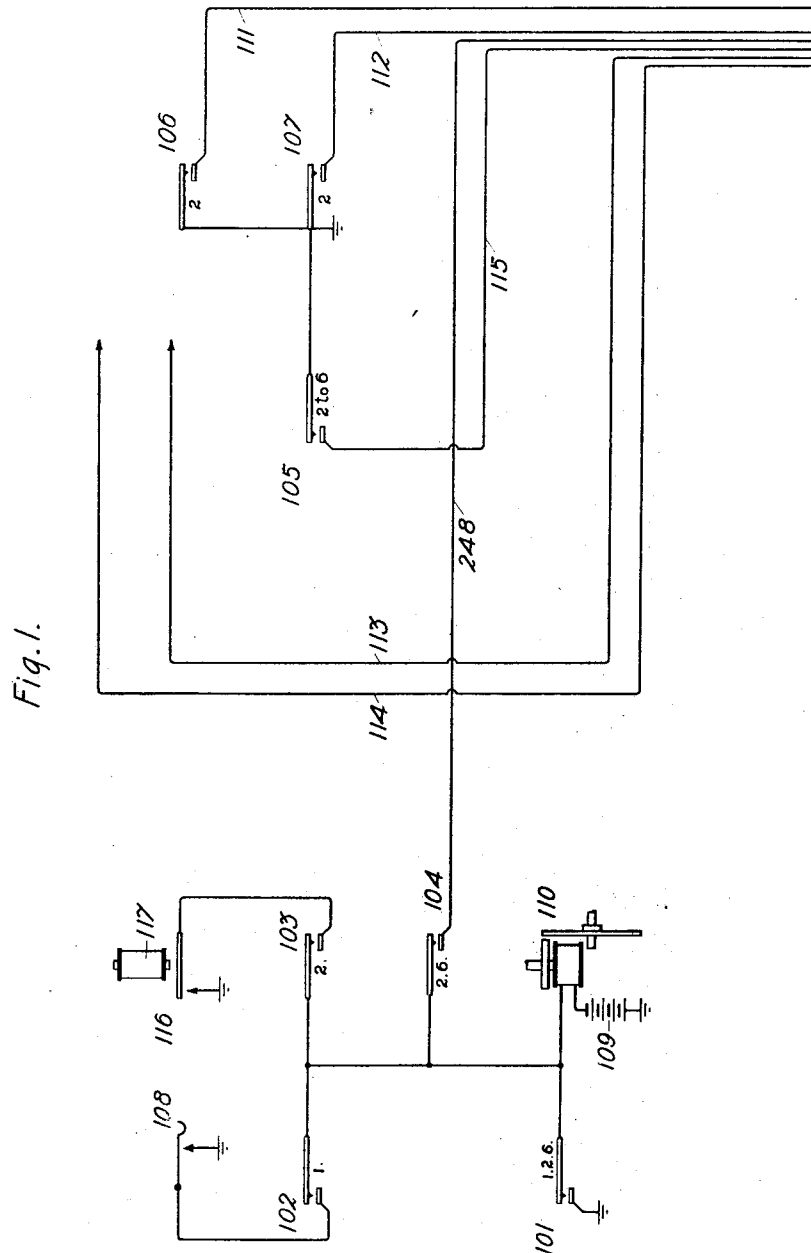


1,141,352.

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SEMI-AUTOMATIC TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED OCT. 24, 1910.

Patented June 1, 1915.

7 SHEETS—SHEET 1.



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7 SHEETS--SHEET 2.



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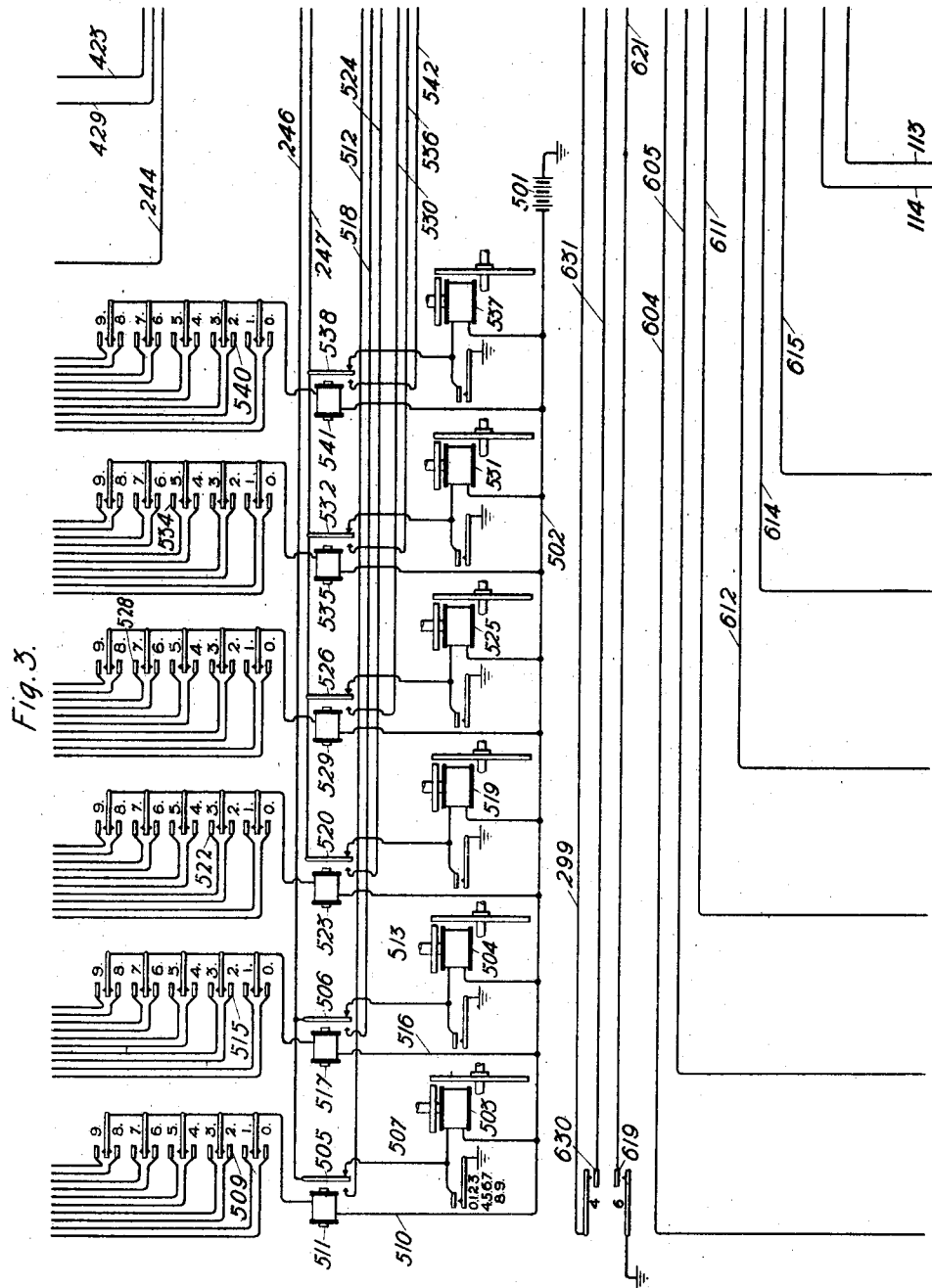
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7 SHEETS—SHEET 3.



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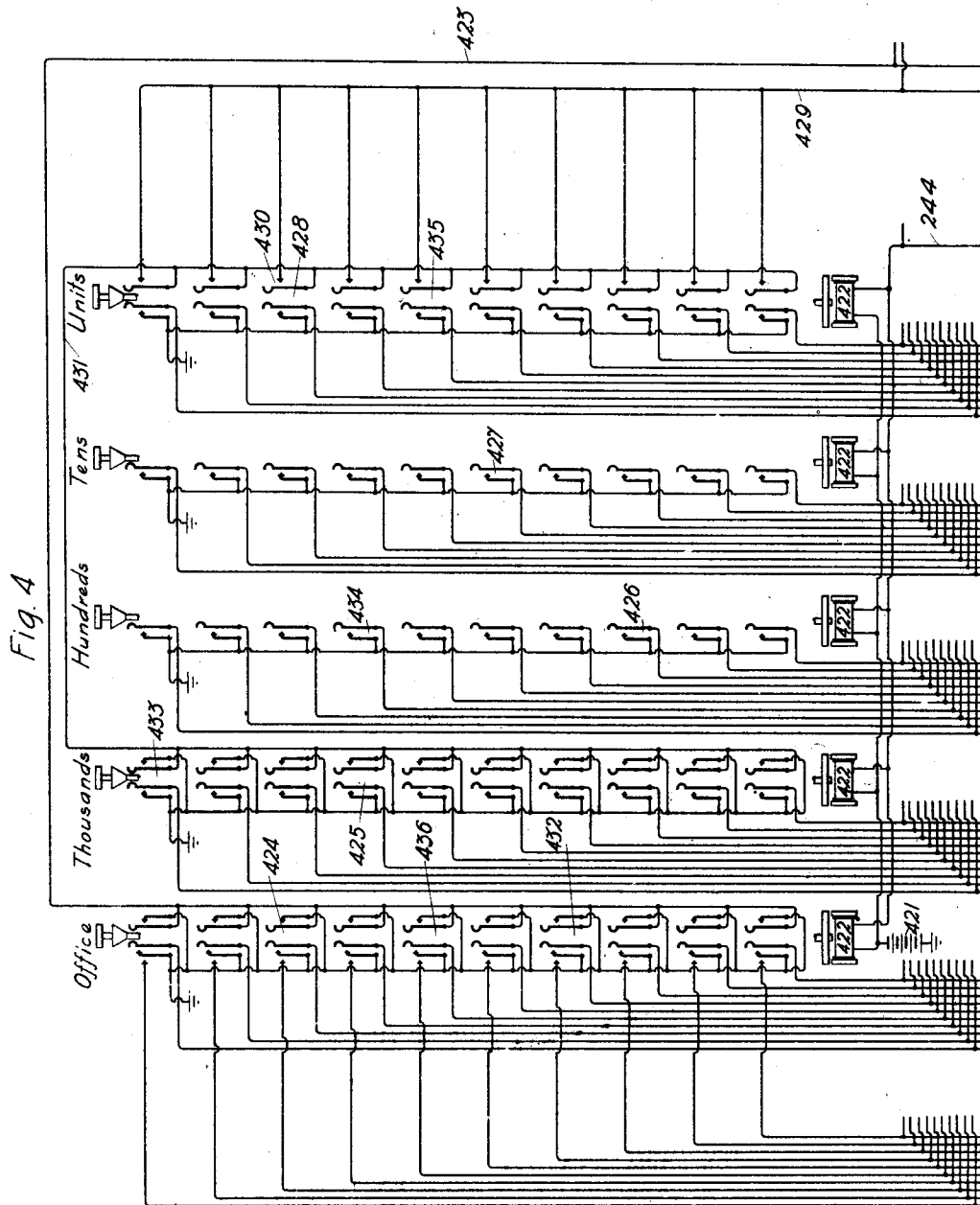
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7 SHEETS—SHEET 4.



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7 SHEETS—SHEET 5.

1,141,352.

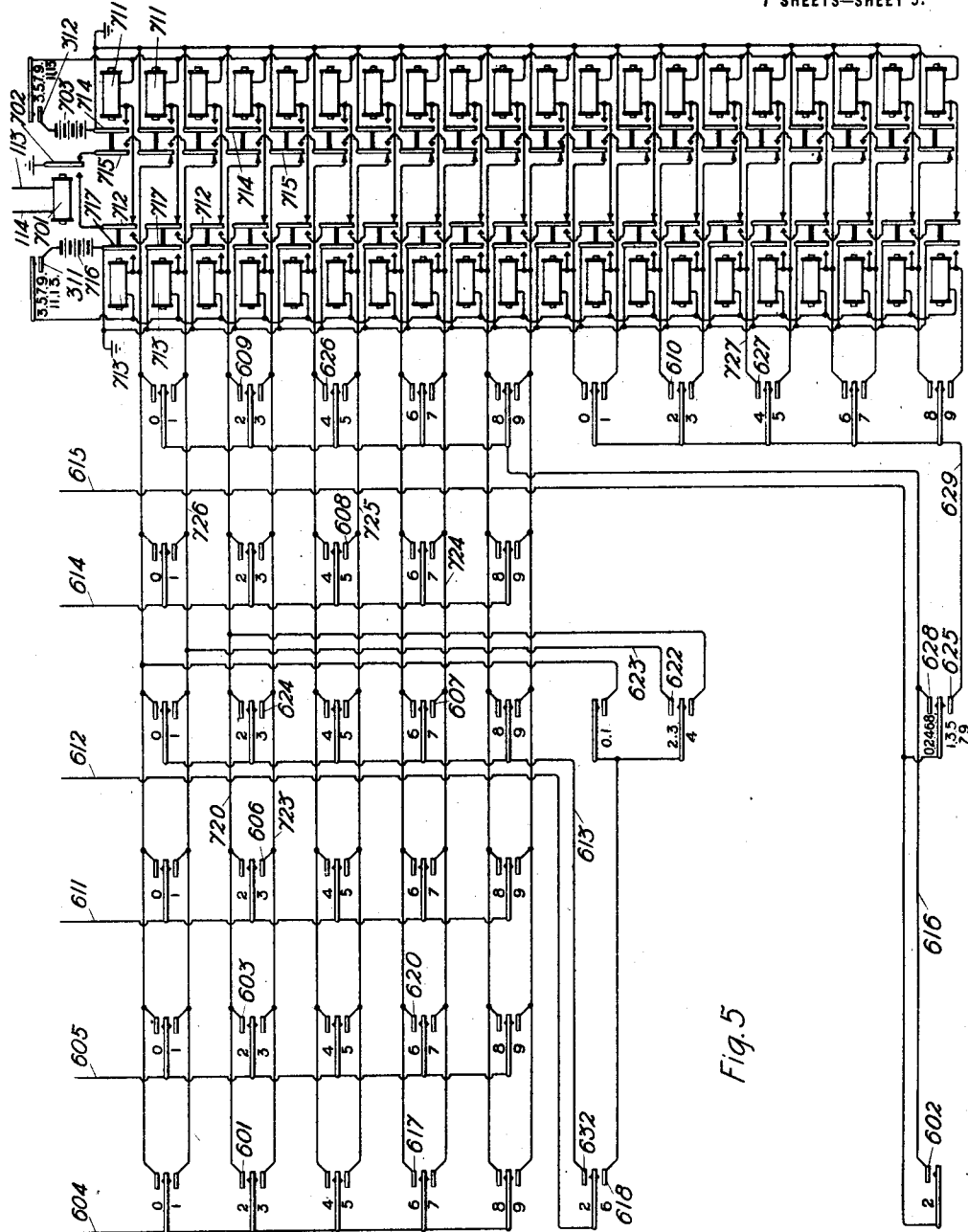


Fig. 5

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1,141,352.

Patented June 1, 1915.
7 SHEETS—SHEET 6.

Fig. 6.

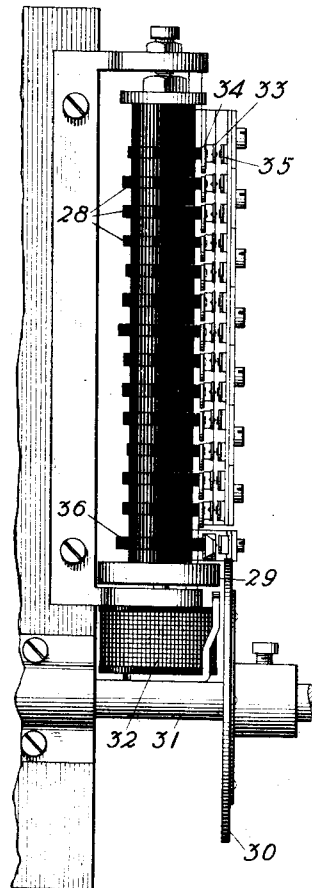
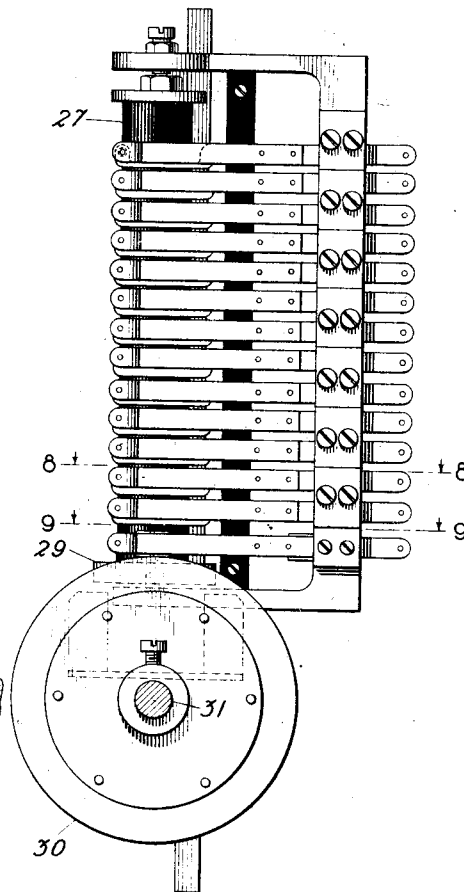


Fig. 7.



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APPLICATION FILED OCT. 24, 1910.

1,141,352.

Patented June 1, 1915.

7 SHEETS—SHEET 7.

Fig. 8.

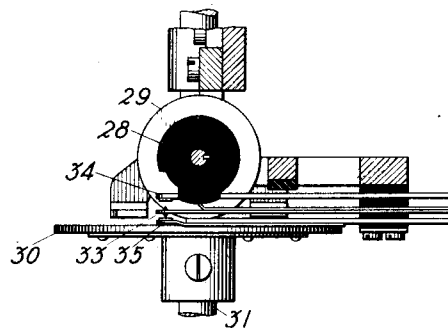
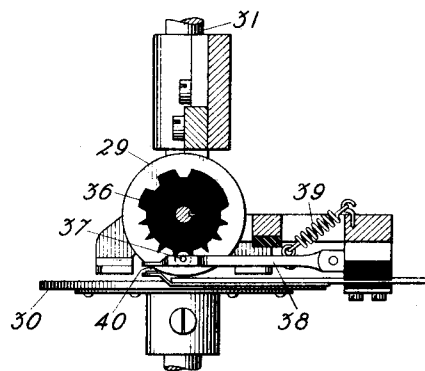


Fig. 9.



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UNITED STATES PATENT OFFICE.

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SEMI-AUTOMATIC TELEPHONE-EXCHANGE SYSTEM.

1,141,352.

Specification of Letters Patent.

Patented June 1, 1915.

Application filed October 24, 1910. Serial No. 588,840.

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, citizen of the United States, residing at New Rochelle, in the county of Westchester and State of New York, have invented a certain new and useful Improvement in Semi-Automatic Telephone-Exchange Systems, of which the following is in full, clear, concise, and exact description.

My invention relates to telephone exchange systems and contemplates in general an improved organization and arrangement of circuits and apparatus, whereby the control of the interconnection of telephone lines and trunk lines in a system comprised in whole or in part of exchanges of the semi-mechanical type, may be at all times so maintained and exercised that such interconnection may be accomplished speedily and with precision.

The object of my invention is to provide for use in an exchange of the semi-mechanical type, in which the interconnection of subscribers' lines and trunk lines is designed to be accomplished by mechanical switching apparatus controlled by an operator, an operator's sending or controlling equipment comprising means whereby such interconnection may be simply and easily controlled and whereby such controlling means and the various parts thereof may be automatically placed in or out of operative relation with the apparatus which it is designed to control at proper stages in the operation thereof.

A further object of my invention is to provide in an operator's sending or controlling equipment, as designed for use in a semi-mechanical exchange, improved and novel means for automatically controlling a plurality of selecting operations in a single sending operation by the repeated and successive use of a part or parts thereof capable of exercising such control.

A further object of my invention is to provide, as a part of an operator's sending or controlling equipment in a semi-mechanical telephone exchange, simple and efficient selection controlling means adapted to accurately control selections of various extent and character, and to arrange such means in said operator's sending or controlling equipment in such a manner that it may be readily and quickly restored to normal and prepared for a subsequent controlling operation.

A further object of my invention is to provide, in a semi-mechanical telephone exchange, improved and novel means for controlling the automatic selection of trunk lines leading from such exchange to a distant exchange, whether such distant exchange is of the semi-mechanical type or of the manual type, and that such selection may be accomplished accurately and with rapidity.

A further object of my invention is to provide an improved and novel operator's sending or controlling equipment adapted to be used in systems, the character and operation of the exchanges whereof are varied and dissimilar, and involves means whereby such equipment, by the operation of self-contained means and without the interposition of any additional act on the part of the operator, or any extraneous mechanism, will adapt itself for the proper control of the connection whatever may be the character of the exchange toward which the call is directed, and whatever may be the manner of the operation of such exchange.

A further object of my invention is to provide, in an operator's sending or controlling equipment for exchanges of the semi-mechanical type, improved and novel supervisory apparatus whereby there is indicated before the operator at all times during the control of selection, a signal or signals indicating to her the stage reached by the controlling apparatus in such control.

More particularly, my invention relates to a switching system involving an improved operator's sending or controlling equipment adapted for use with systems of practically any size, having any desired grouping of lines or trunks, the various exchanges of such systems being varied in their character and in the character of the operation thereof, such sending or controlling equipment being adapted to operate with accuracy and at high speed to cause the various selecting and trunk-hunting operations throughout a train of selectors to take place, in proper sequence and with absolute precision.

My invention to this end involves means in an operator's sending equipment adapted under the control of a key or keys to perform a series of controlling operations to successively control, over a single selecting or controlling circuit, a series of mechanisms brought one after another into association

with such circuit, such series of mechanisms desired; this sending equipment being furthermore adapted for rapid operation by comparatively feeble current impulses transmitted over long lines or cables, and to continue automatically to perform the entire sequence of controlling operations at proper intervals and in definite order without requiring any attention from the operator beyond the initial registration of the call upon the key or keys.

Another feature of my invention involves the arrangement in an operator's sending apparatus of registers or translating devices, whereby a number designating a line to be selected, indicated by the operator upon keys arranged according to the decimal system of notation, may be stored up and translated by such registers or translators in such a manner that the selection controlling devices operated under the control of such registers or translators will, if necessary, select the line desired and indicated upon the keys, even though the lines from which such line must be selected or the trunks through which such line must be connected are not, or a part of them are not, arranged according to the decimal system of notation.

Another feature of my invention involves means, in an operator's sending or controlling equipment involving such translating means, whereby such translation may be eliminated automatically and without any further or separate act by the operator when the mechanisms to be controlled and the lines and trunks connected thereto are arranged wholly according to the decimal system of notation.

Another feature of my invention involves improved and novel means, whereby the operator's sending equipment may be automatically associated with any one of a plurality of connecting circuits which is put into use, and involves automatic cord finder apparatus adapted to test said connecting circuits, find the one with which it is desired to associate the sending equipment and unite it therewith, maintaining such connection until the sending equipment has completed its operation, and then automatically disconnect it from the connecting circuit, leaving it free to be associated with another connecting circuit to control another connection.

Another feature of my invention involves means whereby a single set of keys may suffice to control the operation of a plurality of sender mechanisms proper, such control being exercised through the interposition of register devices upon which the designation of the line desired is registered or stored up to determine the control, means acting upon the completion of such registration to permit these keys to be utilized to register upon the registers of another such sender mechanism.

the designation of some other desired line, and means preventing the use of such keys with a second sender mechanism until the designation indicated upon such keys has been received and stored up by the registers of a sender mechanism in connection with which the keys have been used.

Another feature of my invention involves improved means, whereby the various operations of the sender are caused to take place in the proper sequence, and involves the association with the various parts of the equipment of automatic sequence switching devices, each provided with switch contacts arranged to control circuits to insure proper operation of the various parts of the sender and in turn of the sequence switching devices themselves.

My invention also includes certain details of the construction and organization of the apparatus and circuits involved in my improved operator's sending equipment by which the foregoing operations and other operations incidental to the proper and expeditious control of a system of this character may be best accomplished.

The accompanying drawings, which illustrate the preferred form of my invention, show as portions thereof features which in themselves form no part of my present invention, and are not therefore claimed in this application. These features are claims in my applications for Letters Patent as follows:—Serial No. 515,933, filed September 2, 1909, for selective controlling apparatus; Serial No. 451,868, filed September 5, 1908, for sequence switch; Serial No. 511,983, filed August 9, 1909, for telephone exchange systems.

In the drawings, Figures 1 to 5 inclusive, when placed together, form a single diagram illustrating diagrammatically the apparatus and circuits involved in an operator's sending equipment in accordance with my invention; the lines which extend to the edge of each sheet being continued on the neighboring sheets. The proper arrangement of the sheets for viewing the equipment as a whole is made by placing Fig. 2 immediately below Fig. 1; Fig. 3 should then be placed to the left of Fig. 2 and Figs. 4 and 5 respectively above and below Fig. 3. Figs. 6, 7, 8 and 9 show a form of sequence switch structure which may be used in connection with my invention.

Sequence switches.—The local controlling circuits associated with various parts of the operator's sender or controlling equipment disclosed herein, which must be established in definite order at successive stages of the operation to bring into service the different devices or parts as they are required, are in the present embodiment of my invention, established by automatic switching appliances which are termed sequence switches.

As will be noted by reference to the drawings there is a sequence switch associated with and individual to the connecting circuit, a sequence switch associated with and individual to each cord finder, and a sequence switch associated with and individual to the counting relays. Each of these sequence switches consists in its elements of a movable switch operating member, a number of circuit changers or contact devices actuated in sequence as said member is moved from one position to another, an electromagnet and a motor mechanism operated or controlled by said magnet for advancing said movable member through its successive positions.

The sequence switch may control any desired sequence of operations whether of the same or different devices. In each position to which its movable member is advanced a circuit is established whereby a given operation of the device or devices under control is made possible, and at the same time another circuit is established whereby the motor mechanism of the sequence switch may be actuated automatically when such operation of the device or devices under control has been completed; so that as each operation takes place the sequence switch will be automatically moved to the next position, in which position a new operation or another stage of the same operation will be brought about, and so on. Finally the sequence switch establishes a condition whereby the apparatus under control is returned to its normal condition, and also establishes a circuit whereby the sequence switch itself will be returned to its normal position.

Each portion of the apparatus and its associated sequence switch may be, and are preferably, so related that local reciprocal controlling circuits will be progressively established by said devices in their operation, in such a manner that when a normal operation of either is started both devices will be progressively carried through a complete cycle of operations, which may be controlled and checked at different stages through the agency of energizing circuits established by some other portion of the apparatus for this purpose, but which unless so checked will terminate in the automatic return of both the sequence switch and its associated apparatus to normal condition. In case of a failure of current in such checking or controlling circuit even immediately after a sequence switch and its associated apparatus have started in operation such sequence switch and apparatus cannot become permanently displaced or "stalled" in an off-normal condition, but will complete their cycle of operations and be positively returned to normal under control of circuits which are purely local.

The mechanism of the sequence switches

may be as shown in Figs. 6, 7, 8 and 9. The movable member is a vertical roller shaft 27 carrying a number of switch operating cams 28, said shaft being arranged to be driven by power applied through the agency of an electromagnetic clutch. The constantly driven power shaft 31 carries a friction driving disk 30, which is adapted to be drawn by the action of a clutch magnet or motor magnet 32 into engagement with a friction roller 29 carried upon the shaft 27. The roller 29 and the disk 30 are of iron and the clutch magnet 32 is adapted when energized to magnetize the roller 29 which serves as a rotary pole piece for the magnet; whereby the driving disk 30 is attracted into engagement with the roller and so rotates the shaft 27, this rotation continuing as long as the motor magnet 32 remains excited.

The cams 28 carried by the rotary shaft 27 are arranged to operate switch springs 33, forcing such springs into engagement with outer contacts 35, allowing them to engage their alternate inner contacts 34 or holding them out of contact with either of said contacts according to the position of said cams. Obviously as many cams and switches may be provided as the particular apparatus to be controlled may require. Certain of the switch contacts operated in the successive positions of the movable switch element may control circuits for the motor magnet 32. A special switch such as shown in Fig. 9 is also preferably provided to control the local circuit for said motor magnet, whereby after the shaft has begun to move and the initial energizing circuit is broken at one of the other switches the motor magnet may still be excited by current in the local circuit until the next intended stopping position of the rotary element is fully reached. As shown in Fig. 9 the cam 36 for operating the local or special switch is adapted to be engaged by the cam roller 37, carried by a pivoted switch lever 38. A spring 39 is arranged to act upon said pivoted lever 38 so as to press the cam roller 37 against the cam 36. When the roller 37 rides upon a tooth or high portion of the cam 36, said lever 38 closes a contact 40 which controls the local circuit of the motor magnet. The teeth or high portions of the cam 36 have inclined edges so that the cam roller 37 after riding over the top of the tooth or high portion is forced down the opposite slope by the action of the spring 39, and thus tends to push against the cam to continue the rotation thereof until the roller 37 reaches the bottom of the following notch. The rotary element is thus brought to rest accurately in each of the positions where it is intended to stop. In the operation of the device the circuit will first be closed for the motor magnet through one of the springs 33 and one or the other of the contact anvils 34 or

35 of such spring. Then as the motor magnet is excited and the shaft of the sequence switch begins to rotate the contact through which the motor magnet was initially excited may be broken, but the local circuit will be maintained for the motor magnet through the contact 40 closed by the cam 36, and the rotary element will continue to advance until the cam roller 37 reaches the bottom of the next notch of the cam 36.

In the circuit diagram herein, illustrating my invention, the switch springs of the sequence switches are not shown in their actual arrangement, but are so located as to give the clearest arrangement of circuits; and the operating cams are not shown. The positions of the rotary element of each sequence switch in which any of its contacts are closed are indicated by numbers placed adjacent to such contacts, each contact being open in all positions except those indicated by the adjacent numbers. Furthermore, the sequence switch contacts may be identified with the sequence switch motor apparatus indicated upon the diagrammatic showing by the fact that the hundreds digit of the reference character applied to each sequence switch contact is the same as the hundreds digit of the reference character applied to the sequence switch with which it is associated. For example, the sequence switch contact 207 is operated by the sequence switch 222, see Fig. 2, and is closed in the second and third positions of such sequence switch as indicated by the numerals 2 and 3 placed adjacent to that contact but is open in all other positions of the sequence switch; on the other hand the sequence switch contact 310 is operated by the sequence switch 336 and is closed in the third, fifth, seventh, ninth, eleventh and thirteenth positions of such sequence switch as is indicated by the numerals adjacent to such sequence switch contact, but is open in all the other positions of this sequence switch 336. Each sequence switch has, however, as has been before noted, a special contact governing the local circuit of its motor magnet, such as the contact 40 operated by the cam 36 in Fig. 9. As these special contacts, which are represented by the contacts 101, 201 and 301 of the respective sequence switches 110, 222 and 336 upon the drawings, are closed only while the rotary element of the sequence switch is in transit from one stopping position to the next the numbers are placed on the side of the switch lever opposite from the contact and indicate positions in which such contact is open, such contact being closed while the rotary element is in transit between the positions indicated by the numbers. Thus by reference to the numerals 1, 2, 5, 6, 7, 8, 9, 15 appearing adjacent to the switch lever of the special contact 201 of the sequence

switch 222 it is seen that this contact is open in the first position of the sequence switch, closed between the first and second positions, open in the second, closed continuously between the second and fifth positions, open in the fifth, closed between the fifth and sixth positions, open in the sixth, and so on. The contact being continuously closed between the second and fifth positions, between the ninth and fifteenth positions, and between the fifteenth and normal positions of the sequence switch so that the sequence switch will not stop in the intermediate positions, but stop only in those indicated by the numerals.

Keys and registers.—The various circuits which determine the selection controlling operations of the operator's sender or controlling equipment shown herein are established by a plurality of recording devices, herein termed registers, which take their positions in response to the operation of manually operable keys controlled by an operator, upon which the designation of the line desired may be indicated. In systems of the character in which my invention is designed to be used some of the lines and trunks, or the lines and trunks at some of the exchanges, may be grouped or classified upon a non-decimal basis and in order to control the proper selection of a line or trunk where such line or trunk is grouped or classified upon a non-decimal basis, "translation" is required in order that the number keys, which are usually arranged according to the decimal system, may cause operations of the sender proper, in the embodiment shown a set of so-called "counting relays," to control the selection according to the non-decimal grouping of lines and trunks in an exchange. In the equipment shown, where such translation is necessary or desirable, it is accomplished by the registers referred to, which are in this instance adapted to take positions in response to the depression of keys representing a number according to the decimal system, and in such position to control selecting operations according to a non-decimal system, such selection controlling operations governing a selection according to such translated system of the number designated by the keys. When, however, the line desired is to be found in an exchange in which the grouping of lines and trunks is upon the decimal system the registers will take positions in response to the depression of the keys representing the number according to the decimal system, and will in turn produce selection controlling operations according to the decimal system of notation. As will be hereinafter pointed out, whether this control will involve translation or not will depend upon the office key depressed and will not require any additional or fur-

ther act by the operator than the depression of the keys indicating the designation of the line desired.

The registers which are associated with the counting relays also serve to record or store up designations indicated by any combination of depressed keys, and thereby establish permanent conditions for governing the conditions of selection controlling operations required to cause the selection of the desired line, so that when the call is thus registered or stored up upon one sender apparatus the set of keys may be used thereafter to register another call upon another sender apparatus before the first sender apparatus has finished the selection controlling operations of the first call. There may be, and is preferably, one key for each office or exchange of the system, and also a bank of number keys, which, as diagrammatically indicated, comprise four rows of ten keys each, representing the figures 0 to 9, inclusive, of thousands, hundreds, tens and units digits respectively. These keys, both the office and number keys, are designed to be held in their depressed position by the locking magnets 422 indicated upon the drawing, the locking magnet associated with any one set of keys being adapted to retain in its depressed position the depressed key of said set of keys until such locking magnet is deenergized. Upon the deenergization of the locking magnet associated with any set of keys the depressed key will be restored to its normal position by means not shown, but which are usual in apparatus of this character. Each key when depressed is adapted to close certain contacts governing circuits which are shown in the diagram and which will be hereinafter traced in detail.

The preferred form of the registers, such as are used in connection with my invention and shown diagrammatically in Fig. 3, is the same as that of the sequence switches hereinbefore referred to and described, with the addition of a stop relay. These registers are shown each as embodying the usual power magnet, a stop relay and a plurality of sets of contact devices. The sets of contact devices shown above the power magnet and stop relay are those connected to the operators' keys and by which is determined the position in which the register will stop, and the sets of contact devices located below the power magnet and stop relay upon Figs. 3 and 5 are the ones closed in the various positions of the register to determine the operation of the sender proper. The registers, as do the sequence switches, involve a special contact which in the registers is open in each of the positions of the register but closed between each two positions thereof. This special contact is shown immediately to the left of the associated power magnet. As in the ordinary sequence switches, the contact

devices of the registers are open in all the positions except those indicated upon the drawings immediately adjacent the contact devices. It will be noted, however, that the positions of the registers range from zero to nine and that there is no normal position of the register, the register remaining, after it has performed its function, in the position in which it was set, and when next taken for use in connection with the operators' keys, it starts from such position.

As shown in the circuit diagram, each sender device proper forming a part of my invention may have, and preferably does have, six registers associated therewith, corresponding respectively to the districts of the system, the offices in a district, and the thousands, the hundreds, the tens and the units of the designation of the line desired. As will be hereinafter described, when the registers are brought successively into association with the sender or selection controlling apparatus proper, herein shown as counting relays, the contact devices shown below the power magnets of the respective registers will control the operation of such counting relays to accomplish the selection controlling operation desired. Thus when the tens key 427 is depressed, for example, it causes the tens register to take up its sixth or No. 5 position, thereby closing the contact device 608, which at the proper time will ground conductor 725 leading to the counting relays to control the action of such relays, which relays in turn govern the selection controlling operation of the sender as a whole. It will be noted that both the district and office registers respond to the depression of a single key of the set of office keys, whereas the other registers of the group are individual to the corresponding sets of keys. It will, therefore, be apparent that the district and office registers will respond to the depression of an office key to record the district in which such office is located and which particular office in such district the office corresponding to the depressed key is. The numerical registers similarly will respond to the depression of the numerical keys to take up positions corresponding to the depressed keys in their respectively associated sets of keys. In each position the cams of the registers will close a certain distinctive combination of switch contacts, whereby the operation of the counting relays may be controlled.

Cord finder.—The cord finder forming a part of the embodiment of my invention herein shown may be of any suitable construction, but preferably involves a set of brushes adapted to sweep over the terminals leading to the various connecting circuits and to stop with its brushes in contact with the terminals leading to the connecting circuit over which it is desired to intercon-

nect the desired line with a calling line. The structure of this cord finder may be of any suitable design and the particular structure shown forms no essential part of my invention. The operation of the cord finder will sufficiently appear from the description of the operation of my invention as a whole, it being understood that the power magnet 226 serves as an electromagnetic clutch to couple the constantly rotating power shaft upon which such magnet is mounted with the disk mounted upon the shaft of the cord finder carrying the contact brushes, such disk being of soft iron and forming the armature of said power magnet. The arrangement and operation of the counting relays as such will also sufficiently appear in the description of the operation of my invention as hereinafter set forth and need not be separately described in detail.

General description and operation.—Referring particularly to the diagrammatic showing of my invention in Figs. 1 to 5 of the drawings, the operation of the form of my invention shown therein is as follows:—When a call has been received by the operator it is necessary that an operator's sending or controlling equipment, such as the one embodying my invention shown herein, be associated with the connecting circuit which has been taken for use in receiving a call and over which the calling line is to be interconnected with the desired line. In order to bring this about the switch 108 is closed, which establishes a circuit from battery 109 through the connecting circuit sequence switch 110, sequence switch contact 102, switch 108, to ground and back to battery. Before proceeding with the consideration of the results accomplished by the closure of this circuit, it should be noted that the switch 108 may be such as to be operated manually by the operator at the proper time, or it may be, and is preferably, arranged to be automatically operated by the apparatus associated with the connecting circuit taken for use when the connecting circuit is united with the calling line, or upon the depression of an operator's listening key, or at any other suitable time. Since, however, the particular means for operating the switch forms no part of my present invention, such means need not be further considered. It should also be further noted that the connecting circuit proper, over which the conversation is actually to take place, is not shown herein, since it in itself forms no part of my present invention. The leads 111, 112, 113, 114, 115, and 248, however, are individual to and associated with the connecting circuit, the leads 113 and 114 being the usual sender leads of the connecting circuit, and it is over these leads, which are connected to the connecting circuit proper in the usual and well-known

manner, that the controlling circuit is established to control the operation of the usual and well known selector switches necessary to obtain the desired connection. Since, therefore, these leads referred to are sufficient to typify the connecting circuit and to make clear the arrangement and operation of the various parts and features of my invention and its relation to the connecting circuit, they alone are shown in order to simplify as much as possible the disclosure.

A circuit having been completed through the connecting circuit sequence switch 110 by the closure of the switch 108, this sequence switch 110 is energized and moves from its first or normal position into its second position. In this position the sequence switch contact 102 is opened so that original energizing circuit of the sequence switch 110 is no longer closed and these sequence switch contacts 103, 104, 105, 106 and 107 are closed. The closure of the sequence switch contact 106 has established a circuit from the battery 221 through the sequence switch 222 of the first cord finder, conductor 223, sequence switch contact 202 of the first cord finder sequence switch, conductor 224, sequence switch contact 275 of the sequence switch associated with the second cord finder, conductor 111, sequence switch contact 106, to ground and back to battery. The closure of this circuit energizes the cord finder sequence switch 222 which moves from its first or normal position into its second position, thereupon opening the sequence switch contact 202 and closing the sequence switch contacts 203, 205, 207, 208, 209, 210 and 217. A circuit is now closed from the battery 225 through the power magnet 226 of the cord finder apparatus, generally indicated as 227, sequence switch contact 205, back contact and armature 228 of the test relay 229 to ground and back to battery. The cord finder thereupon starts to move and continues its movement until the brushes 230, 231, 232, 233 and 234 reach the terminals 235, 236, 237, 238, 239 associated with the particular connecting circuit taken for use. As soon as these terminals are reached by the brushes a circuit is completed from the battery 240 through the test relay 229, sequence switch contact 203, brush 230, terminal 235, conductor 112, sequence switch contact 107 to ground and back to battery. The test relay 229 is thereupon energized and attracts its armature 228 opening the circuit of the power magnet and thereby stopping the movement of the cord finder. The same movement of the armature 228 has closed the circuit from the battery 225 through the holding magnet 242, sequence switch contact 207, front contact and armature 228 of the test relay 229 to ground and back to battery. By the closure of this circuit the holding magnet is energized and serves to main-

tain the cord finder in the position it now occupies.

Simultaneously with the closure of the circuit through the holding magnet 242 the armature of the test relay 229 has closed a circuit from the battery 221 through the sequence switch 222, sequence switch contact 217, front contact and armature 228 of the test relay 229 to ground and back to battery. This again energizes this sequence switch which now moves out of its second position and continues to move, due to the closure of the special sequence switch contact 201 in positions 3 and 4, until it reaches its fifth position. The sequence switch in moving from second position has opened the sequence switch contacts 205 and 217, and in moving past its third position has opened the sequence switch contacts 203 and 207. When, however, this sequence switch reaches its fourth position the sequence switch contact 204 is closed and upon reaching its fifth position sequence switch contacts 206 and 212 are also closed and the sequence switch comes to rest in its fifth position. Upon the closure of the sequence switch contact 210, which took place at the time the cord finder sequence switch came into its second position and which sequence switch contact is still closed, a circuit was established from the battery 421 through the various key-locking magnets 422 in parallel, conductor 244, sequence switch contact 210 to ground and back to battery. The closure of this circuit energizes the various locking magnets 422, which magnets are associated with the respective sets of manually operable keys before the operator, through which keys the operator controls the operation of the sending apparatus by indicating thereon the designation of the line desired. These locking magnets, as will be well understood, serve to hold a depressed key in its depressed position so long as the circuit through the locking magnets is maintained.

As the cord finder sequence switch reaches its fourth position it closes and maintains closed in the fifth position the sequence switch contact 204, as has been before noted. This establishes a circuit from the battery 240 through the test relay 229, sequence switch contact 204, reset relay 332, sequence switch contact 304, conductor 245, cord finder brush 232, contact 237, conductor 115, sequence switch contact 105 to ground and back to battery. This circuit maintains the test relay energized and energizes the reset relay 332 which relay immediately upon its energization closes for itself by its armature 333 and its front contact a locking circuit independent of the sequence switch contact 304, such circuit, however, except for the sequence switch contact 304, being the circuit just traced. The energization of the reset relay 332 has also caused it to attract

its armature 334 which has closed at its front contact the circuit from the battery 335 through the sender sequence switch 336, sequence switch contact 302, front contact and armature 334 of the reset relay 332 to ground and back to battery. Upon the closure of this circuit the sender sequence switch moves from its first or normal position into its second position, opening the sequence switch contact 302 and closing the sequence switch contacts 303 and 306.

With the connecting circuit sequence switch 110 in its second position, the cord finder sequence switch 222 in its fifth position and the sender sequence switch 336 in its second position the apparatus is now ready to receive upon the manually operable keys thereof the designation of the line desired. This desired line may either be a particular subscriber's line or private branch trunk line, in an exchange in which the interconnection of lines is accomplished by mechanical or semi-mechanical means, or it may be a trunk line leading to a manually operable exchange. It will be further noted that the desired line or trunk may or may not be one of a plurality arranged upon the decimal system of notation.

We will first assume that the line desired is located in an exchange in which the lines and trunk lines leading to such lines are arranged according to the decimal system of notation. In the particular showing herein such an exchange is indicated by the office key No. 2, which is the third key from the top of the set of office keys to the extreme left of Fig. 4. We will further assume, for the purpose of illustration, that the line desired is No. 3752 in the exchange referred to. The first act of the operator will be, therefore, the depression of the district and office key representing the exchange No. 2 and the depression of the No. 3 thousands key, the fourth key in the set, the No. 7 hundreds key, the eighth key in the set, the No. 5 tens key, the sixth key in the set, and the No. 2 units key, the third key in the set. Immediately upon the depression of the office and district key a circuit is closed as follows:—from battery 501 through conductor 502, register operating magnets 503 and 504 of the district and office registers, respectively, and the back contacts and armatures 505, 506 of their stop relays in parallel, conductor 246, sequence switch contact 208, conductor 423, right hand contact spring of the third or No. 2 office key 424 to ground and back to battery.

Upon the energization of the register operating or power magnet 503, the district register 507 will commence to move until it reaches its third or No. 2 position in which position the contact device 509 associated with the depressed office key 424 will be closed. A circuit will thereupon be estab-

lished from the battery 501 through the conductor 502, conductor 510, stop relay 511 of the district register, contact device 509, left-hand contact springs of the office key 424 to ground and back to battery. Immediately upon the closure of this circuit the stop relay 511 will attract its armature 505 opening the circuit of and thereby deenergizing the register operating magnet 503 to stop the district register in its third position. The armature 505 by the same movement closes a circuit from battery 335 through the sender sequence switch 336, sequence switch contact 306, conductor 512, front contact and armature 505 of the stop relay 511, conductor 246, sequence switch contact 208, conductor 423, office key 424 to ground and back to battery. The closure of this circuit causes the sender sequence switch 336 to move from its second to its third position, in which position it is ready for the control of district selection.

At the same time that the district register is moving to close the circuit heretofore described through the stop relay 511 the office register 513 is moved due to the energization of the office register operating magnet 504 and will move until it reaches its third or No. 2 position in which position the contact device 515 associated with the depressed office key 424 will be closed. The closure of this contact device completes a circuit from the battery 501 through conductor 502, conductor 516, stop relay 517 of the office register, contact device 515, office key 424 to ground and back to battery. This will cause the stop relay 517 to attract its armature 506 opening the circuit of and thereby deenergizing the office register operating magnet 504 and causing the office register to stop in its third position with the contact device 515 closed. The same movement of the armature 506 has closed a circuit from the battery 221 through the cord finder sequence switch 222, sequence switch contact 212, conductor 518, front contact and armature 506 of the stop relay 517, conductor 246, sequence switch contact 208, conductor 423, office key 424 to ground and back to battery. The closure of this circuit causes the cord finder sequence switch to leave its fifth position and move into its sixth position, thereby opening the sequence switch contact 212 and closing the sequence switch contact 213.

The district register in response to the depression of the third or No. 2 office key and the closure of the contact device 509 associated with such key has come to rest in its third or No. 2 position. In this position the sender controlling contact devices 601, 602 and 632 of the district register will be closed and all of its other contact devices will remain open. Similarly, by reference to Figs. 3 and 5 of the drawings, it will be seen that

in the office register the contact device 603 is closed and all the others open in the third or No. 2 position of the register in which it now is.

The movement of the sender sequence switch 336 into its third position has closed the sequence switch contacts 309, 310, 311, 312, and 314. The closure of the sequence switch contact 309 has closed the circuit at the sender over which the control of the selecting operations at the distant selector switching apparatus is exercised, such circuit being indicated by the conductors 113 and 114, the closure of this circuit energizing, by means of the inclusion in the circuit of a battery located, as is usual and customary, at the selector switching apparatus, the stepping relay 701, which thereupon attracts its armature 702 opening a circuit at the back contact thereof and closing a circuit at the front contact thereof. The selecting or controlling circuit having been closed by the sequence switch contact 309 at the sender end thereof the selector switching apparatus at the apparatus at the distant end will begin to move due to the closure of such circuit and will, as is usual and customary in apparatus of this kind, intermittently cut off the current, by any means such as may be preferred, from the relay 701, thereby causing the alternate energization and deenergization of such relay. The intermittent operation of this relay will, therefore, correspond with the movement of the selector apparatus and in the form of my invention herein shown it will be assumed that the relay 701, which is known as the stepping relay, will be energized and deenergized once for each selective movement or stage of the selector switching apparatus, which may be at any particular time under the control of the sender apparatus. The original energization, however, of the stepping relay 701 has by the attraction of its armature 702 closed a circuit from the battery 703 through the sequence switch contact 312 and the first relay 711 of one series of the relays known as the counting relays, through the back contact and armature 712 of the first relay 713 of the second series of counting relays, the front contact and armature 702 of the stepping relay 701 to ground and back to battery. The closure of this circuit energizes the first counting relay 711 which attracts its armature and closes for itself a locking circuit from the battery 703, through sequence switch contact 312, the first counting relay 711, front contact and armature 714 of such relay and back to battery. It will, therefore, be seen that the first counting relay 711 will be maintained energized after having once been energized so long as the sequence switch contact 312 remains closed. The energization of the first counting relay 711 has caused its armature 715 to make contact with the

front contact associated therewith and upon the ensuing deenergization of the stepping relay 701 a circuit will be established from the battery 716, through sequence switch contact 311, the first of the counting relays 713, back contact and armature 715 of the second counting relay 711, front contact and armature 715 of the first counting relay 711, back contact and armature 702 of the stepping relay 701 to ground and back to battery. The closure of this circuit causes the first counting relay 713 to be energized which, upon drawing up its armatures, opens the original circuit of the first relay 711, extends an energizing circuit for the second relay 711 preparatory for the next energization of the stepping relay 701, and furthermore establishes for itself a locking circuit from the battery 716, through sequence switch contact 311, the first of the relays 713, front contact and armature 717 of such relay and back to battery. It will, therefore, be seen that a similar locking circuit has been established for the first of the relays 713 as was established for the first of the relays 711, this locking circuit being maintained after having been once established until the opening of the sequence switch contact 311.

Upon the second energization of the stepping relay 701 a circuit is established from the battery 703 through the sequence switch contact 312, the second one of the counting relays 711, back contact and armature 712 of the second one of the counting relays 713, front contact and armature 712 of the first one of the relays 713, front contact and armature 702 of the stepping relay 701 to ground and back to battery. This circuit, as will be noticed, is similar to the original energizing circuit of the first relay 711, except that it includes the front contact and armature 712 of the first of the relays 713, which has, since the energization of the first relay 711, been energized and locked up to prepare this circuit for the energization of the second relay 711. This second relay 711 will, therefore, attract its armatures closing a locking circuit for itself and preparing a circuit through its armature 715 and the front contact thereof for the energization of the second one of the relays 713, which will take place upon the second deenergization of the stepping relay 701 and the retraction of the armature 702. It will be further noted that this energization of the second one of the relays 713 will, as did the first one of the relays 713 upon its energization, close a locking circuit for itself, open the original energizing circuit for the second relay 711, the operation of which just preceded the energization of the second relay 713, and prepare an energizing circuit for the next, or first as yet, unoperated, relay 711. This operation of the counting relays 711 and 713 will continue until the en-

energization of the counting relay 713 corresponding to the contact 601 closed in the district register takes place. Immediately upon the energization of this counting relay 713 a circuit will be closed from the battery 703 through the cutoff relays 719, sequence switch contact 314, conductor 604, contact device 601, conductor 720, front contact and armature 717 of the counting relay 713 corresponding to the contact 601, in the case assumed the third counting relay 713, to ground and back to battery. The closure of this circuit energizes the cutoff relays 719, which thereupon attract their armatures, the armature 721 opening the selecting or controlling circuit, thereby stopping in the usual manner the selective operation of the selector switching apparatus at the distant end thereof, and the armature 722 closing a circuit from the battery through the sender sequence switch 336, sequence switch contact 310, front contact and armature 722 of the cutoff relays 719 to ground and back to battery. The closure of this latter circuit causes the sender sequence switch 336 to move from its third position into its fifth position, the special sequence switch contact 301, being closed in the fourth position, serving to maintain the sender sequence switch 336 energized until the opening of such special sequence switch contact 301 in the fifth position allows the sender sequence switch 336 to come to rest in such position. This movement of the sender sequence switch has opened and again closed the sequence switch contacts 309, 310, 311 and 312, the temporary opening of the sequence switch contacts 311 and 312 serving to restore to normal all of the counting relays 711 and 713. The movement of the sender sequence switch has also opened the sequence switch contact 314 and closed the sequence switch contact 315.

It will be here noted that the selection controlling operation in response to the position taken by the district register has now been completed, such operation having accomplished the control of the selection of the district in which the desired office is located. Upon the completion of this first selecting operation over the selecting or controlling circuit 113, 114, the switch 116 associated with the connecting circuit will be operated either manually or by any suitable means controlled by the first selector switching apparatus in which district selection has just been accomplished, which operation will establish a circuit from battery 109 through the connecting circuit sequence switch 110, sequence switch contact 103, switch 116 to ground and back to battery. The connecting circuit sequence switch 110 will thereupon move from its second into its sixth position. This movement may be accomplished by having the special sequence

switch contact 101 closed in the intermediate positions as herein shown or by any other suitable means which will insure the movement of the sequence switch 110 into its sixth position. Upon leaving its second position, the connecting circuit sequence switch 110 has opened the sequence switch contacts 103, 104, 106 and 107, but upon reaching its sixth position again closes the sequence switch contact 104. It will be further noted that the sequence switch contact 105 is maintained closed from the second to the sixth positions, inclusive, of the connecting circuit sequence switch 110 in order that the energizing circuit for the reset relay 232 and the test relay 229 may be maintained and the armatures of these relays not permitted to retract. The means whereby the switch 110 is closed as above described may be of any suitable character, but is preferably in the form of an electro-responsive device such as the relay 117 shown upon the drawings, adapted to be de-energized momentarily or otherwise upon the completion of the district selection, but since such means forms no part of my present invention, it need not be further shown and will not be further described.

The operator's sender or controlling equipment embodying my invention is now ready to take up the control of the selection of the office desired in response to the set position of the office register, which position has been taken by the office register under the control of the office key corresponding to the office desired. The restoration of the counting relays 711 and 713 to normal has opened the circuit of the cutoff relays 719 and the armatures 721 and 722 are again retracted, such retraction, as will be noted, having taken place as soon as the sender sequence switch 336 left its third position and before it had reached its fifth position. A circuit will therefore again be established through the stepping relay 701, the armature 721, sequence switch contact 309 and the conductors 113, 114 from the sender to the selector switching apparatus in which the second selecting operation necessary for the particular connection desired is to take place. The closure of this circuit has, by the inclusion of the usual or customary battery at the selector switching apparatus, again energized the stepping relay 701, which by attracting its armature 702 has closed a circuit from the battery 703 through the sequence switch contact 312, the first of the counting relays 711, back contact and armature 712 of the counting relay 713, front contact and armature 702 of the stepping relay 701 to ground and back to battery. The closure of this circuit precisely as in the district selection causes the energization of the first counting relay 711 which thereupon attracts its armatures 714

and 715 closing a locking circuit for itself and preparing an energizing circuit for the first counting relay 713 which will be closed upon the deenergization of the stepping relay 701. The energization of the counting relay 713 by the deenergization of the stepping relay 701 and the retraction of its armature will in turn, precisely as in the district selection, attract its armatures 712 and 717 to close a locking circuit for itself and prepare an energizing circuit for the second counting relay 711, which energizing circuit will be closed as before upon the next energization of the stepping relay 701. The respective counting relays 711 and 713 will, therefore, one after another be energized in office selection as in district selection until the energization of the counting relay 713 which corresponds to the contact device 603 closed by the office register. When this counting relay 713 is energized a circuit will be established analogous to the one established in district selection from the battery 718 through the cutoff relays 719, sequence switch 315, conductor 605, contact device 603 of the office register, conductor 720, front contact and armature 717 of the counting relay 713 corresponding to the contact device 603, which in the case assumed is the third such counting relay, to ground and back to battery. This will, as before, energize the cutoff relays 719, opening the circuit through the conductors 113, 114 and stopping the movement of the selector switching apparatus at the distant end of such circuit, and at the same time closing through the armature 722 a circuit from the battery 335 through the sender sequence switch 336, sequence switch contact 310, front contact and armature 722, to ground and back to battery. The closure of this circuit at this time causes the sender sequence switch 336 to move from its fifth position to its sixth position, thereby opening the sequence switch contacts 308, 309, 310, 311, 312 and 315 and closing the sequence switch contact 307. The opening of the sequence switch contacts 311 and 312 has as before restored the various counting relays 711 and 713 to the normal deenergized condition. The closure of the sequence switch contact 308 in the fourth position of the sender sequence switch and the opening of this sequence switch contact after the fifth position of the sender sequence switch is without effect in the control of the connection assumed, but its utility and operation will be hereinafter referred to in connection with the control of selection involved in a call directed to an exchange of different character from the one with which connection is now being brought about.

The control of the selection of the district and office in which the line desired is located

has now been accomplished, and the sender sequence switch and its associated apparatus is ready to initiate the control of the numerical selection of the line desired in the office selected. While the selections heretofore described have been taking place and before the further operation of the counting relays and their associated apparatus can take place the operator depresses the numerical keys designating the number of the line desired. These keys have been heretofore referred to and pointed out with respect to the line desired, No. 3752. The numerical key 425 of the thousands set, numerical key 426 of the hundreds set, numerical key 427 of the tens set and numerical key 428 of the units set will therefore be assumed to have been depressed by the operator, and each of such keys is now held depressed by the holding magnets 422, individual to the several sets, which magnets are maintained energized by the battery 421 over the same circuit that the holding magnet 422 of the office set of keys is maintained energized. The depression of each of these keys has placed a ground upon one of the contacts of each of the several numerical registers, one of which is associated with each of the sets of keys. The depression of one of the thousands keys and one of the units keys has in addition closed a circuit from the battery 501 through the conductor 502, operating magnet 519 of the thousands register, back contact and armature 520 of the cutoff relay 523 of such register, conductor 247, sequence switch contact 209, conductor 429, righthand contacts 430 of the depressed units key 428, conductor 431, righthand contacts of the depressed thousands key 425 to ground and back to battery. Upon the closure of this circuit the operating magnet of the thousands register is energized and such register moves until it reaches its position in which circuit is closed through the contact device 522 connected with the depressed thousands key 425. This will be its fourth or No. 3 position. A circuit is thereupon established from battery 501 through conductor 502, stop relay 523 of the thousands register, contact device 522, lefthand contacts of the depressed thousands key 425 to ground and back to battery. The stop relay 523 is thereupon energized and attracts its armature 520, which opens the circuit to the operating magnet 519, stopping the movement of the register in its fourth or No. 3 position, and closes a circuit at its front contact from the battery 221 through the cord finder sequence switch 222, conductor 223, sequence switch contact 213, conductor 524, front contact and armature 520 of the stop relay 523, conductor 247, sequence switch contacts 209, conductor 429, contacts 430 of the depressed units key, conductor 431, depressed thou-

sands key 425 to ground and back to battery. The closure of this circuit causes the cord finder sequence switch 222 to move from its sixth position into its seventh position, in which movement the sequence switch contact 213 will be opened and the energizing circuit to the sequence switch 222 just described will be destroyed.

At the same time that the thousands register is coming to its set position, in response to the depression of the thousands key and the closure of the circuit controlled by the thousands key and the units key, the hundreds register is moving to its position, the register operating magnet 525 being energized over the circuit including battery 501 and the contacts of the units and thousands key in parallel with the thousands register operating magnet 519. The hundreds register will, therefore, move until it closes contact at the contact device 528 corresponding to the depressed hundreds key 426. A circuit will thereupon be established from battery 501, conductor 502, stop relay 529, contact device 528, depressed hundreds key 426 to ground and back to battery. The closure of this circuit will cause the energization of the stop relay 529, which upon attracting its armature 526 opens the circuit of the operating magnet 525 stopping the movement of the register in its eighth or No. 7 position. The same movement of the armature 526 closes a circuit at its front contact which extends from the battery 221 through the cord finder sequence switch 222, conductor 223, sequence switch contact 214, which is closed if the sequence switch is in its seventh position, conductor 530, front contact and armature 526 of the stop relay 529, conductor 247, sequence switch contact 209, conductor 429, contacts 430 of the depressed units key 428, conductor 431, contact of the depressed thousands key 425 to ground and back to battery. If, due to the closure of the circuit of the cord finder sequence switch 222 through the sequence switch contact 213 by the attraction of the armature 520 of the stop relay 523 of the thousands register, the sequence switch 222 is in its seventh position at the time of the closure of the circuit just traced the sequence switch will now move into its eighth position, opening the sequence switch contact 214 and closing the sequence switch contact 215. Should, however, the sequence switch 222 still be in its sixth position the closure of the circuit controlled by the stop relay of the hundreds register will await the movement of the sequence switch 222 into its seventh position, due to the energization of the stop relay 523 of the thousands register. Similarly and at the same time that the thousands and hundreds registers are moving to their set position the tens register is also moving to its set position in response to

the depression of the tens key 427 and the closure of the circuit controlled by the contacts of the units and thousands key. In this case again the operating magnet 531 is energized by the battery 501 in parallel with the operating magnets 519 and 525 of the thousands and hundreds registers respectively. The tens register therefore moves until it reaches the position in which circuit is closed through the contact device 534 corresponding to the depressed tens key 427. A circuit is thereupon established from the battery 501, conductor 502, stop relay 535, contact device 534, depressed tens key 427 to ground and back to battery. The stop relay 535 is thereupon energized attracting its armature 532, opening the energizing circuit of the operating magnet 531 and thereby stopping the movement of the register in its sixth or No. 5 position. The movement of the armature 532 of the stop relay 535 has closed at its front contact an energizing circuit for the cord finder sequence switch 222, provided this sequence switch is now in its eighth position. This circuit may be traced from the battery 221 through the sequence switch 222, conductor 223, sequence switch contact 215, conductor 536, front contact and armature 532 of the stop relay 535, conductor 247, sequence switch contact 209, conductor 429, contact 430 of the depressed units key 428, conductor 431, contacts of the depressed thousands key 425 to ground and back to battery. The closure of this circuit will cause the sequence switch 222 to move into its ninth position. If, however, at the time this circuit is closed at the armature 532 the sequence switch 222 has not yet reached its eighth position the closure of its circuit will not be accomplished until the sequence switch has moved into its eighth position. In this way the regular and complete operation of the various registers and the cord finder sequence switch 222 is readily accomplished. The cord finder sequence switch 222 moving from its sixth to its seventh position only upon the completion of the operation of the thousands register, then moving from its seventh to its eighth position upon the completion of the operation of the hundreds register, or immediately moving from its seventh to its eighth position if the operation of the hundreds register had been completed prior to the completion of the operation of the thousands register. The sequence switch having been brought to its eighth position by the completion of the operation of the hundreds register will now move into its ninth position only upon the completion of the tens register, and similarly if the operation of the tens register was completed before the completion of the operation of the hundreds register the cord finder sequence switch will not stop in its eighth position,

but will immediately move to its ninth position.

In a way precisely analogous to the operation of the thousands, hundreds and tens registers, the units register will be operated simultaneously with such other registers, the operating magnet 537 being energized by the battery 501 in parallel with the respective operating magnets 519, 525 and 531. The units register will thereupon move until circuit is closed through the contact device 540 corresponding to depressed units key 428. A circuit will thereupon be established from battery 501 through conductor 502, stop relay 541, contact device 540, lefthand contacts of depressed units key 428 to ground and back to battery. The closure of this circuit will energize the stop relay 541, which attracts its armature 538 opening the circuit of the operating magnet 537 and thereby stopping the movement of the register in its third or No. 2 position. The same movement of the armature 538 will close at its front contact an energizing circuit for the cord finder sequence switch 222 provided this sequence switch is at this time in its ninth position. This circuit may be traced from the battery 221 through the sequence switch 222, conductor 223, sequence switch contact 216, conductor 542, front contact and armature 538 of the stop relay 541, conductor 247, sequence switch contact 209, conductor 429, contacts 430 upon the depressed units key 428, conductor 431, contacts of the thousands key 425 to ground and back to battery. As will be readily understood from the description of the operation of the cord finder sequence switch 222 under the control of the stop relays of the thousands, hundreds and tens registers, if the cord finder sequence switch 222 is not as yet in its ninth position the closure of the circuit just traced will await the coming of such sequence switch into its ninth position and will then operate such sequence switch to drive it from its ninth into its fifteenth position, the special sequence switch contact 201 being closed all of the time that the cord finder sequence switch is moving from its ninth to its fifteenth position. As the cord finder sequence switch 222 leaves its ninth position it opens at the sequence switch contact 210 the energizing circuit of the various holding magnets 422 associated with the respective sets of keys, and upon the deenergization of these magnets the keys heretofore held depressed are released and restore themselves to their normal positions. As the cord finder sequence switch 222 leaves its tenth position it opens at the sequence switch contacts 208 and 209 the energizing circuits of the various register operating magnets 503, 504, 519, 525, 531 and 537. It will, therefore, be obvious that as long as the cord finder sequence switch 222 associated with the first cord

finder remains in its fifteenth position, it will be impossible for the various keys shown on sheet 4 to in any way effect the position or condition of these registers; the operation of which has just been described. As the cord finder sequence switch 222 associated with the first cord finder comes into its eleventh position it closes the sequence switch contact 218, thereby associating the original energizing circuit for the cord finder sequence switch with the cord finder sequence switch 272 associated with the second cord finder, sender and set of registers for purposes to be hereinafter described.

The entire apparatus is now in condition for the control of the numerical selection in response to the designation indicated by the keys as they were depressed, which designation has been taken up and indicated upon the various numerical registers, the thousands register being in its fourth or No. 3 position in response to the depression of the thousands key 425 has closed the contact device 606, the hundreds register being in its eighth or No. 7 position in response to the depression of the hundreds key 426 has closed its contact device 607, the tens register being in its sixth or No. 5 position in response to the depression of the tens key 427 has closed the contact device 608, and the units register being in its third or No. 2 position in response to the depression of the units key 428 has closed the contact device 609. Furthermore, as will be remembered, the district register has closed and maintains closed the contacts 632 and 602. The hundreds register, moreover, has closed the contacts 625 and the units register has closed the contacts 610. The closure of these contacts 610 and 625 is, however, without effect in accomplishing the connection under consideration, but these contacts are closed for purposes which will hereinafter appear in connection with a call directed to an exchange of a different character. It will be remembered that the sender sequence switch is now in its sixth position having controlled already the district and office selection, and on moving into its sixth position closed sequence switch contact 307. A circuit, therefore, is now established by the closure of the sequence switch contact 211 closed in the tenth to fifteenth positions, inclusive, of the cord finder sequence switch, from the battery 335 through the sender sequence switch 336, sequence switch contact 307, conductor 248, sequence switch contact 211 to ground and back to battery. The sender sequence switch 336 will upon the closure of this circuit move out of its sixth position into its seventh position opening the sequence switch contact 307 and closing again sequence switch contacts 309, 310, 311 and 312, as well as the contacts 313 and 316. The closure of the sequence switch contact

313 in this instance is without effect, but it is closed for purposes which will be hereinafter described.

Upon the closure of the sequence switch contact 309 the selecting or controlling circuit 113, 114 will be again closed through the stepping relay 701 and the armature 721 and its back contact of the cutoff relays 719. The closure of this circuit will as before, by the inclusion of the battery usually and customarily associated with the selector switching apparatus at the distant end of the circuit, energize the stepping relay 701, which will thereupon attract its armature 702. This armature 702 will close at its front contact the energizing circuit of the first counting relay 711, as has been heretofore described in connection with the district and office selection. Upon the deenergization of the stepping relay 701 its armature 702 in retracting will close a circuit for the first counting relay 713, which circuit as has been heretofore described in connection with previous selections and as will be noted, includes the armature 715 and the front contact of the locked up counting relay 711. It will, therefore, be obvious that as before the counting relays 711 and 713 will be one after another energized and locked up in response to the alternate energization and deenergization of the stepping relay 701 until the counting relay 713, associated with the contact device 606 of the thousands register, is energized, at which time, due to the sequence switch 336 being in its seventh position, a circuit is established from the battery 718 through the cutoff relays 719, sequence switch contact 316, conductor 611, contact device 606, conductor 723, front contact and armature 717 of the last operated counting relay 713, which in this instance will be the fourth such counting relay, to ground and back to battery. It will be noted that this circuit will be closed upon the fourth alternate energization and deenergization of the stepping relay 701, the contact device 606 being closed in the fourth or No. 3 position of the thousands register and indicating that the line desired is in the fourth thousand of the lines of the exchange to which selection is being made, as is the fact in the case assumed. The closure of this circuit energizes the cutoff relays 719 opening the controlling circuit 113, 114 at the armature 721 and thereby stopping selection and closing the circuit to the sender sequence switch 336 over a circuit which has been heretofore described in connection with district and office selections at the armature 722 and its front contact. The sender sequence switch 336 thereupon moves from its seventh to its ninth position momentarily opening and again closing the sequence switch contacts 309, 310, 311, 312, opening the sequence switch contact 316 and

closing sequence switch contact 317. The momentary opening of the sequence switch contacts 311 and 312 has as before restored the various counting relays 711 and 713 to their normal deenergized condition. The apparatus is now ready to control the hundreds selection.

The closure of the sequence switch contact 309 by the movement of the sender sequence switch 336 into its ninth position, accomplishes again the closure of the selecting or controlling circuit including the stepping relay 701, the bank contact and armature 721 of the cutoff relays 719, and the conductors 113 and 114. The closure of this circuit including as before the usual and customary battery associated with the selector switching apparatus now associated with the distant end of this circuit has energized the stepping relay 701 which, by the attraction of its armature, has closed again a circuit for the first counting relay 711 which has thereupon attracted its armature and, as before, completed the locking circuit for itself and prepared a circuit for the energization of the first counting relay 713. Upon the deenergization of the stepping relay 701, due to the operation of the selector switching apparatus at the distant end of the controlling circuit, the circuit prepared by the energization of the first counting relay 711 will be closed to energize the first counting relay 713 which in turn attracts its armature, thereby closing a locking circuit for itself and preparing an energizing circuit for the second counting relay 711. It will therefore be obvious that as in the previous selections, the alternate energization and deenergization of the stepping relay 701, due to the operation of the selector switching apparatus at the distant end of the controlling circuit, will alternately energize and lock up the respective counting relays 711 and 713 until that counting relay 713 has been energized which corresponds to the contact device 607 of the hundreds register which is now closed, this register being in its eighth or No. 7 position, and this will require eight alternate energizations and deenergizations of the stepping relay 701 as will be readily manifest.

Upon the energization of the eighth counting relay 713, a circuit will be established from the battery 718 through the cutoff relays 719, sequence switch contact 317, conductor 612, contact device 632 of the district register which, as will be remembered, is now closed owing to the fact that the district register is now in its third or No. 2 position in response to the depression of the No. 2 office key, conductor 613, contact device 607 of the hundreds register, conductor 724, front contact and armature 717 of the eighth counting relay 713 to ground and back to battery. The closure of this circuit energizes the cutoff relays 719, opening the

controlling circuit by the attraction of the armature 721, thereby stopping selection at the selector switching apparatus at the distant end of the controlling circuit and at the same time again closing by the attraction of the armature 722 the circuit for the sender sequence switch 336 through the sequence switch contact 310. The sender sequence switch will now move from its ninth to its eleventh position, momentarily opening by the action of its sequence switch contacts 311 and 312 the circuits to the various counting relays and restoring them to normal, and at the same time momentarily opening and again closing the sequence switch contacts 309 and 310. This same movement of the sender sequence switch has opened the sequence switch 317 and closed the sequence switch 318, thereby transferring the control of the counting relays from the contacts of the hundreds register to the contacts of the tens register.

The control of the tens selection will now take place in a manner precisely similar to the control of thousands and hundreds selection, the various counting relays 711 and 713 being alternately energized and locked up by the action of the stepping relay 701 until the energization of the counting relay 713 which corresponds with the contact device 608 upon the tens register, which in this case would be the sixth counting relay 713, the contact device 608 of the tens register being closed in the sixth or No. 5 position of such register. A circuit will thereupon be established from the battery 718 through the cutoff relays 719, sequence switch contact 318, conductor 614, contact device 608, conductor 725, front contact and armature 717 of the sixth counting relay 713 to ground and back to battery. The closure of this circuit will again energize the cutoff relay or relays 719, again opening the controlling circuit to stop selection at the selector switching apparatus at the distant end of such circuit, and again at the same time closing at the armature 722 an energizing circuit for the sender sequence switch 336 through the sequence switch contacts 310. The sender sequence switch now moves from its eleventh to its thirteenth position, opening momentarily as before the sequence switch contacts 309, 310, 311 and 312, the opening of the two latter contacts causing the deenergization of the various locked up counting relays 711 and 713, restoring them to normal condition. The same movement of the sequence switch 336 has opened the sequence switch contact 318 and closed the sequence switch contact 319, thereby transferring the control of the counting relays from the tens register to the units register.

The control of units selection will now take place in a manner precisely analogous to the selection controlling operations al-

ready described, the counting relays 711 and 713 being alternately energized and locked up due to the operation of the stepping relay 701 in response to the selecting operation of the selector switching apparatus at the distant end of the controlling circuit. This alternate energization of the counting relays will continue until the counting relay 713, which corresponds to the contact device 609 of the units register, is energized which in this instance would be the third counting relay 713, since in the case assumed the units register has been moved into its third or No. 2 position, and has closed the third contact device therein, 609. A circuit will thereupon be established from battery 718 through the cutoff relays 719, sequence switch contact 319, conductor 615, contact device 602 of the district register which is now closed, as it will be remembered the district register is in its third or No. 2 position in response to the depression of the office key, conductor 616, contact device 609 of the units register, conductor 720, front contact and armature 717 of the third counting relay 713 to ground and back to battery. This will again energize the cutoff relays 719 which, by the attraction of the armature 721, stop selection at the selector switching apparatus at the distant end of the controlling circuit, and by the attraction of the armature 722 again close a circuit for the sequence switch 336 through the sequence switch contact 310. The sender sequence switch 336 will thereupon leave its thirteenth position, and due to the closure of the special sequence switch contact 301 during the fourteenth, fifteenth, sixteenth and seventeenth positions will continue to move until it reaches its eighteenth position.

The sender sequence switch 336 upon leaving its thirteenth position has opened the sequence switch contacts 309, 310, 311, 312 and 319, causing by the opening of the sequence switch contacts 311 and 312 the restoration to normal of the various counting relays 711 and 713. When the sender sequence switch 336 comes into its fourteenth position, it closes and maintains closed in its eighteenth position the sequence switch contact 305, the closure of this sequence switch contact establishing a circuit from the battery 109, connecting circuit sequence switch 110 associated with the connecting circuit in use, sequence switch contact 104, conductor 248, contact terminal 236, contact brush 231, conductor 337, sequence switch contact 305, conductor 245, contact brush 232, contact terminal 237, conductor 115, sequence switch contact 105 to ground and back to battery. The connecting circuit sequence switch 110 will thereupon be energized and move out of its sixth position and continue to move until it again reaches its first or normal position. It will be obvious, of course, that there may

or may not be, as will be necessary to fulfil the requirements of the particular exchange in which the operator's sender equipment of my invention may be used, intermediate positions of this sequence switch between the sixth position referred to and the first or normal position thereof, and that as preferred such sequence switch may rest in such intermediate positions and be further driven until it reaches its normal position by such associated apparatus as may be used or convenient in the exchange system referred to; since, however, such intermediate positions and the circuit closing apparatus for moving such sequence switch in its intermediate positions are not necessary to and form no part of my present invention they are not here shown and will not be further referred to. The connecting circuit sequence switch 110 will, however, in leaving its sixth position, open the sequence switch contacts 104 and 105. This opening of the sequence switch contact 105 opens the energizing circuit of the reset relay 332 and the test relay 229. The reset relay upon its deenergization, allows the armature 334 to retract, closing a circuit from battery 335 through the sender sequence switch 336, sequence switch contact 303, back contact and armature 334 of the reset relay 332 to ground and back to battery. In response to the closure of this circuit, the sender sequence switch will now move from its eighteenth to its first or normal position, opening the sequence switch contacts 303 and 305 and closing the sequence switch contacts 302 and 304.

The test relay 229 upon deenergizing allows the test armature 228 to retract, closing a circuit from battery 221 through the cord finder sequence switch 222, sequence switch contact 206, back contact and armature 228 of the test relay 229 to ground and back to battery. The closure of this circuit causes the cord finder sequence switch to move from its fifteenth through its sixteenth, seventeenth and eighteenth positions into its first or normal position. The cord finder sequence switch in moving to its normal position has opened the sequence switch contacts 204, 211, 218 and 206, and upon reaching its normal position has closed the sequence switch contact 202.

It will therefore be seen that the entire apparatus is again in its normal position and ready to associate itself with another connecting circuit and to control the interconnection of lines or trunks thereover. It will be noted, however, that while the sender apparatus shown in full has been controlling the numerical selection of the particular connection in question, the manually operated keys shown in Fig. 4 have been available for use in connection with the duplicate sender, the cord finder sequence switch of which is shown at the lower righthand

portion of Fig. 2 and the multiple connections to the registers of which are shown leading off from the leads between the keys and the registers in Fig. 4. The sequence switch 272 associated with the second cord finder apparatus and its associated counting relay apparatus is precisely similar to the cord finder sequence switch 222, with the exception that in place of the sequence switch contacts indicated at 202 and 218, there is provided a sequence switch contact 275 closed in the normal position of the sequence switch and also in its eleventh to its eighteenth positions. From an inspection of the circuit through the sequence switch contacts 202, 218 and 275 it will be seen that the first cord finder apparatus is normally associated with the originating circuit 111, both the sequence switch contacts 202 and 275 being closed in the normal or resting positions of the two sequence switches. As soon as the cord finder sequence switch 222 reaches its eleventh position, at which time the manually operable keys are no longer necessary for the operation of the registers and counting relays, the sequence switch contact 218 is closed and the originating circuit is now associated with the second cord finder sequence switch 272. Another connecting circuit being taken for use at this time, the originating circuit being associated with the cord finder sequence switch 272, will cause the operation of this sequence switch which immediately upon leaving its normal position, opens the sequence switch 275, maintaining it open and thereby preventing the seizure of either cord finder sequence switch and its associated apparatus by a connecting circuit taken for use until the cord finder sequence switch 272 has reached its eleventh position, in which position the manually operable keys are again available for use for controlling another connection. At this point, therefore, the cord finder sequence switch 222 and its associated apparatus are again associated with the originating circuit 111 by the closure of the sequence switch contact 275 when the sequence switch contact 202 again closes.

Having thus described a complete controlling operation of the operator's sending equipment for the selection of a line in an exchange, the lines of which and the trunk lines of which, through which such lines are interconnected, are arranged according to the decimal system of notation, it will next be assumed that the line desired is located in an exchange in which the lines terminating therein and the trunk lines by which such lines are interconnected, are arranged according to some other system of notation. To present a still further modification it will be assumed that the exchange in

which the line desired is located is an exchange of but five hundred lines. Such an exchange is represented by the seventh office key on Fig. 4, that is by the No. 6 key 432 of the set of office keys. In this exchange the lines are arranged on switches having a capacity of two hundred lines, such two hundred lines being arranged on the switches in ten banks of twenty lines each. It will therefore be apparent that while the tens selection will be accomplished as heretofore, the units selection will necessarily comprise the selection of the desired one of twenty lines. In such an exchange of five hundred lines, there obviously may be two sets of multiple final selector switches, each set accommodating two hundred lines and one set of multiple final selector switches accommodating but a single hundred lines, although any other suitable arrangement may be used. Assuming this arrangement, however, it will be seen that it will be necessary, in order to complete the selection of a line in such an exchange, to first select the district in which the office desired is located, to then select the office in which the line desired is located, to then select the one of the three final selector switches in which the line desired is located, to then select the bank of line terminals in which such line appears, and finally to select the set of the twenty sets of terminals in the selected bank representing the terminals of the desired line. It will therefore appear that thousands selection will be unnecessary in such an exchange and that hundreds and units selection will be distinctly changed. Assuming therefore that it is desired to control the selection of line No. 354 in such exchange No. 6 of the character just referred to, the operator will first depress the seventh or No. 6 office key 432, the first or No. 0 thousands key 433, the fourth or No. 3 hundreds key 434, the sixth or No. 5 tens key 427 and the fifth or No. 4 units key 435. The control of the district and office selection will thereupon take place in a manner precisely analogous to the control of the district and office selection in the case heretofore assumed and described in connection with the selection of a line located in office No. 2, the control in this case, however, causing the selection of the seventh district or district No. 6 and the seventh office or office No. 6 in such district. It will be noted; however, that the district register in taking up its seventh or No. 6 position in response to the depression of the office key 432 has not only closed the contact device 617, but has also closed the contact device 618 and the contact device 619. The closure of the contact devices 618 and 619 is without effect in the control of district and office selection, but is of utility in the control of the numerical selection as will be here-

inafter set forth. It may here be noted that the office register in taking up its seventh or No. 6 position in response to the depression of the office key 432 has closed contact device 620, the closure of which controls the counting relays in office selection.

At the completion of the control of office selection, during which time the sender sequence switch 336 is in its fifth position, the usual circuit will be closed by the armature 722 of the cutoff relays 719 from the battery 335 through the sender sequence switch 336, sequence switch contact 310, front contact and armature 722 to ground and back to battery. In response to the closure of this circuit, the sender sequence switch 336 will move from its fifth position into its sixth position, by such movement closing the sequence switch contact 307 and, in the manner heretofore set forth, restoring the counting relays 711 and 713 to their normal deenergized condition by the opening of the sequence switch contacts 309, 310, 311 and 312. When the cord finder sequence switch at this stage reaches its tenth position in the manner heretofore described, each of the registers having taken the record impressed thereon by the depression of the manually operable keys of the various sets, a circuit is closed from the battery 335 through the sender sequence switch 336, sequence switch contact 307, conductor 248, sequence switch contact 211, to ground and back to battery. The sender sequence switch 336 thereupon moves out of its sixth position and immediately upon coming into its seventh position, establishes a circuit by the closure of the sequence switch contact 313 from the battery 718 through the cutoff relay or relays 719, sequence switch contact 313, conductor 621, district register contact device 619 to ground and back to battery. This circuit will energize the cutoff relays 719 which will immediately attract the armatures 721 and 722, the immediate attraction of the armature 721 preventing the closure of the controlling circuit which would otherwise be accomplished by the closure of the sequence switch contact 309, and the attraction of the armature 722 again establishing an energizing circuit for the sender sequence switch 336. The sender sequence switch 336 thereupon moves from its seventh to its ninth position, no selection controlling operation having taken place while the sender sequence switch was in its seventh position. As soon, however, as the sender sequence switch 336 reaches its ninth position, the controlling circuit including the conductors 113 and 114 is closed at the sequence switch 309 and the stepping relay 701 is again, as has been before described, energized to attract its armature 702. The attraction of this armature 702 energizes the first counting relay 711 and its retraction in turn energizes the

first counting relay 713, as has been before described. This operation continues until the attraction, in the case assumed, of the second counting relay 713, when a circuit is established from the battery 718 through the cutoff relays 719, sequence switch contact 317, conductor 612, contact device 618 upon the district register, (contact device 632 being open at this time), contact device 622 which is now closed, the hundreds register being in its fourth or No. 3 position in response to the depression of the No. 3 hundreds key, conductor 623, conductor 726, front contact and armature 717 of the second counting relay 713 to ground and back to battery. The closure of this circuit, by the energization of the cutoff relays 719, accomplishes the cessation of selection. The movement of the sender sequence switch 336 from its ninth to its eleventh position, the restoration of the counting relays 711 and 713 to their normal condition and the preparation of the controlling circuit for the control of the next selecting operation, all as has been before described. It will be noted, however, before passing on to the next operation that in the just described selection controlling operation, the contact device 624 upon the hundreds register was also closed in addition to the contact device 622, but since the contact device 632 upon the district register was at this time open, the closure of any one of the first group of contact devices upon the hundreds register, in which group the contact devices 607 and 624 appear, is without effect and the control of this selection is entirely dependent upon which of the contact devices in the second group, of which the contact device 622 is one, is closed. It will also be here noted that the contact device 625 of a third group of contact devices upon the hundreds register, is also closed at this time for purposes which will hereinafter appear.

The apparatus now being ready for the next selection controlling operation, the sender sequence switch having reached its eleventh position, the energization of the stepping relay 701 has, by the operation of its armature 702, caused the energization of the first counting relay 711. The deenergization of the stepping relay in the manner heretofore described has energized the first counting relay 713. The alternate energization and deenergization of this stepping relay will, in the manner heretofore described, continue to energize alternately the counting relays 711 and 713 until the energization of the counting relay 713 corresponding to the contact device 608 upon the tens register, at which time in a manner now well understood, a circuit will be closed through such contact 608 and the sequence switch contact 318 to energize the cutoff relays 719 to cause the cessation of selection,

the movement of the sender sequence switch into its thirteenth position and the restoration of the various counting relays 711 and 713 to their normal condition. Upon the coming of the sender sequence switch 336 into its thirteenth position, the controlling circuit is again completed and the stepping relay 701 is again alternately energized and deenergized under the influence of the distant selector switching apparatus to alternately energize the counting relays 711 and 713. It will at this point be remembered that the units register is now in its fifth or No. 4 position in response to the depression of the No. 4 units key and the contact devices 626 and 627 on such register are both closed. The closure of the contact device 626 upon the units register is, however, without effect, the contact device 602 upon the district register being open and the contact device 628 upon the hundreds register being also open. The circuit for the cutoff relay or relays 719 will therefore not be established upon the energization of the counting relay 713 corresponding to the contact device 626 upon the units register, that is the fifth such counting relay, and the stepping relay 701 will continue to be alternately energized and deenergized, in turn alternately energizing the counting relays 711 and 713 until the counting relay 713 corresponding to the contact device 627 upon the units register is energized, this being the fifteenth such counting relay. A circuit will then be established from the battery 718 through the cutoff relay or relays 719, sequence switch contact 319, conductor 615, contact device 625 upon the hundreds register, conductor 629, contact device 627 upon the units register, conductor 727, front contact and armature 717 of the fifteenth counting relay 713 to ground and back to battery. The closure of this circuit again energizes the cutoff relays 719, which, by the attraction of the armatures 721 and 722, causes the cessation of the selective operation of the distant selector switching apparatus and the movement of the sender sequence switch from its thirteenth to its eighteenth position. This movement of the sender sequence switch has restored the counting relays 711 and 713 to their normal condition, and from this point the operation of the apparatus is the normal and usual operation of such apparatus, which operation has already been described in the establishment of the connection first assumed.

It will be obvious that the arrangement of the contact devices upon the district register, the hundreds register and the units register are so related that no matter what may be the designation of the particular line desired, the proper selection will be controlled to accomplish the connection with this line. It will be noted, for example, that the first

multiple set of switches, as indicated by the first contact device of the second group upon the hundreds register, contains the first two or "zero" and "one" hundred lines; the second multiple set of switches the next two, or "two" and "three," hundred lines; and the third multiple set of switches the last or "four" one hundred lines. Furthermore, it is assumed that the lines are so arranged upon the switches that in units selection, the selector apparatus is first adapted to make connection with one of a set of ten lines of the first hundred associated with such switch, and after passing over such set of ten lines, to make connection with one of the corresponding group of ten lines of the second hundred lines terminating in said switch. It is for this reason that the contacts 625 and 628 appear upon the hundreds register. If the line desired is in the zero, two or four hundreds, the closure of the contact device 628 stops the selecting operation of the final selector switching apparatus, through the medium of the counting relays, in response to the closure of one of the contact devices of the upper ten such contact devices upon the units register. If, however, the line desired is in the one or three hundreds, the opening of the contact device 628 and the closure of the contact device 625 upon the hundreds register accomplishes the cessation of the selecting operation of the final selector switching apparatus, through the medium of the counting relays, only in response to the closure of one of the contact devices in the lower set of ten upon the units register.

The contacts 632 and 618 upon the district register control whether the hundreds selection shall take place under the control of the first set of contact devices upon the hundreds register, as is necessary where the line desired terminates in an exchange, the lines of which are arranged upon a decimal system of notation, or under the control of the second set of contact devices upon the hundreds register, as is necessary where the line desired terminates in an exchange in which the lines are arranged upon some other system than the decimal system of notation, as in the second case assumed.

It will, of course, be understood that the various operations in the setting of the several registers and the release of the depressed manually operable keys and such other operations as have not been described in connection with the second case assumed, have been similar or analogous to such operations as described in connection with the first case assumed.

Continuing further, it will be assumed that connection is desired with the line located in a manual exchange, to connect with which exchange it is only necessary to accomplish the first or district selection, thereby eliminat-

ing the necessity of the office selection controlling operation and the entire numerical selection controlling operations hereinbefore referred to and described. In this instance it is only necessary that the operator should depress the office key indicating the office in which the line desired is located, as for example, the office represented by the No. 4 key 436 which is the fifth key in the set of office keys upon Fig. 4 of the drawings. District selection thereupon takes place in the same manner as has been heretofore described. It will be noted, however, that in this case the district register in taking up its fifth or No. 4 position in response to the depression of the No. 4 office key 436 has closed the contact device 630.

For purposes which will be hereinafter described, when the sender sequence switch 336 at the end of district selection leaves its third position, upon coming into its fourth position it closes the sequence switch contact 308. A circuit is thereupon established from the battery 109 through the connecting circuit sequence switch 110, sequence switch contact 104, conductor 248, contact terminal 236, contact brush 231 upon the cord finder, conductor 337, sequence switch contact 308, conductor 631, contact device 630 upon the district register, conductor 299, conductor 245, contact brush 232 upon the cord finder, contact terminal 237, conductor 115, sequence switch contact 105 to ground and back to battery. The closure of this circuit causes the connecting circuit sequence switch 110 to move from its second to its sixth position. The same circuit, however, is maintained in the sixth position of the connecting circuit sequence switch 110 and this sequence switch will therefore continue to move until it again reaches its first or normal position in the manner heretofore described. In leaving its sixth position, however, the connecting circuit sequence switch 110 has opened the sequence switch contact 105, thereby opening the energizing circuit of the reset relay 332 and the testing relay 229. The deenergization of the reset relay 332 has closed, by the retraction of its armature 334, the energizing circuit for the sender sequence switch 336 through the sequence switch contact 303. The sender sequence switch will thereupon be energized and will move from its fifth position to which it has come at the completion of the district selection into its first or normal position, such movement being continuous and without interruption, due to the fact that the sequence switch contact 303 remains closed during all of the intermediate positions. The deenergization of the test relay 229 has, by the retraction of its armature, closed an energizing circuit for the cord finder sequence switch through the sequence switch contact 206, and this sequence switch there-

upon moves from its fifth position into its first or normal position, such movement also being continuous and without interruption due to the fact that the sequence switch contact 206 is maintained closed in all of the intermediate positions. The selection controlling operation, therefore, when the line desired terminates in an exchange of the character last assumed, comprises only the control of the selection of an idle trunk line by a district selector switching apparatus to such exchange and the controlling apparatus automatically adapts itself to eliminate all selection controlling operations further than is necessary to accomplish this district selection upon the depression, merely, of an office key representing an exchange of this particular character, such, for example in the case assumed, the exchange represented by the office key No. 4, the fifth key in the set of office keys.

Having now described the manner in which selection will be controlled by the operator's sender or controlling equipment embodying my invention in connection with the various classes of exchanges likely to be met with in standard telephone practice, I will now describe that feature of my invention which relates to the signaling means whereby the operator may know at any time at what particular stage in the controlling operation the sender or controlling equipment and the selector switching apparatus associated therewith are at that time. This signaling apparatus comprises a row of lamps 351, 352, 353, 354, 355 and 356 which appear before the operator and are successively lighted as the apparatus passes from one stage to the succeeding stage. These lamps are controlled by the sequence switch contacts 361, 362, 363, 364, 365 and 366 upon the sender sequence switch. As will be noted, the sequence switch contact 361 which controls the circuit of the battery 370 through the lamp 351 is closed only in the second position of the sequence switch. By referring back to the operation of the sequence switch in connection with the control of the selection of the line desired, it will be observed that the sender sequence switch does not reach its second position until immediately after the cord finder has seized upon the connecting circuit taken for use, and the lighting of the lamp 351 which will only occur at this time, will serve to indicate to the operator that the sender apparatus is now connected with the cord over which connection will take place.

Again referring to the operation of the sender sequence switch in connection with the controlled selection, it will be observed that the sender sequence switch 336 takes its third position just before the commencement of the district selection controlling operation and maintains such position only

until it is completed. The extinguishment, therefore, of the lamp 351 and the lighting of the lamp 352 by the closure of the sequence switch 362, will indicate to the operator that district selection is now taking place. It will be furthermore remembered that immediately after the district selection controlling operation is completed, the sender sequence switch moves from its third position into its fourth and fifth positions and without further delay the office selection controlling operation takes place. The lamp 352 is therefore extinguished, the sequence switch contact 362 being closed only in the third position of the sender sequence switch, and the lamp 353 is now lighted due to the closure of the sequence switch contact 363. As will be observed, this lamp is lighted immediately upon the completion of the district selection controlling operation and will be maintained lighted until the completion of the office selection controlling operation, at which time the sender sequence switch moves from its fifth position, thereby opening the sequence switch contact 363. From the time that the sender sequence switch 336 comes into its sixth position after the completion of the office selection controlling operation until the completion of the hundreds selection controlling operation, the lamp 354 will be lighted due to the closure of the sequence switch contact 364 and the lighting of this lamp will indicate to the operator that thousands and hundreds selections are one after the other now taking place, or in case thousands selection is unnecessary, that hundreds selection is now taking place. As soon, however, as hundreds selection is completed, the sender sequence switch 336 will move from its ninth position and without stopping in its tenth position, come to rest in the eleventh position where the tens selection controlling operation will now take place. The extinguishment of the lamp 354 and the lighting of the lamp 355 in the tenth and eleventh positions of the sender sequence switch will indicate to the operator that tens selection is taking place. In like manner the lighting of the lamp 356, due to the closure of the sequence switch contact 366 in the twelfth and thirteenth positions and the extinguishment of the lamp 355 as the sender sequence switch comes into the twelfth position, will indicate to the operator that the units or final selection is going on. The extinguishment of the lamp 356 finally indicates to the operator that the entire operation of her sender or controlling equipment has been completed. By this means the operator may at a glance inform herself as to the progress of the selection under control. Furthermore if by any mischance selection should be held up at any stage, the continued lighting of

one of the signal lamps will immediately inform the operator at precisely what stage the trouble or other delay has occurred.

It will, of course, be understood that while I have for convenience shown a plurality of batteries, all such batteries where they are of the same polarity and potential and located at the same exchange may be and preferably are one and the same battery. It will be furthermore understood that while I have described the particular mode of operation of my invention in connection with some of the various operations of a telephone system of the type referred to, my invention is in no way confined or restricted to these operations nor to the particular manner or sequence in which the operations described take place, but may be varied and modified as desired to perform the necessary controlling operations in any preferred manner, being limited only by the hereinafter appended claims.

Having described my invention what I claim is:—

1. In a sender, a selection controlling device and a sequence switch controlling said device alternately to render it effective for operation and to restore it to normal a plurality of times during a single sending operation.

2. In a sender, a series of counting relays selectively operated to determine the number of controlling impulses transmitted, and electromagnetic means arranged to render said series of counting relays effective a plurality of times during a single sending operation.

3. In a sender, a series of counting relays selectively operated to determine the number of selection controlling impulses transmitted, and a sequence switch adapted to render said series of counting relays effective successively a plurality of times during a single sending operation.

4. In a sender, the combination with a series of cooperating electromechanisms selectively operated to determine the number of impulses, of a selecting circuit, and electromagnetic means for automatically associating said series of electromechanisms with said selecting circuit a plurality of times during a single sending operation.

5. In a sender, the combination with a series of selection controlling electromechanisms, of a selecting circuit, and an electromagnetic switching apparatus arranged to automatically render said series of electromechanisms effective for operation and to restore them to normal a plurality of times during a single sending operation.

6. In a sender, the combination with a series of counting relays selectively operated to determine the number of selection controlling impulses, a selecting circuit, and a sequence switch controlling the association

of said counting relays with said selecting circuit.

7. In a sender, the combination with a series of counting relays selectively operated to determine the number of selection controlling impulses, of a selecting circuit, and a sequence switch arranged to automatically control successive associations of said counting relays with said selecting circuit a plurality of times during a single sending operation.

8. In a sender, the combination with a series of selection controlling electromechanisms, of a selecting circuit, a relay responsive to the operation of said electromechanisms to control said circuit, and electromagnetic switching apparatus adapted to associate said electromechanisms with said circuit.

9. In a sender, the combination with a series of selection controlling electromechanisms, of a selecting circuit, means in said circuit adapted to operate said electromechanisms, a relay device controlled by the operation of said electromechanisms and controlling said circuit, and electromagnetic switching apparatus adapted to initially control said circuit and associate said electromechanisms therewith.

10. In a sender, a series of selection controlling counting relays and a sequence switch controlling said relays alternately to render them effective for operation and to restore them to normal.

11. In a sender, the combination with a series of selection controlling electromechanisms of a selecting circuit, and electromagnetic switching apparatus controlling said electromechanisms alternately to automatically associate them with said circuit for operation and to restore them to normal a plurality of times during a single operation.

12. In a sender, selection controlling apparatus, a sequence switch adapted to take up a plurality of positions and contacts controlled by said sequence switch adapted in one position to render said apparatus effective, in another position to restore said apparatus to normal, and in a still further position to render said apparatus again effective.

13. In a sender, a series of selection controlling counting relays, and a sequence switch adapted to take up a plurality of positions and contacts controlled by said sequence switch adapted in one position to render said counting relays effective, in another position to render said counting relays again effective and in the passage from one such position to the other such position to restore said counting relays to normal.

14. In a sender, the combination with a selecting circuit, of a series of selection controlling electromechanisms adapted to be

placed in cooperative relation with said selecting circuit a plurality of times during a single sending operation, means for selectively operating said electromechanisms to determine the number of selecting impulses transmitted, and electromagnetic switching apparatus adapted to restore said electromechanisms to normal condition between their successive periods of association with said selecting circuit.

15. In a sender, the combination with a selecting circuit, of a series of counting relays adapted to be successively brought into cooperation with said selecting circuit a plurality of times, a stepping relay in said selecting circuit adapted to operate said counting relays one after another, a stop relay controlled by said counting relays and adapted to control said selecting circuit, and a sequence switch controlling the association of said counting relays with said selecting circuit and adapted to restore said counting relays to their normal condition between successive periods of association with said selecting circuit.

16. In a sender, the combination with a series of selection controlling electromechanisms, of a selecting circuit, a plurality of contact devices for operating said electromechanisms, a relay controlled by said electromechanisms and adapted to control said selecting circuit, and electromagnetic switching apparatus controlling the cooperation of said electromechanisms with said relay and the cooperation of said contact devices with said electromechanisms.

17. In a sender, the combination with a series of counting relays, of a selecting circuit, a plurality of contact keys, one adapted to be associated with each of said counting relays, a stepping relay in said selecting circuit adapted to operate said counting relays one after another, a stop relay jointly controlled by said counting relays and said contact keys and controlling said selecting circuit, and a sequence switch adapted to control the cooperation of said counting relays with said stepping relay and said contact keys with said counting relays.

18. In a sender, the combination with a selecting circuit, of a single series of selection controlling electromechanisms, a plurality of sets of contact devices adapted to be successively brought into cooperation with said series of electromechanisms, means for operating said electromechanisms, an electro-responsive device under the joint control of said electromechanisms and a contact device of the associated set adapted to control said selecting circuit, and electromagnetic switching apparatus arranged to associate the respective sets of contact devices with said electromechanisms and restore said electromechanisms to normal.

19. In a sender, the combination with a

selecting circuit, of a single series of electro-mechanisms, a plurality of sets of contact devices adapted to be associated, one set after another, with said electromechanisms, means in said selecting circuit for operating said electromechanisms, an electro-responsive device jointly controlled by said electromechanisms and a contact device of the associated set, and electromagnetic switching apparatus adapted to associate the respective sets of said contact devices with said electromechanisms and restore said electromechanisms to normal.

20. In a sender, the combination with a selecting circuit, of a single series of counting relays, a plurality of sets of contact devices adapted to be associated one set after another with said counting relays, a stepping relay in said selecting circuit adapted to operate said counting relays one after another, a stop relay under the joint control of one of said counting relays, and a contact device of the associated set of contact devices, and a sequence switch adapted to bring the respective sets of contact devices into association with said counting relays and restore said counting relays to normal.

21. In a sender, the combination with a selecting circuit, of a plurality of selection controlling electromechanisms adapted to control said circuit, means for operating said electromechanisms, switching apparatus arranged to repeatedly associate said electromechanisms with said selecting circuit during a single sending operation, and means forming a part of said switching apparatus for restoring said electromechanisms to normal between successive periods of association thereof with said selecting circuit.

22. In a telephone exchange system, the combination with an operator's connecting circuit, of a selecting circuit, a series of counting relays, means for operating said relays, a plurality of contact devices, a relay controlling said selecting circuit and under the joint control of said relays and an operated one of said contact devices, and electromagnetic switching apparatus adapted to connect said selecting circuit with said connecting circuit and render operative said contact devices.

23. In a telephone exchange system, the combination with an operator's connecting circuit, of a series of selection controlling electromechanisms, a selecting circuit, means for operating said electromechanisms, a relay controlled by said electromechanisms adapted to control said selecting circuit, and electromagnetic switching apparatus arranged to connect said selecting circuit with said connecting circuit and initially control said electromechanisms.

24. In a sender the combination with manually operable means for registering line

designations, of automatic registering means operable under the influence of said manual means, and a series of selection controlling counting relays governed by said automatic registering means.

25. In a sender, the combination with a series of electro-mechanisms, a selecting circuit controlling the operation of said electromechanisms, a series of mechanisms, a register controlled by said mechanisms, and an electro-responsive device under the joint control of said register and one of said electromechanisms to control said circuit.

26. In a sender, the combination with a single series of counting relays, of a selecting circuit, a stepping relay in said selecting circuit adapted to operate said counting relays one after another after the initial closure of said selecting circuit, a plurality of sets of manually operable keys, a plurality of registers one associated with each said set of keys, said registers being adapted to be one after another operatively associated with said series of counting relays, a stop relay controlling said selecting circuit and under the joint control of one of said counting relays and the associated register, and a sequence switch arranged to substitute one of said registers for another in operative relation with said counting relays and at the same time restore said counting relays to normal.

27. In a sender, the combination with a set of keys, of a register mechanism having terminals connected to different keys of the set and provided with means for successively engaging said terminals in response to the operation of a connected key, a series of selection controlling counting relays, and a circuit controlling said counting relays governed by said register and one of said counting relays.

28. In a sender, the combination with a set of keys, of a register mechanism provided with terminal contact devices connected to different keys respectively, electrically connected means successively engaging said terminal contact devices, switching mechanism for actuating said contact devices in correspondence with the operation of said means, a series of selection controlling counting relays, and a circuit controlling said counting relays governed by a contact device of said register.

29. In a sender, the combination with a set of keys, of a register mechanism having terminal contact devices connected to different keys respectively, electrically connected means successively engaging said terminal contact devices, switching mechanism for actuating said contact devices in correspondence with the operation of said means, a series of selection controlling counting relays provided respectively with

contact terminals connected to said contact devices, and means for operating said counting relays.

30. In a sender, the combination with a plurality of sets of manually operable contact devices, automatic means for separately registering for each set of contact devices conditions existing thereat, and a series of selection controlling counting relays governed by the various registrations produced at the automatic registering means.

31. In a sender, the combination with a set of keys, of a registering mechanism having a terminal electrically cooperating with each key, electrically connected means for successively engaging said terminals, means controlled by any key for actuating said electrically connected means, and a series of selection controlling counting relays governed by said register.

32. In a sender, the combination with a set of keys, of a register mechanism having a terminal electrically cooperating with each said key, electrically connected means for successively engaging said terminals, means controlled by any key for actuating said electrically connected means, a series of selection controlling counting relays, means for operating said relays, and a circuit controlling said relays governed by said register and the contacts of one of said relays.

33. In a sender the combination with a series of electro-mechanisms, of a selecting circuit, means for operating said electro-mechanisms one after another, a series of mechanisms, a register controlled by said contact devices, and an electro-responsive device under the joint control of said register and one of said electromechanisms to control said circuit.

34. In a sender, the combination with a series of counting relays, of a selecting circuit, a stepping relay in said circuit adapted to operate said relays one after another, a series of keys, a register controlled by said keys, and a stop relay controlling said circuit operated over a circuit including said register and the contacts of one of said counting relays.

35. In a telephone exchange system, the combination with a plurality of operator's connecting circuits, of a series of counting relays, a selecting circuit, a stepping relay in said selecting circuit adapted to control said counting relays one after another, a stop relay controlled by said counting relays adapted to control said selecting circuit, and a cord finder arranged to connect said selecting circuit with a connecting circuit taken for use.

36. In a sender the combination with a series of electromechanisms adapted to be operated one after another, contact devices associated with said electromechanisms, a

selecting circuit, switching apparatus adapted to extend said selecting circuit for use, means controlled by said switching apparatus for rendering operative said contact devices, and an electroresponsive device controlled by the operation of one of said electromechanisms and an operated contact device to control said selecting circuit.

37. In a sender, the combination with selection controlling apparatus, of manually operable registering means arranged according to one system of notation, selection controlling apparatus, an electromechanism operable under the influence of said manual means to control said selection controlling apparatus according to the same system of notation under one condition and according to a different system of notation under another condition, and means for associating said selection controlling apparatus with said electromechanism for control under either of said conditions.

38. In a sender, the combination with office and numerical keys, of a plurality of registers each adapted to take up a position in response to the depression of keys indicating a line designation according to the decimal system of notation, a series of selection controlling counting relays, contact devices forming a part of said registers for controlling said counting relays to control selection according to the decimal system of notation, contact devices also forming a part of said registers for controlling said counting relays to control selection according to some other system of notation, contact devices also forming a part of one of said registers adapted to control said registers to determine a partial selection and render the remaining selection control ineffective, and means responsive to the office key depressed adapted to associate one of said sets of contact devices with said counting relays.

39. In a sender, the combination with manually operable office and numerical keys, of registers associated with said keys adapted to take up their positions in response to the indication of a line designation upon said keys, a plurality of sets of contact devices forming a part of each of said registers, selection controlling apparatus adapted to be controlled by either of said sets of contact devices, and means for associating one or the other of said sets of contact devices with said selection controlling apparatus.

40. In a sender, the combination with a series of selection controlling electromechanisms, a plurality of register devices adapted to successively control said electromechanisms, and manually operable contact devices controlling said register devices, a plurality of said registers responding to the operation of a single contact device.

41. In a sender, the combination with se-

- lection controlling apparatus, manually operable contact devices to determine the operation of said apparatus, and means intermediate said devices and said apparatus
- 5 under the control of said contact devices and adapted to control said apparatus, a plurality of said intermediate means responding to the operation of a single contact device of one of said sets of contact devices
- 10 42. In a sender, the combination with a series of counting relays, a plurality of registers adapted one after another to control said counting relays, and a set of manual keys operable to control said registers, a
- 15 plurality of said registers responding to the operation of a single key.
43. In a sender, a switching device comprising a plurality of sets of contact devices, said sets being arranged to effect selection
- 20 of line terminals arranged according to different systems of notation, and means for selecting any one of said sets for effective operation in setting up a call.
44. In a sender, an electromagnetic switching device having a set of contact devices for selecting terminals arranged according to the decimal system of notation, and another set of contact devices for selecting ter-

minals arranged according to another system of notation, and means for selecting any one of said sets for effective operation in setting up a call. 30

45. In a calling device, a register comprising a plurality of sets of contacts arranged to effect selection of line terminals arranged according to different systems of notation, a selection controlling circuit, and means for selectively associating for effective operation any one of said sets of contacts with said selection controlling circuit. 35 40

46. In a selector switch, the combination with two hundred sets of terminals in ten levels of twenty each, the lines represented by said terminals being those whose designations are of two given hundreds, and each level of twenty sets of terminals comprising the corresponding tens digits of the lines of both hundreds appearing in the switch. 45

In witness whereof, I hereunto subscribe my name this 22nd day of October, A. D., 1910. 50

FRANK R. McBERTY.

Witnesses.

IRVING MacDONALD,
MORGAN WASHBURN, Jr.