

L. POLINKOWSKY.
MACHINE SWITCHING TELEPHONE SYSTEM.
APPLICATION FILED AUG. 27, 1918.

1,381,431.

Patented June 14, 1921.
6 SHEETS—SHEET 1.

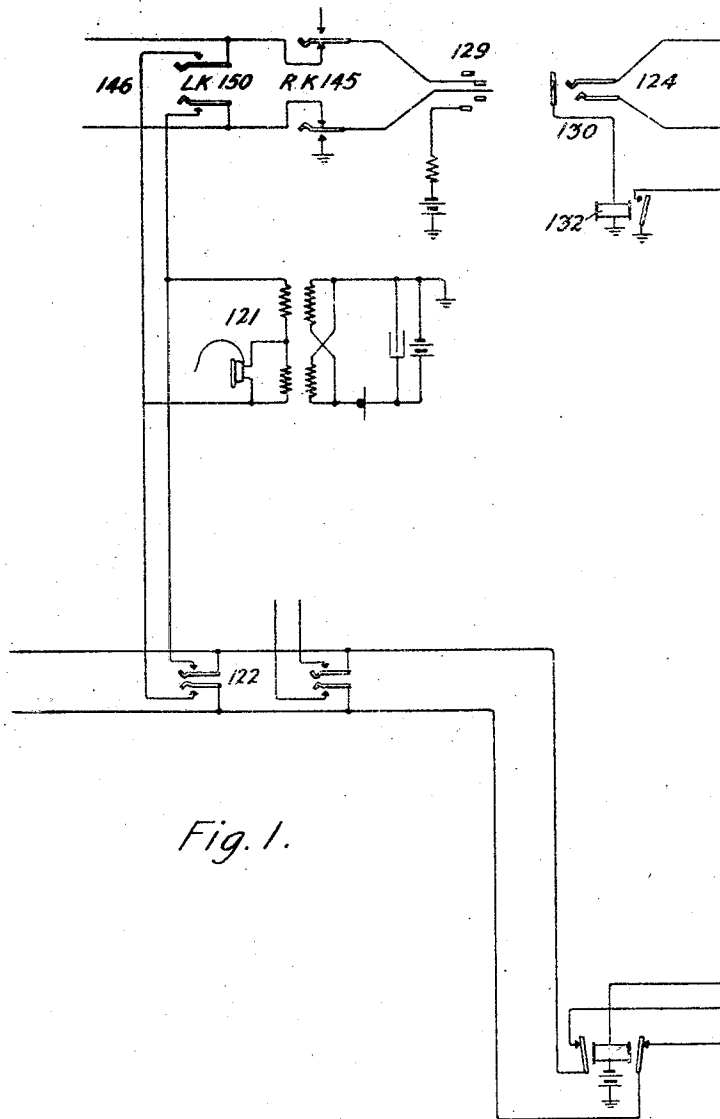


Fig. 1.

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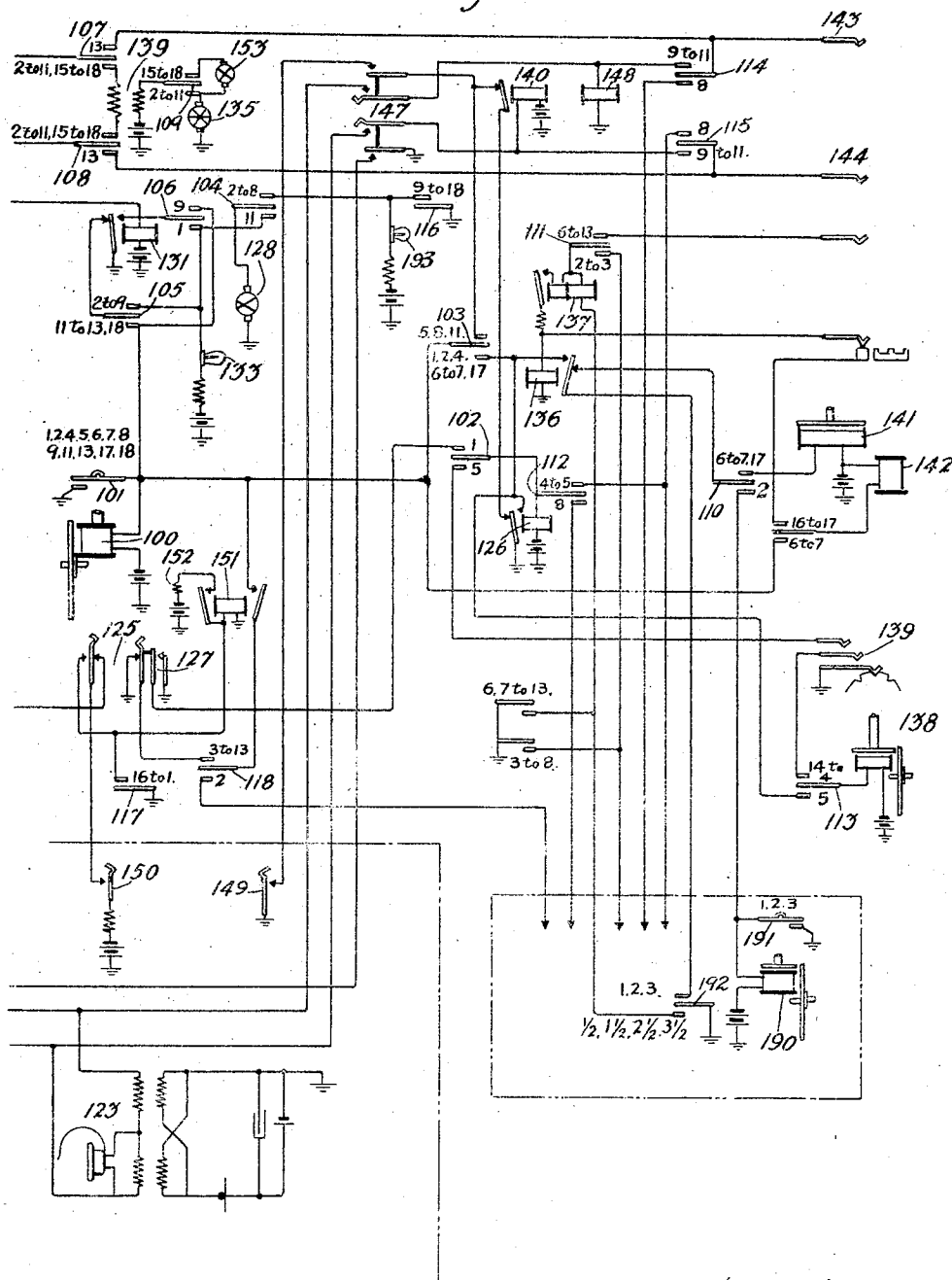
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6 SHEETS—SHEET 2.

Fig. 2.

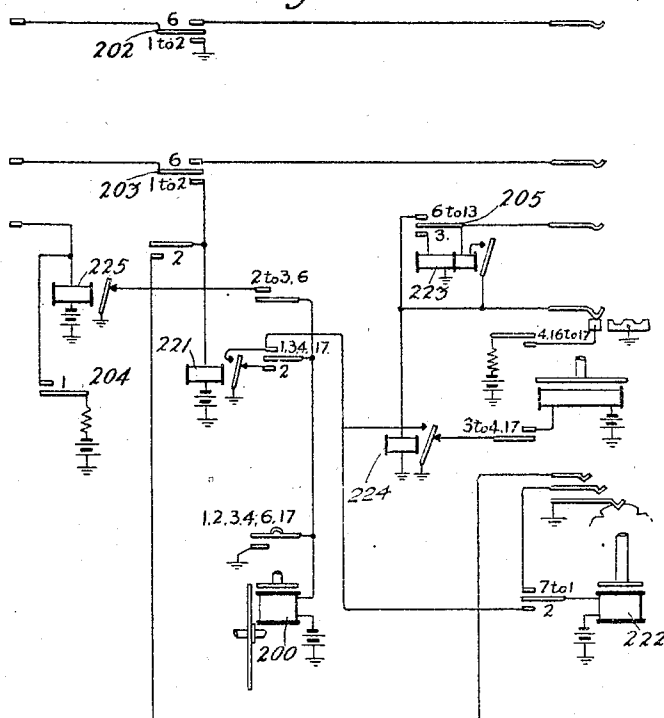


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6 SHEETS—SHEET 3.

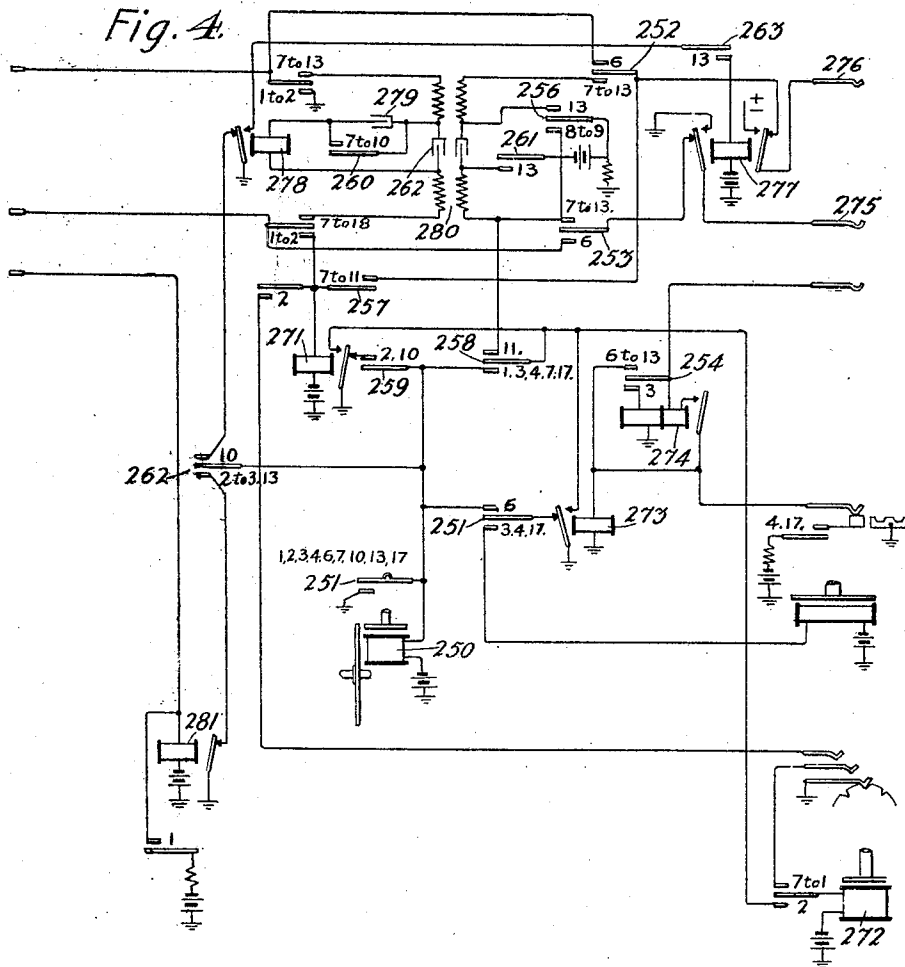
Fig.3.



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6 SHEETS--SHEET 4.



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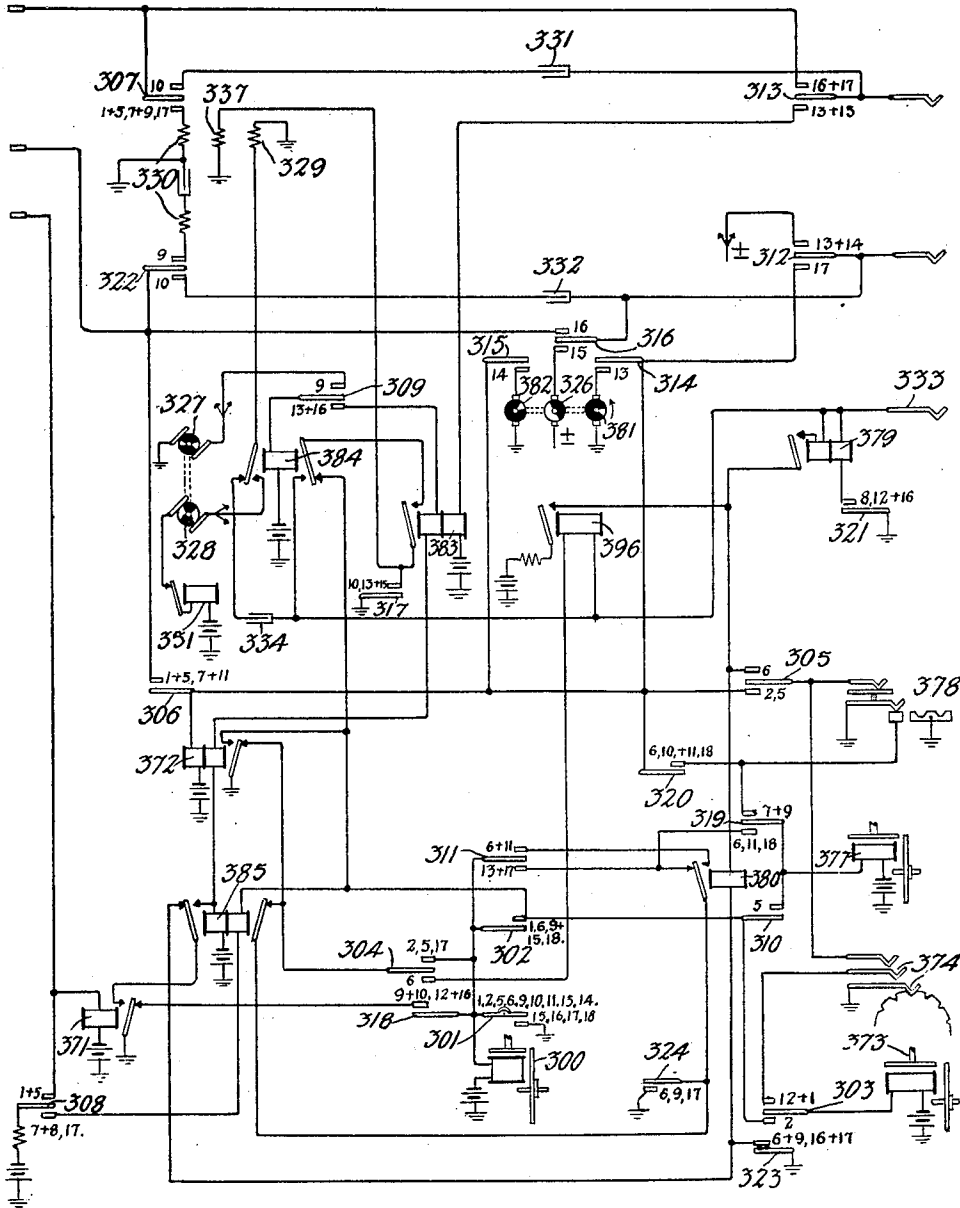
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6 SHEETS—SHEET 5.

Fig. 5.



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6 SHEETS—SHEET 6.

Fig. 6.

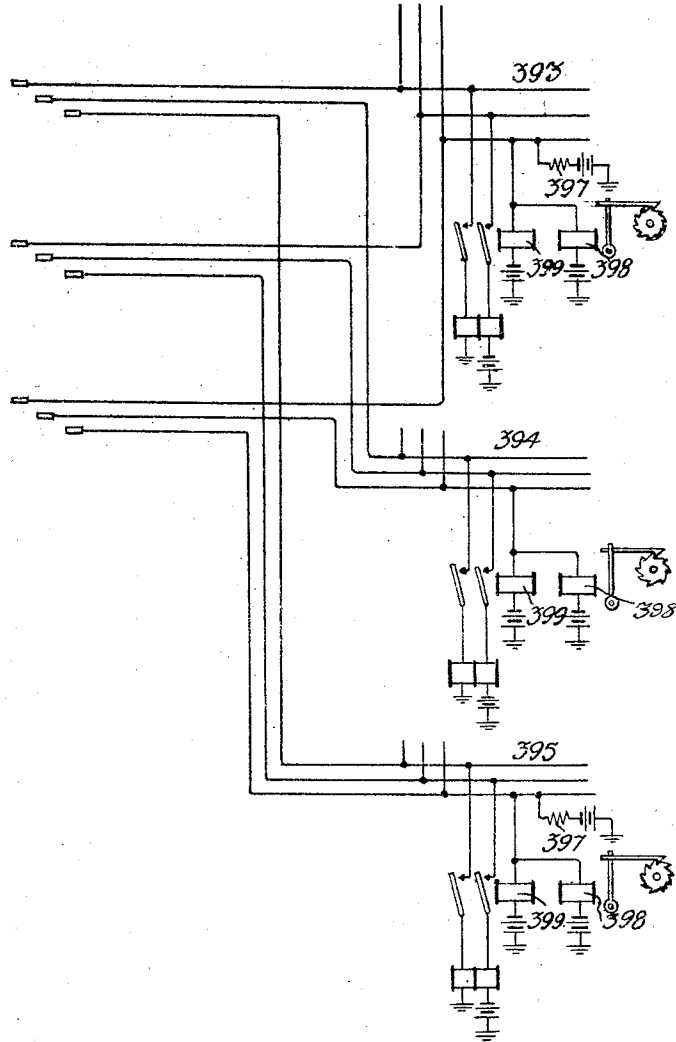
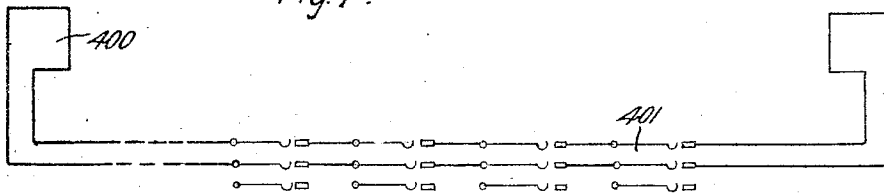


Fig. 7.



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UNITED STATES PATENT OFFICE.

LIPA POLINKOWSKY, OF HYDE PARK, LONDON, ENGLAND, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

MACHINE-SWITCHING TELEPHONE SYSTEM.

1,381,431.

Specification of Letters Patent. Patented June 14, 1921.

Application filed August 27, 1918. Serial No. 251,603.

To all whom it may concern:

Be it known that I, LIPA POLINKOWSKY, a citizen of Russia, residing at 70 Westbourne Terrace, Hyde Park, London, W., England, have invented certain new and useful Improvements in Machine-Switching Telephone Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to machine switching telephone systems and more particularly to systems wherein, in addition to the usual or ordinary service provided for the interconnection of the subscribers' stations of an exchange network, a special service is provided such, for example, as the service in which the subscribers' stations of such network are interconnected with stations of some other network reached over toll or junction lines extending between the respective networks.

A particular feature of the invention involves a novel arrangement of circuits and apparatus by means of which the extension of an incoming call over a toll operator's position is produced to the desired line in an expeditious and simple manner. More specifically this feature involves such an arrangement of the apparatus that the control of the extension of the call is divided between the manual toll operator and the semi-automatic switching operator, the division of duties being such that the manual toll operator is able to handle a call precisely as though it were a call to a manual switchboard, the semi-automatic switching operator exercising the necessary control to extend the call over the machine switching apparatus, which operation she is in the best position to perform with efficiency and despatch. To this end the semi-automatic switching operator receives an order with regard to an incoming call from the manual toll operator over an order wire in the usual manner, and, informing the manual toll operator of the trunk assigned to the call, depresses the corresponding assignment key to initiate the activity of the machine switching apparatus to extend the call, subsequently controlling the extension of the call to the desired line by the usual number key apparatus and determining whether, when the line has been found, if such line is busy, the existing connection therewith is to be broken down. The circuits and apparatus provided for the purposes mentioned in-

volve also novel dispositions and use of visual and other signals which will be more specifically referred to hereinafter.

Still another feature of the invention involves that the breaking down of an established connection to the line with which the special service call is to be extended is caused by a temporary condition placed upon a terminal individual to such desired line, such breaking down condition being removed after the duration of a brief interval sufficient to insure the restoration of the apparatus involved in such previous connection.

Another feature related to the feature just mentioned provides that, after the establishment and removal of the breaking down condition on the terminal of the desired line already engaged with the previous connection, a busy tone is placed upon the same terminal, which tone will be received by subsequent special service calls attempting extension to the same desired line, that is, the circuits and apparatus are so arranged that in the extension of a special service call to a desired line already engaged with a call over which such special service call takes precedence, there is first applied a breaking-down condition to the test terminal of the desired line and which condition is then removed, there being applied thereafter to such test terminal a distinctive busy tone indicating that such desired line is in use in connection with a special service call.

Still another feature of the invention provides that in systems of the character referred to, that is, wherein a special service call first passes over a toll operator's manual position, then over a switching operator's semi-automatic controlling position and finally over a series of automatic switches terminating in a final selector switch, means provided at the first group selector switch is placed upon the completion of the selecting operations first under the control of the toll operator and then under the control of the final selector switch and the apparatus associated therewith, such means serving, unless operated in the required manner from the toll operator's position and then from the final selector switch, to prevent the through connection from such switching operator's position to the desired line. In the particular form of the invention herein disclosed, such means takes the form of a sequence switch which is first retained in a

given position until the extension of the special service call from the toll operator's position to the assigned trunk has been completed and subsequently is retained in a particular position thereof responsive to the finding busy of the desired line at the final selector, being moved from such position if the desired line is idle, but remaining in such position and causing the flashing of a busy lamp if such desired line is found busy.

A related feature of the invention provides that a special service call having been extended over a manual toll operator's position to a semi-automatic controlling switching operator's position and such switching operator having established a controlling condition to produce the extension of such special service call to the terminals of the desired line, the extension of the telephonic circuit of such desired line from such toll operator's position automatically takes place if such desired line is found idle, whereas such telephonic extension is prevented if such desired line is found busy. More specifically, if the desired line is found busy, the attention of the switching operator is attracted to this fact and such switching operator having determined that the call with which such desired line is already engaged is of the character over which such special service call takes precedence, she may by a manual operation cause the completion of the telephonic connection from the toll operator's position to the desired line, or, if the previously established call is one over which the special service call being extended does not take precedence, such switching operator may, by a manual operation, cause the breaking-down of the special service call as extended over the automatically operating machine switches and the transmission to the toll operator's position of a signal indicating the busy condition of the desired line and the breaking-down of the call as extended.

Still another feature of the invention involves the provision of signaling means associated with a switching operator's position whereby the toll operator is at all times informed of the condition of the call as it is being extended or is established, the embodiment of the invention herein disclosing a progress tone which will be received by such toll operator when listening in upon her connecting circuit over which the special service call in question is extended, so long as the selection of the desired line and the testing thereof is in progress and a busy tone which is extended to such connecting circuit upon the toll operator's position, if the desired line is found unconnectible to by this special service call. The toll operator when listening in upon this connecting circuit and hearing no tone thereon, knowing that the desired line is connectible to, and is idle if no conversation is heard thereon, or, if con-

versation is heard, is engaged in a prior call of the character over which the special service call being extended takes precedence. The operator may therefore in the latter event converse with the desired subscriber at her convenience, it being understood that, as herein disclosed, the extension of a special service call of a desired line busy with an ordinary or local connection, does not interfere with the electrical or telephonic condition of the desired line except upon the manual act of the toll operator, and having conversed with such desired subscriber from time to time as may be necessary or convenient, may either await the completion of the previous call or break down such call in the manner referred to and to be hereafter described.

Further features of the invention will sufficiently appear from the detailed description thereof in which Figure 1 discloses diagrammatically a toll operator's position; Fig. 2 a switching operator's position, together with a first group selector associated with the connecting circuit which appears upon the special switching operator's position; Fig. 3 discloses diagrammatically the second group selector and its associated apparatus; Fig. 4 discloses diagrammatically a third group selector and its associated apparatus; Fig. 5 discloses a final selector and its associated apparatus; Fig. 6 discloses the exchange ends of a plurality of subscribers' lines and the apparatus associated therewith; and Fig. 7 shows diagrammatically an established local connection.

The system disclosed as embodying the present invention will be best understood from a description of the operation thereof.

It will be assumed that the toll operator whose apparatus is diagrammatically indicated to the left of Fig. 1 and whose telephonic equipment is shown at 121 has received a call which requires to be extended to a subscriber's station connected to the exchange network served by the automatic apparatus disclosed. The toll operator depresses her order wire key 122 and is thereupon connected with the telephonic equipment 123 of the switching operator of the machine switching exchange and communicates to her the particulars of the desired extension. The switching operator, having received these particulars, assigns a trunk line, as, for example, that shown at 124, in the usual manner, and depresses the assignment key 125 individual to such trunk line.

The depression of this key causes the sequence switch 100, also individual to such trunk line, to move out of its first and into its second position. Such movement is caused by the energization of the relay 126 over a circuit including the contacts 127 of the assignment key and the sequence switch contact 102 top, the consequent energization

of the relay 126 closing a circuit for the sequence switch 100 over the sequence switch contact 103 bottom.

In the second position of sequence switch 100, the busy lamp 193 is intermittently lighted over a circuit including the interrupter 128 and the sequence switch contact 104 top. At this time, provided the toll operator has inserted the plug 129 into the jack 130 of the correct trunk 124, the relay 131 is energized due to the energization of the relay 132. This being the case, the guard lamp 133 will be prevented from lighting as the circuit for such lamp over the sequence switch contact 105 top is open at the back contact of relay 131. On the other hand, if the toll operator had inserted the plug 129 into the jack 130 of some other trunk than that assigned by the switching operator, the lamp 133 of both the trunk assigned and the trunk taken in error by the toll operator would be lighted, the one over the back contact and armature of the relay 131 and the sequence switch contact 105 top, and the other over the front contact and armature of the corresponding relay 131 and the sequence switch contact 106 bottom of the other trunk, the sequence switch 100 of which is, of course, still in its normal position.

In the second position of the sequence switch 100, the sequence switch contacts 107 bottom and 108 top are closed and a progress tone is applied to the assigned trunk so that the toll operator may be assured that she has plugged into the correct trunk and that the extension of the call is in progress. This progress tone is applied through the induction coil 139 and the interrupter 135, the sequence switch contact 109 bottom being closed at this time. Also in the second position of the sequence switch 100 a circuit is closed over the equipment searching sequence switch 190 by the closure of the sequence switch contact 110 bottom, which circuit also includes the back contact and armature of the relay 136 and the sequence switch contact 192 top associated with the equipment searching sequence switch 190. This sequence switch 190 searches for and seizes an idle registering and controlling equipment of a switching operator in the well known manner, the test relays 136 and 137 cooperating in such selection in the usual manner, the sequence switch contact 111 bottom being closed at this time. For a detailed description of the operation of the sequence switch 190 in the association of a controlling equipment with the group selector, reference is made to applicant's Patent No. 1,365,269, issued January 11, 1921.

An idle equipment having been found and seized and the relays 136 and 137 energized, the sequence switch 100 is moved out of its

second position and into its fourth position over a circuit including sequence switch contact 192 top, the armature and front contact of the relay 136 and the sequence switch contact 103 bottom. The relays 136 and 137 being deenergized as the sequence switch passes out of its 3rd position due to the opening of sequence switch contact 111 bottom and the local contact 101 of the sequence switch being open in the fourth position thereof, the sequence switch 100 stops in its fourth position. The switching operator now depresses her number keys in accordance with the numerical designation of the desired line, and such designation is taken up by the registers of the equipment taken for use. As soon as this has occurred a circuit is established in the usual manner by such equipment, including the sequence switch contact 112 top, to energize the relay 126 which closes a circuit including sequence switch contact 103 bottom, to drive the sequence switch 100 into its fifth position. In this position the operation of the tripping spindle 138 takes place in the usual manner, the circuit for the power magnet of such spindle including the sequence switch contact 113 bottom and the front contact and armature of the relay 126. In the operation of the tripping spindle, the usual interrupter 139, while not affecting the relay 126, intermittently shunts that portion of the fundamental circuit extending to the controlling equipment to cause the operation of such equipment in the well known manner. When the tripping spindle 138 has taken the required number of steps to cause the brush selection required, the fundamental circuit will be opened at the controlling equipment in the well understood manner and cause the deenergization of the relay 126 which opens the circuit for the power magnet of the tripping spindle and drives the sequence switch 100 into its sixth position over a circuit including the armature and back contact of relay 126, armature and back contact of the relay 140 and the sequence switch contact 103 top. In this position of the sequence switch 100, the usual operation of the brush carriage takes place at the group selector, indicated on Fig. 2, the circuit of the power magnet 141 for such brush carriage being closed over the sequence switch contact 110 top and the back contact and armature of the test relay 136. In such movement of the brush carriage, the test relays 136 and 137 operate in the usual manner to select and seize an idle trunk line of the selector group and cause the stoppage of the brush carriage by the deenergization of the power magnet 141 and the energization of the holding magnet 142 in the well known manner. The energization of the relay 136 in this operation causes the sequence switch 100 to move into its eighth position, the circuit for such move-

ment including the sequence switch contact 103 bottom.

In the 8th position of the sequence switch 100, the fundamental circuit extending from the controlling equipment is extended to the second group selector shown in Fig. 3 over the sequence switch contact 114 bottom and brush 143 and the sequence switch contact 115 top and the brush 144 respectively.

The operation of the second group selector is entirely normal and in the well understood manner, the sequence switch 200 associated therewith being driven from its normal position by the energization of the relay 221 as soon as the fundamental circuit is closed to this switch. In the second position the operation of the tripping spindle 222 takes place. In the third position the brush carriage is moved and the relays 223 and 224 test and seize an idle trunk in the selected group and bring the brush carriage to a stop with the selected set of brushes in contact with the terminals of such idle line. In the 6th position, the fundamental circuit and later the talking circuit is extended to the third group selector by the closure of the sequence switch contacts 202 and 203 top. The movement of the sequence switch out of its first position opens the sequence switch contact 204 and in the second position of the sequence switch 200 and subsequently the relay 225 is energized and the relay 136 at the first group selector deenergized due to the high resistance of such relay 225. Furthermore in the 6th position of the sequence switch 200 the sequence switch contact 205 top is closed, the circuit through the left winding of the relay 223 having been opened as the sequence switch left its 3rd position.

The operation of the third group selector shown in Fig. 4 now takes place, the relay 271 associated therewith being energized upon the closure of the fundamental circuit preparatory to controlling the third selection from the controlling equipment. The sequence switch 250 thereupon moves into its 2nd position and the tripping spindle 272 of such third group selector operates in the usual manner. Upon the completion of the operation of such tripping spindle the sequence switch 250 moves into its third position in which the movement of the brush carriage takes place in the usual manner. Upon the completion of such movement and the selection of an idle trunk line in the group selected by the operation of the tripping spindle, the relays 273 and 274 operate in the well known manner to seize such idle trunk line and drive the sequence switch into its sixth position, in which position the sequence switch contacts 252 top and 253 bottom being closed, the fundamental circuit is extended to the final selector indicated on Fig. 5.

Assume that the desired line is an ordi-

nary subscriber's line and that it is idle. The fundamental circuit being again closed at the controlling equipment, the relay 372 is energized and sequence switch 300 thereupon moves into its 2nd position in which position the operation of the tripping spindle 373 takes place, the circuit therefor including the sequence switch contact 303 bottom and the front contact and armature of the relay 372. The interrupter 374 of such tripping spindle places the usual intermittent shunt upon the portion of the fundamental circuit extending to controlling equipment over the sequence switch contact 305 bottom. Upon the completion of the operation of the tripping spindle 373 to cause it to release the desired set of brushes in the subsequent operation of the brush carriage, the relay 372 is deenergized and the sequence switch 300 moved out of its second position and into its fifth position.

Before the sequence switch 300 comes into its fifth position, the fundamental circuit will be again closed in the usual manner at the controlling equipment and the relay 372 being energized over such fundamental circuit, the movement of the brush carriage will take place in the fifth position of the sequence switch 300 due to the energization of the brush carriage power magnet 377, the interrupter 378 intermittently shunting the fundamental circuit, with the exception of the relay 372, in the well understood manner. The selected brushes of the final selector having in this manner been brought to the terminals of the line desired, that is, the line the numerical designation of which has been recorded by the operator upon the registering and controlling equipment taken for use, the fundamental circuit will be again opened and the relay 372 deenergized to stop the movement of the brush carriage and to drive the sequence switch 300 into its sixth position.

It should be noted that as the sequence switch 300 left its fifth position and opened the sequence switch contact 308 top, the relay 273 at the third group selector, which was energized over a circuit including the sequence switch contact 254 top and such sequence switch contact 308 top, is deenergized due to the insufficiency of current supplied thereto through the high resistance relay 371. It will be recalled that the sequence switch 300 only left its fifth position upon the completion of the final selection to be controlled over the fundamental circuit from the controlling equipment. The deenergization of the relay 273 drives the sequence switch 250 out of its sixth position over the sequence switch contact 251 top and such sequence switch comes to rest in its 7th position.

The sequence switch 300 having left its fifth position now comes to rest in its sixth

position, which position is utilized for the hunting of an idle trunk line to a private branch exchange when this is necessary or desirable. In this position the sequence switch contact 304 bottom being closed a circuit is established for the relay 396 which includes the back contact and armature of the relay 372, the sequence switch contact 304 bottom, the test brush 333, and the resistance 397, cut-off relay 399 and service meter 398 of the desired line. It should be noted that on the group or groups of switches of the exchange designed to be utilized for connecting to private branch exchange lines, each direct or ordinary line and each last line of respective groups of private branch exchange lines, in addition to having the usual service meter and cut-off relay attached to the third or test terminal of such line, has in parallel thereto the resistance 397 connected to such terminal. The private branch exchange lines of a group other than the last such line of the group are not provided with this shunt circuit. The resistance 397 is so proportioned to the battery and the service meter 398 and the cut-off relay 399 that lines provided with the shunt circuits including such resistance, when connected to by the final selector, will have sufficient potential upon the test terminals thereof that in the sixth position of the sequence switch 300 the relay 396 will be energized in any event, that is, whether the desired line is engaged or idle. Consequently, in the case assumed, as the sequence switch 300 comes into its sixth position, the relay 396 is energized closing a circuit over its front contact for the relay 380, such circuit including the sequence switch contact 323 and causing the energization of such relay, which in turn closes a circuit including the sequence switch contacts 324 and 311 top to drive the sequence switch 300 out of its sixth position.

The sequence switch 300, under the control of its local contact 301 now passes without stopping through its seventh and eighth positions. In the seventh position, the sequence switch contact 307 bottom being closed, a circuit is established from ground over such sequence switch contact, brush 276 of the third group selector, right armature and back contact of the ringing control relay 277, sequence switch contact 257 and relay 271 to energize said relay. As a consequence the sequence switch 250 is moved out of its seventh position, to come to rest in its tenth position, over a circuit including the sequence switch contact 258 bottom.

As the sequence switch 250 is running through its eighth position, the sequence switch 300 is also passing through its seventh or eighth position. Consequently a circuit is established for the relay 372 including the left winding of such relay, se-

quence switch contact 306, brush 275 of the third group selector, the left armature and back contact of the relay 277, sequence switch contact 253 top and sequence switch contact 256 bottom. The energization of the relay 372 closes a circuit for the right winding of the relay 385 including the sequence switch contact 308 bottom. The relay 385 energizes and closes for itself a locking circuit over its left winding, including its left armature and front contact and the front contact and armature of the relay 371.

It is the energization of the relay 385 at this time which causes the differentiation of the operation of the final selector shown between that when used for the purpose of extending a call over the toll operator's position and that when used to extend an ordinary or local call from the machine switching exchange of which it forms a part. It will be observed that the control of this relay is exercised from the third group selector, this third group selector being one of the relatively few such third group selectors over which trunk or toll calls may be extended in the manner described. The final selector shown, if it had been connected to by ordinary third group selectors, that is, a group selector carrying the usual or ordinary local service, would have operated substantially in the manner of ordinary final selectors, as will be hereinafter described, since such ordinary third group selectors would not be provided with the necessary means to cause the energization of the relay 385 as has just been described.

Continuing the description of the extension of a call from the toll operator's position to a line assumed to be an ordinary line and idle, the eighth position of the sequence switch 300 through which it passes without stopping is a testing position and in this position the line will be tested by the relays 379 and 380 in the usual manner and as such line is assumed to be idle is seized and has a busy guard placed upon the test terminal thereof by the operation of the relay 379. The operation of the relay 380 closes a circuit to drive the sequence switch 300 through its ninth position and into its tenth position where the sequence switch contact 324 being open and the relay 385 energized, it stops. In this position the sequence switch contact 307 bottom is open causing the movement of the sequence switch 250 into talking position as will be hereinafter described, and the sequence switch contact 307 top and 322 bottom are closed to connect the call as extended to the subscriber's line through the condensers 331 and 332. Furthermore, as the relay 385 is at this time energized and the sequence switch contact 323 is open, the circuit of the test

relays 379 and 380 is open and no ground exists thereon. Consequently the called line is not made busy and is free to call and be called in the usual manner, the extension thereto through the condensers 331 and 332 affecting it in no way and serving only for purposes to be hereinafter described.

The opening of the sequence switch contact 307 bottom as described, when the sequence switch 300 comes into its tenth position, causes the deenergization of the relay 271, which thereby closes a circuit over the sequence switch contact 259 to drive the sequence switch 250 into its thirteenth position which is the talking position of this sequence switch.

During the operation of the registering and controlling equipment to control the second and third group selectors and the final selector, the relay 126 was maintained energized, as is usual in systems of this character, over a circuit extending from such equipment to such relay, including the sequence switch contact 112 bottom. As is also usual in systems of this character, immediately upon the completion of the final selection controlling operation of this equipment, the circuit for such relay 126 was opened at the equipment, and such relay deenergizing drives the sequence switch 100 out of its eighth position and into its ninth position.

In the ninth position, assuming that the toll operator has inserted the plug 129 into the jack 130, a circuit is found to drive the sequence switch into its eleventh position, such circuit including the front contact of the relay 131 and the sequence switch contact 106 top. In the eleventh position of the sequence switch 100, the relay 140 is deenergized, although such relay has been but momentarily energized due to the brief closure of a circuit including the sequence switch contact 260 of the third group selector, and then released, the desired line being idle, the sequence switch 250 having been moved out of its tenth position and the sequence switch contact 260 opened. The relay 140 being, therefore, deenergized, the sequence switch 100 will be moved direct into its thirteenth position, which is the talking position of this sequence switch. In this position the progress tone is removed from the trunk line extending to the toll operator's position, the sequence switch contacts 107 bottom and 108 top being opened. The connection is now established directly from the cord circuit appearing on the toll operator's position through to the desired subscriber's line, such circuit including, on the one hand, sequence switch contacts 107 top and 108 bottom, and, on the other hand, condensers 331 and 332. When the sequence switch 100 left its eighth position, the circuit connecting busy lamp 193 through the interrupter

128 was opened and an alternative circuit for such lamp direct to ground was connected over the sequence switch contact 116, so that this lamp which had, up to that time, been intermittently lighted, is now continuously lighted to indicate to the operator that the selection controlling operations have been completed. The guard lamp 133 is now extinguished.

The toll operator may now listen in upon the desired line and, hearing no conversation taking place thereon, may proceed to complete the connection or may wait until such time as the completion of the connection may be desired. If she does not immediately complete the connection, she may at any time listen in upon the desired line and, if the desired line is then busy, may inform the subscriber thereon of the fact that a toll call is awaiting his attention, and may break down the then existing local connection as will be hereinafter described. On the other hand, assuming that the subscriber's line is still free, all that is necessary for her to do is to operate the ringing key 145 to apply ringing current to the connection as extended from her position. As a matter of fact, the ringing current as actually impressed upon the connection by the action of the ringing key 145, does not reach the subscriber's station to operate the signal located thereon, but there is no reason why it is necessary that the toll operator should be aware of this fact, it being necessary for her to know only that, having been connected to the desired line, such line being idle, it is merely necessary for her to operate her ringing key in order to complete the connection and cause the signaling of the desired subscriber. To accomplish this, the operation of the ringing key 145 serves to energize the relay 278 at a third group selector, the circuit including the condenser 279, the relay 278 being adapted to be energized by either alternating or direct current. Each time the relay 278 is energized by the operation of the ringing key 145, it closes a circuit for the ringing control relay 277, which relay is therefore correspondingly energized and connects over its front contacts ringing current to the brush 276 and ground to the brush 275.

The connection of ground to the brush 275 causes the energization of the relay 372 over the sequence switch contact 306, and this relay energizing, drives the sequence switch 300 out of its tenth, eleventh, twelfth, thirteenth, fourteenth and fifteenth positions, the relay 372 being maintained energized after the opening of the sequence switch contact 306 by a circuit including the front contact of the relay 371, the left armature and front contact of the relay 385, the right winding of the relay 372, the left winding of the relay 383, sequence switch contact 130

309 bottom and relay 384. The sequence switch 300 will stop in its sixteenth position, however, due to the opening of the sequence switch contact 302. The desired subscriber's line is now being rung directly from the armatures of the relay 277, the sequence switch contacts 313 top and 316 top closing a direct metallic path between such armatures and the desired subscriber's station. Preferably, but not necessarily, the condensers 331 and 332 are so proportioned that, although the toll operator may listen in upon the desired line and may converse with the subscriber thereon, they will not allow the transmission of sufficient ringing current to such line and the ringing of the subscriber's line will only take place when the sequence switch contacts 313 top and 316 top have been closed as described.

Upon the response of the called subscriber no further operation of the group selectors or final selector or the apparatus associated therewith is necessary, the called subscriber's line being connected directly to the repeating coil 280 and supplied with battery therefrom over the sequence switch contacts 256 top and 261, such repeating coil on the other hand being connected directly to the connecting circuit 146 upon the toll operator's position, the sequence switch 250 being in its thirteenth position, the sequence switch 200 being in its sixth position and the sequence switch 100 being in its thirteenth position.

Upon the termination of conversation after a successful call as described restoration takes place under the control of the toll operator as is customary. The initiation of the restoration of the selector switches takes place upon the removal by the toll operator of the plug 129 from the jack 130. This causes the deenergization of the relay 132 and the consequent deenergization of the relay 131, and the sequence switch 100 is driven out of its thirteenth and into its seventeenth position by a circuit including sequence switch 105 bottom and the back contact and armature of the relay 131. In the seventeenth position of the sequence switch 100, the first group selector brush carriage is restored to normal position in the usual manner and such restoring movement being completed the sequence switch 100 is moved into its eighteenth position. In this position a circuit is again established over the armature and back contact of the relay 131 and the sequence switch contact 105 bottom and the sequence switch returns to its first or normal position.

It may be noted that, the sequence switch contact 113 top being closed from the fourteenth to fourth position, the tripping spindle 138 will be restored by the operation of the lower contacts of the interrupter 139 in ample time for a subsequent connection

even in the case of a premature release, since in the new connection to be established such tripping spindle is not required until the sequence switch 100 reaches its fifth position.

Immediately that the sequence switch 100, associated with the first group selector, left its thirteenth position in the restoring operation just described, the circuit of the relay 225 was opened at the sequence switch contact 111 top and the second group selector, both the brush carriage and the tripping spindle thereof, and the sequence switch 200 associated therewith are restored to normal in the well understood manner.

Correspondingly the movement of the sequence switch 200 out of its thirteenth position opens the circuit of the relay 281 at the sequence switch contact 205 top and the third group selector with the brush carriage and tripping spindle thereof and the sequence switch 250 associated therewith are restored to their normal positions in the usual manner.

As the sequence switch 250 left its thirteenth position the circuit of the relay 371 is opened at the sequence switch contact 254 top, the deenergization of such relay driving the sequence switch 300 into its seventeenth position wherein, if the called subscriber has not as yet restored his receiver to its switch hook, the relay 372 is energized over a circuit including the sequence switch contact 312 bottom, the subscriber's line, the sequence switch contact 313 top and the sequence switch contact 307 bottom. The relay 372 being deenergized, however, by the fact that the receiver of the called subscriber has been restored to its switch hook, the sequence switch 300 is driven out of its seventeenth position and into its eighteenth position by a circuit including the armature and back contact of relay 372 and sequence switch contact 304 top.

In the eighteenth position of the sequence switch 300 the brush carriage of the final selector is restored in the well understood manner, and, having been restored, the sequence switch 300 is driven into its first or normal position. The tripping spindle 373 has already been restored, the sequence switch contact 303 having been closed in the twelfth position of the sequence switch 300.

In order that a successful call which has been established to the called subscriber's line from the toll operator's position may not be disturbed when established, only such calls will traverse third group selectors provided with means, such as the sequence switch contact 256 bottom to apply at the proper time, a ground connection to the brush 275 of the third group selector, and all such calls will pass over a third group selector of this character. Consequently in the extension of all toll calls

to a final selector of the character disclosed, the relay 385 will be energized and locked up in the seventh or eighth position of the sequence switch 300, whereas in the extension of ordinary calls over such final selectors, such relay will only be energized in the seventeenth position of such sequence switch.

The relay 385 having been energized, the call assumed being a toll call, when the sequence switch 300 came into its thirteenth position the relays 383 and 384 were energized over a circuit including the armature and front contact of the relay 371, left armature and front contact of the relay 385, the right winding of the relay 372, the left winding of the relay 383, sequence switch contact 309 bottom, and relay 384. The attraction of the left armature of the relay 384 closes the circuit through the winding 329 of the busy tone induction coil, the interrupter 328 and the tone producing apparatus 351. The attraction of the right armature of the relay 384 and the armature of the relay 383 closes in the sixteenth position of the sequence switch 300, that is, the talking position thereof, a circuit connected to the test terminal of the desired line and therethrough to the test terminal of such line on all of the other final selectors having access thereto, including the brush 333, front contact and right armature of the relay 384 and front contact and armature of the relay 383, and the winding 337 of the busy tone induction coil which is, of course, in inductive relation to the winding 329. The tone thus applied indicates that the called subscriber is engaged on a toll call and must not be interrupted. The tone is differentiated from the ordinary busy tone as will be hereinafter described.

Extension of a local call to an idle desired line.

Fig. 7 shows diagrammatically an established connection between a local calling line 400 and a called line. The final selector indicated at 401 is the same as the switch shown in detail in Fig. 5 and is in fact available for toll connections as well as for local connections.

In the case where the idle selector such as shown in Fig. 5 is used for a local call, the relay 385 will not be energized in the seventh or eighth position of the sequence switch 300. Assuming that the desired line was idle, the relay 380 is energized in the eighth position of the sequence switch 300 and is maintained continuously energized thereafter until the breaking down of the call after the completion of conversation by a circuit including back contact and left armature of the relay 385 and the front contact and armature of the relay 371. Consequently the sequence switch 300 will not stop

in its ninth, tenth or eleventh positions but will continue in motion until it reaches its thirteenth position. In this position ringing automatically takes place under the control of the interrupters 326, 381 and 382 which are coupled together and, as indicated, rotate in a counter-clockwise direction. Immediate ringing takes place by the closure of the sequence switch contact 312 top and the sequence switch contact 313 bottom. The sequence switch remains in its thirteenth position until, due to the rotation of the interrupter 381, a circuit is closed including said interrupter and the sequence switch contact 314 to energize the relay 372 to drive the sequence switch 300 into its fourteenth position. The ringing will be continued in the fourteenth position of the sequence switch and said sequence switch will remain in such position until, due to the subsequent closure of a circuit including the interrupter 382 and the sequence switch contact 315, the relay 372 is again momentarily energized to drive the sequence switch 300 into its fifteenth position. In this position the sequence switch contact 312 top being opened, the continuous ringing of the desired line ceases, and there is substituted therefor, over the sequence switch contact 316 bottom, intermittent ringing controlled by the interrupter 326.

At any time during the ringing, that is, while the sequence switch 300 is in its thirteenth, fourteenth or fifteenth position, that the called subscriber responds by removing his receiver from its switch hook, the relay 383 is energized and the sequence switch 300 is immediately driven into its sixteenth or talking position thereby establishing the through connection to the desired subscriber and cutting off the ringing of such subscriber.

The restoration of the final selector after the establishment of a connection on a call of this character takes place in the usual manner, being initiated by the deenergization of the relay 371 and being delayed in the seventeenth position of the sequence switch 300 until the called subscriber has restored his receiver to its switch hook. In a connection of this character, it will be observed that since the relay 385 was not energized, the relay 384 was not energized, and no busy tone was applied to the test terminal of the called line over the brush 333.

Assume that in the extension of an ordinary or local call to a desired subscriber over a final selector switch of the character shown in Fig. 5, such desired line has been found busy, either with a local call or with a toll call. In this case relays 379 and 380 would not be energized in the eighth position of the sequence switch 300, and the sequence switch 300 would stop in its ninth position. In this position a busy tone would

be heard by the calling party, if the local network is of the full automatic type, or by the semi-automatic operator or such operator and the calling party as may be preferred, if the local network is of the semi-automatic type. The closure of the sequence switch contacts 307 bottom and 322 top includes in circuit with the calling line as extended to this final selector the windings 330 of the busy tone induction coil and the sequence switch contact 309 top causes the intermittent energization, due to the interrupter 327, of the relay 384 which in turn causes the intermittent connection of the interrupter 328 and tone producing device 351 to the winding 329 of such busy tone induction coil.

The relation of the interrupter 327 to the interrupter 328 is such that these interrupters being coupled together the circuit will be closed through the interrupter 328 at all times when the circuit is closed through the interrupter 327, the circuit through the interrupter 328 being closed for a longer period, however, than the circuit through the interrupter 327, for purposes which will be hereinafter described. The calling subscriber or the semi-automatic operator hearing the busy tone will cause the breaking down of the connection, as it has been extended, in the usual manner. The deenergization of the relay 371 so produced drives the sequence switch 300 into its eleventh position in which position the restoration of the switch carriage takes place in the well known manner, upon the completion of which sequence switch 300 is driven into its twelfth position where the circuit over the armature and back contact of the relay 371 and sequence switch contact 318 being again established, the sequence switch 300 is driven into its seventeenth position and through such position (the relay 372 being deenergized) and the eighteenth position (the brush carriage being in its normal position) into its normal position.

Extension of toll call to local busy subscriber's line.

Assume now that when, in the extension of a toll call to an ordinary or direct subscriber's line, the sequence switch 300 passed through its eighth position such line was found to be busy in connection with a local or ordinary call. The relays 379 and 380 are therefore not energized and the sequence switch 300 stops in its ninth position. In this position the switching operator hears a busy tone precisely as the calling subscriber or the semi-automatic operator in the extension under similar circumstances of an ordinary call. This busy tone is, however, an intermittent tone applied only for the period of the closure of the interrupter 327 and no tone would be heard when the left armature

of the relay 384 had retracted, as it has been assumed that the call with which the desired line was busy was a local or ordinary one.

As the sequence switch 300 left its fifth position, the sequence switch 250 was moved into its seventh position and as the sequence switch 300 came into its seventh position, the sequence switch 250 was moved out of its seventh position in the manner hereinbefore described in connection with the extension of a toll call to an idle line. In the tenth position of the sequence switch 250, therefore, since the sequence switch 300 has stopped in its ninth position, a circuit is established and maintained for the relay 271 over the sequence switch contact 257, the brush 276, and the sequence switch contact 307 bottom. Furthermore a circuit closed in the seventh position of this sequence switch is maintained in this position through the sequence switch contact 260 (around the condenser 279 and the condenser 262 in the second group selector side of the repeating coil 280), for the relay 278 in series with the supervisory relay 140 at the first group selector. This circuit was closed before the sequence switch 100 at the first group selector reached its eleventh position and such sequence switch therefore stops in its eleventh position. Both the relay 271 and the relay 278 being energized at this time the sequence switch 250 stops in its tenth position. It may be noted that the sequence switch 100 was driven out of its eighth position and the sequence switch 300 out of its fifth position practically simultaneously. As the sequence switch 250 was driven out of its sixth position, immediately upon the movement of the sequence switch 300 from its fifth position, the sequence switch 250 will close the contact 260 to energize the relay 140 as described, before the sequence switch 100 can possibly have come into its eleventh position.

In the eleventh position of the sequence switch 100 in which it now rests, the circuit of the busy lamp 133 is closed through the interrupter 128 by a closure of the sequence switch contact 104 bottom. The flashing of the busy lamp indicates to the operator that the desired line is busy. She thereupon, in order to determine whether it is locally busy or busy with a direct toll call, depresses her listening key 147 and listens in on the line as extended and is able to determine from the tone impressed thereon that the desired line is locally busy. This connection of her telephone set 123 takes place over the center contacts of the listening key 147 and the sequence switch contacts 114 top and 115 bottom. The impedance of the relay 140 and the impedance coil 148 is sufficient to allow her to effectively listen in upon the call as extended. The closure of the bottom contact of the listening key 147, when operated

by the switching operator, causes the cutting off, for the time being, of the order wire from the switching operator's telephone set. Having determined that the desired line is only locally busy, the switching operator, while her listening key 147 individual to the connecting circuit which is in use is still depressed, operates the common advance key 149 of her position, which closes a circuit to drive the sequence switch 100 out of its eleventh position and into its thirteenth position, which, as has been noted, is the talking position of the sequence switch.

As the sequence switch 100 leaves its eleventh position, the sequence switch contacts 114 top and 115 bottom are opened and as the sequence switch contacts 107 top and 108 bottom are not closed until the thirteenth position of this sequence switch, the circuit which has energized the relay 278 at the third group selector in series with the relay 140 at the first group selector is opened and such relay 278 deenergizes, closing a circuit including the sequence switch contact 262 top to drive the sequence switch 250 into its thirteenth position. In passing through its eleventh position, a circuit is established including the armature and front contact of the relay 271, the sequence switch contact 258 top, the sequence switch contact 253 top, back contact and left armature of the relay 277, brush 275 and sequence switch contact 306, to energize the relay 372, whereby the sequence switch 300 is moved out of its ninth position and into its tenth position, in which position, as has been before described, the call is further extended to the desired line through the condensers 331 and 332, although the relays 379 and 380 being deenergized no busy guard is placed upon such desired line by the final selector in question.

The toll operator may now listen in by the depression of her listening key 150 and will no longer receive the progress tone produced by the tone repeating coil 139 as the sequence switch contacts 107 bottom and 108 top are now opened. Having listened in she may converse with the wanted subscriber and inform him that as his line is desired in connection with a toll connection, she is going to break down the already established local connection for the purposes of such toll connection. To accomplish this, the operator depresses the ringing key 145 precisely as though she were ringing a desired idle line, as has been hereinbefore described. The relay 278 is, as a consequence, energized and, the sequence switch contact 263 being closed, produces the energization of the relay 277. A ground is thereby placed upon the brush 275 and the relay 372 is energized to drive the sequence switch 300 out of its 10th position and into its thirteenth position, through which position, as well as its fourteenth position and fifteenth position, it will

be moved, due to the energization of the relays 372, 383 and 384, by the closure of the sequence switch contact 309 bottom, the relay 385 having been energized and locked up in the seventh or eighth position of the sequence switch 300, the call being extended being a toll call. Due to the opening of the sequence switch contact 302, the sequence switch 300 comes to rest in its sixteenth position.

As the sequence switch 300 was passing through its thirteenth to fifteenth positions, a circuit was closed by the sequence switch contact 317, the relays 383 and 384 being energized, to connect a direct path from ground to the test brush 333, which is now in contact with the test terminal of the desired line. This direct path to ground causes the shunting and falling off of the test relays of the switch (final selector or first line finder) by which the desired line is connected to the connection with which it has been previously engaged and the consequent breaking down of such previous connection. It should be noted, however, that although by this means the previous local connection is effectively broken down the condition by which such breakdown is accomplished is removed when the sequence switch 300 comes into its sixteenth or talking position and the normal busy guard produced by the operation of the relays 379 and 380 is restored, so that no detrimental effect can take place in other final selectors testing for the desired line which has now been seized. In the sixteenth position, there is also, as has been previously described, placed upon the test terminal of the desired line a busy guard indicative of the fact that the desired line is engaged in a toll call, the placing of which busy tone upon such terminal being difficult, if not impossible, if the condition producing the breaking down of the local connection were still maintained upon the test terminal of the desired line.

The toll operator is now able to converse with the desired subscriber or to ring him, if he has replaced his receiver upon his switch hook, in the ordinary way, and conversation may take place, upon the termination of which the restoration of the apparatus will take place as hereinbefore described in connection with a successful call to an idle desired line.

Attempted connection to a "toll busy" desired line.

The attempted connection with a "toll busy" desired line takes place precisely as has been described with regard to the connection with a local busy desired line up to the point where the sequence switch 300 comes into its ninth position. The sequence switch 300 is now in its ninth position, the sequence switch 250 is in its tenth position

and the sequence switch 100 is in its eleventh position, as has been hereinbefore described. Responsive to the flashing of the busy lamp 133, the switching operator depresses her listening key and hears a combination of busy tones which indicate to her that the desired line is busy in a previously established toll connection. This combination of busy tones is produced in the following manner: It will be recalled that when a final selector has seized a desired line for a toll call the sequence switch 300, associated with such final selector in its sixteenth position has closed a circuit including the winding 337 of the busy tone repeating coil, the armature and front contact of the relay 383, the right armature and front contact of the relay 384, and the brush 333 of such final selector. Since, at the same time, a circuit is closed for the winding 329 of the busy tone repeating coil through the left armature and front contact of the relay 384 and the interrupter 328 to the tone producing apparatus indicated, an intermittent tone measured by the period the interrupter 328 closes the circuit last described is applied to the test terminal of the line seized. As has been before mentioned, the period of closure of the interrupter 328 is greater than the period of closure of the interrupter 327 although such interrupters being coupled and preferably common to the exchange, the interrupter 328 is closed at all times that the interrupter 327 is closed.

The switching operator in the subsequent toll call for this desired line busy with a prior established toll call will find impressed upon the subsequent call as extended first the busy tone direct from the tone producing apparatus through the interrupter 328 and the front contact and left armature of the relay 384, while such relay 384 is intermittently energized by the interrupter 327 as has been described. As such interrupter 327 opens, however, the armatures of the relay 384 retract and, while the left armature of such relay moves from its front to a back contact, no further tone is received by the switching operator. Immediately, however, that such left armature reaches its back contact, the busy tone will be heard by her which is impressed upon the test terminal of the desired line due to the prior establishment to such desired line of another toll call. It is obvious that this arrangement produces a distinctive busy tone which may be readily differentiated by the switching operator from the normal busy tone heard by her when the desired line is locally busy. She therefore knows that it is not expedient that the previously established connection with the desired line should be broken down and therefore restores her listening key 147 to normal position and operates the assignment key 125 associated with the connecting

circuit shown together with the common release key 150 of her position. This causes the energization of the relay 151, which closes a locking circuit for itself over its left armature and will be maintained energized until, upon the movement of the sequence switch 100 into its sixteenth position, as hereinafter described, the sequence switch contact 117 is closed to shunt the winding of such relay and causes its deenergization. The resistance 152 is provided for the usual purpose of preventing damage to the battery when this shunt circuit is closed.

Upon the energization of the relay 151 and the restoration of the assignment key 125, a circuit is established including the central normal contact of the assignment key 125, the sequence switch contact 118 top and the right armature and contact of the relay 151, to drive the sequence switch 100 out of its eleventh position and into its seventeenth position. In the fifteenth to eighteenth positions of the sequence switch 100 the toll busy tone is impressed upon the trunk line 124 extending to the toll operator's position, the sequence switch contact 107 bottom, 108 top and 109 top being closed. This toll busy tone is shown as differentiating from the progress tone by the interposition of the interrupter 153 in the circuit of the interrupter 135, but such toll busy tone may be obviously produced in any desired manner.

As the sequence switch 100 was leaving its thirteenth position in moving from its eleventh into its seventeenth position as just described, the initiation of the restoration of the second group selector took place by the opening of the sequence switch contact 111 as hereinbefore described. Consequent upon the operation of the restoration of the second group selector so produced, the restoration of the third group selector was initiated in the manner hereinbefore described, and similarly the restoration of the final group selector, restoration in this case of the final group selector taking place from the ninth position of the sequence switch 300, the sequence switch being driven out of its ninth and through its tenth position by the deenergization of the relay 371, the brush carriage of the final selector being restored in the eleventh position of such sequence switch which is then moved into its thirteenth position. From this position the sequence switch will be moved into its seventeenth position by the continued deenergization of the relay 371, in which position, the relay 372 being deenergized the brush carriage having been restored, it will continue in motion to its eighteenth position, in which position in turn the interrupter 378 being in its normal position, the relay 372 will be energized to drive the sequence switch 300 into its first or normal position over a circuit including the sequence switch contact 302. All of the

apparatus of the second and third group selectors and the final selector is thus restored to normal. Upon the coming of the sequence switch 100 into its seventeenth position, the restoration of the brush carriage and the first group selector takes place and the sequence switch 100 passes into its eighteenth position. In this position the sequence switch 100 awaits the removal by the toll operator of the plug 129 from the jack 130 after she has heard the toll busy tone from the switching operator's position produced as above described. When, due to the removal of such plug 129, the relays 132 and 131 are deenergized in the eighteenth position of the sequence switch 100, such sequence switch is restored to its first or normal position by a circuit including the armature and back contact of the relay 131 and the sequence switch contact 105 bottom.

Private branch exchange trunk lines.

In the group or groups of final selectors provided for operating to select an idle one of a group of private branch exchange trunk lines which group or groups of final selectors may comprise the whole or only a part of the final selectors of the exchange, the private branch exchange trunk lines of a group except the last trunk line of the group are differentiated from such last trunk lines of groups and private or ordinary subscribers' lines by the fact that the cut-off relays 399 and message registers 398 are not shunted by the resistance 397 as indicated in connection with the ordinary or direct subscriber's line 393 shown at the upper part of the right hand side of Fig. 6 or the last private branch exchange trunk line 395 of a group as shown at the lower part of the right hand side of Fig. 6. Such a private branch exchange trunk line other than the last trunk line of such a group is indicated at 394, the lines 394 and 395 are assumed to form a group of private branch exchange trunk lines, the final selector in testing such group first testing the line 394 and subsequently line 395 if the line 394 is found busy. It is obvious that this group, although shown as comprising only two private branch exchange trunk lines may comprise three or more of such trunk lines all of the trunk lines of such group being arranged similarly to such line 394 except the last line of the group, 395, which has connected to its test terminal the resistance 397 in a manner hereinbefore described.

The extension of a connection to a private branch exchange trunk line takes place precisely in the same manner as in the case of an extension of a connection to an ordinary subscriber's line, except in regard to the sixth position of the sequence switch 300. To connect with a private branch exchange trunk line, the numerical designation indi-

cated by the operator upon her number keys is always the numerical designation of the terminals of the first private branch exchange trunk line. Consequently when the sequence switch 300 comes into its sixth position, the brushes of the final selector rest upon the terminals of the first private branch exchange trunk line of the group leading to the private branch exchange to which connection is desired. If such first trunk line of the group is idle, the relay 396 will be energized, causing the energization of the relay 380, as has been before described and the sequence switch 300 passes out of its sixth position to again test the desired line by means of the relays 379 and 380 in the eighth position thereof and thence move into its thirteenth position precisely as in connection to an ordinary subscriber's line hereinbefore described. If, on the other hand, the first trunk line of the group is busy, the relay 396 will not be energized and the relay 380 consequently remaining with its armature retracted closes a circuit including the sequence switch contact 324 and the sequence switch contact 319 bottom to energize the brush carriage power magnet 377 to move the brushes of the final selector into contact with the next private branch trunk line of the group selected. If this private branch exchange trunk line is also busy the brush carriage continues in motion. As soon, however, as the brushes of the final selector come into contact with an idle private branch exchange trunk line of the group, the relay 396 is energized followed by the energization of the relay 380 opening the circuit of the power magnet 377 and closing the circuit including the sequence switch contact 311 top to drive the sequence switch 300 out of its sixth position from whence the operation of the final selector and the sequence switch 300 takes place as has been hereinbefore described.

Assuming that all of the private branch exchange trunk lines, except the last trunk line of the group, are busy, the brushes of the final selector will finally come in contact with the last private branch exchange trunk line of the group such as the line 395. When this occurs, whether such last trunk line of the group is busy or idle, the relay 396 will be energized due to the connection of the circuit including the resistance 397 with the test terminal of this trunk line. The sequence switch 300 will therefore be driven out of its sixth position. In passing through its eighth position, the relays 379 and 380 will test the line 395 to determine whether it is busy or idle. If it is found idle, the extension of the call will proceed precisely as has been described in connection with the extension of a call to an idle ordinary or direct subscriber's line. On the other hand, if the line 395 is found busy, the

operation of the final selector apparatus thereafter takes place precisely as in the case of an ordinary or direct subscriber's line which is found busy, that is, among other things the busy tone will be returned to the switching operator and she will be able to determine whether such line is locally busy or toll busy, and, if locally busy, the local call may be broken down by the toll operator in the manner hereinbefore described.

What is claimed is:

1. In a telephone exchange system, a calling line, a called line, means for establishing a connection between said lines, means for rendering the called line busy during such connection, a second calling line, an operator's position, a second operator's position, means at said first position for extending the second calling line to said second position, a series of automatic switches, means for operating said switches to extend the second calling line to said called line, means for notifying the operator at said second position of the busy condition of the called line, and means under the control of said first operator for releasing said first connection.

2. In a telephone exchange system, a calling line, a called line, a series of switches for establishing a connection between said lines, means for rendering the called line busy during said connection, a second calling line, an operator's position, a second operator's position, means at said first position for extending the second calling line to said second position, a second series of switches, means at said second position for controlling the operation of said second series of switches to extend the second calling line to said called line, means for notifying the operator at said second position of the busy condition of the called line, and means under the control of the first operator for releasing said first connection.

3. In a telephone exchange system, a calling line, a called line, a series of switches for establishing a connection between said lines, means for rendering the called line busy during said connection, a second calling line, an operator's position, a second operator's position, means at said first position for extending the second calling line to said second position, a second series of switches, means at said second position for controlling the operation of said second series of switches to extend the second calling line to said called line, tone producing means for notifying the operator at said second position of the busy condition of the called line, and means under the control of the first operator for releasing said first connection.

4. In a telephone exchange system, a calling line, a called line, a series of switches for establishing a connection between said lines, means for rendering the called line busy

during said connection, a second calling line, an operator's position, a second operator's position, means at said first position for extending the second calling line to said second position, a second series of switches, means at said second position for controlling the operation of said second series of switches to extend the second calling line to said called line, means for notifying the operator at said second position of the busy condition of the called line, and a manually operable key at the first operator's position for releasing said first connection.

5. In a telephone exchange system, a calling line, a plurality of final selectors, a called line having terminals in said selectors, a series of switches including one of said selectors for establishing a connection between said lines, means for rendering the called line busy, a second calling line, an operator's position, a second operator's position, means at said first position for extending said second calling line to the second operator's position, a second series of switches, means for operating said switches to extend the second calling line to said called line, means for notifying the second operator of the busy condition of the called line, means controlled by the first operator for altering the electrical condition of said terminals, and means responsive to such alteration for releasing said first connection.

6. In a telephone system, a calling line, a plurality of switches, a called line having test terminals in said switches, means including one of said switches for establishing a connection between said lines, means for placing a condition on the test terminal to render the called line busy, a second calling line, an operator's position, a second operator's position, means at said first position for extending said second calling line to the second operator's position, means including one of said switches for extending the second calling line to said called line, means for notifying the operator at said second position of the busy condition of the called line, means controlled by the operator at said first position for changing the condition on the test terminal of the called line, and means responsive to such change for releasing said first established connection.

7. In a telephone exchange system, called lines, calling lines of two different classes, a series of switches for establishing a connection between a calling line of one class and one of said called lines, an operator's position, a second operator's position, means controlled by said operators for extending a connection from a calling line of the other class to said called line, means for notifying the operator at said second position of the character of the calling line that is connected to the called line, and means under the control

of said first operator for releasing said first connection.

8. In a telephone exchange system, called lines, calling lines of two different classes, a series of switches for establishing a connection between a calling line of one class and one of said called lines, an operator's position, a second operator's position, means controlled by said operators for extending a connection from a calling line of the other class to said called line, tone producing means for notifying the operator at said second position of the character of the calling line that is connected to the called line, and means under the control of said first operator for releasing said first connection.

9. In a telephone exchange system, called lines, calling lines of two different classes, a series of switches for establishing a connection between a calling line of one class and one of said called lines, an operator's position, a second operator's position, means controlled by said operators for extending a connection from the calling line of the other class to said called line, means for producing a plurality of different tones for notifying the operator at said second position of the character of the calling line that is connected to the called line, and means under the control of the operator at said first position for releasing said first connection.

10. In a telephone exchange system, called lines, calling lines of two different classes, a plurality of final selector switches, means including one of said switches for establishing a connection between a calling line of either class and one of said called lines, an operator's position, means for producing a plurality of tones of different character to inform the operator of the character of the calling line that is connected to a called line when a subsequent connection is extended to such called line, and manual means for re-

leasing said first connection as soon as a subsequent connection is extended to the called line.

11. In a telephone exchange system, called lines, calling lines of two different classes, a plurality of final selector switches, said called lines having terminals in said switches, means including one of said switches for establishing a connection between a calling line of either class and one of said called lines, an operator's position, means for producing a plurality of tones of different character to inform the operator of the character of the calling line that is connected to a called line when a subsequent connection is extended to such called line, and manual means for changing the condition of said terminals to release said first connection as soon as a subsequent connection is extended to the called line.

12. In a telephone exchange system, a calling line, a plurality of final selectors, a called line having terminals in said selectors, a series of switches including one of said selectors for establishing a connection between said lines, means for rendering the called line busy during said connection, a second calling line, an operator's position, a second series of switches including one of said selectors for establishing a connection between said second calling line and said called line, means for informing the operator of the busy condition of the called line, means controlled by the operator for grounding the called line terminals, and means responsive to the grounding of said terminals for releasing said first connection, said ground being removed as soon as the release of said first connection is initiated.

In witness whereof I hereunto subscribe my name this 11th day of July, A. D. 1918.

LIPA POLINKOWSKY.