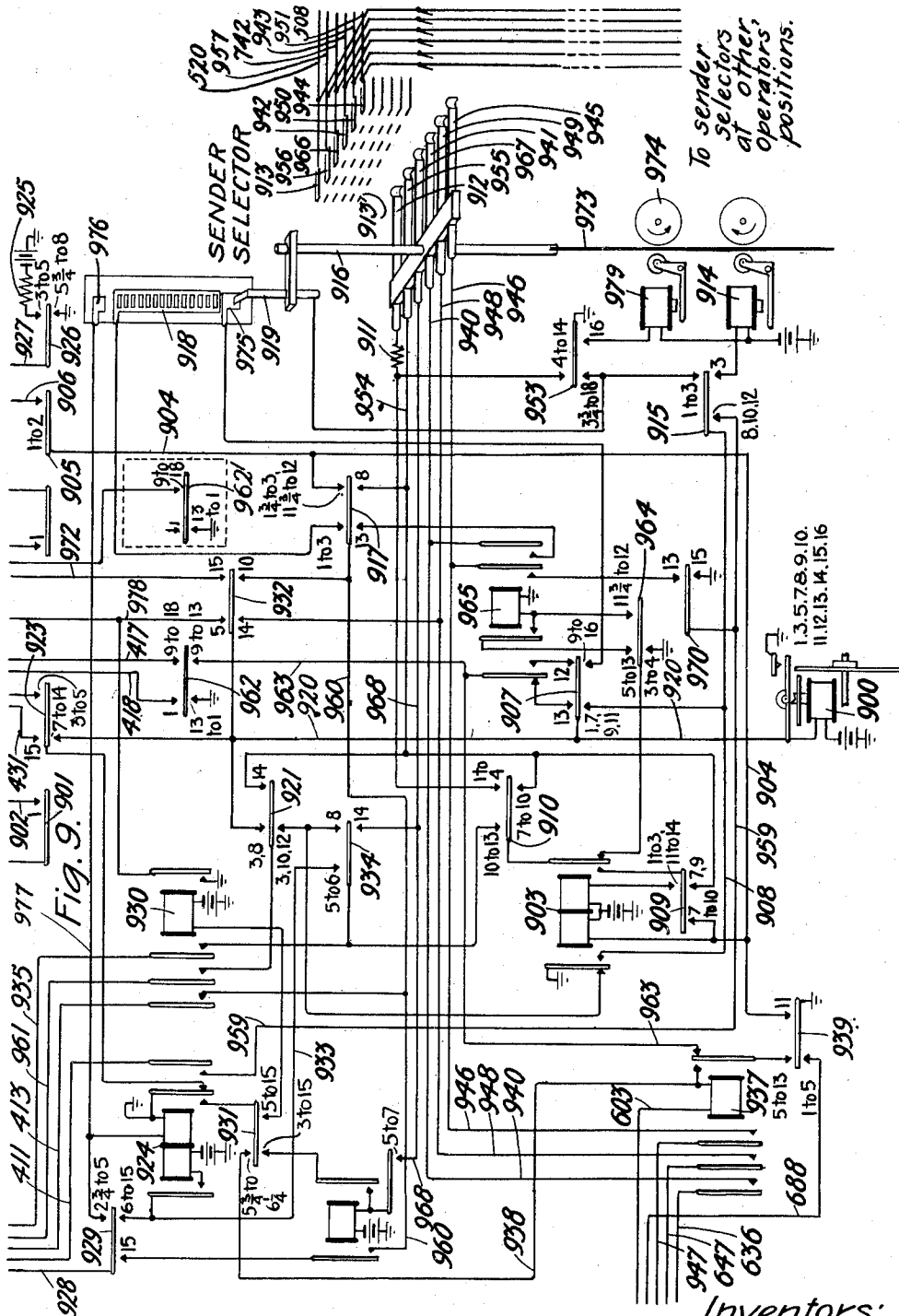
A. E. LUNDELL AND F. A. STEARN.
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16 SHEETS—SHEET 9.



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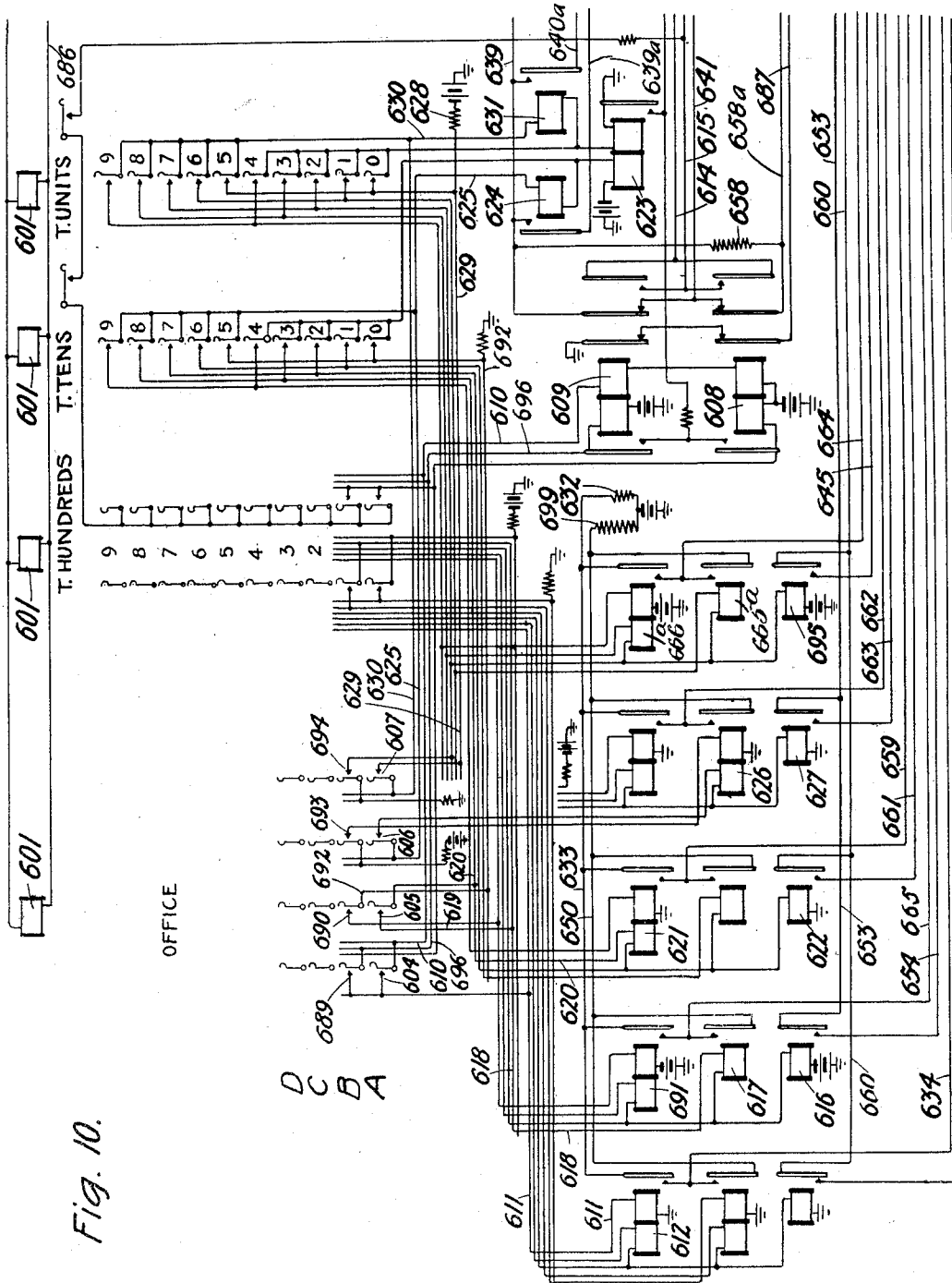


Fig. 10.

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16 SHEETS—SHEET 11.

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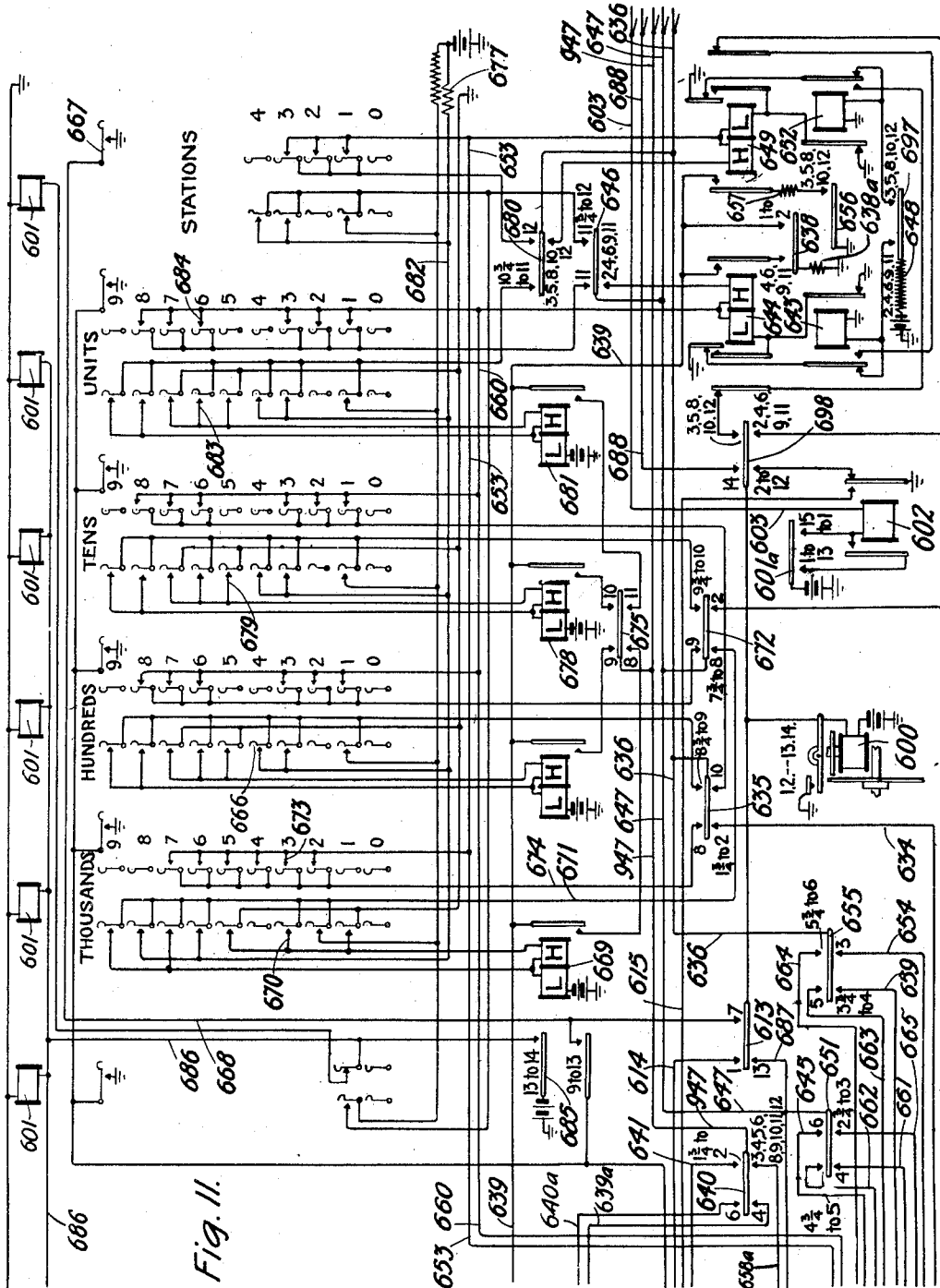


Fig. 11.

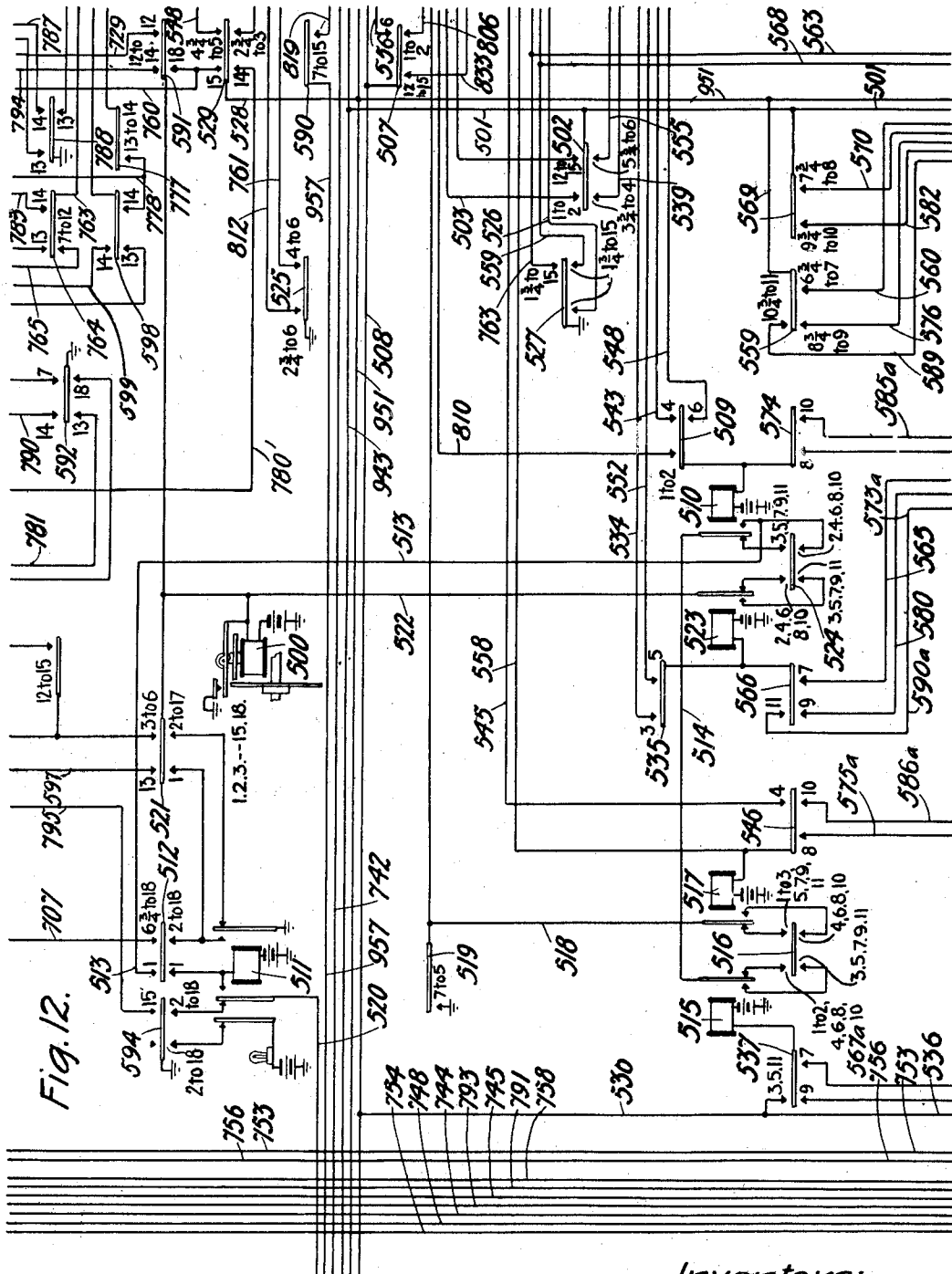
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TELEPHONE SYSTEM.

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16 SHEETS—SHEET 12.

1,345,016.

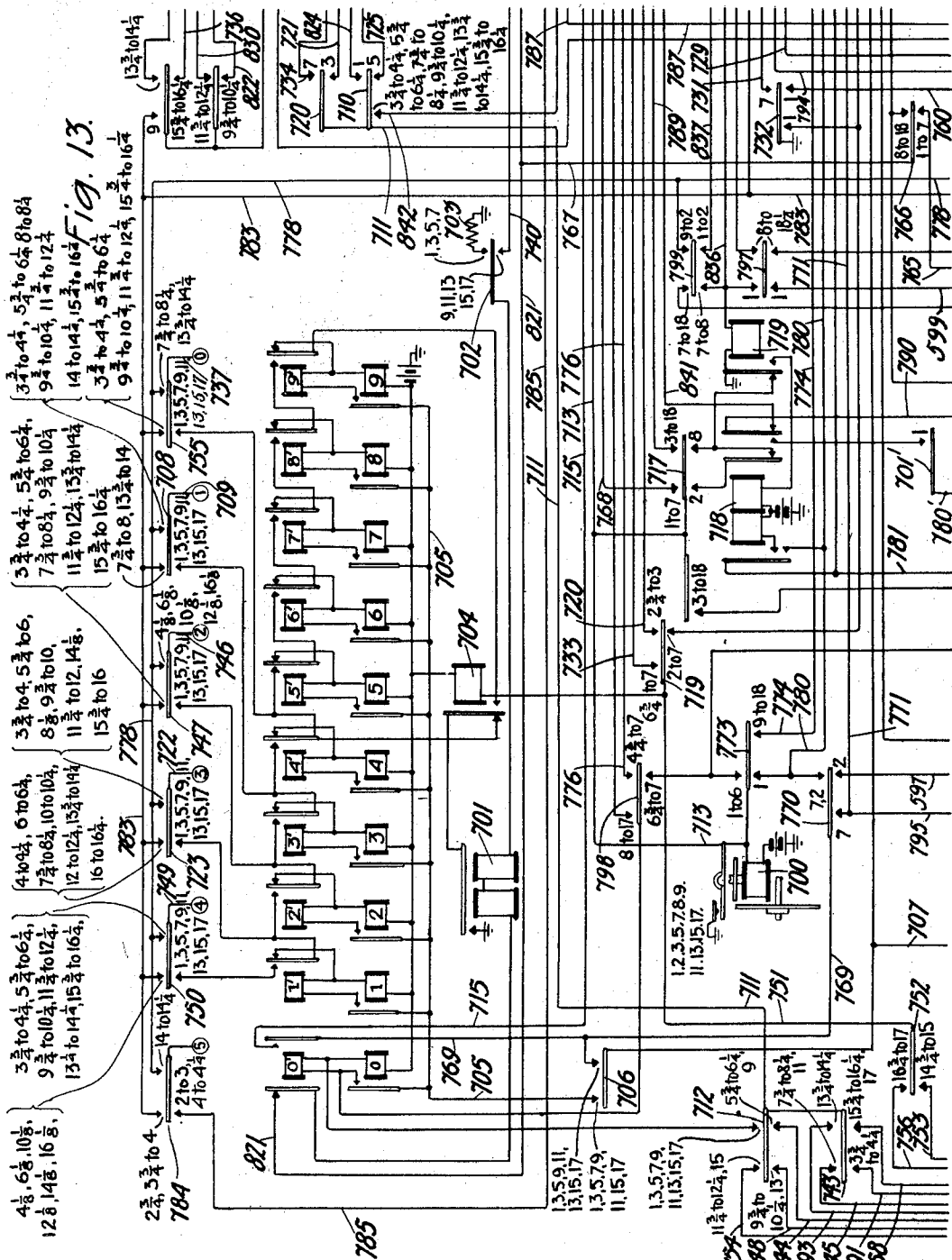


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APPLICATION FILED JULY 22, 1918.

16 SHEETS—SHEET 13.

1,345,016.



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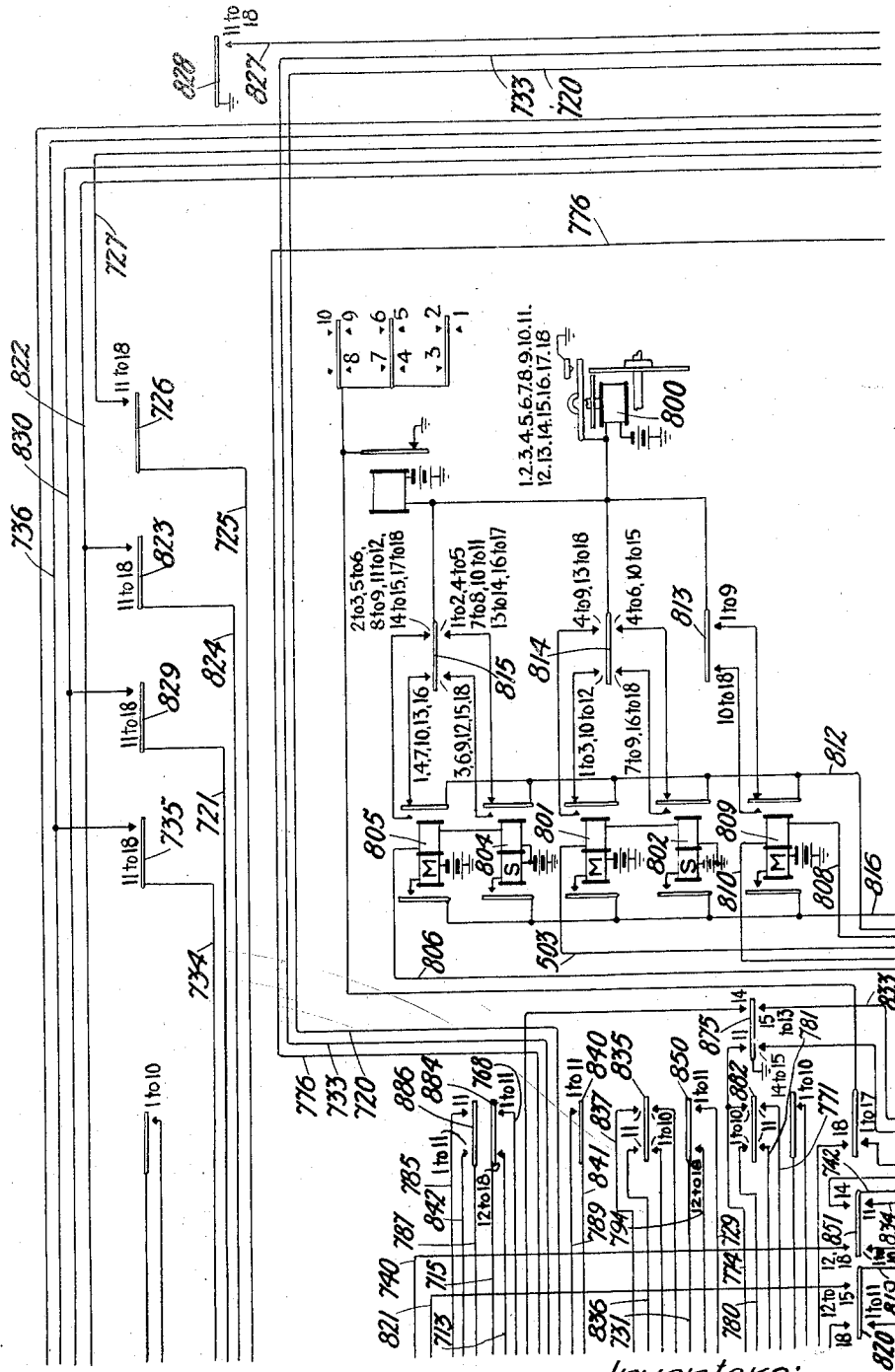
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1,345,016.

A. E. LUNDELL AND F. A. STEARN.
TELEPHONE SYSTEM.
APPLICATION FILED JULY 22, 1918.

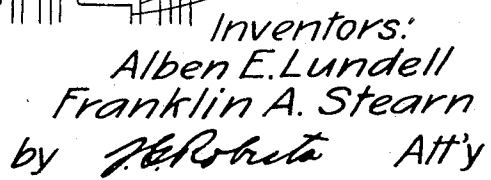
Patented June 29, 1920.
16 SHEETS—SHEET 14.

Fig. 14.



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16 SHEETS--SHEET 15



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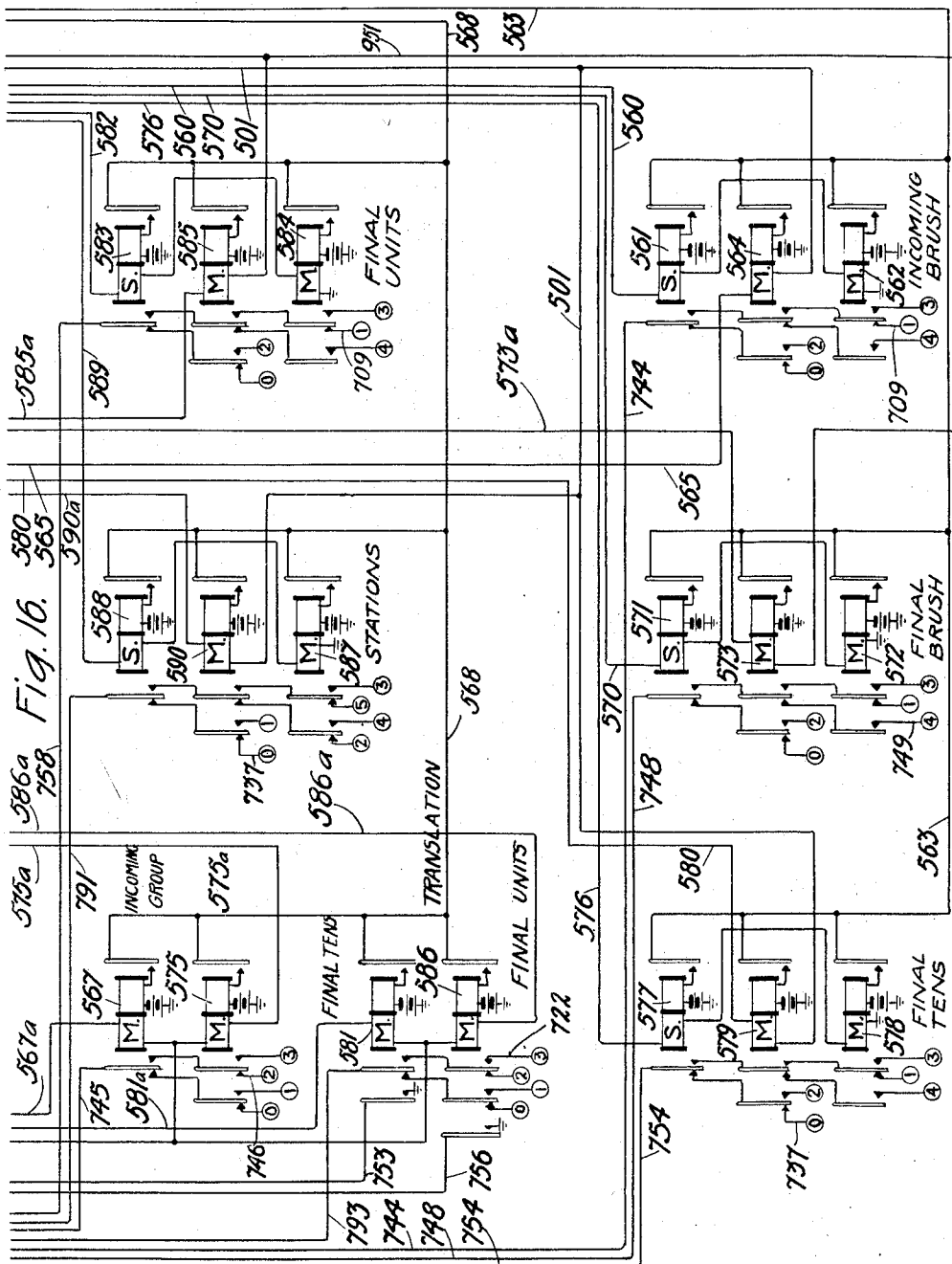
TELEPHONE SYSTEM.

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1,345,016.

Patented June 29, 1920.

16 SHEETS—SHEET 16



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UNITED STATES PATENT OFFICE.

ALBEN E. LUNDELL, OF NEW YORK, N. Y., AND FRANKLIN A. STEARN, OF PATERSON, NEW JERSEY, ASSIGNORS TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,345,016.

Specification of Letters Patent. Patented June 29, 1920.

Application filed July 22, 1918. Serial No. 246,234.

To all whom it may concern:

Be it known that we, ALBEN E. LUNDELL and FRANKLIN A. STEARN, citizens of the United States, residing at New York, in the county of Bronx, State of New York, and at Paterson, in the county of Passaic and State of New Jersey, respectively, have invented certain new and useful Improvements in Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to electrical controlling systems and particularly to electrical controlling systems for automatic and semi-automatic telephone exchanges.

The object of the present invention is to reduce and simplify the impulse controlling units provided in automatic and semi-automatic telephone systems for the control of selector switches.

More particularly one of the objects of this invention is to provide improved and more efficient circuit arrangements to accomplish the features disclosed in a co-pending application to A. E. Lundell, Serial No. 139,511, filed December 29, 1916.

A portion of the present invention may be defined as relating to an electrical controlling system in which a plurality of senders, which control the setting of selectively operable switches, are normally disassociated from a plurality of controlling devices which are arranged to determine the operation of the senders; and also in which means are provided for associating any one of the controlling devices with any one of the senders.

According to one feature of the invention one end of a link circuit terminates in a plurality of different automatic switches. By this arrangement it is possible to use, for instance at a semi-automatic operator's position, cord finders of small capacities, which are usually of simple construction, without increasing the number of sender selectors.

A further feature of the present invention contemplates the use of a controlling device at each of a plurality of operators' positions, a plurality of senders common to the

plurality of operators' positions, and a plurality of automatic switches individual to each operator's position for associating the controlling device thereat with an idle sender.

According to another feature of the present invention, a plurality of pairs of automatic switches are provided at each operator's position to establish a connection between the cord circuits thereat and an idle sender, and means are provided individual to each pair of switches for connecting the controlling device at the operator's position to the sender through only one of the switches of each pair.

Another feature of the invention is the provision of means whereby if either one of the switches of a pair of switches used in establishing a connection between the cord circuits and an idle sender fails to operate properly, both switches are released and another pair of switches are automatically started to establish the desired connection.

Another feature is the provision of a line relay which is common to a plurality of switches. According to this feature the line relays which control the operation of the district selectors are in the sender selector circuits which are common to a plurality of district selectors.

A still further feature relates to a single sending device which is arranged to control different apparatus. According to this feature, the sending device is arranged to control impulses of one character which are used to control one kind of apparatus such as automatic switches, and impulses of a different character which are used to control another kind of apparatus, such as a number indicating device.

Another feature relates to a new counting relay arrangement.

A still further feature relates to a relay which is arranged to perform the functions of a line relay, a test relay and a release relay.

Other features which relate to the present invention will appear in the following description and claims. However, it will be obvious to those skilled in the art that the

use of the present invention is not limited to the particular type of switching and controlling devices hereinafter disclosed and described.

5 Figures 1 to 16 of the drawings taken together show diagrammatically a telephone exchange system comprising the various features of the present invention. The order in which the drawings should be considered is indicated in Fig. 17. As nearly as possible reference characters are used in the following manner: 1 to 99 in Fig. 1, 100 to 149 in Fig. 2, 150 to 199 in Fig. 3, 200 to 239 in Fig. 4, 240 to 299 in Fig. 5, 300 to 399 in Figs. 6 and 7, 400 to 499 in Fig. 8, 500 to 599 in Figs. 12, 15 and 16, 600 to 699 in Figs. 10 and 11, 700 to 799 in Fig. 13, 800 to 899 in Fig. 14, 900 to 999 in Fig. 9.

For the sake of convenience, the names used in the description for designating certain switching devices are displayed in the drawings adjacent to the showing of such devices. S and M designate sensitive and marginal relays and H and L high and low resistances respectively.

Selector switches.

The selector switches used in this system are of the so-called power driven type, described in Patent No. 1,123,696 to E. B. Craft and J. N. Reynolds issued Jan. 5, 1915. For the purpose of distinguishing the various selector switches from each other, they will be hereinafter referred to in the following manner: District selector (Fig. 1); office selector (Fig. 2); local incoming selector (Fig. 3); final selector (Fig. 4); and sender selector (Fig. 9).

Each of the selector switches has a vertically movable brush rod carrying brushes arranged to wipe over a commutator plate and thus control the operation of the respective selector switch. Each rod also carries brushes which are arranged to engage contacts of a terminal bank, by means of which connections to lines leading to switches or to subscribers' stations may be established. With the exception of the sender selector all the selectors referred to carry five sets of brushes, only one set of brushes, however, being shown in the drawings. The terminal bank of the district, office, local incoming, and final selectors comprise 500 rows of terminals divided into five sections of one hundred rows of terminals each. Each set of brushes is arranged to engage any row of terminals in a certain section, and normally rests below the first row of the terminals of each respective section. The brushes of a set are normally held apart by means of a cam whereby they are out of the path of the terminals. By means of a tripping device associated with each of the selectors, any one of the brushes may be tripped to move its brushes into the path of the terminals of

its respective section. The tripping device shown is of the type described in the above mentioned Patent No. 1,123,696.

The brush rod of the sending selector carries a single set of brushes which are always in a tripped position and rest normally on the lowermost row of the terminals of a terminal bank.

Sequence switches.

The sequence switches with the exception of sequence switch 300 shown in the present disclosure are of the type described in Patent No. 1,127,808, issued Feb. 9, 1915, to John N. Reynolds and Chas. F. Baldwin. Sequence switches 10, 100, 150 and 200 control by means of their contacts, the circuits of the district, office, local incoming and final selectors respectively. The sequence switch 900 controls the circuits of an operator's keyboard; sequence switch 500 controls the circuits of a plurality of registers, sequence switch 700 controls the circuits of a sender, and sequence switch 800 also controls the operation of the sender and will be referred to as a class register.

The sequence switch 300 is of substantially the same construction as that disclosed in the above mentioned Patent 1,127,808 except that instead of being driven by a constantly rotating drum it is moved step by step by an operating magnet and any well known ratchet and pawl arrangement.

The construction of each of the cord finders A and B and the allotter 400 is substantially the same as that disclosed in the above mentioned Patent 1,127,808.

All the sequence switch contacts shown in Figs. 1, 2, 3, 4, 6, 9, 11, 12, 13 and 14 are controlled by the sequence switch shown in the respective figures. The contacts of cord finders A and B are shown to the left and right respectively of the vertical dotted line of Fig. 8. The contacts controlled by the allotter 400 are within the dotted square in Fig. 8.

Keyboard.

The operator's keyboard is shown in Figs. 10 and 11. When a key is depressed in any of the rows, it is locked by mechanical means, which may be released in response to the depression of another key in the same row, or by the energization of a magnet 601, one being provided for each row of keys. There are nine rows of keys, referred to as the office, tandem hundreds, tandem tens, tandem units, thousands, hundreds, tens, units and stations rows of keys. Each row, with the exception of the office and station keys, comprises keys numbered from zero to nine, each key controlling as many contacts as is necessary for controlling the selectors and registers. The number of office keys depends upon the traffic requirements. The

office keys are the equivalent of the tandem hundreds, tens and units of the keys; that is, the depression of one office key is the equivalent of the depression of a combination of tandem hundreds, tandem tens and tandem units keys. The office keys are provided for controlling the seizure of trunks leading to important offices, whereas other offices may be reached by depressing a desired combination of tandem keys.

Registers.

Figs. 12, 15 and 16 represent ten registers. These registers will be referred to as district brush, district group, office brush, office group, incoming brush, incoming group, final brush, final tens, final units and stations registers. With the exception of the incoming group register each register comprises three relays, two marginal and one sensitive. The incoming group register comprises two marginal relays. Each of the register relays is provided with a locking circuit, and depending upon the condition of the relays of a certain register, the operation of the sender is determined.

General arrangement of the impulse controlling apparatus.

The present invention is designed to be used in a telephone exchange system employing a plurality of operators' positions. Associated with each operator's position there are a plurality of cord circuits, one end of each cord circuit terminating in an answering plug and the other end in a district selector. A single keyboard is also provided at each operator's position. Common to all the operators' positions there are a plurality of senders and associated with each sender is a set of registers.

A group of link circuits is provided at each operator's position. One end of each of these link circuits terminates in a sender selector which is arranged to select an idle sender whenever the link circuit associated therewith is taken for use. The other end of each link circuit terminates in a plurality of different cord finders, each of which has access to different cord circuits. For example, the link circuit shown in Figs. 8 and 9 terminates in cord finder "A" which is one of a plurality of cord finders having access to twelve cords of a total of twenty-four cords; and it also terminates in cord finder "B" which is one of a plurality of cord finders having access to the other twelve cords of an operator's position. A relay is associated with each link circuit whereby the operator's keyboard, which is common to a particular group of link circuits, can be connected to the link circuit when it is taken for use. An allotter is associated with each group of link circuits so as to always have an idle circuit preselected.

In order to simplify the disclosure only the apparatus and circuits of one operator's position have been shown.

Translation.

The arrangement of the trunk terminals of the various sections of the terminal banks of the district and office selectors depends upon the traffic requirements, and in the present case, it will be assumed that the incoming selector shown in Fig. 3 is accessible in response to the depression of the A office key which controls the tripping of the third set of brushes of the district selector, the stepping of these brushes on to the ninth group of terminals in the third section of the terminal bank, and then the tripping of the second set of brushes in the office selector and the setting of these brushes on to the first group of terminals in the second section of the terminal bank of the office selector.

In the system disclosed, by means of the district and office selectors a ten thousand line exchange may be selected. If the called line terminates in an automatic exchange it is reached by the local incoming and final selector switches, each of which has 500 lines terminating therein. In the present case, it will be assumed that the number of the desired line is 3456. Then with switches of the above mentioned type it is necessary to trip the second set of brushes of the local incoming selector which will have access to trunks leading to a group of final selectors in which lines numbered 2000—3999 terminate. The second set of brushes will then be moved into operative relation with the third group of terminals served by this set of brushes. The trunks which terminate in this group lead to final selectors which have access to lines numbered 3000 to 3499. The local incoming selector is then operated to select an idle trunk in this group. In the final selector associated with the selected idle trunk it will be necessary to trip the fifth set of brushes which will have access to lines numbered 3400—3499. The fifth set of brushes of the final selector will then be positioned below the sixth group of terminals in which terminate lines numbered 3450—3460. The brushes of the final selector will finally be moved into engagement with the seventh set of terminals of the sixth group, thereby completing the connection to the desired line.

If, however, the called line terminates in a manual exchange, the manual exchange is reached by means of the district and office selectors or by trunks leading directly from the district selector to the manual office. Then a call indicator at said manual exchange will be operated in a well known manner to inform the operator thereof.

the number of the called line. The impulses sent to this indicator will be of a different character from those which controlled the operation of the local incoming and final selector. This will be more fully described hereinafter in the specification.

General outline of the description.

First: A call from a subscriber at a semi-automatic exchange to a subscriber at an automatic exchange will be described; that is, only one operator will be used in establishing the connection. The call is first extended to an operator's position at the exchange with which the calling line is associated. The operator connects an idle cord circuit to the calling line and obtains the number of the called line from the calling subscriber. At the same time the operator by pressing an assignment key causes an idle sender to be connected to her keyboard. Both the keyboard and the sender are now connected to the cord circuit assigned to be used in extending the calling line. The operator then sets up the number of the called line upon her keyboard, whereupon the registers, associated with the sender, are set. Then, depending upon the setting of the registers, the operation of the district, office, incoming and final selectors is controlled so as to complete the connection to the called line.

Second: A call from a subscriber at a semi-automatic exchange to a subscriber at a manual exchange will be described. In tracing this call it will be assumed that the manual exchange is reached by trunks leading directly from the district selector instead of from the office selector. It will also be assumed that the same subscriber's number is wanted at the manual exchange as was wanted in the first description. Therefore, the operator at the calling exchange will set up the same number on her keyboard as in the first case, with the exception that she will depress a different office key. The district selector is then controlled by the sender so as to select an idle trunk leading to the desired manual exchange. When the operator at the manual exchange responds by depressing an assignment key, impulses are sent in accordance with the setting of the registers to operate a call indicator at the called exchange so that the number of the called line will be visually indicated at the manual operator's position. She then completes the connection to the called line by inserting a calling plug into the multiple jack of the called line.

Description of the operation of a call to a semi-automatic exchange.

The subscriber at substation 1, desiring to obtain a connection with a subscriber at

substation 201, Fig. 4, removes his receiver from the switchhook, whereupon the line relay 2 becomes energized and causes the lighting of the calling lamp 3. The operator inserts the plug 4 into the jack 5 associated with the calling line and a circuit is closed from grounded battery, winding of cut-off relay 6, sleeve of jack 5, sleeve of plug 4 and the winding of relay 7 to ground. Relay 6 becomes energized, opens the circuit of relay 2, whereupon lamp 3 is extinguished. Relay 7 becomes energized and closes a circuit from grounded battery, armature and back contact of relay 8, resistance 9, winding of relay 11, lower contact of sequence switch spring 12, right-hand armature and contact of relay 7, conductors 27 and 13, lower left-hand contact of sequence switch spring 14 to ground. Relay 11 energizes and closes a circuit from grounded battery, winding of relay 15, right-hand armature and front contact of relay 11 to ground. Upon energization of relay 15 a circuit is closed from grounded battery, through the power magnet of sequence switch 10, lower left-hand contact of sequence switch spring 16, outer right-hand armature and front contact of relay 15, conductor 17, lower left-hand contact of sequence switch spring 18 to ground, for moving the sequence switch 10 out of position 1 and into position 2. As soon as sequence switch 10 leaves position 1 a locking circuit for relay 11 is closed from grounded battery, armature and back contact of relay 8, resistance 9, winding of relay 11, inner left-hand armature and front contact of relay 11, winding of relay 14 to ground. Relay 14 energizes and connects the operator's telephone set (not shown) to the calling lines.

In position 2 of the sequence switch 10, a circuit is completed from grounded battery, power magnet of sequence switch 425 (of cord finder "A" which has access to a group of cord circuits comprising the particular cord circuit shown), lower contact of sequence switch spring 426, sequence switch spring 901, conductor 902, contact of spring 451 controlled by sequence switch 450 of cord finder "B", conductor 401, lower left-hand contact of spring 402 of allotter 400, conductor 403, right-hand contact of sequence switch spring 16, outer right-hand armature and front contact of relay 15, conductor 17, lower left-hand contact of sequence switch spring 18 to ground. Sequence switch 425 thereupon moves out of position 17 and into position 18.

It will be observed at this point that the circuit for sequence switch 425 will not be closed unless both cord finders associated with the preselected idle link circuit are in their idle positions, namely position 17. It should also be observed that no other cord

finder which has access to the cord circuit shown in Fig. 1 can be moved out of the idle position (17) because the circuits of such cord finder sequence switches are opened at the contacts of the allotter 400, nor can the sequence switch 450 of cord finder "B" be moved out of position 17, since its circuit is opened at the contact of sequence switch spring 440. The allotter 400 as shown, has five positions and is designed to allot a different link circuit in positions 1, 2 and 4. Position 3 is a vacant position and therefore ground is connected to the lower contact of spring 408 to cause the allotter to pass by this position. Position 5 is the "awaiting" position where the allotter remains if all the link circuits are busy. As soon as any one of the link circuits becomes idle a circuit will be closed, in a manner to be hereinafter described, for moving the allotter out of position 5 and into whatever position is necessary to allot an idle link circuit.

In position 18 of the sequence switch 425, a circuit is closed from grounded battery, through left-hand winding of relay 903, conductor 904, contact of sequence switch spring 905, conductor 906, left-hand contact of sequence switch spring 427 to ground. Relay 903 energizes and completes a circuit from grounded battery, power magnet of sequence switch 900, lower left-hand contact of sequence switch spring 907, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 900 out of position 1 and into position 3.

If the sender associated with the lowermost set of terminals of the sender selector, and with which the brushes of the sender selector are normally in engagement, is busy, relay 903 closes a locking circuit for itself from grounded battery, through right-hand winding of relay 903, upper contact of sequence switch spring 909, right-hand armature and front contact of relay 903, upper right-hand contact of sequence switch spring 910, resistance 911, brush 912, terminal 913 to ground through a sequence switch contact 953 of another sender selector. Therefore when the sequence switch 900 reaches position 3, the relay 903 remains energized and completes a circuit from grounded battery, winding of up-drive magnet 914, lower right-hand contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903 to ground. Under the control of magnet 914, the brush carrier 916 of the sender selector is moved upward until the test brush 912 engages the test terminal 913 associated with an idle sender. This idle condition of the sender will be designated by an absence of ground on the test terminal 913. Relay 903 remains energized until

the brushes of the sender selector have been accurately centered upon the terminals of this idle sender, due to the following circuit; grounded battery, left-hand winding of relay 903, conductor 904, upper contacts of sequence switch spring 917, conducting segments of commutator 918, brush 919, upper contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903 to ground. As soon as the brushes of the sender selector are accurately centered upon the terminals associated with the idle sender, the brush 919 engages an insulating segment of the commutator 918, thereby causing the deenergization of relay 903. A circuit is then closed from grounded battery, power magnet of sequence switch 900, conductor 920, left-hand contacts of sequence switch spring 921, left-hand armature and back contact of relay 903 to ground, for moving the sequence switch 900 out of position 3 and into position 5.

When sequence switch 900 reaches position 3, a circuit is also closed from grounded battery, through power magnet of sequence switch 425, upper right-hand contact of sequence switch spring 426, conductor 434, upper right-hand contact of sequence switch spring 923, inner right-hand armature and back contact of relay 924 to ground, for moving the sequence switch 425 out of position 18 and into position 5, in which position the cord circuit shown in Fig. 1 is connected through to the sender selector. In each of the positions 1 to 12 inclusive of sequence switch 425, a different cord circuit is connected to the sender selector.

When the sequence switch 425 reaches position 4, a circuit is completed from grounded battery, resistance 925, upper contact of sequence switch spring 926, conductor 927, lower left-hand contact of allotter spring 405, conductor 406, inner right-hand armature and front contact of relay 15, conductor 23, lower right-hand contact of sequence switch spring 24, conductor 430, upper contact of sequence switch spring 421, conductor 928, upper contact of sequence switch spring 929, right-hand winding of relay 924 to ground. Relay 924 energizes and opens the above traced circuit for the sequence switch 425, which stops as soon as it reaches position 5. Upon the energization of relay 924 a circuit is established from grounded battery, through winding of relay 930, lower right-hand contact of sequence switch spring 931, inner right-hand armature and front contact of relay 924 to ground. Relay 930 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 900, conductor 920, upper left-hand contact of sequence switch spring 932, right-hand armature and front contact of relay 930 to

ground, for moving the sequence switch 900 out of position 5 into position 7. While the sequence switch 900 is moving from position 5 to position 6, relay 924 is maintained energized over the following circuit: grounded battery, left-hand winding of relay 924, left-hand armature and front contact of relay 924, conductor 933, upper left-hand contact of sequence switch spring 934, inner left-hand armature and front contact of relay 930, conductor 935, upper contact of sequence switch spring 428, conductor 37, lower left-hand contact of sequence switch spring 25 to ground. While the sequence switch 900 is moving from position 6 to position 7, relay 924 is held energized over the following circuit: grounded battery, left-hand winding of relay 924, left-hand armature and contact of relay 924, lower right-hand contact of sequence switch spring 929, conductor 928, upper contact of sequence switch spring 421, conductor 430, lower right-hand contact of sequence switch spring 24, conductor 23, inner right-hand armature and contact of relay 15, conductor 406, lower left-hand contact of allotter spring 405, conductor 927, lower contact of sequence switch spring 926 to ground.

When the sequence switch 900 reaches position 5½ a circuit is completed from grounded battery, through right-hand contact of sequence switch spring 601^a, (Fig. 11), winding of relay 602, conductor 603, winding of relay 937, conductor 938, upper contact of sequence switch spring 931, inner armature and front contact of relay 924 to ground. Relays 602 and 937 become energized and close the following locking circuit for themselves: Grounded battery, through the left-hand contact of sequence switch spring 601^a, left-hand armature and contact of relay 602, winding of relay 602, conductor 603, winding of relay 937, right-hand armature and front contact of relay 937, upper left-hand contacts of sequence switch spring 939 to ground. The relay 937 connects the operator's keyboard to the selected idle sender seized by the sender selector. After the setting of the cord finder "A" and the sender selector, the sequence switches are in the following positions: sequence switch 10 in position 2; sequence switch 425 in position 5; allotter 400 in position 4; sequence switch 900 in position 7, and all the other sequence switches in position 1.

Operation when the cord finder or sender selector fails to function properly.

It might be well at this point to describe the operation in case either the sender selector fails to find an idle sender, or the cord finder fails to stop on the assigned cord. First assume that the sender selector 908 fails to find an idle sender. The sender-selector will thereupon move to its overflow position, at which time the brushes thereof will be out of engagement with any of the sender terminals and the commutator brush 919 will be out of engagement with the commutator 918 and in engagement with the overflow contact 976. The sequence switch 900 will be moved into position 5 in the manner described. Relay 924, however, will not become energized when the cord finder sequence switch 425 reaches position 4½ because a shunt circuit is closed around the right-hand winding of the relay through conductor 977, overflow contact 976, brush 919, lower left-hand contact of sequence switch spring 953 to ground. The contacts of relay 924 remaining in their normal position, the sequence switch 425 will continue to rotate until it reaches position 16. When sequence switch 425 reaches position 16, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, upper left-hand contact of sequence switch spring 932, conductor 978, lower contact of sequence switch spring 427 to ground for moving the sequence switch 900 out of position 5 and into position 7. A circuit is then closed from grounded battery, through power magnet of sequence switch 900, conductor 920, lower contact of sequence switch spring 923, inner right-hand armature and back contact of relay 924 to ground, for moving the sequence switch 900 out of position 7 and into position 15. In position 15 of sequence switch 900 a circuit is closed from grounded battery, through power magnet of sequence switch 425 upper left-hand contact of sequence switch spring 426, conductor 431, upper left-hand contact of sequence switch spring 923, to ground at the inner right-hand armature and back contact of relay 924, for moving the sequence switch 425 out of position 16 and into position 17 (its normal position). In position 17 of sequence switch 425, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, upper right-hand contact of sequence switch spring 932, conductor 972, lower right-hand contact of sequence switch spring 452, upper right-hand contact of sequence switch spring 427 to ground, for moving the sequence switch 900 out of position 15 and into position 16. In position 16 a circuit is closed from grounded battery, through winding of down-drive magnet 979, lower right-hand contact of sequence switch spring 953 to ground. Under the control of the down-drive magnet 979 the sender selector is restored to normal. When the commutator brush 919 reaches its normal position a circuit is closed from grounded battery, through the power magnet of sequence switch 900, lower right-hand contact of sequence switch spring 907, nor-

mal conducting segment 975, commutator brush 919, lower left-hand contact of sequence switch spring 953 to ground, for moving the sequence switch 900 out of position 16 and into position 1.

When the sequence switch 900 reached position 13 a circuit was closed from grounded battery, through power magnet of the allotter 400, upper contact of allotter spring 408, conductor 417, upper right-hand and lower left-hand contacts of sequence switch spring 962, to ground, for moving the allotter into another position to allot an idle link circuit. This operation of the allotter will be more fully described hereinafter. The apparatus associated with the next allotted link circuit will then be operated to establish the desired connection in exactly the same manner as in the first assumed case.

If, however, it is the cord finder that fails to operate properly, that is to say, the relay 924 fails to become energized when the cord finder reaches the position for connecting the assigned cord circuit to the sender selector, the sequence switch 425 continues to rotate until it reaches position 16. When the sequence switch 425 reaches position 16 the above traced circuits are closed in the manner described, to restore the cord finder and sender selector to normal and to start a new cord finder and sender selector operating.

It will be observed that if either the cord finder or the sender selector fails to operate properly, the relay 924 does not become energized, and therefore relay 937, which connects the operator's keyboard to the sender selector cannot become energized. As a result of this arrangement the key circuit is in no way affected under the assumed conditions.

Adjustment of the keyboard.

Supposing that the called subscriber's number is A-3456, the operator depresses the A office key, number 3, 4, 5, 6 thousands, hundreds, tens and units keys, respectively, and the start key 667, whereupon the keys remain locked in their depressed position.

In response to the depression of the "A" office key, contacts 604, 605, 606 and 607 of this key, are closed. The closure of the contact 604 completes a circuit from grounded battery, through right-hand winding of relay 608, right-hand winding of relay 609, conductor 610, contact 604, conductor 611, right-hand winding of relay 612 to ground. Relays 608, 609 and 612 are energized. The closure of contact 605 completes a circuit from grounded battery, through winding of relay 616, winding of relay 617, conductors 618 and 619, contact 605, conductor 620, left-hand winding of relay 621, winding of relay 622, to ground. Relays 616, 617, 621 and 622 are energized. The closure of contact 606

completes a circuit from grounded battery, left-hand winding of relay 623, winding of relay 624, conductor 625, contact 606, left-hand winding of relay 626, winding of relay 627 to ground. Relays 623, 624, 626 and 627 are energized. The closure of contact 607 completes a circuit from grounded battery, resistance 628, conductor 629, contact 607, conductor 630, winding of relay 631, right-hand winding of relay 623 to ground. Relay 631 is energized in this circuit.

In response to the energization of relays 608 and 609, a circuit is closed from grounded battery, through power magnet of sequence switch 600 (Fig. 11), upper left-hand contact of sequence switch spring 613, conductor 614, outer armatures and front contacts of relays 608 and 609 in parallel, conductor 615, right-hand armature and front contact of relay 602 to ground, for moving the sequence switch 600 out of position 1 and into position 2.

Setting of the class register.

As soon as the sequence switch 600 reaches position 1 $\frac{1}{2}$, a circuit is closed from grounded battery, through a relatively low resistance 632 (Fig. 10), conductor 633, right-hand armature and contact of relay 612, conductor 634, lower left-hand contact of sequence switch spring 635, conductor 636, outer left-hand armature and front contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, upper left-hand contact of sequence switch spring 502, conductor 503, right-hand winding of marginal relay 801, right-hand winding of sensitive relay 802 to ground. Due to the low resistance of this circuit both of the relays 801 and 802 are energized.

In position 1 $\frac{1}{2}$ of sequence switch 600, a circuit may also be traced from grounded battery, through right-hand winding of sensitive relay 804 (Fig. 14), right-hand winding of marginal relay 805, conductor 806, lower right-hand contact of sequence switch spring 507, conductor 508, terminal 944, brush 945, conductor 946, inner left-hand armature and front contact of relay 937, conductor 947, upper right-hand contact of sequence switch spring 640 to conductor 641. Since relays 608 and 609 are energized, the last traced circuit is opened at the middle armatures and back contacts of these relays. As soon as sequence switch 600 reaches position 2, a circuit is closed from ground, through right-hand armature and back contact of relay 643, both windings of relay 644 in series, lower contact of sequence switch spring 646, conductor 647, middle left-hand armature and front contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 808, right-hand winding of marginal relay 809, conductor 810, upper left-hand contact of sequence switch spring

509, winding of relay 510 to grounded battery. The resistance of both windings of relay 644 in series, is so high as to prevent the energization of the marginal relay 809; however, relays 510 and 644 are energized. The energization of relay 644 removes a shunt (extending through the left-hand back contacts of relays 643 and 644) from around the winding of relay 643, and this relay becomes energized by current flowing through the following circuit: grounded battery, resistance 648, left-hand contact of sequence switch spring 697, winding of relay 643 to ground. Relay 644, however, remains energized due to a locking circuit closed through its left-hand armature and front contact to ground.

The relay 510 closes a circuit from grounded battery, through winding of relay 511, left-hand contacts of sequence switch spring 512, conductor 513, left-hand armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground. Relay 511 energizes and closes a locking circuit for itself from grounded battery, through winding of relay 511, left-hand armature and front contact of relay 511, conductor 520, terminal 913, brush 912, resistance 911, upper contact of sequence switch spring 953 to ground.

The relay 511 also closes a circuit from grounded battery, through power magnet of sequence switch 500, lower left-hand contact of sequence switch spring 521, right-hand armature and front contact of relay 511 to ground, for moving the sequence switch 500 out of position 1 and into position 2. When the sequence switch 500 reaches position 2, a locking circuit is closed for relays 801 and 802 as follows: from grounded battery, through left-hand winding and left-hand armature and front contact of relay 801 in parallel with the left-hand winding and left-hand armature and front contact of relay 802, conductors 816 and 526, lower left-hand contact of sequence switch 527 to ground.

In position 2 of sequence switch 500 a circuit is closed from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 2 and into position 3.

As soon as sequence switch 500 reaches

position 2, a circuit is closed for moving the sequence switch 800 of the class register into the position determined by the condition of the relays 801, 802, 804, 805 and 809. Since only relays 801 and 802 are energized at this time, if we assume that the sequence switch has been left in position 13, the sequence switch 800 will be moved into position 12 in the following manner: A circuit is closed from grounded battery, through power magnet of sequence switch 800, the upper right-hand contact of sequence switch spring 814, right-hand armature and front contact of relay 801, conductor 812, left-hand contact of sequence switch spring 525 to ground, for moving the sequence switch 800 into position 1. A circuit is then closed from grounded battery, through power magnet of sequence switch 800, right-hand contact of sequence switch spring 813, right-hand armature and back contact of relay 809, conductor 812, left-hand contact of sequence switch spring 525 to ground for moving the sequence switch 800 into position 10. A circuit is then closed from grounded battery, through power magnet of sequence switch 800, lower right-hand contact of sequence switch spring 815, right-hand armature and back contact of relay 804, conductor 812, left-hand contact of sequence switch spring 525 to ground for moving the sequence switch out of position 10 and into position 12, in which no circuit is closed for the power magnet of the sequence switch 800.

When the sequence switch 500 leaves position 2, the above traced circuit of relays 510 and 644 is opened, and these relays become deenergized. The relay 644 completes a circuit from grounded battery, through power magnet of sequence switch 600, lower right-hand contact of sequence switch spring 698, outer right-hand armature and back contact of relay 649, left-hand armature and front contact of relay 643, left-hand armature and back contact of relay 644 to ground, for moving the sequence switch 600 out of position 2 and into position 3. As soon as the sequence switch moves out of position 2, relay 643 becomes deenergized.

Setting of the district brush register.

When the sequence switches 600 and 500 reach position 2, a circuit is closed from grounded battery, through a relatively high resistance 699, conductor 650, armature and front contact of relay 617, conductor 665, lower right-hand contact of sequence switch spring 651, conductor 647, middle left-hand armature and front contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 528, lower right-hand contact of sequence switch spring 529, conductor 530, right-hand winding of sensitive relay 531, right-hand winding of marginal re-

lay 532 to ground. Due to the fact that the high resistance 649 is in this circuit only the sensitive relay 531 is energized and closes a locking circuit for itself through conductor 763 and the upper contact of sequence switch spring 527 to ground.

When the sequence switches 600 and 500 reach position 3, a circuit is closed from ground, through left-hand armature and back contact of relay 652, right-hand low resistance winding of relay 649, conductor 653, armature and front contact of relay 616, conductor 654, lower right-hand contact of sequence switch spring 655, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductor 943, right-hand winding of marginal relay 533, conductor 534, left-hand contact of sequence switch spring 535, winding of relay 523 to grounded battery. Due to the fact that only the low resistance winding of relay 649 is connected to this circuit, all of the relays included therein are energized. Relay 649 by attracting its inner right-hand armature closes a locking circuit for itself and removes a shunt which is normally closed around the winding of relay 652. Relay 652 thereupon becomes energized over the following circuit: grounded battery, resistance 648, right-hand contact of sequence switch spring 697, winding of relay 652 to ground. Relay 649 by attracting its left-hand armature closes a circuit from ground, through contact of sequence switch spring 656, a relatively low resistance 657, left-hand armature and front contact of relay 649, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and front contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, upper contact of sequence switch spring 537, winding of relay 515 to grounded battery. The relay 515 closes a circuit from grounded battery, through power magnet of sequence switch 500, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 3 and into position 4.

As soon as the sequence switch 500 reaches position 4, relays 515, 523 and 649 are deenergized. The relay 649 closes a circuit from grounded battery, through power magnet of sequence switch 600, upper right-hand contact of sequence switch spring 698, outer left-hand armature and back contact

of relay 644, right-hand armature and front contact of relay 652, inner right-hand armature and back contact of relay 649 to ground. Sequence switch 600 thereupon moves out of position 3 and into position 4, whereupon relay 652 becomes deenergized.

Setting of the district group register.

When the sequence switches 500 and 600 reach position 3 $\frac{1}{2}$, a circuit is closed from grounded battery, through low resistance 632, conductor 633, armature and contact of relay 621, conductor 659, lower left-hand contact of sequence switch spring 655, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, lower left-hand contact of sequence switch spring 502, conductor 539, right-hand winding of sensitive relay 540, right-hand winding of marginal relay 541 to ground. Due to the fact that resistance 632 is of low quantity, both the relays 540 and 541 become energized and by attracting their left-hand armatures close locking circuits for themselves to ground, over the conductor 526.

When the sequence switches 600 and 500 reach position 4, a circuit is closed from ground, through right-hand armature and back contact of relay 643, left-hand low resistance winding of relay 644, conductor 660, armature and contact of relay 622, conductor 661, lower left-hand contact of sequence switch spring 651, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductor 951, right-hand winding of marginal relay 542, conductor 543, upper right-hand contact of sequence switch spring 509, winding of relay 510, to grounded battery. Due to the fact that the left-hand winding of relay 644 is of low resistance, marginal relay 542 is energized, as are also relays 510 and 644. Relay 542 closes a locking circuit for itself, and relay 644 by attracting its inner left-hand armature causes the energization of relay 643 in the manner described.

Relay 644 by attracting its right-hand armature closes a circuit from ground, through a relatively low resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and contact of relay 644, conductor 639, armature and front contact of relay 624, conductor 639^a, lower left-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductor 508, right-hand winding of marginal relay 544, conductor 545, upper contact of sequence switch spring 546, winding of relay 517, to grounded battery. Due to the fact that the low resistance 638^a is included in this circuit both

relays 517 and 544 are energized. Relay 544 by attracting its left-hand armature closes a locking circuit for itself to ground, through the conductor 559 and the lower right-hand contact of sequence switch spring 527. The relay 517 completes a circuit from grounded battery, through power magnet of sequence switch 500, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 4 and into position 5.

As soon as the sequence switch 500 leaves position 4, relays 517, 510 and 644 become deenergized. The relay 644 closes a circuit from grounded battery, through power magnet of sequence switch 600, lower right-hand contact of sequence switch spring 698, outer right-hand armature and back contact of relay 649, left-hand armature and front contact of relay 643, left-hand armature and back contact of relay 644 to ground, for moving the sequence switch 600 out of position 4 and into position 5. As soon as the sequence switch 600 leaves position 4, relay 643 becomes deenergized.

Setting of the office brush register.

As soon as the sequence switches 600 and 500 reach position 4, a circuit is closed from grounded battery, through high resistance 699, conductor 650, armature and contact of relay 626, conductor 662, upper left-hand contact of sequence switch spring 651, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 528, upper right-hand contact of sequence switch spring 529, conductor 548, right-hand winding of sensitive relay 549, right-hand winding of marginal relay 550 to ground. Relay 549 becomes energized, but due to the high resistance 699 being included in the circuit the marginal relay 550 does not become energized. When the sequence switches 600 and 500 reach position 5, a circuit is closed from ground, through left-hand armature and back contact of relay 652, right-hand low resistance winding of relay 649, conductor 653, armature and contact of relay 627, conductor 663, upper left-hand contact of sequence switch spring 655, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductor 943, right-hand winding of marginal relay 551, conductor 552, right-hand contact of sequence switch spring 535, winding of relay 523 to ground-

ed battery. Relays 523 and 649 energize and due to the fact that the high resistance winding of relay 649 is not connected in this circuit, marginal relay 551 also becomes energized. Relay 649 by attracting its inner right-hand armature removes the shunt from around the winding of relay 652, whereupon relay 652 becomes energized. Marginal relay 551 closes a locking circuit for itself through its left-hand winding and armature to ground through conductors 816 and 526.

The relay 649 closes a circuit from ground, through right-hand contact of sequence switch spring 656, resistance 657, left-hand armature and contact of relay 649, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, upper contact of sequence switch spring 537, winding of relay 515 to grounded battery. Relay 515 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 5 and into position 6. As soon as the sequence switch 500 leaves position 5, relays 515, 523 and 649 become deenergized. The relay 649 closes the above traced circuit for the power magnet of sequence switch 600. Sequence switch 600 is thereupon moved out of position 5 and into position 6.

Setting of the office group register.

As soon as the sequence switches 600 and 500 reach position 5, a circuit is prepared from ground, through right-hand winding of marginal relay 553 (Fig. 15), right-hand winding of sensitive relay 554, conductor 555, lower right-hand contact of sequence switch spring 502, conductors 501 and 943, terminal 942, brush 941, conductor 940, outer left-hand armature and contact of relay 937, conductor 636, upper right-hand contact of sequence switch spring 655 to conductor 664, but due to the fact that relays 665^a and 666^a are deenergized, this circuit is not completed and relays 553 and 554 remain deenergized.

When the sequence switches 600 and 500 reach position 6, a circuit is closed from ground, through right-hand armature and back contact of relay 643, both windings

of relay 644 in series, lower contact of sequence switch spring 646, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductor 951, right-hand winding of marginal relay 547, conductor 548, lower contact of sequence switch spring 509, winding of relay 510 to grounded battery. Due to the fact that the high resistance winding of relay 644 is included in the above traced circuit, marginal relay 547 does not become energized. However, relays 510 and 644 become energized. Relay 644 by attracting its inner left-hand armature closes the above traced locking circuit for itself and also removes the shunt from around the relay 643, which thereupon becomes energized.

The relay 644 also closes a circuit from ground, through resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and contact of relay 644, conductor 639, armature and contact of relay 631, conductor 640^a, upper contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductor 508, upper contact of sequence switch spring 507, conductor 556, right-hand winding of marginal relay 557, conductor 558, winding of relay 517 to grounded battery. Due to the low resistance of this circuit, marginal relay 557 becomes energized and by attracting its left-hand armature closes a locking circuit for itself to ground through the conductor 559 and the lower right-hand contact of sequence switch spring 527. Relay 517 also is energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contacts of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground for moving the sequence switch 500 out of position 6 and into position 7.

As soon as the sequence switch 500 leaves position 6, relays 517, 510 and 644 deenergize. The relay 644 closes the above traced circuit for the power magnet of sequence switch 600. Sequence switch 600 thereupon moves out of position 6 and into position 7.

It will be assumed that the operator has completed the setting up of the called line number on her keyboard. The depression of the start key 667 will therefore result in a circuit being closed from grounded battery, through power magnet of sequence switch 600, upper right-hand contact of se-

quence switch spring 613, conductor 668, start key 667 to ground, for moving the sequence switch 600 out of position 7 and into position 8.

Setting of the incoming brush and group registers.

When the sequence switch 600 reaches position 7 $\frac{1}{2}$ and the sequence switch 500 reaches position 6 $\frac{1}{2}$, a circuit is closed from grounded battery, through low and high resistance windings of relay 669, in series, key-contact 670, conductor 671, lower left-hand contact of sequence switch spring 672, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductor 951, lower right-hand contact of sequence switch spring 559, conductor 560, left-hand winding of sensitive relay 561, left-hand winding of marginal relay 562 to ground. Due to the fact that the high resistance winding of relay 669 is included in this circuit, marginal relay 562 does not become energized, but relays 669 and 561 do become energized. Relay 561 by attracting its right-hand armature closes a locking circuit for itself, from grounded battery, through right-hand winding of relay 561, right-hand armature and contact of relay 561, conductors 563 and 763, upper contact of sequence switch spring 527 to ground.

When the sequence switch 600 reaches position 8 and the sequence switch 500 reaches position 7, a circuit is closed from ground, through left-hand armature and back contact of relay 652, right-hand low resistance winding of relay 649, conductor 653, key-contact 673, conductor 674, upper left-hand contact of sequence switch spring 635, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, left-hand winding of marginal relay 564, conductor 565, right-hand contact of sequence switch spring 566, winding of relay 523 to grounded, battery. Due to the fact that only the low resistance winding of relay 649 is included in this circuit, marginal relay 564 becomes energized and by attracting its right-hand armature, closes a locking circuit for its right-hand winding to ground through conductor 563 and the upper contact of sequence switch spring 527. Relays 523 and 649 also become energized. Relay 649 by attracting its inner right-hand armature closes a locking circuit for itself and removes the shunt from around the winding of relay 652, which thereupon becomes energized.

The relay 649 also closes a circuit from ground, through contact of sequence switch spring 656, low resistance 657, left-hand armature and contact of relay 649, conductor 639, armature and contact of relay 669, 130

lower left-hand contact of sequence switch spring 675, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, left-hand winding of marginal relay 567, conductor 567^a, lower right-hand contact of sequence switch spring 537, winding of relay 515 to grounded battery. Due to the low resistance of this circuit, marginal relay 567 becomes energized and by attracting its right-hand armature it closes a locking circuit for its right-hand winding to ground through conductors 568 and 559, and the lower right-hand contact of sequence switch spring 527.

Relay 515 is also energized in the above traced circuit and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 7 and into position 8. As soon as the sequence switch 500 leaves position 7, relays 515, 523 and 649 become deenergized. The relay 649 closes the above traced circuit for the power magnet of sequence switch 600. This sequence switch then moves out of position 8 and into position 9 whereby the relay 652 becomes deenergized.

40 *Setting of the final brush and incoming group registers.*

As soon as the sequence switch 600 reaches position 8 $\frac{1}{2}$ and the sequence switch 500 reaches position 7 $\frac{1}{2}$, a circuit is closed from grounded battery, through the relatively low resistance 677, conductor 682, key contact 666, upper right-hand contact of sequence switch spring 635, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, right-hand contact of sequence switch spring 569, conductor 570, left-hand winding of sensitive relay 571, left-hand winding of marginal relay 572 to ground. Due to the low resistance of this circuit, relays 571 and 572 are both energized and by attracting their right-hand armatures close a holding circuit through their right-hand windings to ground through conductors 563 and 763, and the upper contact of sequence switch spring 527.

When the sequence switch 600 reaches position 9 and the sequence switch 500 reaches

position 8, a circuit is closed from ground, through right-hand armature and back contact of relay 643, low and high resistance windings of relay 644 in series, lower contact of sequence switch spring 646, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951, left-hand winding of marginal relay 573, conductor 573^a, left-hand contact of sequence switch spring 574, winding of relay 510 to grounded battery. Due to the fact that the high resistance winding of relay 644 is included in the circuit, marginal relay 573 does not become energized. Relays 510 and 644 are, however, energized. Relay 644 by attracting its inner left-hand armature closes a locking circuit for itself and also causes the energization of relay 643 in the manner above described.

Relay 644 by attracting its right-hand armature closes a circuit from ground, through low resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and contact of relay 644, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, left-hand winding of marginal relay 575, conductor 575^a, left-hand contact of sequence switch spring 546, winding of relay 517 to grounded battery. Due to the high resistance 658 being included in this circuit, marginal relay 575 does not become energized. Relay 517 is, however, energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 8 and into position 9.

As soon as the sequence switch 500 leaves position 8, relays 517, 510 and 644 become deenergized. The relay 644 closes the above traced circuit for the power magnet of sequence switch 600. This sequence switch thereupon moves out of position 9 and into position 10, thereby causing the deenergization of relay 643.

Setting of the final tens register.

In response to the actuation of the No. 5 tens key, the relay 678 was energized by current flowing through a circuit from grounded battery, through low and high resistance

windings of relay 678, key contact 679 to ground.

When sequence switch 600 reaches position 10 and sequence switch 500 reaches position 9, a circuit is closed from ground, through left-hand armature and back contact of relay 652, low and high resistance windings of relay 649 in series, lower contact of sequence switch spring 680, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, left-hand winding of marginal relays 579, conductor 580, lower left-hand contact of sequence switch spring 566, winding of relay 523 to grounded battery. Due to the fact that the high resistance winding of relay 649 is included in this circuit, marginal relay 579 does not energize. Relays 523 and 649 are, however, energized. Relay 649 by attracting its inner right-hand armature closes a locking circuit for itself and also causes the energization of relay 652 in the manner described.

Relay 649 by attracting its left-hand armature closes a circuit from ground, through contact of sequence switch spring 656, low resistance 657, left-hand armature and contacts of relay 649, conductor 639, armature and contact of relay 678, upper right-hand contact of sequence switch spring 675, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, left-hand winding of marginal relay 581, conductor 581^a, lower left-hand contact of sequence switch spring 537, winding of relay 515 to grounded battery. Due to the low resistance of this circuit, marginal relay 581 becomes energized and by attracting its right-hand armature closes a locking circuit for its right-hand winding to ground over conductor 568 and the lower right-hand contact of sequence switch spring 527. Relay 515 is also energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground for moving the sequence switch 500 out of position 9 and into position 10.

As soon as the sequence switch 500 leaves position 9, relays 515, 523 and 649 become deenergized. The relay 649 closes the above traced circuit for the power magnet of sequence switch 600. The sequence switch 600 thereupon moves out of position 10 and into

position 11 whereby the relay 652 becomes deenergized.

Setting of the final units register.

When the sequence switch 600 reaches position 10 $\frac{1}{2}$ and the sequence switch 500 reaches position 9 $\frac{1}{2}$, a circuit is closed from grounded battery, through low and high resistance windings of relay 681, key contact 683, upper left-hand contact of sequence switch spring 680, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, left-hand contact of sequence switch spring 569, conductor 582, left-hand winding of sensitive relay 583, left-hand winding of marginal relay 584 to ground. Due to the fact that the high resistance winding of relay 681 is included in this circuit, the marginal relay 584 does not become energized. Relays 583 and 681 are however, energized. Relay 583 by attracting its right-hand armature closes a locking circuit for its right-hand winding to ground over conductor 568, and the lower right-hand contact of sequence switch spring 527.

When the sequence switch 600 reaches position 11, and sequence switch 500 reaches position 10, a circuit is closed from ground, through right-hand armature and back contact of relay 643, left-hand low resistance winding of relay 644, key contact 684, upper left-hand contact of sequence switch spring 646, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductor 951, left-hand winding of marginal relay 585, conductor 585^a, right-hand contacts of sequence switch spring 574, winding of relay 510 to grounded battery. Due to the low resistance of this circuit, marginal relay 585 becomes energized and by attracting its right-hand armature closes a locking circuit for itself through its right-hand winding to ground over conductor 568 and the lower right-hand contact of sequence switch spring 527. Relays 644 and 510 are also energized. Relay 644 by attracting its inner left-hand armature closes a locking circuit for itself and also causes the energization of relay 643 in the manner above described.

Relay 644 by attracting its right-hand armature closes a circuit from ground, through low resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and front contact of relay 644, conductor 639, armature and contact of relay 681, lower right-hand contact of sequence switch spring 675, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, left-hand winding of marginal relay 586, conductor 586^a, lower right-hand contact of sequence switch spring

546, winding of relay 517 to grounded battery. Due to the low resistance of this circuit, marginal relay 586 is energized and, by attracting its right-hand armature, closes a locking circuit for itself to ground over conductor 568 and the lower right-hand contact of sequence switch spring 527. Relay 517 is also energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519 to ground, for moving the sequence switch 500 out of position 10 and into position 11.

As soon as the sequence switch 500 leaves position 10, relays 517, 510 and 644 become deenergized. Relay 644 by retracting its left-hand armature closes the above traced circuit for the power magnet of sequence switch 600. The sequence switch thereupon moves out of position 11 and into position 12, whereby relay 643 becomes deenergized.

Setting of the station register.

When the sequence switch 600 reaches position 11 $\frac{1}{2}$ and the sequence switch 500 reaches position 10 $\frac{1}{2}$, a path is prepared from ground, through left-hand winding of marginal relay 587 (Fig. 16), left-hand winding of sensitive relay 588, conductor 589, upper contact of sequence switch spring 559, conductor 951, terminal 950, brush 949, conductor 948, middle left-hand armature and back contact of relay 937, conductor 647, to the upper right-hand contact of sequence switch spring 646; but due to the fact that none of the station keys were depressed, this path is not completed, and therefore the relays 587 and 588 remain deenergized.

When sequence switch 600 reaches position 12 and sequence switch 500 reaches position 11, a circuit is completed from ground, through left-hand armature and back contact of relay 652, low and high resistance windings of relay 649 in series, lower contact of sequence switch spring 680, conductor 636, outer armature and front contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, left-hand winding of marginal relay 590, conductor 590^a, upper contact of sequence switch spring 566, winding of relay 523 to grounded battery. Due to the fact that the high resistance winding of relay 649 is included in this circuit, marginal relay 590 does not become energized. Relays 523 and 649 are, however, energized. Relay 649 by attracting its inner right-hand armature closes a locking cir-

cuit for itself and also causes the energization of relay 652 in the manner above described.

The relay 649 also closes a circuit from ground, through contact of sequence switch spring 656, low resistance 657, left-hand armature and contact of relay 649, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, upper contact of sequence switch spring 537, winding of relay 515 to grounded battery. Relay 515 becomes energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 11 and into position 12.

As soon as the sequence switch 500 leaves position 11, relays 515, 523 and 649 become deenergized. The relay 649 closes the above traced circuit for the power magnet of sequence switch 600, which sequence switch thereupon moves out of position 12 and into position 13, thereby causing the deenergization of relay 652.

Restoration of the keyboard and its controlling apparatus.

In position 13 of the sequence switch 600, a circuit is closed from grounded battery, through contact of sequence switch spring 685, conductor 686, windings of all the key-releasing magnets 601 in parallel to ground. Magnets 601 release the depressed keys, and when all the keys have released, the holding circuits of all the relays that were held energized under the direct control of the keys, are opened. The relays 608 and 609 close a circuit from grounded battery, through power magnet of sequence switch 600, lower contact of sequence switch spring 613, conductor 687, right-hand armature and back contact of relay 608, right-hand armature and back contact of relay 609 to ground, for moving the sequence switch 600 out of position 13 and into position 14. As soon as the sequence switch 600 leaves position 13, relays 602 and 937 become deenergized.

If there is a sender selector associated with the operator's position which is not in use at this time, the sequence switch 600 is immediately moved out of position 14 and into position 1, due to the following circuit: 130

grounded battery, power magnet of sequence switch 600, upper left-hand contact of sequence switch spring 698, conductor 688, to ground through a sequence switch spring corresponding to 939 at such idle sender selector. However, if all the sender selectors are busy, sequence switch 600 remains in position 14 until one of these sender selectors reaches its normal position, at which time the above traced circuit will be closed to move the sequence switch 600 into its normal position.

When the sequence switch 600 reaches its normal position, the keyboard and its controlling apparatus are ready for controlling the setting of another sender and register set.

District brush selection.

When the sequence switch 500 reaches position 7, the control of the brush selecting operation at the district selector begins. A fundamental circuit is closed from grounded battery, through left-hand winding of relay 903, lower contacts of sequence switch spring 909, conductor 954, brush 955, terminal 956, conductor 957, contact of sequence switch spring 590, conductor 819, upper right-hand contact of sequence switch spring 820, conductor 821, left-hand armature and back contact of counting relay 0', winding of stepping relay 701, upper contact of sequence switch spring 702, resistance 703 to ground. Relays 903 and 701 become energized. The relay 701 closes a circuit from grounded battery, through winding of counting relay 4, armature and back contact of counting relay 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. Counting relay 4 becomes energized and closes a circuit from grounded battery, through winding of counting relay 4, winding of counting relay 4', armature and contact of counting relay 4, conductor 705, left-hand contact of sequence switch spring 706, conductor 707, right-hand contacts of sequence switch spring 512, right-hand armature and front contact of relay 511 to ground. Counting relay 4', however, does not energize at this time due to a shunt around its winding, which is closed at the armature and front contact of relay 701.

Relay 903 by attracting its right-hand armature closes a locking circuit for itself from grounded battery, through left-hand winding of relay 903, lower left-hand contact of sequence switch 909, right-hand armature and front contact of relay 903, lower contact of sequence switch spring 910 to ground over the circuit previously described. The relay 903 also closes a circuit from grounded battery, through power magnet of sequence switch 900, lower left-hand contact of sequence switch spring 907,

conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 900 out of position 7 and into position 8. A circuit is closed in position 8 of sequence switch 900 from grounded battery, through power magnet of sequence switch 10 (Fig. 1), lower left-hand contact of sequence switch spring 26, conductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature and front contact of relay 924, conductor 959, lower left-hand contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 10 out of position 2 and into position 4.

In position 4, of the sequence switch 10, a circuit is closed from grounded battery, through winding of up-drive magnet 28, lower right-hand contact of sequence switch spring 14, conductors 13 and 27 to ground at the left-hand armature, and front contact of relay 903 over the circuit previously described. Magnet 28, by attracting its armature, presses the driving ribbon 29 against the constantly rotating roller 30. The brush shaft 31 thereupon moves in an upward direction. As the commutator brush 32 engages the conducting segment of the commutator 33, a circuit is closed from ground, through upper right-hand contact of sequence switch spring 18, commutator brush 32, conducting segment 33, left-hand contact of sequence switch spring 34, conductor 35, upper contact of sequence switch spring 422, conductor 413, outer left-hand armature and contact of relay 930, conductor 960, lower right-hand contact of sequence switch spring 917, conductor 954, lower contact of sequence switch spring 910, right-hand armature and front contact of relay 903, lower left-hand contact of sequence switch 909, left-hand winding of relay 903 to grounded battery. This shunt circuit diverts sufficient current from the winding of stepping relay 701 to cause its deenergization, whereupon the counting relay 4' becomes energized. As soon as the commutator brush 32 engages an insulating segment of the commutator 33, the relay 701 is again energized and closes a circuit from grounded battery, through winding of counting relay 3, armature and back contact of counting relay 3', armature and front contact of counting relay 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. The counting relay 3 energizes and prepares a circuit for counting relay 3' in the well known manner. The energization of counting relay 4' also closes a circuit in parallel with counting relay 3, from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, con-

ductor 711, upper right-hand contact of sequence switch spring 710, conductor 824, contact of sequence switch spring 823, conductor 822, right-hand armature and front contact of relay 531, inner right-hand armature and front contact of relay 533, inner right-hand armature and back contact of relay 532, conductor 709 (Figs. 15 and 13), lower contact of sequence switch spring 708, armature and front contact of counting relay 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. Counting relay 0 is energized and by attracting its armature, closes a circuit for counting relay 0'. Counting relay 0 is, however, shunted at this time, through the armature and front contact of relay 701. As soon as the brush 32 engages a second time the conducting segment of the commutator 33, stepping relay 701 again deenergizes and thereupon counting relay 0' is energized and opens at its left-hand armature and back contact the energizing circuit of relay 903. As soon as the commutator 32 engages the next insulated segment of the commutator 33, relay 903 deenergizes and opens the circuit of magnet 28. The relay 903 also closes a circuit from grounded battery, through power magnet of sequence switch 10, lower contact of sequence switch spring 36, conductor 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and front contact of relay 930, upper right-hand contact of sequence switch spring 934, left-hand armature and back contact of relay 903, to ground for moving the sequence switch 10 out of position 4 and into position 5.

When counting relay 0' becomes energized, a circuit is also closed from grounded battery, through power magnet of sequence switch 700, conductor 713, left-hand contact of sequence switch spring 884, conductor 715, right-hand armature and contact of counting relay 0', right-hand contact of sequence switch spring 706, conductor 707, right-hand contacts of sequence switch spring 512, right-hand armature and front contact of relay 511 to ground, for moving the sequence switch 700 out of position 1 and into position 2. A circuit is then closed from grounded battery, through power magnet of sequence switch 700, conductor 713, lower left-hand contact of sequence switch spring 717, inner right-hand armature and back contact of relay 718, armature and back contact of relay 719 to ground, for moving the sequence switch 700 out of position 2 and into position 3. As soon as the sequence switch 700 leaves position 2, the circuits of the counting relays are opened at the sequence switch spring 706.

When the sequence switch 10 reaches position 5, a circuit is closed from grounded battery, through power magnet of sequence

switch 900, conductor 920, upper left-hand contact of sequence switch spring 921, middle left-hand armature and contact of relay 930, conductor 961, upper contact of sequence switch spring 424, conductors 415 and 38, lower left-hand and upper right-hand contacts of sequence switch spring 24, left-hand armature and front contact of relay 7 to ground, for moving the sequence switch 900 out of position 8 and into position 9.

Allotment of an idle sender selector.

When the sequence switch 900 reaches position 9, a circuit is closed from grounded battery, through power magnet of allotter sequence switch 400, upper contact of spring 408, conductor 417, right-hand contacts of sequence switch spring 962, conductor 963, right-hand armature and back contact of relay 937 (it being assumed that all the registers have been set), upper left-hand contact of sequence switch spring 939 to ground. The allotter sequence switch 400 thereupon moves out of position 4 and into position 5. Sequence switch 400 is immediately moved out of position 5 and into position 1 if a sender selector is idle at this time, due to the following circuit: grounded battery, power magnet of sequence switch 400, contact of sequence switch spring 407, conductor 418, left-hand contacts of a sequence switch spring corresponding to 962 at the idle sender selector, to ground. Otherwise, the sequence switch 400 remains in position 5 until a sender selector becomes idle. If the sender selector, which is allotted in position 1 of the allotter 400, is busy, a circuit is closed to ground for the power magnet of the sequence switch 400 through the contacts of the sequence switch spring 962' (corresponding to 962) controlled by the sequence switch of this busy sender selector. The sequence switch 400 thereupon moves into position 2. In a similar manner the sequence switch 400 continues to hunt for the idle sender selector. When the sequence switch 400 reaches the position in which an idle sender selector is allotted, the hunting movement is stopped as there will not be a circuit completed for the power magnet of the sequence switch 400 since the sequence switch 900 associated with the idle allotted sender selector will be in position 1.

District group selection.

When the sequence switch 700 reaches position 2, a circuit is closed from grounded battery, through winding of relay 704, upper right-hand contact of sequence switch spring 719, conductor 720, outer right-hand armature and contact of relay 544, conductor 827, contact of sequence switch spring 828 to ground.

When the sequence switch 900 reaches position 9 and sequence switch 700 reaches po-

sition 3, the above traced fundamental circuit is closed, whereupon relays 903 and 701 again become energized. Relay 701 by attracting its armature completes a circuit

5 from grounded battery, through winding of counting relay 9, armature and back contact of counting relay 9', armature and front contact of relay 704, armature and contact of relay 701 to ground.

10 The relay 903 closes a circuit from grounded battery, through power magnet of sequence switch 900, lower left-hand contact of sequence switch spring 907, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 900 out of position 9 and into position 10. Relay 903 by attracting its right-hand armature closes the above traced locking circuit for itself to ground over the

20 fundamental circuit. In position 10 of sequence switch 900 a circuit is closed from grounded battery, through power magnet of sequence switch 10, lower left-hand contact of sequence switch spring 26, conductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature of relay 924, conductor 959, left-hand contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 10 out of position 5 and into position 6.

35 In position 6 of sequence switch 10, the circuit of magnet 28 is closed again from grounded battery, winding of up-drive magnet 28, lower right-hand contact of sequence switch spring 14, conductors 13 and 27, and thence to ground at the left-hand armature and front contact of relay 903 over the circuit previously described. Under the control of the up-drive magnet 28, the brush rod 31 is again moved upward. This movement of the brush rod trips the second set of brushes 44, 45 and 46 due to the trip magnet 65 being energized over the following circuit: grounded battery, winding of trip magnet 65, lower contact of sequence switch spring 18 to ground.

50 As the commutator brush 39 engages the conducting segment of the commutator 40, during the upward movement of the brush rod, a circuit is closed from grounded battery, through left-hand winding of relay 903, lower left-hand contact of sequence switch spring 909, right-hand armature and front contact of relay 903, upper left-hand contact of sequence switch spring 910, inner left-hand armature and front contact of relay 930, conductor 935, upper contact of sequence switch spring 428, conductors 37 and 43, upper contacts of sequence switch spring 42, conductor 41, commutator 40, brush 39, upper right-hand contact of sequence switch

65 spring 18 to ground. The closure of this

circuit causes the shunting of the stepping relay 701, which in turn causes the energization of counting relay 9'. As soon as the brush 32 engages an insulating segment of the commutator, the stepping relay 701 is again energized. In a similar manner the counting relays are energized until the commutator 39 engages the eighth conducting segment, at which time the counting relay 2' is energized. Then when the commutator 39 engages the eighth insulated segment and relay 701 becomes energized, a circuit is closed from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, conductor 711, lower contact of sequence switch spring 720, conductor 721, contact of sequence switch spring 829, conductor 830, right-hand armature and front contact of relay 540, inner right-hand armature and front contact of relay 542, inner right-hand armature and front contact of relay 541, conductor 722 (Figs. 15 and 13), lower contact of sequence switch spring 723, armature and front contacts of counting relays 2' to 9' in series, armature and front contact of relay 704, armature and front contact of stepping relay 701 to ground. Counting relay 0 becomes energized and prepares a circuit for counting relay 0'. As soon as the commutator brush 39 engages the ninth conducting segment of the commutator 40, the stepping relay 701 becomes deenergized, whereupon the counting relay 0' is energized. Counting relay 0' by attracting its right-hand armature closes a circuit from grounded battery, through power magnet of sequence switch 700, conductor 713, left-hand contact of sequence switch spring 884, conductor 715, right-hand armature and contact of counting relay 0', right-hand contact of sequence switch spring 706, conductor 707, right-hand contacts of sequence switch spring 512, right-hand armature and front contact of relay 511 to ground, for moving the sequence switch 700 out of position 3 and into position 5. As soon as the sequence switch 700 leaves position 3, the circuits of the counting relays are opened at the left-hand contact of sequence switch spring 706.

The counting relay 0' also opens at its left-hand armature and contact the energizing circuit of relay 903. This relay 903, however, remains energized until the commutator 39 engages the ninth insulated segment of the commutator 40, at which time the brushes 44, 45 and 46 will be in engagement with the lowermost set of terminals of the ninth group of terminals in the second section of the district selector terminal bank. When the commutator brush 39 engages the ninth insulated segment of the commutator 40, relay 903 deenergizes, and by retracting its left-hand armature opens

the circuit of the up-drive magnet. The left-hand armature of relay 903 also closes a circuit from grounded battery, through power magnet of sequence switch 10, upper
 5 left-hand contact of sequence switch spring 36, conductor 415, upper contact of sequence switch spring 424, conductor 961, middle left-hand armature and contact of relay 930,
 10 lower contact of sequence switch spring 921, left-hand armature and back contact of relay 903 to ground, for moving the sequence switch 10 out of position 6 and into position 7.

From the foregoing description of the operation of the district selector, it will be observed that the line relay 903 for controlling this switch is normally associated with the cord finder circuit, and therefore is common to all the district selectors which
 20 are individual to the operator's position. Since the number of cord finders is less than the total number of cords, the total number of line relays is also less than the total number of district selectors.

In position 7 of the sequence switch 10, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, lower right-hand contact of sequence switch spring 932, conductor 960, outer left-hand armature and contact of relay 930, conductor 413, upper
 30 contact of sequence switch spring 422, conductor 35, lower contact of sequence switch spring 34 to ground, for moving the sequence switch 900 out of position 10 and into position 11.

In position 11 of sequence switch 900, a circuit is closed from grounded battery, through left-hand winding of relay 903, upper right-hand contact of sequence switch spring 939 to ground. Relay 903 energizes and completes a circuit from grounded battery, through power magnet of sequence switch 900, left-hand contact of sequence switch spring 907, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 900 out of position 11 and into position 12. Relay 903 also closes a locking circuit for itself from grounded battery, through right-hand winding of relay 903, upper contact of sequence switch spring 909, right-hand armature and front contact of relay 903, upper left-hand contact of sequence switch spring 910, inner left-hand armature and contact of relay 930, conductor 935, upper contact of sequence switch spring 428, conductor 37, lower contact of sequence switch spring 25 to ground. When the sequence
 60 switch 900 reaches position 12, a circuit is closed from grounded battery, through power magnet of sequence switch 10, upper contact of sequence switch spring 26, right-hand armature and contact of relay 7, con-

ductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature and contact of relay 924, conductor 959, lower left-hand contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903 to ground, for moving the sequence switch 10 out of position 7 and into position 8. If the trunk with which the set of brushes 47, 48 and 49 is in engagement is busy, relay 903 remains energized over the
 75 above traced circuit to conductor 37, then through the lower right-hand contact of sequence switch spring 25, conductor 76, resistance 52, test brush 44, test terminal 47, to ground at a contact of a sequence switch spring similar to 18. In position 8 of sequence switch 10, a circuit is then closed from grounded battery, through winding of up-drive magnet 28, lower right-hand contact of sequence switch spring 14,
 85 conductors 13 and 27 and then to ground at the left-hand armature and front contact of relay 903 over the circuit previously described.

As the brush rod 31 is moved upward under the control of the up-drive magnet 28, the test brush 44 engages the test terminals 47, and as long as a busy test terminal is engaged, relay 903 will remain energized. However, as soon as the test brush 44 engages the test terminal of an idle trunk, no ground will be found thereon and relay 903 becomes deenergized. The relay 903 opens the energizing circuit for the up-drive magnet 28. This magnet remains
 90 energized until the brushes are accurately centered upon the terminals of the trunk, due to the following circuit: grounded battery, winding of up-drive magnet 28, right-hand contacts of sequence switch spring 14, commutator brush 50, commutator 51, upper right-hand contact of sequence switch spring 34, conductor 35, then to ground at the left-hand armature and front contact of relay 903 over the circuit above described.
 100 As soon as the brushes 44, 45 and 46 are centered upon the terminals 47, 48 and 49, and the relay 903 is deenergized, a circuit is closed from grounded battery, through power magnet of sequence switch 10, upper left-hand contact of sequence switch spring 36, conductor 415, upper contact of sequence switch spring 424, conductor 961, middle left-hand armature and contact of relay 930, lower contact of sequence switch spring 921,
 110 left-hand armature and back contact of relay 903 to ground, for moving the sequence switch 10 out of position 8 and into position 10. A circuit is now closed from ground, through upper left-hand contact of sequence switch spring 18, resistance 52, test brush 44 to the test terminal 47 and the multiples thereof to prevent the seizure
 125

of the trunk associated with this set of terminals by any other district selector.

In position 10 of sequence switch 10, a circuit is also closed from grounded battery, through resistance 53, upper contact of sequence switch spring 25, conductor 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and contact of relay 930, upper left-hand contact of sequence switch spring 910, right-hand armature and back contact of relay 903, upper right-hand contact of sequence switch spring 964, winding of relay 965 to ground. Relay 965 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 900, conductor 920, upper right-hand contact of sequence switch spring 907, outer left-hand armature and front contact of relay 965, conductor 963, right-hand armature and back contact of relay 937, upper left-hand contact of sequence switch spring 939, to ground, for moving the sequence switch 900 out of position 12 and into position 13. Relay 965 by attracting its inner left-hand armature closes a locking circuit for itself to grounded battery, at the upper contact of sequence switch spring 25.

With sequence switch 10 in position 10, sequence switch 900 in position 13, sequence switch 500 in position 12, and sequence switch 800 in position 12, a circuit is closed from grounded battery, through winding of relay 8, upper contact of sequence switch contact 16, outer right-hand armature and front contact of relay 15, conductor 17, upper contact of sequence switch spring 14, conductor 13, conductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature and contact of relay 924, conductor 959, upper contact of sequence switch spring 970, inner right-hand armature and contact of relay 965, conductor 946, brush 945, terminal 944, conductor 508, lower left-hand contact of sequence switch spring 507, conductor 833, lower right-hand contact of sequence switch spring 875 to ground. Relay 8 energizes and opens the circuit of relay 11 which deenergizes and causes in turn the deenergization of relays 14 and 15. The deenergization of relay 15 opens the circuit of relay 8 and closes a circuit from grounded battery, through power magnet of sequence switch 10, conductor 58, lower left-hand contact of sequence switch spring 59, outer right-hand armature and back contact of relay 15 to ground, over the circuit previously described, for moving the sequence switch 10 out of position 10 and into position 11.

As soon as the sequence switch 10 leaves position 10, the locking circuit of relay 965 is opened at the upper contact of sequence switch spring 25. Relay 965 deenergizes and closes a circuit from grounded battery,

through power magnet of sequence switch 900, conductor 920, upper left-hand contact of sequence switch spring 907, outer left-hand armature and back contact of relay 965, conductor 963, lower contacts of sequence switch spring 962, to ground, for moving the sequence switch 900 out of position 13 and into position 14.

Disconnection of operator's telephone set.

When relay 14 becomes deenergized the operator's telephone set is automatically disconnected from the assigned cord circuit, provided she has not already disconnected her telephone set by operating the listening-out key 81.

It may be well to describe at this point how the operator may listen in and listen out on a connection. By depressing the listening-in key 80, a circuit is closed for relay 11 from grounded battery, through armature and back contact of relay 8, resistance 9, winding of relay 11, upper contact of sequence switch spring 12, listening-in key 80 to ground. Relay 11 energizes and closes the above-traced locking circuit for itself, through the winding of relay 14. Relay 14 energizes and connects the operator's telephone to the desired cord circuit. When the operator wishes to become disconnected from the cord circuit, she depresses listening-out key 81, thereby closing a circuit from grounded battery, through winding of relay 8, listening-out key 81 to ground. Relay 8 becomes energized and causes the deenergization of relay 14 whereby the operator's telephone set is disconnected from the cord circuit.

If the operator should accidentally listen out without having first set up a number on her keyboard the operation is as follows: From the preceding description it will be observed that after the cord finder "A" has found the assigned cord and the sender selector has seized an idle sender, sequence switch 900 remains in position 7 until the sequence switch 500 reaches position 7; that is until the office registers have all been set. Therefore the sequence switch 10 remains in position 2, because the circuit for moving this sequence switch out of position 2 is not closed until the sequence switch 900 reaches position 8.

If then the operator should operate her listening-out key before she has completely set up the number on her keyboard, relay 11 deenergizes in the usual way, and completes a circuit from grounded battery, through lamp 83, resistance 84, upper contact of sequence switch spring 85, outer armature and back contact of relay 11, conductor 87, interrupter 86 to ground, causing the flashing of lamp 83. The operator is thereby informed of the fact that she has not yet depressed the keys, and may there-

upon complete the setting up of the number on her keyboard. The establishment of the connection will then proceed in the ordinary way.

5 *Office brush selection.*

With the sequence switch 10 in position 11 and the sequence switch 900 in position 14 the fundamental circuit is again established, but now extends from grounded battery, through winding of relay 101 (Fig. 2), lower contact of sequence switch spring 102, conductor 103, terminal 49, brush 46, upper right-hand and lower left-hand contacts of sequence switch spring 54, conductors 38 and 415, upper contact of sequence switch spring 424, conductor 961, middle left-hand armature and front contact of relay 930, upper right-hand contact of sequence switch spring 921, conductor 954, brush 955, terminal 956, conductor 957, contact of sequence switch spring 590, conductor 819, upper right-hand contact of sequence switch spring 820, conductor 821, left-hand armature and contact of counting relay 0', winding of stepping relay 701, upper contact of sequence switch spring 702, resistance 703 to ground. Relays 701 and 101 are energized. The relay 701 closes a circuit from grounded battery, through winding of counting relay 4, armature and back contact of counting relay 4', armature and back contact of relay 704, armature and front contact of stepping relay 701 to ground. Counting relay 4 becomes energized and prepares a circuit for counting relay 4', in the well-known manner. Relay 101 by attracting its right-hand armature closes a locking circuit for itself from grounded battery, through winding of relay 101, right-hand armature and front contact of relay 101, upper contact of sequence switch spring 102 to ground over the fundamental circuit described. The relay 101 also closes a circuit from grounded battery, through winding of holding relay 104, contact of sequence switch spring 105, left-hand armature and front contact of relay 101 to ground. Relay 104 by attracting its left-hand armature closes a locking circuit for itself from grounded battery, through winding of relay 104, left-hand armature and front contact of relay 104, resistance 106, conductor 107, terminal 47, brush 44, resistance 52, upper left-hand contact of sequence switch 18 to ground. Relay 104 by attracting its right-hand armature closes a circuit from grounded battery, through power magnet of sequence switch 100, lower contact of sequence switch spring 108, right-hand armature and front contact of relay 104 to ground, for moving the sequence switch 100 out of position 1 and into position 2.

In position 2 of sequence switch 100, a circuit is closed from grounded battery,

through winding of up-drive magnet 109, lower right-hand contact of sequence switch spring 110, conductor 111, left-hand armature and front contact of relay 101 to ground. Under the control of the up-drive magnet 109, brush rod 112 is moved upward. As the rod 112 is moved upward a circuit is closed for the relay 101 as follows: grounded battery, winding of relay 101, right-hand armature and front contact of relay 101, conductor 113, lower contact of sequence switch spring 114, conducting segments of commutator 115, commutator brush 116, to ground. Each time this circuit is closed the relay 701 is shunted out, thereby causing the operation of the counting relays in a well-known manner.

As soon as the commutator brush 116 engages the first insulated segment of the commutator 115, the counting relay 4' being energized, a circuit is closed from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, conductor 711, lower right-hand contact of sequence switch spring 710, conductor 725, contact of sequence switch spring 726, conductor 727, armature and front contact of relay 549, inner armature and front contact of relay 551, inner armature and back contact of relay 550, conductor 709 (Figs. 15 and 13), the lower contact of sequence switch spring 708, armature and front contact of relay 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. As soon as the commutator brush 116 engages the next conducting segment of commutator 115, relay 701 becomes deenergized, whereupon the counting relay 0' energizes. Counting relay 0' by attracting its left-hand armature opens the fundamental circuit, thereby causing the deenergization of relay 101 as soon as the commutator brush 110 reaches the second insulated segment of the commutator 115. Relay 101 by retracting its left-hand armature opens the circuit of the up-drive magnet 109 and closes a circuit from grounded battery, through power magnet of sequence switch 100, upper right-hand contact of sequence switch spring 108, left-hand armature and back contact of relay 101 to ground, for moving the sequence switch 100 out of position 2 and into position 3. The counting relay 0' also closes the above-traced circuit from the power magnet of sequence switch 700 for moving this sequence switch out of position 5 and into position 7. As soon as sequence switch 700 leaves position 5, the holding circuit of the counting relay is opened in the upper left-hand contact of sequence switch spring 706.

In position 7 of the sequence switch 700, a circuit is closed from grounded battery, through power magnet of the sequence switch 500, upper left-hand contact of se-

sequence switch spring 591, conductor 794, left-hand contact of sequence switch spring 850, conductor 731, upper contact of sequence switch spring 732 to ground, for moving the sequence switch 500 out of position 12 and into position 15.

Office group selection.

When the sequence switch 100 reaches position 3 and sequence switch 700 reaches position 7, the above-traced fundamental circuit is again closed whereby relays 101 and 701 become energized. Relay 101 by attracting its right-hand armature closes a locking circuit for itself, through the above-traced fundamental circuit, and by attracting its left-hand armature closes a circuit from grounded battery, through power magnet of sequence switch 100, lower contact of sequence switch spring 122, conductor 111, left-hand armature and front contact of relay 101 to ground, for moving the sequence switch 100 out of position 3 and into position 4.

In position 7 of the sequence switch 700 a circuit is closed from grounded battery, through winding of relay 704, upper left-hand contact of sequence switch spring 719, conductor 733, outer right-hand armature and contact of relay 557, conductor 827, contact of sequence switch spring 828 to ground. Therefore when the relay 701 becomes energized upon the closure of the fundamental circuit, a circuit is closed from grounded battery, through winding of counting relay 9, armature and back contact of counting relay 9', armature and front contact of relay 704, armature and front contact of stepping relay 701 to ground. Counting relay 9 prepares a circuit for counting relay 9' in the well-known manner.

In position 4 of the sequence switch 100, the above-traced circuit for the up-drive magnet 109 is again closed, and the magnet moves the brush rod 112 upward. By thus moving the brush rod 112, the second set of brushes is tripped due to the tripping magnet 119 being energized over the following circuit: grounded battery, winding of trip magnet 119, upper right-hand contact of sequence switch spring 120 to ground. During this upward movement of the brush rod 112 each time the commutator brush 116 engages a conducting segment of the commutator 118, a circuit is closed from grounded battery, through winding of relay 101, right-hand armature and contact of relay 101, conductor 113, upper contact of sequence switch spring 114, commutator 118, commutator brush 116 to ground. This circuit places a shunt around the winding of relay 701 which deenergizes and causes the counting relays to be successively actuated in the well-known manner. When commutator 116 engages the fifth insulated

segment of the commutator 118, a circuit is closed from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, conductor 711, upper contact of sequence switch spring 720, conductor 734, contact of sequence switch spring 735, conductor 736, armature and back contact of relay 554, outer right-hand armature and back contact of relay 547, conductor 737 (Figs. 15 and 13), lower contact of sequence switch spring 755, armatures and front contacts of the counting relays 5' to 9' inclusive, armature and front contact of relay 704, armature and front contact of relay 701 to ground. As soon as the commutator 116 engages the next conducting segment of the commutator 118, the counting relay 0' becomes energized and opens the above-traced fundamental circuit. Relay 101 then becomes deenergized as soon as the commutator brush 116 engages the next insulated segment of the commutator 118. Relay 101 by retracting its left-hand armature opens the circuit of the up-drive magnet 109 and closes a circuit from grounded battery, through power magnet of sequence switch 100, right-hand contact of sequence switch spring 108, left-hand armature and back contact of relay 101 to ground, for moving the sequence switch 100 out of position 4 and into position 7. The second set of brushes 123, 124 and 125 carried by the brush rod 112 is now in engagement with the lowermost set of terminals 126, 127 and 128 respectively, in the sixth group served thereby.

In position 7 of the sequence switch 100, a circuit is closed from grounded battery, through left-hand winding of relay 121, lower left-hand contact of sequence switch spring 120 to ground. Relay 121 becomes energized and closes a circuit from grounded battery, through power magnet of sequence switch 100, the upper right-hand contact of spring 122, left-hand armature and front contact of relay 121 to ground, for moving the sequence switch 100 out of position 7 and into position 9. If the trunk, associated with the terminals 126, 127 and 128 with which the brushes 123, 124 and 125 are in engagement, is busy, ground is connected to the test terminal 123 thereof in a manner to be hereinafter described, and a locking circuit for relay 121 will be closed from grounded battery, through right-hand winding of relay 121, right-hand armature and front contact of relay 121, test brush 123, test terminal 123 to ground. In position 9 of the sequence switch 100, a circuit will then be closed from grounded battery, through winding of up-drive magnet 109, upper contact of sequence switch spring 110, left-hand armature and front contact of relay 121 to ground. Under the control of the up-drive magnet 109, the brushes 123, 124

124 and 125 will be moved over the terminals of the selected group until an idle set is found, at which time the circuit of relay 121 will be opened due to the absence of ground upon the test terminal 126. The relay 121 opens the circuit of the up-drive magnet 109 and closes a circuit from grounded battery, through power magnet of sequence switch 100, left-hand contact of sequence switch spring 122, left-hand armature and back contact of relay 121 to ground, for moving the sequence switch 100 out of position 9 and into position 16.

When the counting relay 0' became energized in response to the group selecting movement of the office selector, a circuit was closed from grounded battery, through power magnet of sequence switch 700, conductor 713, left-hand contact of sequence switch spring 884, conductor 715, right-hand armature and contact of counting relay 0', conductor 769, left-hand contact of spring 770, conductor 795, upper contact of sequence switch spring 594 to ground, for moving the sequence switch 700 out of position 7 and into position 8. As soon as sequence switch 700 leaves position 7, the counting relays and relay 701 become de-energized. In position 8 of sequence switch 700, a circuit is closed from grounded battery, through power magnet of sequence switch 700, conductor 713, lower right-hand contact of sequence switch spring 717, armature and back contact of relay 719 to ground, for moving the sequence switch 700 out of position 8 and into position 9.

Incoming brush selection.

When the sequence switch 100 reaches position 14 and sequence switch 700 reaches position 9, the fundamental circuit is again closed but now extends from grounded battery, through right-hand winding of relay 151 (Fig. 3), lower contacts of sequence switch spring 152, resistance 153, conductor 154, terminal 128, brush 125, contact of sequence switch spring 130, conductor 103, then over the circuit previously described to the lower contact of sequence switch spring 702, then through conductor 740, upper left-hand contact of sequence switch spring 851, conductor 742, terminal 966, brush 967, conductor 968, lower contact of sequence switch spring 934, inner left-hand armature and contact of relay 930, conductor 935, upper contact of sequence switch spring 428, conductors 37 and 43, upper left-hand and lower right-hand contacts of sequence switch spring 42, brush 45, terminal 48, conductor 131, contact of sequence switch spring 132, brush 124, terminal 127, conductor 155, left-hand contact of sequence switch spring 156, resistance 157 to ground. Relays 151 and 701 are energized.

Relay 701 by attracting its armature closes a circuit from grounded battery, through winding of counting relay 4, armature and back contact of relay 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. Counting relay 4 becomes energized and prepares a circuit for counting relay 4' in the manner described.

Relay 151 by attracting its left-hand armature closes a locking circuit for itself from grounded battery, through right-hand winding of relay 151, upper contact of sequence switch spring 158, left-hand armature and front contact of relay 151, lower contact of sequence switch spring 159, resistance 153 to ground, over the fundamental circuit previously described. The relay 151 also closes a circuit from grounded battery, through power magnet of sequence switch 150, lower left-hand contact of sequence switch spring 160, conductor 164, right-hand armature and front contact of relay 151 to ground, for moving the sequence switch 150 out of position 1 and into position 2.

In position 2 of sequence switch 150, a circuit is closed from grounded battery, through winding of up-drive magnet 162, lower contact of sequence switch spring 163, conductor 164, right-hand armature and front contact of relay 151 to ground. Magnet 162 by attracting its armature causes the upward movement of the brush rod 165 in the well-known manner. During the upward movement of the brush rod 165, each time the commutator brush 168 engages a conducting segment of commutator 167, a circuit is closed from grounded battery, through right-hand winding of relay 151, upper contact of sequence switch spring 158, left-hand armature and front contact of relay 151, lower contact of sequence switch spring 159, lower left-hand contact of sequence switch spring 152, lower right-hand contact of sequence switch spring 166, commutator 167, commutator brush 168, lower contacts of sequence switch spring 169 to ground. This circuit places a shunt around the stepping relay 701 whereupon the counting relays are actuated in the well-known manner. As soon as the commutator 168 engages the first insulated segment after counting relay 4' is energized, a circuit is closed from grounded battery, through winding of counting relay 0, right-hand contacts of sequence switch spring 712, conductor 744, left-hand armature and front contact of relay 561, inner left-hand armature and front contact of relay 564, inner left-hand armature and back contact of relay 562, conductor 709 (Figs. 16 and 13), lower contact of sequence switch spring 708, armature and front contact of counting relay 4', armature and back contact of re-

lay 704, armature and front contact of relay 701 to ground. As soon as the commutator 168 engages the second conducting segment of the commutator 167, relay 701 becomes deenergized, thereby causing the counting relay 0' to become energized.

The energization of counting relay 0' closes the above-traced circuit for the power magnet of sequence switch 700 to move the sequence switch out of position 9 and into position 11. Counting relay 0' by attracting its left-hand armature also opens the above-traced fundamental circuit, thereby causing the deenergization of relay 151 as soon as the commutator brush 168 engages the next insulated segment of the commutator 167. Relay 151 by retracting its right-hand armature opens the circuit of the up-drive magnet 162 and closes a circuit from grounded battery, through power magnet of sequence switch 150, right-hand contact of sequence switch spring 160, conductor 161, right-hand armature and back contact of relay 151 to ground, for moving the sequence switch 150 out of position 2 and into position 3. In position 3 of sequence switch 150, a circuit is closed from grounded battery, through winding of trip magnet 170, contact of sequence switch spring 171 to ground. Magnet 170 becomes energized and places trip rod 175 in a position to trip the second set of brushes of the incoming selector, as soon as the brush rod 165 is again moved upward.

Incoming group selection.

As soon as the sequence switch 150 reaches position 3 and the sequence switch 700 reaches position 11, the above-traced fundamental circuit is again closed, thereby causing the energization of relays 151 and 701. The relay 701 closes the above-traced circuit for the counting relay 4 in the manner described, which becomes energized and prepares a circuit for counting relay 4'. Relay 151 by attracting its left-hand armature closes the above traced locking circuit for itself. Relay 151 also closes a circuit from grounded battery, through power magnet of sequence switch 150, left-hand contact of sequence switch spring 160, conductor 164, right-hand armature and front contact of relay 151 to ground, for moving the sequence switch 150 out of position 3 and into position 4. In position 4, the above-traced circuit for the up-drive magnet is again closed to move the brush rod 165 upward. During the upward movement of the brush rod a circuit is closed each time the commutator brush 173 engages a conducting segment of the commutator 172, from grounded battery, over the locking circuit of relay 151 to the lower left-hand contact of sequence switch spring 152, then through upper left-hand contact of sequence

switch spring 166, commutator 172, brush 173, lower contacts of sequence switch spring 169 to ground. This circuit places a shunt around the winding of the stepping relay 701. The counting relays are operated in the well-known manner until the counting relay 3' is energized. Then upon the next energization of relay 701, a circuit is closed from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, upper left-hand contact of sequence switch spring 743, conductor 745, left-hand armature and front contact of relay 567, inner left-hand armature and back contact of relay 575, conductor 746 (Figs. 16 and 13), lower contact of sequence switch spring 747, armatures and front contacts of counting relays 3' and 4', armature and back contact of relay 704, armature and front contact of relay 701 to ground. Counting relay 0 becomes energized and prepares a circuit for counting relay 0'. As soon as the commutator 173 engages the next conducting segment of the commutator 172, stepping relay 701 deenergizes and causes the energization of counting relay 0', which in turn closes the above-traced circuit for the power magnet of sequence switch 700 to move this sequence switch out of position 11 and into position 13. Counting relay 0', by attracting its left-hand armature, also opens the above-traced fundamental circuit, thereby causing the deenergization of relay 151. Relay 151 by retracting its left-hand armature opens the circuit of the up-drive magnet 162 and closes a circuit from grounded battery, through power magnet of sequence switch 150, lower right-hand contact of sequence switch spring 160, conductor 161, right-hand armature and back contact of relay 151 to ground, for moving the sequence switch 150 out of position 4 and into position 5. The second set of brushes 182, 185 and 177 of the incoming selector is now in engagement with the lowermost set of terminals of the third sub-group served thereby. In position 5 of the sequence switch 150, a circuit is closed from grounded battery, through right-hand winding of relay 151, right-hand contacts of sequence switch spring 152, to ground. Relay 151 becomes energized and closes a locking circuit for itself from grounded battery, through left-hand winding of relay 151, lower contact of sequence switch spring 158, left-hand armature and front contact of relay 151, upper right-hand contact of sequence switch spring 159, conductor 174, resistance 176, test brush 177 to ground over the test terminal 178, provided this terminal is made busy in a manner to be hereinafter described. Relay 151 by attracting its right-hand armature closes a circuit from grounded battery, through power magnet of se-

sequence switch 150, left-hand contact of sequence switch spring 160, conductor 164, right-hand armature and contact of relay 151 to ground, for moving the sequence switch 150 out of position 5 and into position 6.

When sequence switch 150 reaches position 6, the above-traced circuit for the up-drive magnet 162 is closed to again move the brush rod 165 upward, provided the locking circuit of relay 151 is closed. As long as the test brush 177 engages test terminals 178 of busy trunks, the above-traced locking circuit for relay 151 is maintained closed. As soon, however, as an idle trunk is found this circuit is opened, due to the absence of ground on the test terminal 178, but the relay 151 is held energized over the following circuit until the brushes are accurately centered upon the selected set of terminals: grounded battery, right-hand winding of relay 151, lower right-hand contact of sequence switch spring 152, upper right-hand contact of sequence switch spring 166, commutator 180, commutator brush 179, upper right-hand contact of sequence switch spring 163, conductor 164, right-hand armature and front contact of relay 151, to ground. As soon as the brushes are centered, the last-traced circuit is opened by the commutator brush 179 engaging an insulated segment of the commutator 178. Relay 151 thereupon deenergizes and opens the circuit of the up-drive magnet 162. The relay 151 also closes a circuit from grounded battery, through power magnet of sequence switch 150, right-hand contact of sequence switch spring 160, conductor 161, right-hand armature and back contact of relay 151, to ground, for moving the sequence switch 150 out of position 6 and into position 8.

As soon as sequence switch 150 reaches position 6, ground is connected to the test terminal 178 over the following circuit: ground, lower left-hand and upper right-hand contacts of sequence switch spring 169, resistance 176, brush 177 and terminal 178, to render the terminals 181, 186 and 178 non-selectable to other incoming selectors.

Final brush selection.

When the sequence switch 150 reaches position 8 and sequence switch 700 reaches position 13, the above-traced fundamental circuit is closed, thereby causing the energization of relays 151 and 701. Relay 701 energizes and closes the above-traced circuit for counting relay 4, which thereupon energizes and prepares a circuit for the counting relay 4' in the manner described. Relay 151, by attracting its left-hand armature, also closes the above traced locking circuit for itself. Relay 151, by attracting its right-hand armature, closes a circuit from grounded battery, through power magnet of

sequence switch 150, left-hand contact of sequence switch spring 160, conductor 164, right-hand armature and front contact of relay 151, to ground, for moving the sequence switch out of position 8 and into position 9. In position 9 of sequence switch 150, a circuit is closed from grounded battery, through windings of relay 202 in series, left-hand contact of sequence switch spring 203, conductor 204, terminal 181, brush 182, conductor 183, upper left-hand contact of sequence switch spring 163, conductor 164, right-hand armature and front contact of relay 151, to ground. Relay 202, by attracting its right-hand armature, completes a locking circuit for itself from grounded battery, through windings of relay 202 in series, upper contacts of sequence switch spring 205, right-hand armature and front contact of relay 202, lower right-hand contact of sequence switch spring 203, to ground, over the circuit previously described. Relay 202, by attracting its left-hand armature, closes a circuit from grounded battery, through winding of relay 206, lower left-hand and upper right-hand contacts of sequence switch spring 207, left-hand armature and front contact of relay 202 to ground. Relay 206 becomes energized and closes a locking circuit for itself from grounded battery, through winding of relay 206, right-hand armature and front contact of relay 206, resistance 208, conductor 209, terminal 178, brush 177, resistance 176, upper right-hand and lower left-hand contacts of sequence switch spring 169, to ground. The relay 206 also closes a circuit from grounded battery, through power magnet of sequence switch 200, upper right-hand contact of sequence switch spring 210, left-hand armature and front contact of relay 206, to ground, for moving this sequence switch out of position 1 and into position 2.

In position 2 of sequence switch 200, a circuit is closed from grounded battery, through winding of up-drive magnet 211, conductor 212, left-hand contacts of sequence switch spring 205, and then to ground at the right-hand armature and front contact of relay 151, over circuit previously described. Magnet 211, by attracting its armature, presses the driving ribbon 213 against the constantly rotating roller 214, thereby causing the upward movement of the brush rod 215.

As the commutator brush 216 engages the conducting segment of the commutator 217, the following circuit is closed to shunt out the stepping relay 701: grounded battery, right-hand winding of relay 151, upper contact of sequence switch spring 158, left-hand armature and front contact of relay 151, lower contact of sequence switch spring 159, lower left-hand contact of sequence switch spring 152, lower left-hand contact of sequence switch spring 166, conductor 184, 130

brush 85, terminal 186, conductor 216, left-hand contact of sequence switch spring 217, conductor 218, upper contact of sequence switch spring 219, conducting segment of commutator 217, brush 216, to ground. The successive deenergizations of the stepping relay 701 cause the operation of the counting relays in the manner described.

In response to the fifth energization of relay 701, a circuit is completed from grounded battery, through winding of counting relay 0, upper right-hand and lower left-hand contacts of sequence switch spring 712, conductor 748, left-hand armature and front contact of relay 571, inner left-hand armature and back contact of relay 573, outer left-hand armature and front contact of relay 572, conductor 749 (Figs. 16 and 13), lower contact of sequence switch spring 750, armatures and front contacts of counting relays 1' to 4' inclusive, armature and back contact of relay 704, armature and front contact of relay 701 to ground. As soon as the commutator brush 216 engages for the fifth time the conducting segment of the commutator 217, the stepping relay 701 is again deenergized, whereupon the counting relay 0' becomes energized. The counting relay 0', by attracting its right-hand armature, closes the above-traced circuit for the power magnet of the sequence switch 700 to move this sequence switch out of position 13 and into position 15.

Counting relay 0', by attracting its left-hand armature, opens the fundamental circuit. The relay 151 is maintained energized, however, until the commutator brush 216 engages the next insulating segment of the commutator 217, due to the above-traced circuit.

Upon the deenergization of relay 151 the above-traced circuits of the up-drive magnet 211 and of the relay 202 are opened and a circuit is closed from grounded battery, through power magnet of sequence switch 150, right-hand contact of sequence switch spring 160, conductor 161, right-hand armature and back contact of relay 151, to ground, for moving the sequence switch 150 out of position 9 and into position 10.

The relay 202 closes a circuit from grounded battery, through power magnet of sequence switch 200, lower right-hand and upper left-hand contacts of sequence switch spring 207, left-hand armature and back contact of relay 202, to ground, for moving this sequence switch out of position 2 and into position 3.

Final tens selection.

When the sequence switch 700 reaches position 14 $\frac{1}{2}$, a circuit is closed from grounded battery, through winding of relay 704, conductor 751, lower contact of sequence switch spring 752, conductor 753,

outer left-hand armature and contact of relay 581, to ground. Relay 704 becomes energized and prepares a circuit for a counting relay 9, which circuit is closed as soon as the stepping relay 701 is energized.

When the sequence switch 150 reaches position 10 and the sequence switch 700 reaches position 15, the fundamental circuit is again closed, resulting in the energization of relays 151 and 701. The relay 701 completes the circuit of the counting relay 9, which becomes energized and prepares a circuit for the counting relay 9'. The relay 151 closes the above-traced circuit for the power magnet of sequence switch 150 to move this sequence switch out of position 10 and into position 11.

In position 11, relay 202 becomes energized over the above-traced circuit and closes the circuit for the power magnet of sequence switch 200 to move this sequence switch out of position 3 and into position 4. Relay 202 also closes the above-traced locking circuit for itself. In position 4 of sequence switch 200 the up-drive magnet 211 is again energized over the circuit described, to move the brush rod 215 upward. Due to the fact that the trip magnet 220 is energized in positions 3 and 4 over the following circuit: grounded battery, winding of trip magnet 220, contact of sequence switch spring 221, to ground, the fifth set of brushes is tripped by this second upward movement of the brush rod 215. During this upward movement of the brush rod 215, a circuit is closed for the relay 151 over the path traced, to lower contact of the sequence switch spring 219 and then through the conducting segment of commutator 222, brush 223, to ground. The closures of this shunt path result in the successive deenergizations of stepping relay 701, and in turn in the operation of the counting relays in the manner described.

In response to the sixth energization of the stepping relay 701, a circuit is closed from grounded battery, through winding of counting relay 0, upper contacts of sequence switch spring 712, conductor 754, left-hand armature and back contact of relay 577, outer left-hand armature and back contact of relay 579, conductor 737 (Figs. 16 and 13), lower contact of sequence switch spring 755, armatures and front contacts of counting relays 5' to 9' inclusive, armature and front contact of relay 704, armature and front contact of relay 701, to ground.

As soon as the commutator brush 223 engages the next conducting segment of commutator 222, stepping relay 701 is again deenergized and causes the energization of the counting relay 0'. Counting relay 0', by attracting its right-hand armature, closes the above-traced circuit for moving the sequence switch 700 out of position 15 and

into position 17. As soon as the sequence switch 700 leaves position 15 the counting relays and relay 704 are deenergized.

Counting relay O', by attracting its left-hand armature, also opens the fundamental circuit. Relay 151 is held energized, however, until the commutator brush 223 engages the next insulated segment of the commutator 222, at which time this relay deenergizes. Relay 151, by retracting its right-hand armature, opens the circuits of the up-drive magnet 211 and of the relay 202, and closes the above-traced circuit for the power magnet of sequence switch 150 to move this sequence switch out of position 11 and into position 12. The relay 202 closes the above-traced circuit for the power magnet of sequence switch 200, to move this sequence switch out of position 4 and into position 5.

Final units selection.

When the sequence switch 700 reaches position 16½, a circuit is closed from grounded battery, through winding of relay 704, conductor 751, upper contact of sequence switch spring 752, conductor 756, outer left-hand armature and contact of relay 586, to ground. Relay 704, by attracting its armature, prepares a circuit for the counting relay 9.

When the sequence switch 150 reaches position 12, and sequence switch 700 reaches position 17, the fundamental circuit is again closed and the relays 151 and 701 become energized. The relay 701 completes the circuit of counting relay 9, which becomes energized and prepares circuit for the counting relay 9'.

Relay 151, by attracting its left-hand armature, closes the above-traced locking circuit for itself. Relay 151, by attracting its right-hand armature, closes the above-traced circuit for the power magnet of sequence switch 150 to move this sequence switch out of position 12 and into position 13. In position 13 of the sequence switch 150, the relay 202 is again energized over the circuit described and, by attracting its right-hand armature, closes a locking circuit for itself. Relay 202, by attracting its left-hand armature, closes the above-traced circuit for the power magnet of sequence switch 200, to move the sequence switch out of position 5 and into position 6. In position 6 of the sequence switch 200, a circuit is closed from grounded battery, through winding of up-drive magnet 225, conductor 226, lower right-hand and upper left-hand contacts of sequence switch spring 205, then to ground at the right-hand armature and front contact of relay 151, over the circuit above described. Magnet 225, by attracting its armature, presses the driving ribbon 213 against the constantly and relatively slowly

rotating roller 227, thereby causing the upward movement of the brush rod 215. During this upward movement, the commutator brush 216 successively engages conducting segments and the insulated segments of the commutator 217, thereby causing the successive deenergization and energization of the stepping relay 701 in the manner described.

In response to the seventh energization of the stepping relay 701, a circuit is closed from grounded battery, through winding of counting relay O, upper right-hand contact of sequence switch spring 712, lower right-hand contact of sequence switch spring 743, conductor 758, left-hand armature and front contact of relay 583, inner left-hand armature and front contact of relay 585, inner left-hand armature and back contact of relay 584, conductor 709 (Figs. 16 and 13), lower contact of sequence switch spring 708, armatures and front contacts of counting relays 4' to 9' inclusive, armature and front contact of relay 704, armature and front contact of relay 701, to ground.

In response to the next deenergization of relay 701, counting relay O' becomes energized. Counting relay O', by attracting its right-hand armature, closes the above-traced circuit for the power magnet of sequence switch 700 for moving this sequence switch out of position 17 and into position 1. As soon as the sequence switch 700 leaves position 17 the counting relays and relay 704 are deenergized. Counting relay O', by attracting its left-hand armature, opens the fundamental circuit. Relay 151 is held energized, however, until the brush 216 engages the next insulated segment of the commutator 217, at which time the relay 151 deenergizes.

The brushes 228, 229 and 230 are now accurately centered on the terminals 231, 232 and 233 of the called line. The relay 151 closes the above-traced circuit for the power magnet of sequence switch 150 to move this sequence switch out of position 13 and into position 14. Upon the deenergization of relay 151 the circuits of the up-drive magnet 225 and the relay 202 are opened. Relay 202 deenergizes and closes the above-traced circuit to move the sequence switch 200 out of position 6 and into position 7.

Restoration of cord finder, sender selector, sender and registers.

When the sequence switch 700 reaches position 1, a circuit is closed from grounded battery, through winding of power magnet of sequence switch 900, conductor 920, lower left-hand contact of sequence switch spring 932, conductor 948, brush 949, terminal 950, conductors 951 and 528, upper left-hand contact of sequence switch spring 529, conductor 760, lower right-hand contact of se-

quence switch spring 732, to ground, for moving the sequence switch 900 out of position 14 and into position 15. As soon as the sequence switch 900 leaves position 14, the circuit of relay 511 is opened at the upper contact of sequence switch spring 953. This relay deenergizes and closes a circuit from grounded battery, through power magnet of sequence switch 500, lower right-hand contact of sequence switch spring 521, right-hand armature and back contact of relay 511, to ground, for moving this sequence switch out of position 15 and into position 18. As soon as the sequence switch 500 leaves position 15 the locking circuits of the register relays are opened at the contacts of sequence switch spring 527. In position 18 a circuit is closed from grounded battery, through power magnet of sequence switch 500, lower contact of sequence switch spring 591, conductor 760, lower right-hand contact of sequence switch spring 732, to ground, for moving the sequence switch 500 out of position 18 and into its normal position.

When the sequence switch 900 reaches position 15, a circuit is closed from grounded battery, through power magnet of sequence switch 10, lower left-hand contact of sequence switch spring 26, conductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature and contact of relay 924, conductor 959, lower contact of sequence switch spring 970, to ground, for moving the sequence switch 10 out of position 11 and into position 13.

As soon as the sequence switch 10 leaves position 11, the holding circuit for relay 924 is opened at the upper left-hand contact of sequence switch spring 24. Relay 924 deenergizes and closes a circuit from grounded battery, through power magnet of cord finder "A", sequence switch 425, upper left-hand contact of sequence switch spring 426, conductor 431, upper left-hand contact of sequence switch spring 923, inner right-hand armature and back contact of relay 924, to ground, for moving the sequence switch 425 out of position 5 and into position 17.

When the sequence switch 425 reaches position 17, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, upper right-hand contact of sequence switch spring 932, conductor 972, lower right-hand contact of sequence switch spring 452, upper right-hand contact of sequence switch spring 427, to ground, for moving the sequence switch 900 out of position 15 and into position 16.

In position 16 of sequence switch 900, a circuit is closed from grounded battery, through winding of down-drive magnet 979, lower right-hand contact of sequence switch spring 953, to ground. Down-drive magnet 979, by attracting its armature, presses the

driving ribbon 973 against the constantly rotating drum 974 to return the brush rod 916 to its normal position. As soon as the brush rod 916 reaches its normal position, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, lower right-hand contact of sequence switch spring 907, normal conducting segment 975, commutator brush 919, lower left-hand contact of sequence switch spring 953, to ground, for moving the sequence switch 900 out of position 16 and into its normal position.

As soon as the sequence switch 900 leaves position 16, the circuit of the down-drive magnet 972 is opened at the lower right-hand contact of sequence switch spring 953.

Completion of the connection to an idle line.

When the sequence switch 10 reaches position 13, a circuit is closed from grounded battery, through right-hand winding of relay 151, lower right-hand and upper left-hand contacts of sequence switch spring 152, conductor 154, terminal 128, brush 125, contact of sequence switch spring 130, conductor 103, terminal 49, brush 46, upper contacts of sequence switch spring 54, inner left-hand back contact of relay 15, upper right-hand winding of repeating coil 55, to ground. Relay 151 becomes energized and closes the above-traced circuit for the power magnet of sequence switch 150 to move the sequence switch out of position 14 and into position 15.

Relay 151, by attracting its left-hand armature, closes a locking circuit for itself from grounded battery, through left-hand winding of relay 151, lower contact of sequence switch spring 158, left-hand armature and front contact of relay 151, upper left-hand contact of sequence switch spring 159, resistance 149, conductor 148, terminal 126, brush 123, right-hand armature and back contact of relay 121, upper left-hand contact of sequence switch spring 120, to ground.

It will be assumed that the commutator brush 187 of the incoming selector is in engagement with the conducting segment of the commutator 188 and therefore, a circuit is closed from grounded battery, through power magnet of sequence switch 150, upper left-hand contact of sequence switch spring 189, conducting segment of commutator 188, brush 187, lower contacts of sequence switch spring 169, to ground, for moving the sequence switch out of position 16 and into position 17.

When the sequence switch 150 reaches position 15, a circuit is closed from grounded battery, through windings of relay 202, lower left-hand contact of sequence switch spring 203, conductor 204, terminal 181, brush 182, conductor 183, relay contact 190,

upper contact of sequence switch spring 191, conductor 154, to ground, through the upper right-hand winding of repeating coil 55 over the circuit previously described. Relay 202 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 200, right-hand contacts of sequence switch spring 207, left-hand armature and front contact of relay 202, to ground, for moving this sequence switch out of position 7 and into position 8.

It will be assumed that the called line is idle and therefore, full battery potential exists upon the test terminal 231. When the sequence switch 200 reaches position 8, a circuit is then completed from grounded battery, through winding of cutoff relay 249 of the called line, test terminal 231, brush 228, contact of sequence switch spring 235, left-hand low resistance winding of relay 236, lower contacts of sequence switch spring 237, right-hand high resistance winding of relay 236, to ground. Relay 236 thereupon energizes and closes a locking circuit for itself through its left-hand low resistance winding, its left-hand armature and front contact, left-hand armature and back contact of relay 238, to ground. Due to the low resistance of this circuit, the potential at the test terminal 231 is reduced so as to cause the multiples thereof to test busy.

Relay 236, by attracting its right-hand armature, closes a circuit from grounded battery, through power magnet of sequence switch 200, lower left-hand contact of sequence switch spring 210, right-hand armature and front contact of relay 236, right-hand armature and back contact of relay 238, to ground, for moving this sequence switch out of position 8 and into position 14.

When sequence switch 200 reaches position 14, the last-traced circuit is again closed for the power magnet of sequence switch 200 to move this sequence switch out of position 14 and into position 16.

When the sequence switch 150 reaches position 17, a circuit is closed from grounded battery, through resistance 192, right-hand armature and back contact of relay 193, left-hand contact of sequence switch spring 194, winding of relay 195, left-hand back contact of relay 196, lower contact of sequence switch spring 191, to ground at the repeating coil 55, through the circuit previously described.

Relay 195 becomes energized and closes a ringing circuit from the source of ringing current 197, right-hand contact of sequence switch spring 198, left-hand winding of relay 193, right-hand contact of sequence switch spring 199, lower armature and front contact of relay 195, conductor 184, brush 185, terminal 186, conductor 216, lower contacts of sequence switch spring 217, brush

229, terminal 232, loop at substation 201, terminal 233, brush 230, upper contact of sequence switch spring 203, conductor 204, terminal 181, brush 182, conductor 183, upper armature and front contact of relay 195, to ground. Ringing current is thus applied to the called line. Due to the high resistance of the bell at the substation 201, the marginal relay 193 is not energized at this time. However, as soon as the called party removes his receiver in response to the operation of the bell at his substation, sufficient current flows in the last-traced circuit to operate the marginal relay 193.

Relay 193, by attracting its right-hand armature, closes a circuit from grounded battery, through resistance 192, right-hand winding of relay 193, left-hand contact of sequence switch spring 194, armature and front contact of relay 193, contact of sequence switch spring 150', left-hand armature and back contact of relay 196, lower contact of sequence switch spring 191, to ground at repeating coil 55 over the above-traced circuit. A shunt is thereby closed around the winding of relay 195. Relay 195 thereupon deenergizes and closes a circuit from grounded battery, through lower left-hand winding of repeating coil 55, winding of supervisory relay 57, lower contacts of sequence switch spring 42, brush 45, terminal 48, conductor 131, contact of sequence switch spring 132, brush 124, terminal 127, conductor 155, lower contact of sequence switch spring 156, winding of supervisory relay 151', lower armature and back contact of relay 195, conductor 184, brush 185, terminal 186, conductor 216, lower contacts of sequence switch spring 217, brush 229, loop of substation 201, terminal 233, brush 230, upper contact of sequence switch spring 203, conductor 204, terminal 181, brush 182, conductor 183, relay contact 190, upper contact of sequence switch spring 191, conductor 154, terminal 128, brush 125, contact of sequence switch spring 130, conductor 103, terminal 49, brush 46, upper contacts of sequence switch spring 54, left-hand inner back contact of relay 15, upper right-hand winding of repeating coil 55, to ground.

Supervisory relays 57 and 151' become energized. The relay 151' closes a circuit from grounded battery, through left-hand winding of relay 196, armature and contact of relay 151' to ground. Relay 196, by attracting its armatures, closes a locking circuit for the marginal relay 193 as follows: grounded battery, resistance 192, right-hand winding of relay 193, right-hand armature and contact of relay 196, left-hand armature and front contact of relay 196, to ground.

The supervisory relay 57 closes a circuit from grounded battery, through power mag-

net of sequence switch 10, conductor 58, lower left-hand contact of sequence switch spring 59, outer right-hand armature and back contact of relay 15, conductor 17, upper contacts of sequence switch spring 60, armature and front contact of supervisory relay 57, to ground, for moving the sequence switch 10 out of position 13 and into position 14.

10 A talking connection is now completed between the calling subscriber at substation 1 and the called subscriber at substation 201.

Restoration of the selector switches.

15 If disconnection is desired, the subscribers replace their receivers upon the switchhooks. This results in the deenergization of supervisory relays 20, 57 and 151'.

20 The relay 20 closes a circuit from grounded battery, through lamp 19, armature and back contact of relay 20, right-hand winding of relay 21, lower contact of sequence switch spring 22, to ground. The supervisory relay 57 closes a circuit from grounded battery, through lamp 61, resistance 62, upper right-hand contact of sequence switch spring 63, armature and back contact of relay 57, to ground. The operator, seeing the lamps 19 and 61 lighted is informed that the parties are through talking and that disconnection is desired. She thereupon takes the plug 4 from the jack 5, causing the deenergization of relay 7. A circuit is then closed from grounded battery, through power magnet of sequence switch 10, conductor 58, lower left-hand contact of sequence switch spring 59, outer right-hand armature and back contact of relay 15, conductor 17, upper left-hand contact of sequence switch spring 60, left-hand armature and back contact of relay 7, to ground, for moving the sequence switch 10 out of position 14 and into position 18.

45 In position 18 of sequence switch 10, a circuit is closed from grounded battery, through winding of down-drive magnet 74, lower contact of sequence switch spring 73, to ground. Under the control of the down-drive magnet, the brush rod 31 of the district selector is restored to its normal position. As soon as this normal position is reached, a circuit is closed from grounded battery, through power magnet of sequence switch 10, conductor 58, lower right-hand contact of sequence switch spring 59, normal conducting segment 64, brush 50, upper right-hand contact of sequence switch spring 18, to ground, for moving the sequence switch 10 out of position 18 and into its normal position. The circuit of the down-drive magnet is opened as soon as the sequence switch 10 leaves position 18.

60 When the sequence switch 10 leaves position 18, the holding circuit of relay 104 is opened at the upper left-hand contact of

sequence switch spring 18. Relay 104 thereupon deenergizes and closes a circuit from grounded battery, through power magnet of sequence switch 100, upper left-hand contact of sequence switch spring 108, right-hand armature and back contact of relay 104, to ground, for moving the sequence switch 100 out of position 16 and into position 18.

In position 18 of sequence switch 100, a circuit is closed from grounded battery, through winding of down-drive magnet 135, lower right-hand contact of sequence switch spring 120, to ground. Under the control of the down-drive magnet 135 the brush rod 112 of the office selector is restored to normal. As soon as this normal position is reached a circuit is closed from grounded battery, through power magnet of sequence switch 100, contact of sequence switch spring 136, normal conducting segment 137, commutator brush 116, to ground, for moving the sequence switch 100 out of position 18 and into its normal position. The circuit of the down-drive magnet 135 is opened at the lower right-hand contact of sequence switch spring 120 as soon as the sequence switch 100 leaves position 18.

When the sequence switch 100 leaves position 16, the holding circuit of the relay 151 is opened at the upper left-hand contact of sequence switch spring 120. Relay 151 becomes deenergized and by retracting its right-hand armature, closes the above-traced circuit for the power magnet of sequence switch 150 to move this sequence switch out of position 17 and into position 18.

100 In position 18 of sequence switch 150 a circuit is closed from grounded battery, through winding of down-drive magnet 147, contact of sequence switch spring 146, conductor 161, right-hand armature and back contact of relay 151, to ground. Under the control of the down-drive magnet 147, the incoming selector is restored to its normal position. When this normal position is reached, a circuit is closed from grounded battery, through power magnet of sequence switch 150, lower right-hand contact of sequence switch spring 189, normal conducting segment 145, brush 179, lower contacts of sequence switch spring 169, to ground, for moving the sequence switch out of position 18 and into its normal position. The circuit of the down-drive magnet 147 is opened at the contact of the sequence switch spring 146 as soon as the sequence switch 150 leaves position 18.

When the sequence switch 150 leaves position 17, the holding circuit of relay 206 is opened at the upper right-hand contact of sequence switch spring 169. Relay 206 thereupon deenergizes and closes a circuit from grounded battery, through power magnet of sequence switch 200, upper left-hand

contact of sequence switch spring 210, left-hand armature and back contact of relay 206, to ground, for moving this sequence switch out of position 16 and into position 18.

- 5 In position 18 a circuit is closed from grounded battery, through winding of down-drive magnet 240, lower contact of sequence switch spring 241, to ground. Under the control of the down-drive magnet, the
- 10 final selector brush rod 215 is restored to its normal position. As soon as this normal position is reached, a circuit is closed from grounded battery, through power magnet of sequence switch 200, lower right-hand contact of sequence switch spring 210, conductor
- 15 242, conducting segment 243, brush 223, to ground, for moving this sequence switch out of position 18 and into its normal position. The circuit of the down-drive magnet 240 is
- 20 opened at the lower contact of sequence switch spring 241 as soon as the sequence switch 200 leaves position 18.

Attempted connection to a busy line.

- 25 If the called line is busy this fact is indicated by a reduced battery potential on its test terminals, and relay 236, which is marginal, cannot become energized in position 8 of sequence switch 200. The relay 202 is
- 30 energized, however, in position 8 over a circuit traceable from grounded battery, through windings of relay 202 in series, left-hand contacts of sequence switch spring 244, conductor 245, right-hand armature and
- 35 back contact of relay 236, right-hand armature and back contact of relay 238, to ground. A circuit is then closed from grounded battery, through power magnet of sequence switch 200, right-hand contacts of
- 40 sequence switch spring 207, left-hand armature and front contact of relay 202, to ground, for moving the sequence switch 200 out of position 8 and into position 14.

- In view of the fact that relay 236 is de-energized, sequence switch 200 remains in position 14 and a circuit is closed from grounded battery, through winding of down-drive magnet 240, upper contact of sequence switch spring 241, right-hand armature and
- 50 back contact of relay 236, right-hand armature and back contact of relay 238, to ground. Under the control of the down-drive magnet 240, the final selector brush rod 215 is restored to its normal position. When
- 55 this normal position is reached a circuit is closed from grounded battery, through power magnet of sequence switch 200, lower right-hand contact of sequence switch spring 210, conductor 242, normal conducting seg-
- 60 ment 243, brush 223, to ground, for moving the sequence switch out of position 14 and into position 17.

- The busy tone indicating apparatus 247 is now connected through the upper contacts
- 65 of sequence switch spring 237 to the conduc-

tor 216. As soon as the calling subscriber restores his receiver after receiving the busy signal, the operator is informed in the usual manner that disconnection is desired, where-
upon the switches are restored in the above 70 described manner.

The relay 238 is provided to permit the selection of a called line irrespective of the busy or idle condition of such line.

*Description of the establishment of a con- 75
nection to a manual exchange.*

It will now be assumed that the calling subscriber at substation 1 desires to com-
municate with a subscriber whose number 80 is B-3456 and whose line terminates in a manual exchange. The calling subscriber by removing his receiver from the switch-hook causes the illumination of a lamp 3. The operator then inserts the plug 4 into 85 the jack 5, whereupon an idle set of registers and the keyboard is associated with the calling line in the manner above described. Assuming that this operation has taken place, sequence switch 10 will be in position 2, se- 90
quence switch 425 in position 5, sequence switch 450 in position 17, sequence switch 900 in position 7 and all the other sequence switches in position 1.

Adjustment of the keyboard. 95

The operator having obtained the number of the called party now proceeds to set this number up on her keyboard. She depresses the B office key, the No. 3 thousands key, 100
the No. 4 hundreds key, the No. 5 tens key, the No. 6 units key and the start key 667.

In response to the depression of the B office key, contacts 689, 690, 693 and 694 are closed. The contact 689 completes a circuit 105
from grounded battery, through left-hand winding of relay 609, conductor 696, contact 689, conductor 611, right-hand winding of relay 612 to ground, thereby causing the energization of relays 609 and 612. The 110
relay 609 closes a circuit from grounded battery, through power magnet sequence switch 600, upper left-hand contact of sequence switch spring 613, conductor 614, outer right-hand armature and contact of 115
relay 609, conductor 615, right-hand armature and front contact of relay 602, to ground, for moving the sequence switch 600 out of position 1 and into position 2.

The contact 690 of the B office key com- 120
pletes a circuit from grounded battery, through right-hand winding of relay 691, contact 690, conductor 692, to ground, thereby causing the energization of relay 691. The contact 693 of the B office key completes 125
a circuit from grounded battery, through contact 693, right-hand winding of relay 626, to ground, thereby causing the energization of relay 625. The contact 694 of the B office key completes a circuit from grounded 130

battery, through winding of relay 695, contact 694, to ground, thereby causing the energization of relay 695.

Setting of the class register.

When the sequence switch 600 reaches position 1 $\frac{1}{2}$, a circuit is closed from grounded battery, through low resistance 632, conductor 633, armature and contact of relay 612, conductor 634, lower left-hand contact of sequence switch spring 635, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductors 943 and 501, upper left-hand contact of sequence switch spring 502, conductor 503, right-hand winding of marginal relay 801, right-hand winding of sensitive relay 802, to ground. Due to the low resistance of this circuit both of the relays 801 and 802 become energized and by attracting their left-hand armatures close locking circuits for themselves from grounded battery, through the left-hand windings and left-hand armatures and contacts of both relays in parallel, to conductor 816, then through conductor 526, lower left-hand contact of sequence switch spring 527 to ground.

In position 1 $\frac{1}{2}$ of sequence switch 600 another circuit is closed from ground, through upper right-hand contact of sequence switch spring 638, conductor 639, high resistance 658, middle right-hand armature and back contact of relay 608, conductor 641, upper right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductor 508, lower right-hand contact of sequence switch spring 507, conductor 806, right-hand winding of marginal relay 805, right-hand winding of sensitive relay 804, to grounded battery. Due to the fact that the high resistance 658 is included in this circuit, only the sensitive relay 804 is energized. Relay 804 by attracting its left-hand armature closes a locking circuit for itself through its left-hand winding to the grounded conductor 816.

When the sequence switch 600 reaches position 2, a circuit is closed from ground, through right-hand armature and back contact of relay 643, low and high resistance windings of relay 644 in series, lower contact of sequence switch spring 646, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 808, right-hand winding of marginal relay 809, conductor 810, upper left-hand contact of sequence switch spring 509, winding of relay 510, to grounded battery. Relays 510 and 644 become energized but due to the high resistance winding of relay 644 being included in this circuit, marginal relay 809 does not become energized.

Relay 644 by attracting its left-hand armature closes a locking circuit for itself, and also causes the relay 643 to become energized in the manner above described. Relay 510 by attracting its armature closes a circuit from grounded battery, through winding of relay 511, left-hand contacts of sequence switch spring 512, conductor 513, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground. Relay 511 energizes and by attracting its left-hand armature closes a locking circuit for itself to ground at the upper contact of sequence switch spring 953. The relay 511 also closes a circuit from grounded battery, through power magnet of sequence switch 500, lower left-hand contact of sequence switch spring 521, right-hand armature and front contact of relay 511, to ground, for moving the sequence switch 500 out of position 1 and into position 2. The sequence switch 500 is immediately moved out of position 2 and into position 3 due to the following circuit: grounded battery, power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground.

As soon as the sequence switch 500 leaves position 2, the circuit of relays 510 and 644 is opened at the upper left-hand contact of sequence switch spring 509. The deenergization of relay 644 causes the movement of the sequence switch 600 out of position 2 and into position 3 in the manner before described. As soon as the sequence switch 600 leaves position 2, relay 643 becomes deenergized.

When the sequence switch 500 reaches position 2 $\frac{1}{2}$ circuits are completed for moving the sequence switch 800 of the class register into the proper position determined by the class register relays. In the system disclosed, position 11 is the position allotted to the class of the call now being described. Therefore, assuming that sequence switch 800 was left in position 12 by the last call, a circuit is completed from grounded battery, through power magnet of sequence switch 800, lower left-hand contact of sequence switch spring 815, right-hand armature and front contact of relay 804, conductor 812, left-hand contact of sequence switch spring 525 to ground, for moving the sequence switch 800 out of position 12

and into position 13. A circuit is then completed from grounded battery, through power magnet of sequence switch 800, upper right-hand contact of sequence switch spring 814, right-hand armature and front contact of relay 801, to ground through conductor 812, for moving the sequence switch 800 out of position 13 and into position 1. In position 1, a circuit for the power magnet of sequence switch 800 is completed through the right-hand armature and back contact of relay 809 to ground, for moving the sequence switch out of position 1 and into position 10. A circuit is then completed for the sequence switch 800 through the right-hand armature and back contact of relay 805 for moving the sequence switch out of position 10 and into position 11, in which position all the branches of the circuit for sequence switch 800 are open.

Setting of district brush register.

When the sequence switch 600 reaches position 2 $\frac{3}{4}$ and the sequence switch 500 reaches position 2 $\frac{3}{4}$, a circuit is closed from grounded battery, through low resistance 632, conductor 633, armature and contact of relay 691, conductor 665, lower right-hand contact of sequence switch spring 651, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 528, lower right-hand contact of sequence switch spring 529, conductor 530, right-hand winding of sensitive relay 531, right-hand winding of marginal relay 532, to ground. Due to the fact that only the low resistance 632 is included in this circuit both of the relays 531 and 532 are energized. These relays, by attracting their left-hand armatures, close locking circuits for themselves to the grounded conductor 763.

In position 3 of sequence switch 600, a circuit is closed from ground, through left-hand armature and back contact of relay 652, low and high resistance windings of relay 649 in series, lower contact of sequence switch spring 680, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductor 943, right-hand winding of marginal relay 533, conductor 534, left-hand contact of sequence switch spring 535, winding of relay 523, to grounded battery. Relays 523 and 649 become energized, but due to the fact that the high resistance winding of relay 649 is included in this circuit, the marginal relay 533 does not become energized.

Relay 649 by attracting its right-hand armature closes a holding circuit for itself and causes the energization of relay 652 in the manner above described. Relay 649 by attracting its left-hand armature closes a circuit from ground, through upper con-

tact of relay 649, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, upper contact of sequence switch spring 537, winding of relay 515, to grounded battery. Relay 515 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 3 and into position 4.

As soon as the sequence switch 500 leaves position 3, the circuits of relays 515, 523 and 649 are opened. Relay 649, by retracting its armatures, causes the movement of the sequence switch 600 out of position 3 and into position 4 in the manner above described, whereupon the relay 652 becomes de-energized.

Setting of the district group register.

When the sequence switch 600 reaches position 4 and the sequence switch 500 reaches position 4, a circuit is closed from ground, through right-hand armature and back contact of relay 643, low and high resistance windings of relay 644 in series, lower contact of sequence switch spring 646, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductor 951, right-hand winding of marginal relay 542, conductor 543, upper right-hand contact of sequence switch spring 509, winding of relay 510, to grounded battery. Relays 510 and 644 become energized but due to the fact that the high resistance winding of relay 644 is included in this circuit the marginal relay 542 does not become energized.

Relay 644 by attracting its left-hand armature closes a locking circuit for itself and also causes the energization of relay 643 in the manner described. Relay 644, by attracting its right-hand armature closes a circuit from ground, through resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and contact of relay 644, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductor 508, right-hand

winding of marginal relay 544, conductor 545, upper contact of sequence switch spring 546, winding of relay 517, to grounded battery. Due to the fact that the high resistance 658 is included in this circuit, the marginal relay 544 does not become energized. Relay 517, however, does energize and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contacts of relay 510, conductor 514, armature and back contact of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 4 and into position 5.

As soon as the sequence switch 500 leaves position 4, the circuits of relays 517, 510 and 644 are opened. Relay 644 by retracting its left-hand armature causes the movement of sequence switch 600 out of position 4 and into position 5 in the manner above described, whereupon the relay 643 becomes deenergized.

Setting of the office brush register.

When the sequence switch 600 reaches position 4 $\frac{1}{2}$ and the sequence switch 500 reaches position 4 $\frac{1}{2}$, a circuit is closed from grounded battery, through high resistance 699, armature and contact of relay 626, conductor 662, upper left-hand contact of sequence switch spring 651, conductor 647, middle left-hand armature and contact of relay 937, conductor 948, brush 949, terminal 950, conductors 951 and 528, upper right-hand contact of sequence switch spring 529, conductor 548, right-hand winding of sensitive relay 549, right-hand winding of marginal relay 550, to ground. Due to the fact that the high resistance 699 is included in this circuit, the marginal relay 550 does not become energized. Sensitive relay 549, however, becomes energized and by attracting its left-hand armature closes a locking circuit for itself, through the grounded conductor 816. The relay 549 also closes a circuit from grounded battery, through winding of relay 762 (Fig. 15), outer right-hand armature and back contact of relay 550, inner right-hand armature and back contact of relay 551, right-hand armature and front contact of relay 549, conductor 761, right-hand contact of sequence switch spring 525, to ground. Relay 762 by attracting its left-hand armature closes a locking circuit for itself from grounded battery, through winding of relay 762, left-hand armature and front contact of relay 762, conductor 763, upper contact of sequence switch spring 527, to ground.

When the sequence switches 600 and 500 reach position 5, a circuit is closed from ground, through left-hand armature and back contact of relay 652, low and high resistance windings of relay 649 in series, lower contact of sequence switch spring 680, conductor 636, outer left-hand armature and contact of relay 937, conductor 940, brush 941, terminal 942, conductor 943, right-hand winding of marginal relay 551, conductor 552, right-hand contact of sequence switch spring 535, winding of relay 523, to grounded battery. Relays 523 and 649 become energized, but due to the fact that the high resistance winding of relay 649 is included in this circuit, marginal relay 551 does not become energized.

Relay 649 by attracting its right-hand armature closes a locking circuit for itself and also causes the energization of relay 652 in the manner described. Relay 649 by attracting its left-hand armature closes a circuit from ground, through contact of sequence switch spring 656, resistance 657, left-hand armature and contact of relay 649, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductors 508 and 536, upper contact of sequence switch spring 537, winding of relay 515, to grounded battery. Relay 515 becomes energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and front contact of relay 523, lower left-hand and upper right-hand contacts of sequence switch spring 524, armature and back contact of relay 510, conductor 514, armature and front contact of relay 515, lower left-hand and upper right-hand contacts of sequence switch spring 516, armature and back contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 5 and into position 6.

As soon as the sequence switch 500 leaves position 5, the circuits of relays 515, 523 and 649 are opened. Relay 649 by retracting its armatures causes the movement of the sequence switch 600 out of position 5 and into position 6, in the manner above described, thereby causing the deenergization of relay 652.

Setting of the office group register.

When the sequence switch 600 reaches position 6 and the sequence switch 500 reaches position 6, a circuit is closed from ground, through right-hand armature and back contact of relay 643, left-hand low resistance winding of relay 644, conductor 660, armature and contact of relay 695, conductor 645, upper right-hand contact of sequence switch

spring 651, conductor 647, middle left-hand armature and contact of sequence switch spring 937, conductor 948, brush 949, terminal 950, conductor 951, right-hand winding of marginal relay 547, conductor 548, lower contact of sequence switch spring 509, winding of relay 510, to grounded battery. Relays 510 and 644 are energized, and due to the fact that the high resistance winding of relay 644 is not included in this circuit, marginal relay 547 is also energized. Marginal relay 547 by attracting its left-hand armature closes a locking circuit for its left-hand winding to ground through conductor 816.

Relay 644 by attracting its left-hand armature closes a locking circuit for itself, and also causes the energization of relay 643 in the manner above described. Relay 644 by attracting its right-hand armature closes a circuit from ground, through resistance 638^a, left-hand contact of sequence switch spring 638, right-hand armature and contact of relay 644, conductor 639, high resistance 658, conductor 658^a, lower right-hand contact of sequence switch spring 640, conductor 947, inner left-hand armature and contact of relay 937, conductor 946, brush 945, terminal 944, conductor 508, upper contact of sequence switch spring 507, conductor 556, right-hand winding of marginal relay 557, conductor 558, winding of relay 517, to grounded battery. Due to the fact that the high resistance 658 is included in this circuit, marginal relay 557 does not become energized. Relay 517, however, becomes energized and closes a circuit from grounded battery, through power magnet of sequence switch 500, conductor 522, armature and back contact of relay 523, upper left-hand and lower right-hand contacts of sequence switch spring 524, armature and front contact of relay 510, conductor 514, armature and back contact of relay 515, upper left-hand and lower right-hand contacts of sequence switch spring 516, armature and front contact of relay 517, conductor 518, contact of sequence switch spring 519, to ground, for moving the sequence switch 500 out of position 6 and into position 7.

As soon as the sequence switch 500 leaves position 6, the circuits of relays 517, 510 and 644 are opened. Relay 644, by retracting its armatures, causes the movement of sequence switch 600 out of position 6 and into position 7, in the manner above described, thereby causing the deenergization of relay 643.

Since the number of the called line is the same as that assumed for the first call, the remaining registers are set in exactly the same manner as above described. Therefore, in this description this portion of the operation will be omitted.

We will now assume that the called num-

ber has been completely set up on the registers, at which time the sequence switch 500 moves into position 12. The sequence switch 600 will thereupon be restored to its normal position in the manner described.

District brush selection.

When the sequence switch 500 reaches position 7, the fundamental circuit is closed from grounded battery, through left-hand winding of relay 903, lower contacts of sequence switch spring 909, conductor 954, brush 955, terminal 956, conductor 957, contact of sequence switch spring 590, conductor 819, lower contact of sequence switch spring 820, conductor 763, lower contact of sequence switch spring 764, conductor 765, lower contact of sequence switch spring 766, conductors 767 and 821, left-hand armature and back contact of counting relay 0', winding of stepping relay 701, upper contact of sequence switch spring 702, resistance 703, to ground. Relays 701 and 903 thereupon become energized. Relay 701 by attracting its armature closes the above-traced circuit for counting relay 4, which in turn prepares a circuit for the counting relay 4'.

Relay 903 by attracting its right-hand armature closes a locking circuit for itself from grounded battery, through left-hand winding of relay 903, lower left-hand contact of sequence switch spring 909, right-hand armature and front contact of relay 903, lower contact of sequence switch 910, and then to ground over the fundamental circuit. Relay 903 by attracting its left-hand armature completes a circuit from grounded battery, through power magnet of sequence switch 900, lower left-hand contact of sequence switch spring 907, left-hand armature and front contact of relay 903, to ground, for moving the sequence switch out of position 7 and into position 8.

In position 8 of sequence switch 900 a circuit is closed from grounded battery, through power magnet of sequence switch 10, lower left-hand contact of sequence switch spring 26, conductor 27, upper contact of sequence switch spring 420, conductor 411, outer right-hand armature and contact of relay 924, conductor 959, lower left-hand contact of sequence switch spring 915, conductor 908, left-hand armature and front contact of relay 903, to ground, for moving the sequence switch out of position 2 and into position 4.

In position 4 of sequence switch 10, a circuit is closed from grounded battery, through winding of up-drive magnet 28, lower right-hand contact of sequence switch spring 14, conductors 13 and 27, and then to ground at the left-hand armature and front contact of relay 903 over the circuit above described. Under the control of

the up-drive magnet 28, the brush rod 31 is moved upward. During this upward movement of the brush rod, the relay 701 is shunted out by means of the commutator 33 and the commutator brush 32, in the manner above described, causing thereby the operation of the counting relays in the well-known manner.

In response to the fifth energization of relay 701, a circuit is closed from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, conductor 711, upper contact of sequence switch spring 710, conductor 824, contact of sequence switch spring 823, conductor 822, right-hand armature and front contact of relay 531, inner right-hand armature and back contact of relay 533, outer right-hand armature and front contact of relay 532, conductor 749 (Figs. 15 and 13), lower contact of sequence switch 750, armatures and front contacts of counting relays 1' to 4' in series, armature and back contact of relay 704, armature and front contact of relay 701, to ground. Counting relay 0 becomes energized and prepares a circuit for the counting relay 0'. As soon as the commutator brush 32 reengages the conducting segment of the commutator 33, relay 701 becomes deenergized, whereupon the counting relay 0' becomes energized.

Counting relay 0' by attracting its right-hand armature closes a circuit from grounded battery, through power magnet of sequence switch 700, conductor 713, upper left-hand contact of sequence switch spring 717, conductor 768, lower right-hand contact of sequence switch spring 884, conductor 715, right-hand armature and contact of counting relay 0', right-hand contact of sequence switch spring 706, conductor 707, right-hand contacts of sequence switch spring 513, right-hand armature and front contact of relay 511 to ground, for moving the sequence switch 700 out of position 1 and into position 2.

A circuit is immediately completed from grounded battery, power magnet of sequence switch 700, conductor 713, lower left-hand contact of sequence switch spring 717, right-hand armature and back contact of relay 718, left-hand armature and back contact of relay 719 to ground, for moving sequence switch 700 out of position 2, and into position 3.

Counting relay 0' by attracting its left-hand armature opens the fundamental circuit, thereby causing the deenergization of relay 903, as soon as the commutator 32 engages the next insulated segment of the commutator 33. Relay 903 by retracting its left-hand armature opens the circuit of the up-drive magnet 28 and closes a circuit from

grounded battery, through power magnet of sequence switch 10, lower contact of sequence switch spring 36, conductor 37, upper contact of sequence switch 428, conductor 935, inner left-hand armature and contact of relay 930, upper right-hand contact of sequence switch spring 934, armature and back contact of relay 903, to ground, for moving the sequence switch 10 out of position 4 and into position 5.

In position 5 of sequence switch 10, a circuit is closed from grounded battery, through power magnet of sequence switch 900, upper left-hand contact of sequence switch spring 921, middle left-hand armature and contact of relay 930, conductor 961, upper contact of sequence switch spring 424, conductor 415, lower left-hand and upper right-hand contacts of sequence switch spring 24, left-hand armature and front contact of relay 7, to ground for moving the sequence switch 900 out of position 8 and into position 9.

In position 5 of the sequence switch 10, a circuit is closed from grounded battery, through winding of trip magnet 65, lower contact of sequence switch spring 18, to ground. The energization of magnet 65 moves the trip rod 66 into a position to trip the fifth set of brushes when the brush rod 29 is again moved upward.

District group selection.

When sequence switch 900 reaches position 9 and sequence switch 700 reaches position 3, the fundamental circuit is again closed, thereby causing the energization of relays 903 and 701. Since the marginal relay 544 is deenergized, relay 704 does not become energized and therefore the relay 701 closes the circuit for the counting relay 4 instead of counting relay 9 as was the case in the first traced connection. The counting relay 4 prepares a circuit for the counting relay 4' in the usual manner. Since none of the relays of the district group register are energized, the relay 701 also closes a circuit from grounded battery, through winding of counting relay 0, upper right-hand contact of sequence switch spring 712, conductor 711, lower contact of sequence switch spring 720, conductor 721, contact of sequence switch spring 829, conductor 830, right-hand armature and back contact of relay 540, outer right-hand armature and back contact of relay 542, conductor 737 (Figs. 15 and 13), lower contact of sequence switch spring 755, armature and back contact of relay 704, armature and front contact of relay 701, to ground. Counting relay 0 becomes energized and prepares a circuit for counting relay 0'.

Relay 903 by attracting its right-hand armature closes the above-traced locking cir-

cuit for itself. Relay 903 by attracting its left-hand armature closes the above-traced circuit for the sequence switch 900 to move this sequence switch out of position 9 and into position 10. In position 10 of sequence switch 900, the above-traced circuit for the sequence switch 10 is closed at the lower left-hand contact of sequence switch spring 915 and the left-hand armature and front contact of relay 903 to move the sequence switch 10 out of position 5 and into position 6.

In position 6 of sequence switch 10, the up-drive magnet 28 is energized over the above-traced circuit, thereby causing the upward movement of the brush rod 31. During this upward movement, the engagement of the commutator brush 39 with the conductor segments of commutator 40 causes the de-energization of the relay 701. The counting relays are thereby operated in the well-known manner. As soon as the commutator brush 39 engages the first conducting segment of commutator 40 and the relay 701 de-energizes, counting relay 0' becomes energized and by attracting its right-hand armature closes the above-traced circuit for sequence switch 700, for moving the sequence switch out of position 3 and into position 5.

When the sequence switch 700 reaches position 4 $\frac{1}{2}$, a circuit is closed from grounded battery, through winding of counting relay 0, winding of counting relay 0', upper right-hand contact of sequence switch spring 798, conductor 776, right-hand armature and contact of relay 762, to ground. Counting relays 0 and 0' are thereby held energized over this circuit while the sequence switch 700 is in positions 4 $\frac{1}{2}$ to 7. When the sequence switch 700 reaches position 5, the above-traced circuit for the power magnet of sequence switch 700 is again closed to move this sequence switch out of position 5 and into position 7.

In position 7 of sequence switch 700, a circuit is closed from grounded battery, through power magnet of sequence switch 500, upper right-hand contact of sequence switch spring 591, conductor 729, right-hand contact of sequence switch spring 850, conductor 731, upper contact of sequence switch spring 732 to ground, for moving the sequence switch 500 out of position 12 and into position 13. A circuit is then closed for the power magnet of sequence switch 700 over the above-traced circuit to conductor 769, then through the lower left-hand contact of sequence switch spring 770, conductor 771, lower contacts of sequence switch spring 882, conductor 781, lower left-hand contact of sequence switch spring 592, to ground, for moving the sequence switch 700 out of position 7 and into position 8.

In position 8 of sequence switch 700, a circuit is closed from grounded battery,

through power magnet of sequence switch 700, conductor 713, lower right-hand contact of sequence switch spring 717, armature and back contact of relay 719 to ground, for moving the sequence switch out of position 8 and into position 9.

In position 9 of sequence switch 700, a circuit is closed from grounded battery, through power magnet of sequence switch 700, lower right-hand contact of sequence switch spring 773, conductor 774, upper left-hand contact of sequence switch 875, to ground, for moving the sequence switch 700 out of position 9 and into position 1.

When the counting relay 0' becomes energized in position 3 of sequence switch 700, the fundamental circuit is opened, thereby causing the de-energization of relay 903 as soon as the commutator brush 39 engages the next insulated segment of the commutator 40. Relay 903 by retracting its left-hand armature opens the circuit of the up-drive magnet 28, thereby stopping the fifth set of brushes in engagement with the first set of terminals of its associated contact bank. The retraction of the left-hand armature of relay 903 closes a circuit from grounded battery, through power magnet of sequence switch 10, upper left-hand contact of sequence switch spring 36, conductor 415, upper contact of sequence switch spring 424, conductor 961, middle left-hand armature and contact of relay 930, lower contact of sequence switch spring 921, left-hand armature and back contact of relay 903, to ground, for moving the sequence switch 10 out of position 6 and into position 7.

In position 7 of sequence switch 10, a circuit is closed from grounded battery, through power magnet of sequence switch 900, conductor 920, lower right-hand contact of sequence switch spring 932, conductor 960, outer left-hand contact of relay 930, conductor 413, upper contact of sequence switch spring 422, conductor 35, lower contact of sequence switch spring 34, to ground, for moving the sequence switch 900 out of position 10 and into position 11.

In position 11 of sequence switch 900, a circuit is closed from grounded battery, through left-hand winding of relay 903, conductor 904, right-hand contact of sequence switch spring 939, to ground. Relay 903 energizes and closes a locking circuit for itself from grounded battery, through right-hand winding of relay 903, upper contact of sequence switch spring 909, right-hand armature and front contact of relay 903, upper left-hand contact of sequence switch spring 910, inner left-hand armature and contact of relay 930, conductor 935, upper contact of sequence switch spring 428, conductor 37, lower left-hand contact of se-

quence switch spring 25 to ground. Relay 903 energizes and closes the above-traced circuit for moving the sequence switch 900 out of position 11 and into position 12.

5 A circuit is now closed for sequence switch 10 at the left-hand armature and front contact of relay 903. Sequence switch 10 thereupon moves out of position 7 and into position 8. Trunk hunting now takes place
10 at the district selector in the manner above described, if the trunk with which the brushes 44, 45 and 46 first engage is busy, ground will be found through the lower right-hand contact of sequence switch spring 25, conductor 76, resistance 52, test brush 44,
15 test terminal 47. As soon as the brushes 44, 45 and 46 engage the terminals of an idle trunk, relay 903 becomes deenergized, thereby opening the circuit of the up-drive magnet 28. The relay 903 also closes the above-traced circuit for sequence switch 10 to move
20 this sequence switch out of position 8 and into position 10.

In position 10 of sequence switch 10, a
25 circuit is closed from grounded battery, through resistance 53, upper contact of sequence switch spring 25, conductor 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and
30 contact of relay 930, upper left-hand contact of sequence switch spring 910, right-hand armature and back contact of relay 903, upper right-hand contact of sequence switch spring 964, winding of relay 965, to
35 ground. Relay 965 energizes and closes a circuit from grounded battery, through power magnet of sequence switch 900, conductor 920, upper right-hand contact of sequence switch spring 907, outer left-hand
40 armature and front contact of relay 965, conductor 963, right-hand armature and back contact of relay 937, upper left-hand contact of relay 939, to ground, for moving the sequence switch 900 out of position 12
45 and into position 13.

In position 10 of sequence switch 10, the operator's telephone is automatically disconnected from the cord circuit in the manner above described, at which time relay 15
50 becomes deenergized. A circuit is then closed in position 13 of sequence switch 900 from grounded battery, power magnet of sequence switch 10, conductor 58, lower left-hand contact of sequence switch spring 59,
55 outer right-hand armature and back contact of relay 15, conductor 17, upper left-hand contact of sequence switch spring 14, conductors 13 and 27, upper contact of sequence switch spring 420, conductor 411, outer
60 right-hand armature and contact of relay 924, conductor 959, upper contact of sequence switch spring 970, inner right-hand armature and contact of relay 965, conductor 946, brush 945, terminal 944, conductor

508, lower left-hand contact of sequence switch spring 507, conductor 833, lower right-hand contact of sequence switch spring 875, to ground, for moving the sequence switch 10 out of position 10 and into position 11.

As soon as the sequence switch 10 leaves position 10, the circuit of relay 965 is opened at the upper contact of sequence switch spring 25. Relay 965 deenergizes and closes a circuit from grounded battery, through
70 power magnet of sequence switch 900, conductor 920, upper left-hand contact of sequence switch spring 907, outer left-hand armature and back contact of relay 965, conductor 963, right-hand armature and back
80 contact of relay 937, upper left-hand contact of sequence switch spring 939, to ground, for moving the sequence switch 900 out of position 13 and into position 14.

Setting of the relay call indicator.

When the sequence switch 10 reaches position 11, sequence switch 900 reaches position 14 and sequence switch 700 reaches position 1, a circuit is closed from grounded battery,
90 through left-hand winding of relay 251, Fig. 5, right-hand back contact of relay 272, lower left-hand winding of repeating coil 253, inner lower armature and back contact of relay 254, conductor 255, terminal
95 67, brush 45, lower right-hand and upper left-hand contacts of sequence switch spring 42, conductors 43 and 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and front contact
100 of relay 930, lower contact of sequence switch spring 934, conductor 968, brush 967, terminal 966, conductor 742, lower right-hand contact of sequence switch spring 851, conductor 834, contact of sequence
105 switch spring 777, conductor 778, right-hand contacts of sequence switch spring 799, conductor 837, upper contacts of sequence switch spring 835, conductor 836, winding of relay 719, to ground. Relays 252 and 719
110 are energized through this circuit. The relay 719 closes a circuit from grounded battery, through right-hand winding of relay 718, armature and front contact of relay 719, to ground. Relay 718 becomes ener-
115 gized and closes a circuit from grounded battery, through power magnet of sequence switch 700, lower left-hand contact of sequence switch spring 773, conductor 780, left-hand armature and front contact of re-
120 lay 718, conductor 781, lower left-hand contact of sequence switch spring 592, to ground, for moving the sequence switch 700 out of position 1 and into position 2.

In position 2 of sequence switch 700, a
125 circuit is closed for sequence switch 500 from grounded battery, power magnet of sequence switch 500, upper left-hand contact of se-

quence switch spring 521, conductor 597, right-hand contact of sequence switch spring 770, to ground at the sequence switch spring 592, to move this sequence switch out of position 13 and into position 14.

The relay 251 closes a circuit from grounded battery, through lamp 256, right-hand armature and contact of relay 251, outer left-hand armature and back contact of relay 257, resistance 258, to ground, thereby causing the lighting of lamp 256. The operator at the called office is thereby notified of an incoming call on the trunk associated with the lamp 256. She thereupon depresses a locking key 259. A circuit is then closed from grounded battery, through winding of relay 301, right-hand contacts of sequence switch spring 302, conductor 303, locking key 259, winding of relay 254, to ground. Relay 301, by attracting its right-hand armature, closes a locking circuit for itself to ground over the circuit previously described. Relay 301, by attracting its left-hand armature closes a circuit from grounded battery, through winding of stepping magnet of sequence switch 300, armature and back contact of magnet 300, right-hand contacts of sequence switch spring 304, left-hand armature and front contact of relay 301, to ground. Stepping magnet 303 becomes energized and by attracting its right-hand armature interrupts its energizing circuit. It thereupon deenergizes and moves the sequence switch 300 into position 2.

It will be observed that upon energization the relay 254 interrupts at its inner lower back contact the energizing circuit for relays 251 and 719. The relay 251 opens the circuit of lamp 256 which is thereby extinguished.

The relay 719 causes the deenergization of relay 718. A circuit is then closed from grounded battery, through power magnet of sequence switch 700, conductor 713, lower left-hand contact of sequence switch spring 717, inner right-hand armature and contact of relay 718, armature and back contact of relay 719, to ground, for moving the sequence switch 700 out of position 2 and into position 3.

When the step-by-step switch 300 reaches position 2 and the sequence switch 700 reaches position 2 $\frac{1}{2}$, a circuit is closed from grounded battery, through windings of relays 305 and 306, conductor 307, contact of spring 308, conductor 309, inner upper armature and front contact of relay 254, conductor 261, contact 68, brush 46, upper right-hand and lower left-hand contacts of sequence switch 54, conductors 38 and 415, upper contact of sequence switch spring 424, conductor 961, middle left-hand armature and contact of relay 930, upper right-hand contact of sequence switch spring 921, con-

ductor 954, brush 955, terminal 956, conductor 957, lower contact of sequence switch spring 590, conductor 819, lower contact of sequence switch spring 820, conductor 763, upper right-hand contact of sequence switch spring 764, conductor 783, left-hand contacts of sequence switch spring 784, conductor 785, upper right-hand contact of sequence switch spring 886, conductor 781, upper right-hand contact of sequence switch spring 788, to ground. Hereafter in the description, the portion of the last-traced circuit from grounded battery, to conductor 783, will be referred to as the tip side. Relays 305 and 306 become energized, and relay 305 by attracting its outer right-hand armature closes a circuit from grounded battery, through winding of stepping magnet of sequence switch 300, left-hand contacts of spring 304, outer right-hand armature and contact of relay 305, left-hand armature and front contact of relay 301, to ground. As soon as the sequence switch 700 leaves position 2 $\frac{1}{2}$, the above-traced circuit over the tip side is opened at the upper left-hand contact of sequence switch spring 784. Relays 305 and 306 thereupon deenergize, thereby causing the deenergization of the magnet 300 which by retracting its left-hand armature moves the sequence switch into position 3.

When the sequence switch 700 reaches position 3, a circuit is closed from grounded battery, through power magnet of sequence switch 700, conductor 713, upper right-hand contact of sequence switch spring 717, conductor 789, contact of sequence switch spring 840, conductor 841, outer right-hand armature and back contact of relay 718, conductor 790, upper left-hand contact of sequence switch spring 592, to ground, for moving the sequence switch 700 out of position 3 and into position 1.

When the sequence switch 700 reaches position 3 $\frac{1}{2}$, a circuit is completed from grounded battery, over the tip side to the conductor 783, then through the upper left-hand contact of sequence switch spring 755, conductor 737 (Figs. 13 and 16), outer left-hand armature and back contact of relay 590, left-hand armature and back contact of relay 588, conductor 791, lower left-hand contact of sequence switch spring 743, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand contact of sequence switch spring 788, to ground. Relay 305 becomes energized and causes the energization of stepping magnet of sequence switch 300. When the sequence switch 700 leaves position 4 $\frac{1}{2}$, the above-traced circuit is opened. Thereupon relay 305 deenergizes and causes, in turn, the de-

energization of the stepping magnet of sequence switch 300, which is thereby moved into position 4.

When the sequence switch 700 reaches position 5 $\frac{1}{2}$, a circuit is closed from grounded battery, through winding of relay 310, contact of sequence switch spring 311, conductor 312, inner lower armature and front contact of relay 254, conductor 255, terminal 67, brush 45, lower right-hand and upper left-hand contacts of sequence switch spring 42, conductors 43 and 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and contact of relay 930, lower contact of sequence switch spring 934, conductor 968, brush 967, terminal 966, conductor 742, lower right-hand contact of sequence switch spring 851, conductor 834, contact of sequence switch spring 777, conductor 778, upper left-hand contact of sequence switch spring 708, conductor 709 (Figs. 13 and 16), inner left-hand armature and back contact of relay 562, inner left-hand armature and front contact of relay 564, left-hand armature and front contact of relay 561, conductor 744, lower right-hand contact of sequence switch spring 712, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand contact of sequence switch spring 788, to ground. Hereafter in the specification that portion of the last-traced circuit from grounded battery to conductor 778 will be referred to as the ring side. Relay 310 becomes energized and closes a circuit from grounded battery, through winding of stepping magnet of sequence switch 300, left-hand contacts of spring 304, outer armature and contact of relay 310, left-hand armature and front contact of relay 301, to ground. A circuit is also closed from grounded battery, through outer right-hand armature and contact of relay 313, left-hand winding of relay 314, conductor 317, lower contact of sequence switch spring 315, conductor 316, inner armature and back contact of relay 305, inner armature and front contact of relay 310, left-hand armature and front contact of relay 301, to ground. Relay 314 becomes energized and closes a locking circuit for itself from grounded battery, through outer right-hand armature and back contact of relay 313, both windings of relay 314 in series, inner right-hand armature and contact of relay 314, conductor 318, to ground. When sequence switch 700 leaves position 6 $\frac{1}{2}$, the circuit for relay 310 is opened. Relay 310 thereupon deenergizes and causes the stepping magnet of sequence switch 300 to deenergize and move the sequence switch into position 5.

When the sequence switch 700 reaches position 7 $\frac{1}{2}$, a circuit is completed from grounded battery, over the tip side to conductor 783, then through the upper left-hand contact of sequence switch spring 747, conductor 746 (Figs. 13 and 16), inner left-hand armature and back contact of relay 575, left-hand armature and front contact of relay 567, conductor 745, upper left-hand contact of sequence switch spring 743, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand contact of sequence switch spring 788 to ground. Relays 305 and 306 become energized and close the above-traced circuit for the stepping magnet of sequence switch 300. When the sequence switch 700 leaves position 8 $\frac{1}{2}$, the last-traced circuit is opened. Thereupon the stepping magnet of sequence switch 300 deenergizes and moves the sequence switch into position 6.

When the sequence switch 700 reaches position 9 $\frac{1}{2}$, a circuit is closed from grounded battery over the ring side to conductor 778, then through the upper right-hand contact of sequence switch spring 750, conductor 749 (Figs. 13 and 16), outer left-hand armature and contact of relay 572, inner left-hand armature and back contact of relay 573, left-hand armature and front contact of relay 571, conductor 748, lower left-hand contact of sequence switch spring 712, conductor 711, lower left-hand contact of switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 786, conductor 787, upper right-hand contact of sequence switch spring 788, to ground. Relay 310 becomes energized and closes the above-traced circuit for the stepping magnet of sequence switch 300. Relay 310 also closes a circuit from grounded battery, through outer right-hand armature and back contact of relay 319, left-hand winding of relay 324, conductor 325, upper left-hand contact of sequence switch spring 315, conductor 316, inner armature and back contact of relay 305, inner armature and contact of relay 310, left-hand armature and front contact of relay 301, to ground. Relay 324 becomes energized and by attracting its inner right-hand armature closes a locking circuit for itself, through the grounded conductor 318.

When the sequence switch 700 reaches position 10 $\frac{1}{2}$, a circuit is closed from grounded battery over the tip side to conductor 783, then through the upper left-hand contact of sequence switch spring 750, conductor 749, to ground over the circuit previously described. Relays 305 and 306 energize and close a circuit from grounded battery, through outer right-hand armature and

back contact of relay 319, left-hand winding of relay 320, conductor 321, upper right-hand contact of relay 322, conductor 323, armature and contact of relay 306, inner
 5 armature and contact of relay 310, left-hand armature and contact of relay 301 to ground. Relay 320 becomes energized and by attracting its inner right-hand armature, closes a locking circuit for itself over the
 10 grounded conductor 318.

When the sequence switch 700 leaves position 10½, the circuit over the tip side is opened, thereby causing the deenergization of relays 305 and 306. A circuit is then
 15 closed from grounded battery, through left-hand winding of relay 319, outer right-hand armature and contact of relay 320, conductor 325, upper contact of sequence switch spring 315, conductor 316, inner armature
 20 and back contact of relay 305, inner armature and contact of relay 310, left-hand armature and front contact of relay 301 to ground. Relay 319 by attracting its inner right-hand armature closes a locking circuit
 25 for itself over the grounded conductor 318. Relay 319 by attracting its outer right-hand armature opens the locking circuits of relays 320 and 324, which thereupon deenergize.

30 When the sequence switch 700 leaves position 10½, the circuit over the ring side is opened, thereby causing the deenergization of the stepping magnet of sequence switch 300 to move the sequence switch into position
 35 7.

When the sequence switch 700 reaches position 11½, a circuit is completed from grounded battery, over the tip side to conductor 783, then through the upper left-
 40 hand contact of sequence switch spring 755, conductor 737 (Figs. 13 and 16), outer left-hand armature and back contact of relay 579, left-hand armature and back contact of relay 577, conductor 754, upper left-hand
 45 contact of sequence switch spring 712, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand
 50 contact of sequence switch spring 788, to ground. Relays 305 and 306 become energized and close an energizing circuit for the stepping magnet of sequence switch 300. As soon as the sequence switch 700 leaves position
 55 12½, the last-traced circuit is opened, thereby causing the deenergization of the stepping magnet of sequence switch 300 to move the sequence switch into position 8.

When the sequence switch 700 reaches position 13½, a circuit is completed from grounded battery, over the tip side to conductor 783, then through the upper left-
 60 hand contact of sequence switch spring 723, conductor 722, (Figs. 13 and 16), inner left-hand armature and front contact of relay
 65 586, inner left-hand armature and front contact of relay 581, conductor 793, upper right-hand contact of sequence switch spring 743, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, 70
 upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand contact of sequence switch spring 788, to ground. Relays 305 and 306 become energized and the relay 305 closes the above-
 75 traced energizing circuit of stepping magnet of the sequence switch 300.

When the sequence switch 700 reaches position 14½, a circuit is completed from grounded battery, over the ring side to conductor 778, then through the upper right-
 80 hand contact of sequence switch spring 723 and conductor 722 to ground, over the circuit previously described. Relay 310 energizes and closes a circuit from grounded
 85 battery, over left-hand winding of relay 330, conductor 331, upper left-hand contact of spring 332, conductor 323, armature and contact of relay 306, inner armature and contact of relay 310, left-hand armature and
 90 front contact of relay 301 to ground. Relay 330 becomes energized and by attracting its inner right-hand armature closes a locking circuit for itself over the grounded conductor 318. As soon as the sequence switch
 95 700 leaves position 14½, relay 310 deenergizes. When the sequence switch 700 leaves position 14½, the circuit of relays 305 and 306 is opened, thereby causing the deenergization of the stepping magnet of sequence
 100 switch 300 to move the sequence switch into position 9.

When the sequence switch 700 reaches position 15½, a circuit is completed from grounded battery, over the ring side to conductor 778, then through the upper right-
 105 hand contact of sequence switch spring 708, conductor 709 (Figs. 13 and 16), inner left-hand armature and back contact of relay 584, inner left-hand armature and front contact of relay 585, left-hand armature and
 110 front contact of relay 583, conductor 758, lower right-hand contact of sequence switch spring 743, conductor 711, lower left-hand contact of sequence switch spring 710, conductor 842, upper left-hand contact of sequence switch spring 886, conductor 787, upper right-hand contact of sequence switch
 115 spring 788, to ground. Relay 310 becomes energized and closes the energizing circuit of the stepping magnet of sequence switch 300. A circuit is also completed by the relay 310, from grounded battery, through outer right-
 120 hand armature and back contact of relay 333, left-hand winding of relay 334, conductor 335, upper left-hand contact of sequence switch spring 329, conductor 316, inner armature and contact of relay 305, inner armature and contact of relay 310, left-
 125 hand armature and front contact of relay 330

301 to ground. Relay 334 energizes and by attracting its right-hand armature closes a locking circuit for itself over the grounded conductor 318. When the sequence switch 700 leaves position 16, the above circuit for relay 310 is opened, thereby causing the de-energization of the stepping magnet of sequence switch 300 to move the sequence switch into position 10.

It should be observed that, at this time, the complete number will appear before the operator at the manual exchange. The circuit for lighting the No. 3 thousands lamp may be traced from grounded battery, through right-hand contact of sequence switch spring 336, conductor 337, outer left-hand armature and back contact of relay 338, conductor 339, outer left-hand armature and back contact of relay 340, middle right-hand armature and front contact of relay 314, thousands lamp No. 3, inner right-hand armature and back contact of relay 338, to ground over conductor 318. The circuit of the No. 4 hundreds lamp is completed from grounded battery, through left-hand contact of sequence switch spring 336, conductor 341, outer left-hand armature and back contact of relay 342, conductor 343, outer left-hand armature and back contact of relay 320, middle right-hand armature and back contact of relay 324, outer left-hand armature and front contact of relay 319, conductor 344, No. 4 hundreds lamp, inner left-hand armature and front contact of relay 319, conductor 345, left-hand contact of sequence switch spring 346, to ground. The circuit for the No. 5 tens lamp is closed from grounded battery, through right-hand contact of spring 347, conductor 348, outer left-hand armature and back contact of relay 349, conductor 350, outer left-hand armature and back contact of relay 351, middle right-hand armature and back contact of relay 327, outer left-hand armature and back contact of relay 326, No. 5 tens lamp, inner left-hand armature and back contact of relay 351, left-hand armature and back contact of relay 327, inner left-hand armature and back contact of relay 326, to ground over conductor 328. The circuit of the No. 6 units lamp is completed from grounded battery, through left-hand contact of sequence switch spring 347, conductor 352, outer left-hand armature and front contact of relay 330, No. 6 units lamp, middle right-hand armature and front contact of relay 334, outer left-hand armature and back contact of relay 354, conductor 353, inner right-hand armature and front contact of relay 330, to ground over conductor 318.

The zero stations lamp is also illuminated over the following circuit to indicate to the operator that the called line is not a party line: grounded battery, lower left-hand contact of sequence switch spring 381, 0 sta-

tion lamp, conductor 382, outer right-hand armature and back contact of relay 383, outer left-hand armature and back contact of relay 384, lower contacts of sequence switch spring 380 to ground.

The operator at the manual exchange having thus obtained the number of the called line from the illuminated lamps releases the holding key 259 and inserts the plug 265 into the jack 266 of the called line.

The release of the key 259 opens the locking circuit of relays 301 and 254. The relay 301 closes a circuit from grounded battery, through stepping magnet of sequence switch 300, right-hand armature and back contact of stepping magnet of sequence switch 300, left-hand contacts of sequence switch spring 302, left-hand armature and back contact of relay 301 to ground, for moving the sequence switch 300 out of position 10 and into position 1. When the sequence switch 300 leaves position 17, the locking circuits of the relay call indicator are opened, thereby restoring the indicator to its normal position. The de-energization of relay 254 completes a circuit from grounded battery, left-hand winding of relay 251, right-hand armature and contact of relay 272, lower armature and back contact of relay 254, conductor 255, terminal 67, brush 45, lower right-hand and upper left-hand contacts of sequence switch spring 42, conductors 43 and 37, upper contact of sequence switch spring 428, conductor 935, inner left-hand armature and front contact of relay 930, lower contact of sequence switch spring 934, conductor 968, brush 967, terminal 966, conductor 742, lower contact of sequence switch spring 851, conductor 834, lower contact of sequence switch spring 777, lower right-hand and upper left-hand contacts of sequence switch spring 598, conductor 599, left-hand contacts of sequence switch spring 797, winding of relay 719 to ground. Relays 251 and 719 are energized by this circuit.

Relay 719 by attracting its armature closes a circuit from grounded battery, through right-hand winding of relay 718, armature and contact of relay 719 to ground. A circuit is then closed from grounded battery, through power magnet of sequence switch 900, conductor 920, lower left-hand contact of sequence switch spring 932, conductor 948, brush 949, terminal 950, conductors 951 and 528, lower left-hand contact of sequence switch spring 529, conductor 780, contact of sequence switch spring 701, outer right-hand armature and front contact of relay 718, conductor 790, upper left-hand contact of sequence switch spring 592 to ground, for moving the sequence switch 900 out of position 14 and into position 15.

In position 15 of sequence switch 900 the above-traced circuit for the power magnet of sequence switch 10 is closed to move this

sequence switch out of position 11 and into position 13.

As soon as the sequence switch 10 leaves position 11, relay 924 deenergizes and the cord finder A and the sender selector 908 are restored to their normal positions in the manner described. Relays 719 and 718 are deenergized as soon as the sequence switch 900 leaves position 14.

In position 13 of sequence switch 10 a circuit is closed from grounded battery, through winding of relay 275, upper left-hand winding of repeating coil 253, inner upper armature and front contact of relay 254, conductor 261, terminal 68, brush 46, upper contacts of sequence switch spring 54, inner left-hand contact of relay 15, upper right-hand winding of repeating coil 55 to ground. The energization of relay 275 closes a circuit from grounded battery, through winding of relay 272, right-hand winding of relay 251, armature and contact of relay 275 to ground, for energizing relays 272 and 251.

As soon as the plug is inserted in the jack 266, a circuit is completed from grounded battery, through the lamp 256, windings of relays 257 and 264, sleeve of plug 265, sleeve of jack 266, winding of relay 267 to ground. Relays 257 and 264 attract their armatures. Lamp 256, however, does not become lighted due to the low resistance shunt placed around its winding by the following circuit: grounded battery, winding of relay 271, armature and back contact of relay 263, armature and back contact of relay 280, outer armature and front contact of relay 257, armature and contact of relay 251, to ground through relays 257, 264 and 267. Relay 271 is energized in this circuit. Since none of the relays controlling the station lamp are energized, the circuits of relays 262 and 278 are open.

Ring current is now applied to the called line over a circuit traceable from a source of current 281, through right-hand winding of relay 280, right-hand armature and back contact of relay 262, left-hand armature and back contact of relay 278, lower armature and front contact of relay 271, ring of plug 265, ring of sleeve 266, loop at substation 250, tip of jack 266, tip of plug 265, upper armature and front contact of relay 264, upper armature and front contact of relay 271, right-hand armature and back contact of relay 270 to ground. Relay 280 is marginal and does not become energized until the called subscriber answers. When relay 280 becomes energized it removes a shunt from around relay 263. Relay 263 then energizes and closes a circuit from grounded battery, through armature and front contact of relay 263, winding of relay 263 to ground, through relays 257, 264 and 267. This circuit shunts out the relay 271

which deenergizes and closes a talking circuit through to the called substation traceable from grounded battery, through lower right winding of repeating coil 253, winding of relay 268, lower armature and back contact of relay 271, sleeve of plug 265, sleeve of jack 266, apparatus at substation 250, tip of jack 266, tip of plug 265, upper armature and front contact of relay 264, upper armature and back contact of relay 271, upper right-hand winding of repeating coil 253 to ground.

Relay 268 energizes and closes a circuit from grounded battery, through lower right-hand winding of repeating coil 55, winding of relay 57, lower contacts of sequence switch spring 42, brush 45, terminal 67, conductor 255, inner lower armature and back contact of relay 254, lower left-hand winding of repeating coil 253, winding of inductance 269, armature and contact of relay 268 to ground. Relay 57 energizes and closes the above-traced circuit for moving the sequence switch 10 out of position 13 and into position 14.

A complete talking connection is now established between the calling subscriber at substation 1 and a called subscriber at substation 250.

At the termination of conversation when both subscribers have replaced their receivers upon the switchhook, the relays 20, 57 and 268 are deenergized, causing the disconnect lamps 19 and 61 to become lighted in the manner above described. The operator at the calling exchange seeing lamps 19 and 61 lighted, removes the plug 4 from the jack 5, whereupon the district selector is restored to normal in the manner described.

As soon as the sequence switch 10 leaves position 16, the circuit of relay 275 is opened at the upper contacts of sequence switch spring 54. Relay 275 deenergizes and causes in turn the deenergization of relay 251. Relay 272 is, however, held energized due to a circuit from grounded battery, through winding of relay 272, inner armature and contact of relay 257, resistance 258 to ground.

The deenergization of relay 251 opens the shunt around the lamp 256, so that this lamp becomes lighted and informs the operator at the called exchange that the parties are through talking. She thereupon removes plug 265 from jack 266, thereby opening the circuit of relays 257, 264 and 267 and of lamp 256. The deenergization of relay 257 opens the circuit of relay 272.

What is claimed is:

1. In a telephone system, an operator's position, cord circuits thereat, a plurality of cord finders switches, a plurality of senders, and a plurality of link circuits for connecting any one of said cord circuits to any one of said senders, each of said link circuits

terminating in several of said cord finder switches.

2. In a telephone system, an operator's position, cord circuits thereat, a plurality of groups of cord finder switches, a plurality of senders, and a plurality of link circuits for connecting any one of said cord circuits to any one of said senders, each of said link circuits terminating in a cord finder switch of each of said groups of cord finder switches.

3. In a telephone system, an operator's position, a plurality of groups of cord circuits thereat, a plurality of groups of cord finder switches, each group of cord finder switches having access to a different group of cord circuits, a plurality of senders, and a plurality of link circuits for connecting any one of said cord circuits to any one of said senders, each of said link circuits terminating in a cord finder switch of each of said groups of cord finder switches.

4. In a telephone system, lines, switches in which said lines terminate, other lines, each of said last mentioned lines terminating in the movable contacts of a plurality of said switches, and means for operating said switches to establish connections between said first mentioned lines and other said lines.

5. In a telephone system, a plurality of groups of lines, a plurality of groups of switches, each switch of a group having access to the same group of lines and each group of switches having access to a different group of lines, a plurality of other lines, each of said last mentioned lines terminating in the movable contacts of a switch of each group, and means for operating said switches to establish connections between any of said first mentioned lines and any one of the plurality of other lines.

6. In a telephone system, a plurality of groups of lines, a plurality of switches, each of said groups of lines terminating in a separate one of said switches, another line terminating in the movable contacts of all of said switches, and means for operating any one of said switches to establish a connection between said last mentioned line and any line terminating in the operated switch.

7. In a telephone system, a plurality of lines, a plurality of switches in which said lines terminate, another line terminating in all of said plurality of switches, means for operating each of said switches to establish connections between said last mentioned line and said plurality of lines.

8. In a telephone system, a plurality of lines, a plurality of switches in which said lines terminate, another line terminating in all of said plurality of switches, means for operating any one of said switches to establish a connection between said last mentioned line and a line of said plurality of

lines, and means controlled during the operation of a switch for rendering the other switches inoperative.

9. In a telephone system, a plurality of lines, a plurality of switches in which said lines terminate, another line terminating in all of said switches, means for operating said switches to establish a connection between said last mentioned line and a line of said plurality of lines, and means for operating only one of said switches at a time.

10. In a telephone system, a group of lines, a plurality of switches in which said lines terminate, another line terminating in all of said switches, each of said switches being arranged to establish a connection between said last mentioned line and a plurality of lines in said group of lines, and a starting circuit for each switch extending through the normal contacts of all the other switches.

11. In a telephone system, a group of lines, a plurality of switches in which said lines terminate, another line terminating in all of said switches, each of said switches being arranged to establish a connection between said last mentioned line and a plurality of lines in said group of lines, and means for starting the operation of one of said switches, operative only in case all of the switches are in their normal position.

12. In a telephone system, a plurality of lines, a group of switches in which said plurality of lines terminate, a group of link circuits, each of said link circuits terminating in a plurality of said switches, means for operating any one of the switches in which a link circuit terminates to establish connections between such link circuit and one of said plurality of lines, and means controlled during the operation of a switch for rendering inoperative all of the other switches in which the associated link circuit terminates.

13. In a telephone system, a plurality of groups of link circuits, another group of circuits, switches individual to each of said groups of circuits, another group of link circuits, each of the last mentioned link circuits terminating in a switch individual to each of the other groups of circuits, and means for simultaneously operating a plurality of the switches in which any one of the third mentioned group of circuits terminates for establishing a connection between a link circuit of one of the first mentioned groups and a circuit of the second mentioned group.

14. In a telephone system, a plurality of groups of cord circuits, a plurality of senders, a plurality of link circuits, a plurality of cord finder switches individual to each group of cord circuits, each of said link circuits terminating in a cord finder switch individual to each group, a sender selector switch individual to each link circuit, means for operating a sender selector switch individual to a link circuit to seize an idle

sender, means for operating one of the cord finder switches in which the last mentioned link circuit terminates to establish a connection between the selected sender and one of the cord circuits, and means for rendering inoperative the other cord finder switches in which the last mentioned link circuit terminates.

15. In combination, a plurality of link circuits, a plurality of senders, a plurality of pairs of switching devices, means for actuating a pair of said switching devices for connecting a link circuit of a certain character with a sender of a certain character, and means operative to restore both switching devices of the actuated pair and for actuating another pair of switching devices if either of the switching devices of the first actuated pair fails to establish the desired connection.

16. In combination, a group of circuits, a second group of circuits, a plurality of pairs of switching devices, means for actuating a pair of switching devices for connecting a circuit of a certain character in the first mentioned group with a circuit of a certain character of the second mentioned group, and means operative to restore both switching devices of the actuated pair and to actuate another pair of switching devices if either of the switching devices of the first actuated pair fails to establish the desired connection.

17. In a telephone system, a plurality of cord circuits, a plurality of cord finder switches, a plurality of senders, a plurality of sender selector switches, a plurality of link circuits, one end of each of said link circuits terminating in a cord finder switch and the other end in a sender selector switch, means for starting the operation of the cord finder switch and the sender selector switch associated with a link circuit, and means automatically operated to restore said cord finder and sender selector switches and to start the cord finder switch and sender selector switch associated with another link circuit operating if either the cord finder switch or the sender selector switch first operated fails to establish the desired connection.

18. In a telephone system, a plurality of variably operable senders, a variably adjustable controlling device for said senders normally disassociated therefrom, a plurality of hunting switches, means for operating a hunting switch to seize one of said senders, means automatically operated to restore the last mentioned hunting switch and to start another switch operating to find the desired sender if the first operated switch fails to establish the desired connection, and electromagnetic means operative only in case the desired connection is established

for connecting the controlling device to the desired sender.

19. In a telephone system, a variably operable sender, a variably adjustable controlling device for said sender, a plurality of cord circuits, a plurality of pairs of switching devices, means for actuating any of said pairs of switching devices for interconnecting said sender and a desired one of said cord circuits, electromagnetic means individual to each pair of switching devices for connecting said controlling device to said sender, means automatically operated to restore the actuated pair of switching devices and to start another pair of switching devices operating to establish the desired connection if either of the first actuated pair of switches fails to operate properly, and means for preventing the operation of said electromagnetic means individual to the first actuated pair of switching devices.

20. In combination, a plurality of lines, means including selectively operable switching devices for interconnecting two of said lines, a variably operable sender, a variably adjustable controlling device for said sender normally disassociated therefrom, a finder switch and a selector switch for connecting said sender with said switching devices, and a circuit between said sender and controlling device extending through said selector switch and exclusive of said finder switch.

21. In combination, a plurality of lines, a variably operable sender, a variably adjustable controlling device for said sender normally disassociated therefrom, a plurality of link conductors, an automatic switching device at both ends of each of said conductors, means for operating one of said automatic switching devices to seize one of said lines, means for operating the other of said switching devices to seize said sender, and means for connecting said controlling device to said sender through only the automatic switching device arranged to seize the sender.

22. In combination, a trunk line, a variably operable sender, a variably adjustable controlling device for said sender normally disassociated therefrom, a plurality of pairs of switching devices, means for actuating any of said pairs of switching devices for connecting said sender to said trunk line, and means for connecting said controlling device to said sender through only one of the switching devices of the actuated pair.

23. In combination, a trunk line, a plurality of variably operable senders, a variably adjustable controlling device for said senders normally disassociated therefrom, a plurality of pairs of switching devices, means for actuating any of said pairs of switching devices to connect said trunk line

with any one of said senders, and means for connecting said controlling device to said sender through only one switching device of the actuated pair.

24. In a telephone system, a plurality of variably operable senders, a group of sender selector switches, a variably adjustable controlling device for said senders common to said selector switches and normally disconnected from said senders, means for operating any one of said sender selector switches to seize an idle sender, and a relay individual to each sender selector switch arranged to be operated when a connection is completed to an idle sender to connect the controlling device to the idle selected sender.

25. In a telephone system, a plurality of variably operable senders, a plurality of operators' positions, a group of sender selector switches individual to each operator's position, means for operating any one of the sender selector switches at an operator's position to seize an idle sender, and a key set individual to each operator's position arranged to be connected to the seized sender for controlling the operation thereof.

26. In a telephone system, a variably operable sender, a plurality of groups of sender selector switches, a variably adjustable controlling device for said sender individual to each group of sender selector switches and normally disconnected from said sender, and electromagnetic means individual to each sender selector switch of a group for connecting to the sender the controlling device which is individual to such group.

27. In a telephone system, a plurality of variably operable senders, a plurality of groups of sender selector switches, a variably adjustable controlling device for said senders individual to each group of sender selector switches and normally disconnected from said senders, means for operating any sender selector switch in a group to seize an idle sender, and electromagnetic means individual to each sender selector switch for connecting to the seized sender the controlling device which is individual to the group of sender selector switches containing the operated sender selector switch.

28. In a telephone system, a variably operable sender, a plurality of groups of sender selector switches, means for operating a sender selector switch to seize said sender, and a plurality of variably adjustable controlling devices for said sender, each controlling device being individual to a group of sender selector switches.

29. In a telephone system, a variably operable sender, a plurality of groups of sender selector switches, a plurality of variably adjustable controlling devices for said sender, each controlling device being individual to a group of sender selector switches, means

for operating any one of the sender selector switches of a group to seize said sender, and electromagnetic means responsive to the seizure of said sender by a sender selector switch of a group for connecting to the sender the controlling device which is individual to such group.

30. In a telephone system, a plurality of variably operable senders, a plurality of sender selector switches, each arranged to select any one of said senders, a variably adjustable controlling device for said senders normally disconnected therefrom, and a relay individual to each of said sender selector switches for connecting said controlling device to said senders.

31. In a telephone system, a plurality of variably operable senders, a plurality of sender selector switches, a variably adjustable controlling device for said sender normally disconnected therefrom, means for operating a sender selector switch to seize an idle sender, a relay individual to each sender selector switch, and means for operating the relay individual to an operated sender selector switch to connect the controlling device to the seized idle sender.

32. In a telephone system, an operator's cord circuit, a selectively operable switch in which said cord circuit terminates, a controlling device for said switch normally disconnected therefrom, a cord finder for connecting said controlling device to said selectively operable switch, a control circuit extending from said controlling device to said cord finder switch, means for operating said selectively operable switch in response to impulses in said control circuit, and an electro-responsive device included in said circuit at said cord finder switch for controlling said operating means of the selectively operable switch.

33. In a telephone system, a plurality of selectively operable switches, a plurality of cord circuits, each cord circuit terminating in one of said selectively operable switches, a controlling device for controlling said switches normally disconnected therefrom, a cord finder switch for connecting said controlling device to any desired one of said cord circuits, a control circuit extending from said controlling device to said cord finder switch, means for operating the selectively operable switch in which the desired cord circuit terminates by impulses in said control circuit, and an electro-responsive device included in said circuit at said cord finder switch for controlling said operating means of the selectively operable switch.

34. In a telephone system, a group of selectively operable switches, a controlling device for controlling said switches normally disconnected therefrom, a second group

of switches, each of said second mentioned switches being arranged to connect said controlling device to any desired one of the switches of the first mentioned group, the number of switches in the second mentioned group being less than the number of switches in the first mentioned group, means for operating a desired one of said selectively operable switches under the control of the controlling device, a circuit for said operating means completed at the switch of the second mentioned group used in connecting the controlling device to the desired selectively operable switch, and a relay individual to such switch of the second mentioned group for controlling said circuit of said operating means.

35. In a telephone system, a group of selectively operable switches, a controlling device for controlling said switches normally disconnected therefrom, a second group of switches less in number than said first group, each switch of said second mentioned group of switches being arranged to connect said controlling device to any one of the switches of the first mentioned group, operating means individual to each of said selectively operable switches, a circuit for each operating means arranged to be completed at any of the switches of said second mentioned group, and a relay individual to each switch of the second mentioned group for controlling the said circuits of said operating means.

36. In a telephone system, a plurality of selectively operable switches, a controlling device for controlling said switches normally disconnected therefrom, a hunting switch for connecting said controlling device to any desired one of said selectively operable switches, a control circuit extending from said controlling device to said hunting switch, means for operating the selectively operable switch to which the controlling device is connected by impulses in said control circuit, and a relay in said control circuit at said hunting switch for controlling said operating means.

37. In a telephone system, a group of selectively operable switches, a controlling device for controlling said switches normally disconnected therefrom, a group of hunting switches, the total number of switches in said last mentioned group being less than that of the first mentioned group, each of said hunting switches being arranged to connect said controlling device to any desired one of said selectively operable switches, a control circuit extending from said controlling device to the hunting switch used in connecting the controlling device to the desired selectively controlled switch, means for operating said desired selectively controlled switch in response to

impulses in said circuit, and a relay in said control circuit at said hunting switch for controlling the operating means of said desired selectively controlled switch.

38. The combination with a selecting apparatus, of a set of keys, a series of sets of successively cooperating relays, means to actuate all the relays of a set before the relays of the next set are brought into use, connections whereby the particular key actuated determines the particular relay in said series to be last energized, and means operated when said particular relays become energized for controlling the movement of the selecting apparatus.

39. The combination with a selecting apparatus, of a set of keys, a series of sets of successively cooperating relays, means to actuate all the relays of a set before the relays of the next set are brought into use, and a circuit controlling means for said selecting apparatus arranged to be operated when one or another of said relays becomes energized depending upon the actuation of said keys.

40. The combination with a selecting apparatus, of a set of keys, a series of pairs of successively cooperating relays, a circuit controlling means for said selecting apparatus, and connections controlled by the actuation of said keys whereby the energization of any relay in said series operates said circuit controlling means.

41. The combination with a controlling circuit, of a series of successively cooperating relays, means for supplying current impulses thereto, means for first operating a desired one of said relays, means for determining the number of relays succeeding said particular relay in said series to be operated, and circuit controlling means operable when the determined number of succeeding relays have been operated.

42. The combination with a controlling circuit, of a series of relays arranged for successive operation, means for supplying current impulses thereto, means for selecting a particular one of said relays and a variable number of succeeding relays in said series to be operated, and circuit controlling means operable when the last relay of the selected number of relays is operated.

43. The combination with a controlling circuit, of a series of relays, means for supplying current impulses to the first relay of said series and each succeeding relay of said series in succession, means for determining the number of relays succeeding said first relay of said series to be operated, and circuit controlling means operable when the predetermined number of relays have been operated.

44. The combination with a controlling circuit, of an apparatus for counting cur-

rent impulses in said circuit comprising a plurality of successively cooperating groups of relays, each group composed of a series of successively cooperating relays, means for
 5 operating a variable number of relays in one group if the number of impulses to be counted does not exceed a predetermined value, and means for operating a variable
 10 number of the relays in said last mentioned group and all the relays in another of said groups if the impulses to be counted exceed the predetermined value.

45. The combination with a selecting apparatus, of a set of keys, groups of successively cooperating relays, means determined by the actuation of certain of said
 15 keys for operating only a variable number of relays in one of said groups, means determined by the actuation of other of said
 20 keys for operating a variable number of relays in said last mentioned group and all the relays in another group, and circuit controlling means arranged to be operated upon the energization of the total number of relays
 25 determined by the particular key actuated.

46. The combination with a selecting apparatus, of a set of keys, two groups of successively cooperating relays, means determined by the actuation of certain of said
 30 keys for operating only a variable number of relays in one of said groups, means determined by the actuation of other of said keys for operating a predetermined number
 35 of relays in the other group and a variable number of relays in first mentioned group, and circuit controlling means under the control of relays in only the first mentioned group.

47. In a telephone system, a control circuit, two switching devices, a sender associated with said circuit, a plurality of registers, a third switching device for successively associating said registers with said
 45 sender to control one of the first mentioned switching devices, and means for operating said third switching device to successively associate said registers to said control circuit independently of said sender to control
 50 the other one of said first mentioned switching devices.

48. In a telephone system, a plurality of lines, means including a selector switch for establishing a connection between a calling
 55 and a called line, a number indicating device, a variably adjustable sender, means for connecting said sender to said selector switch and to said indicating device, a plurality of registers, a sequence switch for successively associating said registers with said sender to selectively control said selector switch
 60 and for successively associating said registers directly to said number indicating device to control the operation thereof.

49. In a telephone system, a sending device, two switching devices, means for connecting said sending device to either of said switching devices, means controlled by one of said switching devices for producing series of impulses to actuate said sending device, and means associated with said sending device for producing series of impulses to operate the other one of said switching devices.

50. In a telephone system, a control circuit, a sender in said circuit, two switching devices, means for connecting said control circuit to either of said switching devices, means operative when said control circuit is connected to one of said switching devices for producing series of impulses in said control circuit to actuate said sender, and means operative when said control circuit is connected to the other one of said switching devices for actuating said sender
 85 to produce series of impulses in said control circuit to operate said switching device.

51. In a telephone system, a control circuit, a sender associated with said circuit, a plurality of registers, a switching device for successively associating said registers with said sender, and means controlled by said switching device for producing series of impulses in said control circuit independently of said sender.

52. In a telephone system, a control circuit, a sender associated with said circuit, a plurality of registers, a switching device for successively associating said registers with said sender, and means for operating said switching device to successively associate said registers with said control circuit independently of said sender.

53. In a telephone system, a sending device, two switching devices, means for connecting said sending device to either of said switching devices, means controlled by one of said switching devices for producing impulses, said sending device being arranged to control the number of impulses produced by said switching device, and means associated with said sender for producing series of impulses to operate the other of said switching devices.

54. The combination with a selecting apparatus, of a series of successively cooperating relays, and means for operating a particular one of said relays simultaneously with any one of the other of said relays of said series to control said selecting apparatus.

55. The combination with a control circuit, of a series of successively cooperating relays, and means to operate a particular one of said relays to control said circuit after the operation of any other one of said relays.

56. The combination with a control circuit,

cuit, of a series of successively coöperating relays, and means to operate the last relay of said series to control said circuit after the operation of any other one of said
5 relays.

57. In a telephone exchange system, an automatic selector switch, means to operate said selector switch in a group selecting movement, means to operate said switch in
10 a subgroup selecting movement, means to operate said selector switch in a hunting movement, and a combined line, test, and release relay for said switch.

58. In a telephone exchange system, an
15 automatic selector switch having a plurality of directively controlled movements and a hunting movement, a motormagnet for moving said switch in each of said movements, a release magnet, and a controlling
20 device for controlling the operation of said

motormagnet during each of said movements and also for controlling said release magnet.

59. In a telephone exchange system, an automatic selector switch, a plurality of
25 outgoing lines arranged in groups and subgroups, means for operating said switch to select a group of said outgoing lines, means for operating said switch to select a subgroup of said outgoing lines, means for operating
30 said switch to seize an idle line in the selected group, means for releasing said switch, and a single controlling device arranged to control each of said operations of
35 said switch.

In witness whereof we hereunto subscribe
our names this 17th day of July, A. D. 1918.

ALBEN E. LUNDELL.
FRANKLIN A. STEARN.