

F. G. AGRELL.
TELEPHONE SYSTEM.
APPLICATION FILED OCT. 10, 1908.

1,061,650.

Patented May 13, 1913.

5 SHEETS—SHEET 1.

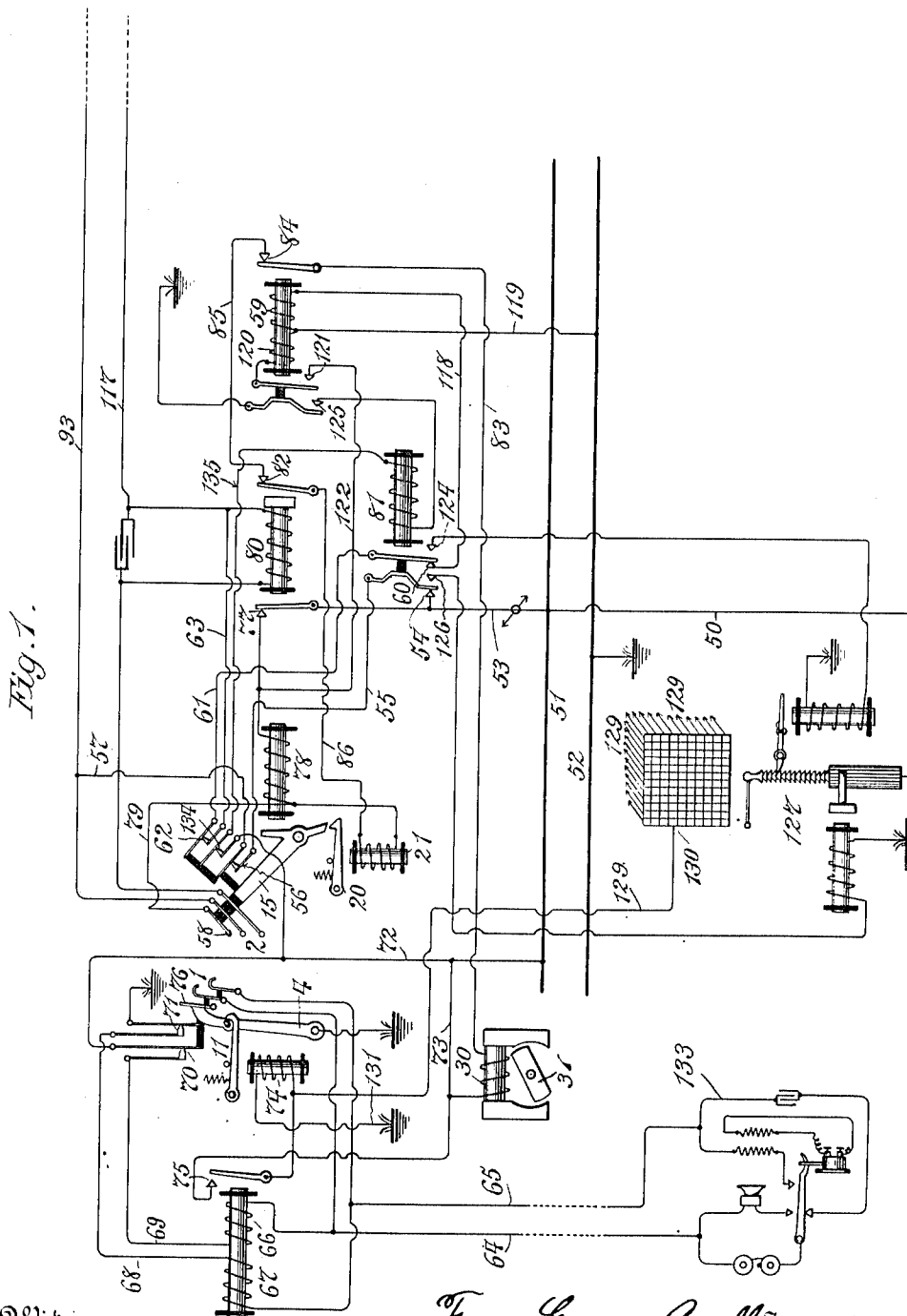


Fig. 1.

Witnesses
Edward Rowland,
Gmt. Fred. M.

Fran Gunnar Agrell, Inventor
By his Attorney, Lewis J. Doolittle

APPLICATION FILED OCT. 10, 1908.

5 SHEETS—SHEET 2.

1,061,650.



Witnesses
Edward C. Rowland.
Gust. Rev. Wm.

Trans Gummor Agrell, Inventor
By his Attorney Lewis J. Soolivale

1,061,650.

Patented May 13, 1913.

5 SHEETS—SHEET 3.

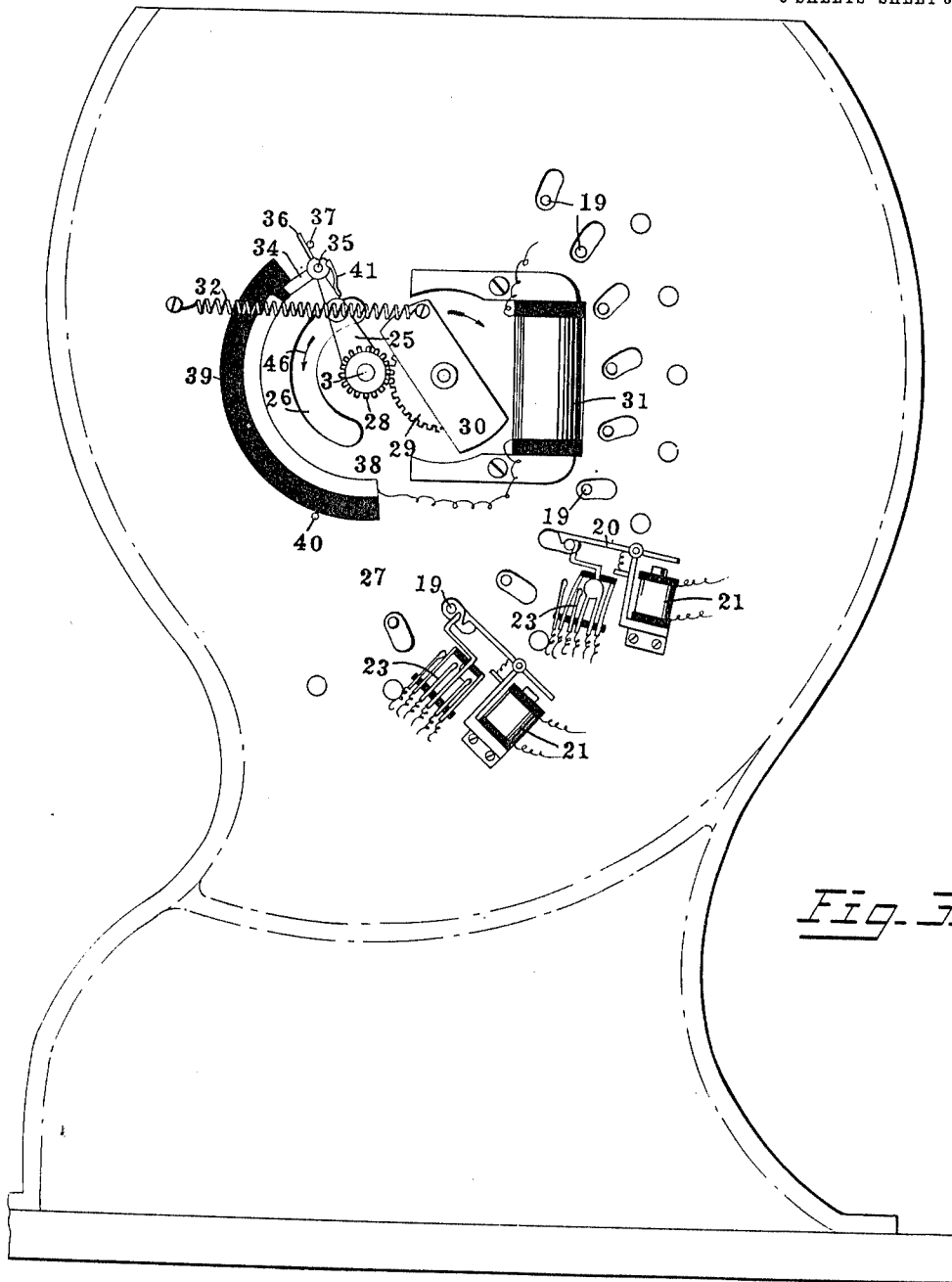


Fig. 3

Witnesses:
Eric S. Thamer
A. Rozinsky

Fraus Gunnar Agrell Inventor

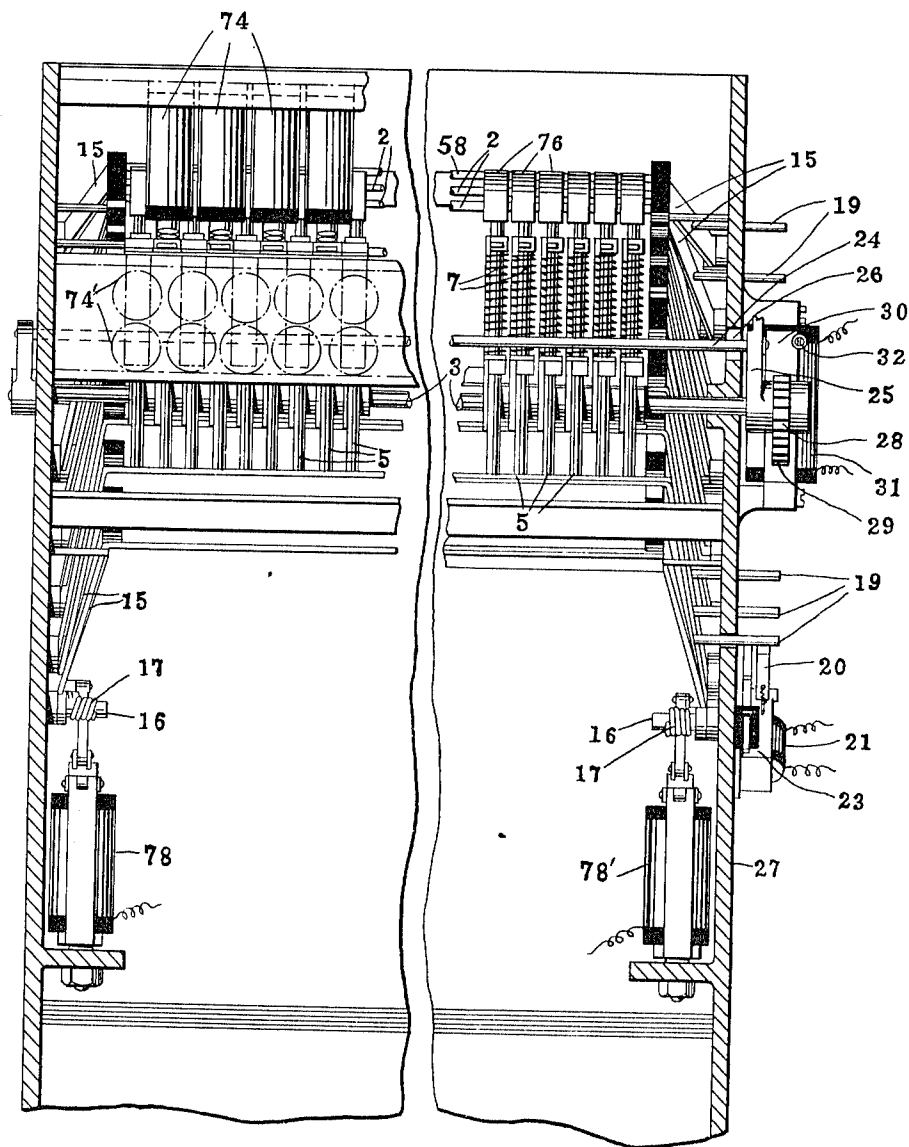
By his Attorney Lewis J. Doolittle

1,061,650.

Patented May 13, 1913.

6 SHEETS—SHEET 4.

Fig. 4.



Witnesses:
Eric B. Kramer.
A. Rozinsky

Franz Gunnar Agrell Inventor

By his Attorney Lewis J. Doolittle

F. G. AGRELL.
TELEPHONE SYSTEM.
APPLICATION FILED OCT. 10, 1906.

1,061,650.

Patented May 13, 1913.

5 SHEETS—SHEET 5.

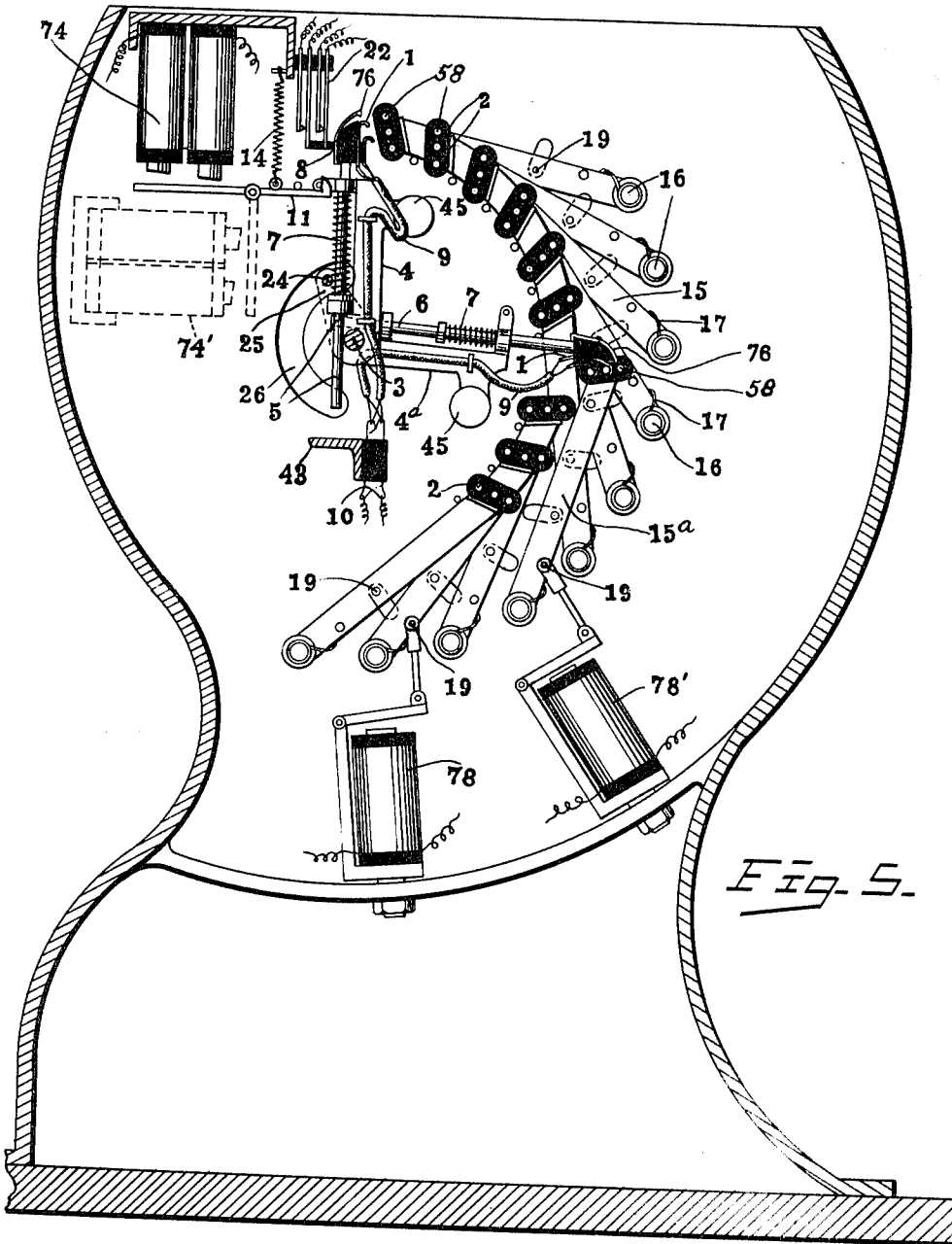


Fig. 5.

Witnesses:
Eric S. Kramer.
A. Rozinsky.

Frans Gunnar Agrell Inventor

By his Attorney Louis J. Doolittle

UNITED STATES PATENT OFFICE.

FRANS GUNNAR AGRELL, OF STOCKHOLM, SWEDEN.

TELEPHONE SYSTEM.

1,061,650.

Specification of Letters Patent.

Patented May 13, 1913.

Application filed October 10, 1906. Serial No. 338,309.

To all whom it may concern:

Be it known that I, FRANS GUNNAR AGRELL, a subject of the King of Sweden, and resident of Stockholm, Sweden, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

This invention relates to telephone systems and has for its object the provision of a new system employing devices and connections by means of which the operation of telephone exchanges is rendered partially automatic and greatly simplified.

A further object of my invention is to provide a system wherein the least possible number of circuits are idle and, consequently, to reduce the number of circuits necessary to provide the required service.

By the use of my system the disadvantages of a party line system, where a number of subscribers' stations are connected to one line, such as the interference between several subscribers who may wish to call at the same time, are avoided, as means are provided for automatically connecting any calling subscriber at once with the central-exchange and when so connected the talking circuit of his line is entirely independent of that of any other line. That this is accomplished in a very simple manner with my invention will be evident from the description of the system illustrated in the accompanying drawings.

Other objects will be in part obvious and in part pointed out hereinafter.

In my new system a large number of subscribers may be connected to a local or sub-exchange which is operated automatically to connect any one of said subscribers with a central exchange. A suitable number of trunk lines are provided between the central exchange and the automatic sub-exchange, which number is less than the number of subscribers. It has been found that one trunk line must be provided for each ten subscribers for ordinary use. By means of a device which I have designated as a connector located in the sub-exchange, any subscriber calling will be automatically connected with the first "not busy" trunk line in the sub-exchange. In the central exchange a connection between different trunk lines may be made in the usual manner by the use of plugs and jacks or by any other suitable devices. One or more selectors of the ordinary type operated in the usual man-

ner are provided in the sub-exchange. In the telephone systems in use at the present time the selector is used as a part of the talking circuit and, consequently it is necessary to provide a separate selector for every line that may be in use, which means in the usual practice at least one for every ten subscribers. In my system the selector is not used as part of the talking circuit, but is only operated to select and release the terminals of the desired line and after this is done the talking circuit is completed independently of the selector which may then be used for the next call. It will thus be seen that in my system a much smaller number of selectors are needed, in fact it is possible to operate the sub-exchange with only one selector for each one-hundred subscribers with my system with the same efficiency of service as with ten selectors to one-hundred subscribers with the best system now in use. This simplifies the operation of the exchanges and reduces the cost of equipment and maintenance on account of the reduced number of devices necessary.

In the drawings accompanying this specification I have illustrated one form or embodiment of my invention in a central energy or common battery system with a combination of circuits and devices, many of which may be altered to meet the various requirements of telephone service and to adapt the same for use with other systems.

Figure 1 represents diagrammatically the circuits of an automatic sub-exchange. Fig. 2 represents diagrammatically the circuits of a central exchange equipped for manual operation. Fig. 3 is an end elevation of a connector device for electrical circuits showing the restoring motor and the means for locking and releasing one group of terminals. Fig. 4 is a side elevation, partially in section, showing the interior construction and arrangement of the parts of the device shown in Fig. 3. Fig. 5 is a cross sectional view showing the arrangement of the connecting members and other parts.

The connector, which is indicated diagrammatically in Figs. 1 and 2 by the movable arms 4 and 15 and the motor 30—31, is shown in detail in Figs. 3, 4 and 5, from which it will be seen that the arms 4 are mounted upon a shaft 3 which is connected with and operated by the motor 30—31, so that when the motor 30—31 is connected in circuit the arms 4 are restored to their origi-

nal positions but when the motor is disconnected are free to fall by gravity to make the desired connections.

The connector, shown in Figs. 3, 4 and 5, is constructed and operated as follows: On the common shaft 3 are pivotally mounted a number of arms, such as 4, each carrying a connecting member, which is indicated by the terminals 1 and 76 mounted upon the insulating block 8. These members form the first group of terminals to which the circuits may be connected by means of a flexible conductor 9 and the terminal springs 10. On the arm 4 is mounted a rod 5, shown at 6 in another position. This rod is movable in a radial direction and is held in the position indicated at 5 by means of a spring 7. The block 8 is fastened to and carried by the rod 5. The arm 4 is held in its normal position by means of the latch 11 which is in turn held in engagement therewith by means of the spring 14. For operating the latch 11 to release the arm 4, I have shown electro-magnets 74. These magnets may be arranged alternately in the positions indicated at 74 and 74' in order to provide the necessary space for the same. The second group of terminals is indicated at 2 and 76 by rods extending over the entire space in front of the first group of terminals. These rods are mounted in an insulating block carried by the arms 15, which are pivotally attached to the casing at 16. The spring 17 operates normally to keep the arms in the position shown at 15 in Fig. 5. When the electro-magnet 78 is energized the arms will be moved to the position indicated at 15^a, where it is locked by means of the latch 20 engaging the pin 19. The latch 20 is operated so as to release the arm 15 when the electro-magnet 21 is energized. For restoring the arms 4 to their original positions, I have provided a motor 30—31, shown in Fig. 3, the construction of which is as follows: On the common shaft 3 are arms 25, which carry a rod 24 which extends the entire length of the first group of terminals. The arms 25 are rotated by means of the gears 28 and 29, which are in turn operated by the armature 30 when the coil 31 of the motor is energized but when the current ceases to flow in the coil 31 the spring 32 operates to move the armature and the attached parts to their original positions. In the construction shown it is only necessary to energize the motor coil 31 long enough to start the motor, as means are provided to continue the movement of the arm as far as it is necessary to restore the terminals completely. These means consist of a brush 34 which is pivotally attached at 35 to the arm 25. This brush normally rests against the insulated surface 39 but when the arm 25 is operated the brush 34 will make contact with the conducting surface 38 and continue

this contact until the pin 36 reaches the stop 40 and moves the brush 34 off from the conducting surface on to the insulating surface. This cuts the operating current out and allows the spring 32 to restore the parts to their original positions, where the pin 36 engages the stop 37 and restores the brush 34 to its former position. When the latch 11 is released by the electro-magnet 74 (or 74') the weight 45 will cause the arm 4 to fall until the movement thereof is arrested by the contact rods 2 on the first arm 15 that is in its original position. If now the electro-magnet 78 is operated the arm 15 will be carried to the position indicated at 15^a in Fig. 5, where it is locked by the latch 20 engaging the pin 19, shown in Fig. 3. At the same time the terminals 1 and 76 and their carrier rod 5 will be moved out to the position indicated at 6 in Fig. 5 and in this latter position the carrier rod is out of reach of the restoring rod 24. When the releasing magnet 21 (in Fig. 3) is energized and the current has ceased to flow in the magnet 89 the latch 20 is caused to release the arm 15, which is then carried back to its original position by the spring 17. The spring 7 will now restore the rod 6 to its original position, as indicated at 5, in which position the same may be engaged by the restoring rod 24 when the same is operated by the motor 30—31, as already described. The contact springs 22 are operated by the movement of the blocks 8 to open or close the circuit connected to these springs. The pin 19 operates in a similar manner to open and close the circuits connected through the contact springs 23. These contacts may be used for controlling the circuits in auxiliary apparatus or for other purposes, as may be desired. The operating magnet 78 may be rendered automatic in its action to move the arm 15 to the position 15^a, as described, by completing the energizing circuit through one of the contacts carried by the arm 4 and the corresponding contact carried by the arm 15. This will cause the magnet 78 to be energized as soon as the connecting members have been operated and the same will move the connecting members so connected to such a position that the same will be inaccessible for a subsequently operated member of the first group.

Referring now to Fig. 1, 51—52 are the bars of the battery at the sub-exchange; they are fed from the central exchange through all idle trunks, such as 93—117 by means of the lead 53, contact 54 and lead 55, contact 56 and lead 57 to 93 and on the ground side through lead 119, relay 59, lead 118, contact 60, lead 61, contact 62 and lead 63 to 117 from the other side of the battery. A subscriber's station as shown at 133, is under normal conditions connected to the battery bars 51—52 by means of its loop

64—65, relay windings 66—67, leads 68—69, the contacts 70—71, lead 72 to battery and ground. The line 64—65 ends in the terminals 1 of the connector. When the subscriber at the station 133 takes his telephone receiver off the hook current goes from the battery bar 51 over the lead 72 and contact 70, lead 69, relay winding 66, line 64 to subscriber station 133, and back through line 65 and relay winding 67 to lead 68, contact 71 to ground and battery bar 52. The relay 66—67 now operates and a current goes from the battery over the lead 73, to contact 75, release magnet 74 and lead 131 to ground and battery. Now the magnet 74 operates the latch 11 and releases the arm 4, which will fall and allow the terminals 1 to make contact with terminals 2 of the first "not busy" trunk, as 93—117. When arm 4 was released contacts 70—71 were broken and the battery current cut off from the subscriber's line. The relay 66—67 became inoperative breaking the contact 75, as did the release magnet 74. Contact was made between the arm 4, which is connected to ground, the spring 76 and terminal 58. Current will now go from the battery bar 51 over lead 53 to contact 77, electro-magnet 78, lead 79 to terminal 58 and contact 76, arm 4 to ground and battery bar 52. Now the magnet 78 operates, moves the arm 15 and terminals 2 to such a position that the same will not be engaged by subsequently operated subscribers' terminals 1 and is locked by the latch 20 in this position. Current is now supplied to the subscriber's station direct from the central station over the sluggish relay 80. This relay closes slowly, breaking the circuit through the magnet 78. The connection between the trunks 93—117 and the battery bars 51—52 over the contacts 56 and 62 is now broken by the movement of the arm 15 above described so that relay 59 cannot operate. The circuit through relay 81 is broken at contact 134 at the same time and cannot operate. If now after connection has been made at the central exchange as will be described hereinafter, and conversation is finished the subscriber puts his telephone on the hook, thus breaking the trunk circuit, the current in the sluggish relay 80 will cease to flow, allowing the contacts 77 and 82 to close. The relay 80 shall be so arranged that the contact 82 closes before 77 to prevent the electromagnet 78 from being energized again. Current goes now from battery lead 73 through the motor 30—31, the lead 83, the contact 84, the lead 85, the contact 82, the lead 86, the release magnet 21, the lead 79, the contact 58 to 76 and the arm 4 to ground. Now the latch 20 will be operated by the magnet 21 releasing the arm 15 and the motor will move the arm 4 to its original position, breaking the contact between 58 and 76 and opening the

circuit through the release magnet 21. Contacts 56 and 62 will go back to their original positions, connecting the trunk 93—117 to the battery bars 51—52. Contacts 70 and 71 close and again connect the battery to this subscriber's station through the relay windings 66—67 as before.

Referring now to Fig. 2 we will see what happened in the central exchange when the subscriber 133 called. Under normal conditions as aforesaid, the trunks 93—117 are connected to the hub-bars 51—52 in the sub-exchange thus supplying the sub-exchange with current from battery bars 87—88. In the central station the battery current goes from the bar 88 over the lead 89 to the relay 90, through the lead 91 and contact 92 to the one side 93 of the trunk to the sub-exchange and through the current consuming apparatus that are at that time connected to the battery bars 51—52 of the sub-exchange as explained above, and back through ground to battery bar 87. The ground side of the battery is connected with the trunk 117 from bar 87 over the lead 94, relay 95, lead 96 and contact 97. It is evident that no current under ordinary circumstances will go through said relay 95 shunted as it is by the ground between the central and the sub-exchange. As soon as the bars 51—52 are disconnected from the trunk 93—117 when a subscriber calls current will go back over said relay 95 and cause the same to close the contact 98 and current goes from the battery over the lead 89, contact 98, lead 99 to lamp 100, plug contact 101 back to ground and battery. The lamp 100 now lights and indicates that a subscriber is calling on the trunk. The trunk ends in multiple jacks of ordinary construction and is provided with a cord circuit. The calling lamp 100 is placed at the plug of this cord. When the relay 95 closed the contact 98, current also went from the contact 98 over the lead 102 to lamps 103 and through lead 94 and bar 87 to ground. These lamps 103 are used for indicating the multiple jacks which are busy. The operator now lifts up the plug 104, causing the plug contact 101 to break, thus putting out the lamp 100. The lamp 105 is now connected to ground through the contact 106. When the subscriber disconnects, that is, when he puts his telephone receiver on the hook, the relays 90 and 95 will cease to operate. The current will then go from lead 89 through the now closed contact 107 of relay 90 through the lamp 105, indicating that the subscriber has finished. At the same time the lamps 103 are disconnected by the breaking of the contact 98 of relay 95. When the operator gets the calling signal she connects her talking set, not shown in drawing, to the calling trunk and asks for the number which tells her which sub-exchange the subscriber

is connected to and the number he has in that sub-exchange. She then plugs in the cord to the first not busy jack, indicated by the lamps 103, that belongs to the desired sub-exchange. Now let us see what happened when the plug 104 was placed into the jack, shown at the right of Fig. 2, of the not busy trunk. Battery current goes through the resistance 108, the sleeve 109 of the plug to the third conductor 110 of the trunk, and from there through the relay 111 to ground. Now this relay 111 is operated and contacts 92 and 97 are broken, disconnecting the battery from the trunk. Battery current will now go through lead 112, contact 113, lead 114, the relay 115, to the cord conductor and ring 116 of the plug, and from there through the jack to the trunk 117. From there it will go to the called sub-exchange, for which we may refer to Fig. 1 as the connections are the same, through the lead 63, contact 62, lead 61, contact 60, lead 118; relay 59, lead 119 and bar 52 to ground. Now the relay 59 will operate and current will go over its locking winding 120, contact 121, lead 122, contact 77, and lead 53 to battery bar 51. Current also goes from the lead 72, over the contact 134, to the lead 135, relay 81, contact 125, back to ground and battery. Now relay 81 closes and breaks the contacts 54 and 60, which connected the trunk with the battery bars, and closes the contacts 124 and 126 which connect the selector 127 to the trunk. If now the operator connects her sending device to the trunk by means of the key 128 shown in Fig. 2, she will be able to select any of the leads 129 which are connected to the selector terminals on the one side and to the release magnet of each subscriber at the other side. The selector may be of any standard construction. In the drawing I have shown the Strowger selector in a very conventionalized manner. When the operator has selected the desired number, current will go from the battery through lead 50, the selector 127, to the terminal 130, lead 129, release magnet 74 of the connector and lead 131 to ground. Now the terminals 1 on the connector of the called subscriber are released and, as the operator has plugged in the calling subscriber's cord to a jack belonging to the first not busy trunk of the called subscriber's sub-exchange, said subscriber's terminals 1 must engage and connect with the terminals 2 which are connected to the calling subscriber. The arm 15 now locks in the same manner as before described for the calling subscriber and the contact 134 breaks, thus disconnecting the relay 81 and the contacts 126 and 124 open disconnecting the selector from the line. Auxiliary devices may be provided to restore the selector to its original position. Everything now operates as on the calling station except that the relay

59 is closed through its locking winding and the sluggish relay 80 has not yet operated. Now the operator signals the called subscriber in the usual manner and when the subscriber takes off his receiver from the hook, the sluggish relay will be energized and break the contact 82 and 77, thus opening the locking winding on relay 59 which will go back to its original position. When the subscriber puts the receiver on the hook again everything is restored as before described. A lamp 132 in Fig. 2 is provided at the central station for supervising of the called subscriber. It is thus seen that the sub-exchange is entirely automatic in its operation while the central exchange is only partially so, employing the usual means for the use of an operator in making connections, consequently this system may be designated as semi-automatic.

It will be noted that a much smaller number of lines is necessary than in the present systems and also as the selector is not used as a part of the talking circuit, it being automatically disconnected as soon as the desired line has been selected and released, a much smaller number of selectors is necessary. It is also evident that a much larger number of subscribers can be connected to the central exchange with my system on account of the reduced number of lines coming into the exchange. This avoids the necessity of using divided multiple when the number of subscribers to be connected to the exchange exceeds 30000 or 40000, or the otherwise unavoidable delay in connecting and the chance of error in repeating the number called which will result if the telephones of a thickly settled territory are operated through several comparatively small central exchanges.

As many changes could be made in the above construction and many apparently widely different embodiments of my invention designed without departing from the scope thereof, I intend that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative merely of an operative embodiment of my invention and not in a limiting sense.

What I claim is:

1. In a telephone system, the combination with a number of subscribers' stations of a number of sub-exchanges, a central exchange, a number of trunk lines each provided with movable terminals and adapted to connect said sub-exchange with said central exchange, lines provided with movable terminals each adapted to connect one of said subscribers' stations with one of said sub-exchanges, means adapted to automatically connect the terminals of one of said subscribers' lines to one of said trunk lines through said movable

terminals, means for automatically moving said trunk terminals when so connected to such a position that the same will not be engaged by subsequently operated subscribers' terminals, means for automatically locking said terminals in said position, means for releasing and allowing said trunk terminals to assume the position in which the same may be engaged by and connected with a subsequently operated subscriber's line, and means for restoring said subscribers' terminals to their original position.

2. In a telephone system, the combination with a number of subscribers' stations of a number of sub-exchanges, a central exchange, a number of trunk lines each provided with movable terminals and adapted to connect said sub-exchanges with said central exchange, lines provided with movable terminals each adapted to connect one of said subscribers' stations with one of said sub-exchanges, a device adapted to automatically connect the terminals of one of said subscribers' lines to one of said trunk lines through said movable terminals, a device adapted to automatically move said trunk terminals when so connected to such a position that the same will not be engaged by subsequently operated subscribers' terminals, means for automatically locking said trunk terminals in said position, means for releasing and allowing said trunk terminals to assume the position in which the same may be engaged by and connected with a subsequently operated subscriber's line, and means for restoring said subscribers' terminals to their original position.

3. In a telephone system, the combination with a number of subscribers' stations of a number of sub-exchanges, a central exchange, a number of trunk lines each provided with movable terminals and adapted to connect said sub-exchange with said central-exchange, lines provided with movable terminals adapted to connect one of said subscribers' stations with a predetermined trunk line, a device adapted to connect the terminals of one of said subscribers' lines to one of said trunk lines through said movable terminals, a device adapted to move said trunk terminals when so connected to such a position that the same will not be engaged by subsequently operated subscribers' terminals, means for automatically locking said trunk terminals in said position, means for releasing and allowing said trunk terminals to assume the position in which the same may be engaged and connected with a subsequently operated subscriber's line, and means for restoring said subscribers' terminals to their original position.

4. In a telephone system, the combination with a number of subscribers' stations of a number of exchanges, a number of lines

provided with movable terminals and adapted to connect one of said subscribers' stations with one of said exchanges, a device operative when released to automatically connect the terminals of one of said subscribers' lines to a predetermined line, a device operative to select and release said connecting device, means for automatically disconnecting said selecting device after the connecting device has been released so as to leave it free to select and release the terminals of a subsequently called subscriber, and means for restoring the terminals and the connecting device to their original positions.

5. In a telephone system, the combination with a number of subscribers' stations of a number of sub-exchanges, a central exchange, a number of trunk lines each provided with movable terminals and adapted to connect said sub-exchange with said central exchange, lines provided with movable terminals adapted to connect one of said subscribers' stations with one of said trunk lines, a connecting device operative when released to automatically connect the terminals of one of said subscribers' lines to one of said trunk lines, a selecting device operative to release said connecting device, means for automatically disconnecting said selecting device after said connecting device has been released leaving the same free to be operated in the same manner to release the terminals of the lines of a subsequently called subscriber, and means for restoring said subscribers' terminals to their original position.

6. In a telephone system, the combination with a number of subscribers' stations of a number of sub-exchanges, a central exchange, a number of trunk lines each provided with movable terminals and adapted to connect said sub-exchange with said central exchange, lines provided with movable terminals each adapted to connect one of said subscribers' stations with one of said sub-exchanges, electrically operated means for releasing said subscribers' terminals allowing the same to connect said subscriber's line with one of said trunk lines, said means being controlled by the calling subscriber, electrically operated means for moving said connected trunk terminals into such position that the same will not be engaged by subsequently operated subscribers' terminals, means for automatically locking said trunk terminals in said position, electrically operated means for releasing and allowing said trunk terminals to assume their original position, said last named means being controlled by the called subscriber, and means controlled by said releasing means for restoring said subscribers' terminals to their original position.

7. In a telephone system, the combination

of a suitable number of subscribers' stations each connected to a sub-exchange by means of individual local lines each of said lines being provided with movable terminals at said sub-exchanges, a number of sub-exchanges connected to a central exchange by means of a suitable number of trunk lines for each sub-exchange, said trunks being provided with terminals of such construction and so located in relation to the local terminals that every local terminal can under certain conditions make contact with any one of the trunk terminals, said trunk terminals being movable in such a way that the same can be carried out of reach of each of the local terminals when required, the local terminals under normal conditions making no direct contact with any trunk terminals, means for releasing any local terminal from its said normal position, thereby permitting it to contact with any trunk terminal, means for carrying any trunk terminal out of reach of all other local terminals when in contact with a local terminal, means for releasing the terminal of any local line from the subscriber's station connected to this line, means for releasing the terminals of any desired local line from the central exchange, means for connecting any trunk at the central exchange with any other trunk at said central, means for disconnecting local lines and trunks, and means for restoring the terminals to their normal position, substantially as set forth.

8. In a telephone system, the combination of a number of subscribers' stations each connected to a sub-exchange by means of individual local lines, each of said lines being provided with movable terminals at said sub-exchange, a number of sub-exchanges each connected to a central exchange by means of a suitable number of trunk lines for each sub-exchange, said trunks being provided with terminals of such construction and so located in relation to the local terminals that every local terminal can under certain conditions make contact with any one of the trunk terminals, said trunk terminals being movable in such a way that the same can be carried out of reach of the local terminals when required, the local terminals under normal conditions making no direct contact with any trunk terminals, electrically operated means controlled from the subscriber's station for releasing the local terminals from their said normal position thereby permitting them to contact with any trunk terminal, means for automatically carrying any trunk terminal out of reach of all other local terminals when in contact with a local terminal, means for releasing the terminal of any local line from the subscriber's station connected to this line, means for releasing the terminal of any desired local line from the central exchange, means for connecting any trunk at the central ex-

change with any other trunk at said central, means for disconnecting local lines and trunks, and means for restoring the terminals to their normal position, substantially as set forth.

9. In a switching device for electrical circuits, in combination, a plurality of groups of connecting members, means for moving any member of one group into contact with a member of another group, a member operated by an electric motor and adapted to restore the connecting members of one group to their original positions when so moved, means for connecting said motor to a source of current when the movement of said member has been started, means for cutting off the current, and means for returning said member to its original position when the connecting members have been restored.

10. In a switching device for electrical circuits, in combination, a group of connecting members, each member provided with a number of contacts mounted on a carrier, a plurality of arms upon which said carriers are movably mounted, a rod extending for the entire length of the space occupied by said arms, a movable part attached to said arm and adapted to be engaged by said rod, an electro-magnet adapted to move said rod in a direction opposite to that of the movement of said arms, means for connecting said magnet to a source of current when the movement of the rod has been started, means for cutting off the current and means for restoring the rod when the same has reached the farthest point of its path.

11. In a switching device for electrical circuits, in combination, a group of connecting members each member provided with a number of contacts insulatedly mounted on a carrier, said carrier being attached to an arm, all arms belonging to said group being pivotally mounted in the same axial line, said carriers being movable with respect to said axis, means for moving said arms in a rotary direction from their original position, means for locking any of said arms in this original position, means for releasing said arms, means for restoring said arms to their original position when moved, another group of connecting members each provided with a number of contacts extending the entire length in front of the members of the first group, said contacts being insulatedly mounted on a carrier and adapted to engage the contacts of any member of the first group, said carrier being movable in a transverse direction relative to the direction of movement of the members of the first group, and means for moving said members of the second group from their original position.

12. In a switching device for electrical circuits, in combination, a group of connecting members each member provided with a

number of contacts insulatedly mounted on a carrier, said carrier being attached to an arm, all arms belonging to said group being pivotally mounted in the same axial line, 5 said carriers being movable with respect to said axis, means for moving said arms in a rotary direction from their original position, means for locking any of said arms in this original position, means for releasing 10 said arms, a rod extending for the entire length of the space occupied by the members of the first group, means for moving said rod in a direction opposite to that of the movement of said arms, a movable part 15 attached to each of said arms and adapted to be engaged by said rod, the movement of said part being controlled by the movement of the connecting member in such a way that when said member is in its original position relative to the arm, said part will extend 20 far enough to be engaged by the rod

and will be moved out of reach of said rod when said connecting member is moved out of its original position, another group of connecting members each provided with a 25 number of contacts extending the entire length in front of the members of the first group, said contacts being insulatedly mounted on a carrier and adapted to engage the contacts of any member of the first 30 group, said carrier being movable in a transverse direction relative to the direction of movement of the members of the first group, and means for moving said members of the 35 second group from their original position.

Signed at New York in the county of New York and State of New York this 9th day of Oct. A. D. 1906.

FRANS GUNNAR AGRELL.

Witnesses:

H. W. FORSYTH,
LEWIS J. DOOLITTLE.