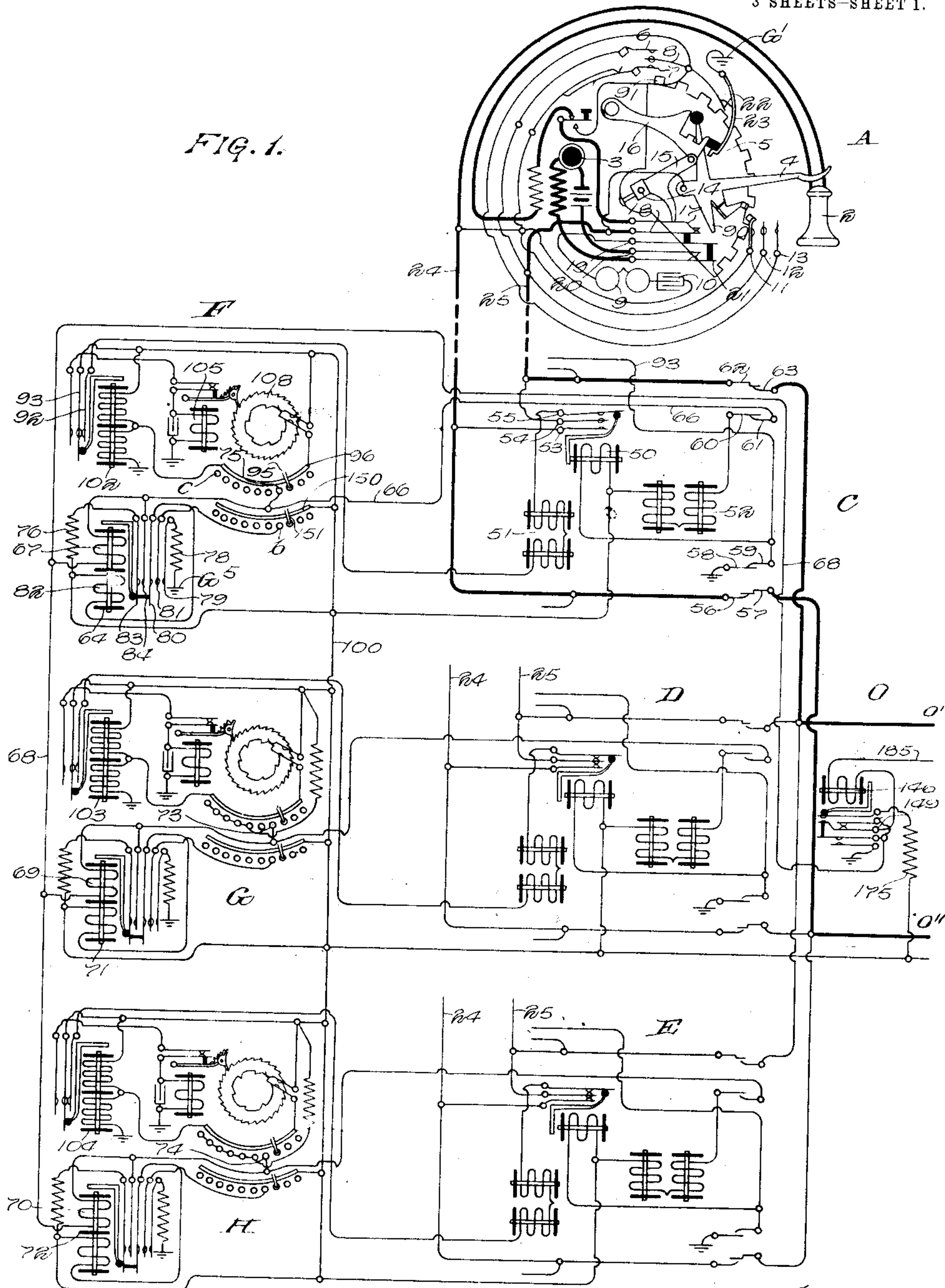


A. E. KEITH.
 AUTOMATIC TRUNKING SYSTEM.
 APPLICATION FILED MAR. 17, 1913.

1,113,354.

Patented Oct. 13, 1914.

3 SHEETS—SHEET 1.



WITNESSES

Arthur J. Ray
 Edward O. Hall

INVENTOR.

Alexander E. Keith
 By Bulkeley & Leonard
 ATTORNEYS.

1,113,354.

Patented Oct. 13, 1914.
 3 SHEETS-SHEET 2.

Fig. 4.

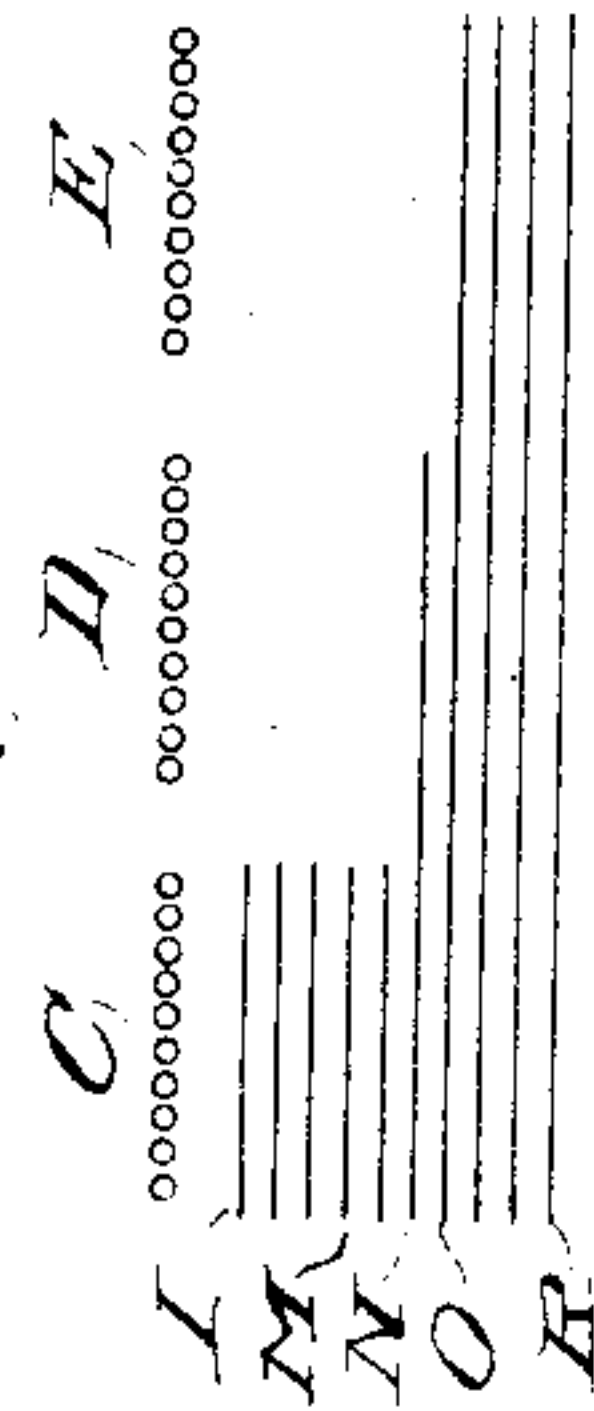
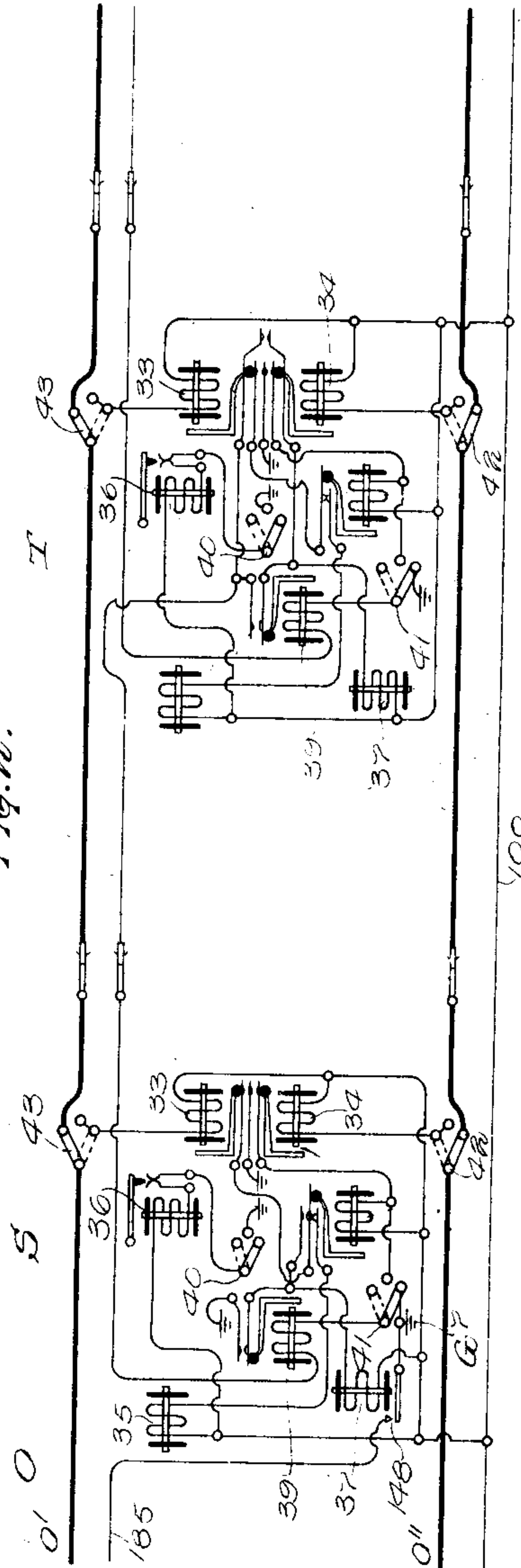


Fig. 5.



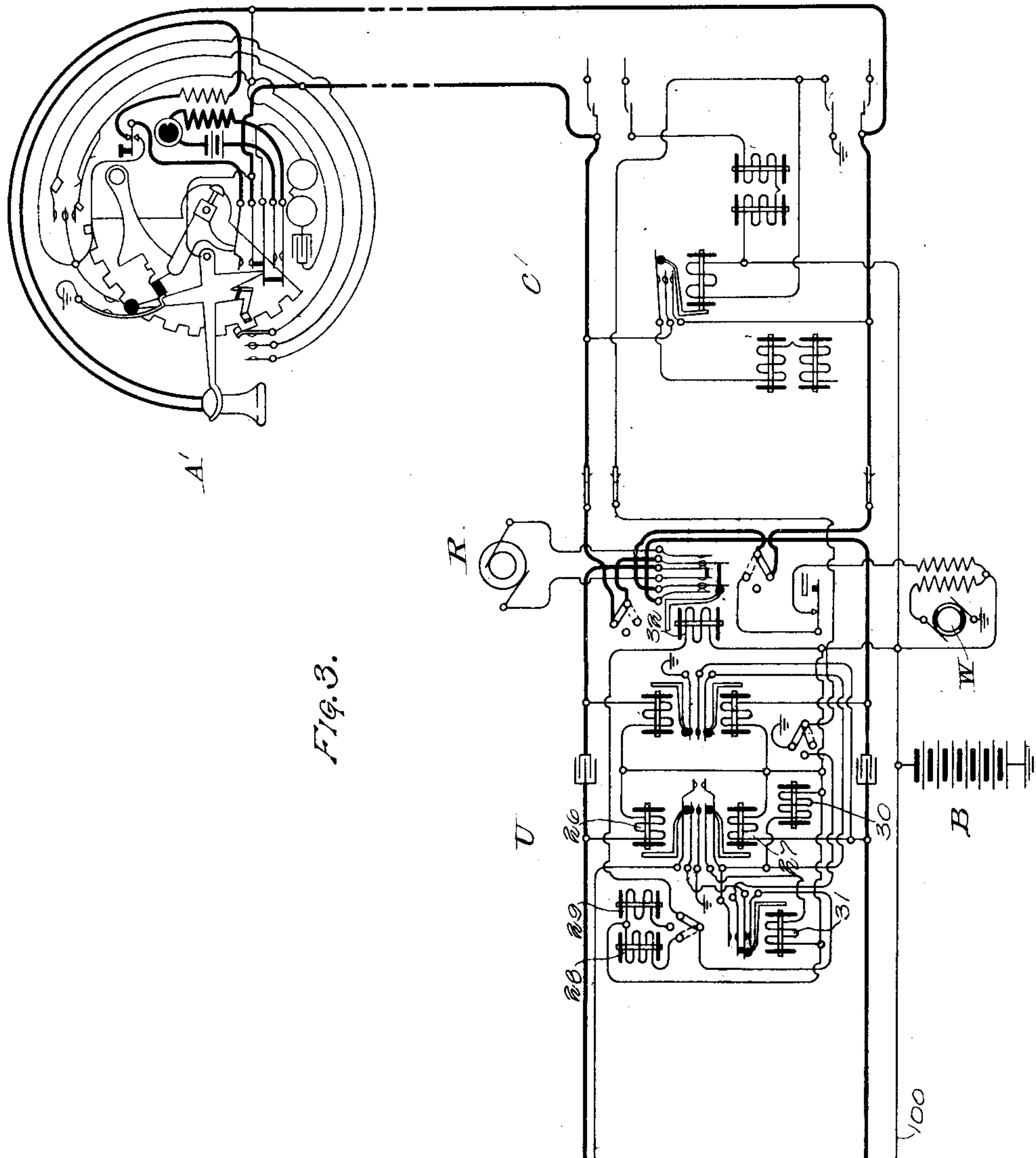
WITNESSES
 Arthur J. Ray
 Edward D. Hales

INVENTOR:
 Alexander E. Keith
 By Bulkeley & Seward
 ATTORNEYS.

A. E. KEITH.
 AUTOMATIC TRUNKING SYSTEM.
 APPLICATION FILED MAR. 17, 1913.

1,113,354.

Patented Oct. 13, 1914
 3 SHEETS—SHEET 3.



WITNESSES
 Arthur J. Ray
 Edward J. Taylor

INVENTOR:
 Alexander E. Keith
 By Bulkeley & Hamand
 ATTORNEYS.

UNITED STATES PATENT OFFICE.

ALEXANDER E. KEITH, OF HINSDALE, ILLINOIS, ASSIGNOR TO AUTOMATIC ELECTRIC COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

AUTOMATIC TRUNKING SYSTEM.

1,113,354.

Specification of Letters Patent.

Patented Oct. 13, 1914.

Application filed March 17, 1913. Serial No. 754,803.

To all whom it may concern:

Be it known that I, ALEXANDER E. KEITH, a citizen of the United States of America, and resident of Hinsdale, in the county of Dupage and State of Illinois, have invented certain new and useful Improvements in Automatic Trunking Systems, of which the following is a specification.

My invention relates to automatic telephone systems in general, and more particularly to a provision in such systems for giving different classes of service to different lines which are served by the same unit of apparatus at the central office, such as a line-switchboard. This difference in the character of service furnished to subscribers has heretofore been accomplished by having single line service, two party line service or four party line service. It often happens, however, that there may be in a certain district a small number of subscribers desiring these three kinds of service, and it may be desirable to install a small subexchange for this district. If there are only a small number of subscribers who desire party line service, or service the equivalent in efficiency to such party line service, it would be somewhat expensive to install regular party line selective signaling apparatus in this subexchange. In order to give these various classes of service under these conditions, I have devised an arrangement in which each subscriber connected to the subexchange has an individual line, and the distinction between the various classes of service arises in connection with the number of trunk lines extending out of this subexchange which are accessible to a particular subscriber's line. Assuming that there are ten trunk lines extending from this subexchange to the central office, the subscribers who pay for single line service will be given access to any one of the ten trunk lines; those subscribers who merely desire the equivalent of two party service will be given access to a lesser number of these outgoing trunks, say five; while those who merely wish the equivalent of four party line service will be given access to a still lesser number of these outgoing trunks, say four.

In this application I have illustrated my invention in connection with what is known as a line-switch system—that is, a system in which each subscriber's line is provided

with a switch which automatically selects an idle trunk extending to a first selector. The line switches employed are divided into groups, each group being controlled by a master switch for controlling the operation of the line switches of its group. Where a plurality of these groups of line switches have access to the same group of trunks, as in my present invention, it becomes necessary to provide special means for providing guarding potentials over the trunk lines in order to prevent one switch from making connection with a trunk line with which a second switch has already made connection.

These and other objects of my invention will be more readily understood by reference to the accompanying drawings, in which—

Figures 1, 2 and 3 taken together represent a calling subscriber's station A connected with a called subscriber's station A'. Fig. 4 is a diagrammatical sketch showing the trunking arrangement of a system embodying the principles of my invention.

The subscriber's apparatus and the central office switches shown herein are of the types well known in the prior art. The general principles of operation of the subscriber's apparatus is disclosed in United States Letters Patent to E. D. Fales No. 866,639, issued September 24, 1907. The general principles of operation of the line and master switches are disclosed in the *Western Electrician* of January 26, 1908, and the selector and connector switches are of the general types disclosed in United States Letters Patent Nos. 815,321 and 815,176, respectively, granted March 13, 1906, to Keith, Erickson and Erickson.

The subscribers' stations A and A' represented herein comprise the following parts: the receiver 2, transmitter 3, switch hook 4, impulse wheel 5, impulse springs 6 and 7, ground post 8, ringer 9, condenser 10, release springs 11, 12 and 13 and a dial (not shown) on a dial shaft 14, to which latter there is attached the cam finger 15, which finger is the means by which the dial is locked when in normal position by the locking cam 16. The switch hook controls the usual springs 17, 18, 19, 20 and 21, together with the ground springs 22 and 23. Each subscriber's telephone set is connected with an individual switch, commonly known as a line switch and shown at C, D and E, by means of the

conductors 24 and 25. The line switch for the called subscriber's station A' is represented at C' (Fig. 3) and is identical with the switches C, D and E. In Fig. 1 there are shown three line switches C, D and E belonging to three different groups, which groups are provided with master switches F, G and H, respectively. The master switch that controls the line switches C' is not shown in the accompanying drawings, but is of the same type as the switches F, G and H.

The selectors S and T are of the well-known type and consist generally of the line relays 33 and 34, vertical magnets 35, rotary magnets 36 and the back-release relays 39. They are also provided with the side switch wipers 40, 41, 42 and 43. The connector switch U (Fig. 3) is of the general form well known in the prior art and comprises the usual line relays 26 and 27, vertical and rotary magnets 28 and 29, release magnet 30, private magnet 31 and the ringer relay 32.

In a system of the general character described herein the lines and their individual switches have heretofore been divided into groups of one hundred each and all have access to the full complement of trunks leading out of such groups. By my present invention, however, the service of certain of the lines is somewhat restricted, a certain percentage of the subscribers being given greater trunking facilities than others, as will be hereinafter pointed out.

Fig. 4 represents a plurality of groups of line switches, one group having access to the full complement of trunk lines leading therefrom, another to five of those same trunks, and another to just four. These three groups of switches may be mounted upon a single frame or "Keith unit" if desired. For the sake of convenience we will say that the group of line switches to which the switch C (Fig. 1) belongs has access to the trunks I to R, inclusive, and the group of line switches to which the switch D belongs has access to the trunks N to R, inclusive, and the group to which the line switch E belongs has access to the trunks O to R, inclusive. It is thus seen that the group of switches to which the switch C belongs has access to five trunk lines that are individual to said switches, and to one trunk which in turn is accessible to one other group of line switches, namely, the D group and also to the remaining trunks O--R, which are accessible to the groups of switches to which the switches C, D and E belong. Each of the line switches shown is provided with the usual bridge-cut-off relay 50, trip magnet 51 and release magnet 52. The bridge-cut-off relay controls the springs 53, 54 and 55, while the trip magnet 51 controls the bank springs 56 to 63, inclusive, through the medium of the plunger. As clearly described in the article in the

Western Electrician above referred to, these line switches, upon being released, are not immediately picked up by the master switch, but their plunger stands in front of the trunk with which they were last in connection until the master switch in its operation again picks up this line switch. Heretofore a guarding potential was provided to prevent two line switches from making connection with the same trunk. In the present instance, however, it is necessary to provide still additional means, namely, to prevent a line switch in a group controlled by a second master switch from making connection with a trunk before which a line switch of another group is standing. Without such provision it will be seen that one line switch might make connection with a trunk, and then if the subscriber whose line switch was standing in front of the same trunk made a call, both subscribers would come in on the same trunk. In order to prevent this I allot to each of the common trunk lines N--R a trunk relay 64 (Fig. 1) for each group of line switches that has access to said common trunk. In Fig. 1 there is shown the trunk line O, which is common to three groups of line switches. Therefore three such relays 64, 71 and 72 are shown. The trunk line N (Fig. 4) is common to two groups and so would have two such trunk relays allotted to it. The trunk lines I--M being accessible only to one group of line switches, it is not necessary to provide such a relay for these trunks. The function of the relay 64 is to maintain a guarding potential on the master switch bank contacts of the trunk all the time a plunger is released from said trunk but not yet picked up by the plunger guide shaft, and so eliminating the possibility of any other subscriber occupying the same trunk opposite which the said plunger is only partially restored to its normal position. During the time the line switch is actually connected with the trunk, the guarding potential for the trunk is extended from the battery B over the conductor 100, release magnet 52 of the line switch C (which is of low resistance), springs 60 and 61, conductor 66 to the contact 75 of the master switch F, and also from the conductor 66 through the winding 67 of the trunk relay 64 (which also has a low resistance) to the conductor 68, and through the windings 69 and 70 of the trunk relays 71 and 72 to the master switch bank contacts 73 and 74 of the master switches G and H. After the line switch is released and before its plunger is picked up by the plunger shaft, the guarding potential is maintained on the master switch bank contact in the following manner: When the line switch is released, as will appear later, the trunk relay becomes energized and forms a lock-

ing circuit for itself in order that it may remain energized after the springs 60 and 61 have been separated. This circuit extends from ground G⁵ through the resistance coil 78, springs 79, 81 and 80, through the winding 82 of the relay 64 to the battery lead 100. In its energized position the relay 64 maintains a guarding potential on the master switch contacts 75, 73 and 74 over the following paths: The guarding potential for the contact 75 is supplied from battery B over the lead 100, resistance 76 and the springs 83 and 84 of the relay 64 to the contact 75. The potential for the contacts 73 and 74 extends from battery B to and through the springs 83 and 84 (same path as before) and thence through the winding 67 of the relay 64 and through the windings 69 and 70 of the relays 71 and 72, respectively, to the respective contacts 73 and 74. If a switch belonging to one of the groups to which the switches C or D belong has obtained connection with the trunk line and has been released therefrom, the corresponding relay 71 or 72 operates in the same manner as explained for the relay 64 to maintain the guarding potential on the master switch banks until the plunger of the released line switch has been picked up by its guide shaft. In general whenever any line switch is released from one of the trunks which is common to a plurality of groups of line switches, the relay which operates to maintain the guarding potential on the master switch bank contacts is the particular one of the relays allotted to said trunk which is associated with the master switch of the group to which the line switch which has been released belongs.

The operation of this type of system is well known and fully described in the patents and publication referred to, and it is accordingly not thought necessary to give a detailed description of the same, except in so far as relates to the operation of the line and master switches, which operation has been slightly changed to provide for the additional guarding potentials hereinabove referred to. The first step which the calling subscriber takes is to remove his receiver from the switch hook, which separates the spring 19 from the projection 90 of said switch hook, thus breaking the ringer circuit, and by the same operation the springs 20 and 21 make contact, thereby closing the primary circuit through the transmitter 3, and the springs 18 and 17 make contact to close the talking circuit. The subscriber now operates his dial in the usual manner to operate the central office switches for the first digit. This operation removes the locking cam 16 and allows the ground spring 23 to come into contact with the ground post 8 and sends a preliminary impulse over the rotary side of the line by means of the spring 7 being pressed against the ground post 8 by the impulse tooth 91, whereupon the trip magnet 51 becomes energized to release the plunger into its bank terminals, pressing together the springs 60 and 61, 62 and 63, 58 and 59 and 56 and 57. The circuit extends from the ground post 8 to the spring 7, conductor 24, springs 53, 54 and 55, magnet 51 and springs 92 and 93 to the battery lead 100. Upon the springs 62 and 63 and 56 and 57 making contact, the subscriber's line is extended to the first selector. By the engagement of the springs 58 and 59 a guarding potential is placed on the private normal 93, which terminates in the private banks of the connector switch through which the calling subscriber is reached. This potential furthermore causes the bridge cut-off relay 50 to be energized, thereby removing the short circuit from across the calling line by opening the springs 53, 54 and 55. When the springs 60 and 61 make contact, guarding potentials are also established at the master switch bank contacts 75, 73 and 74, which are to prevent the trunk O from being engaged while busy. When the call is made it will be assumed that the wiper 95 is resting on and making electrical connection between the common segment 96 and the contact 75, thus establishing a circuit through the lower winding of the relay 102. When this relay energizes the circuit which is the means for supplying battery current to the group of line switches represented by the switch C is opened, and the circuit of the motor magnet 105 is closed, whereupon said magnet energizes and operates its armature to rotate the ratchet wheel 108, which operates the plunger guide shaft in the well known manner and moves all idle plungers onto a non-busy trunk, when the circuits of the motor magnets are broken and the plungers come to rest. It will be seen that in Fig. 4 there are five bank terminals in one group, to which terminals there are no trunk lines connected, and in another group there are six like terminals. The plungers to which these terminals belong are kept from coming to rest opposite these so-called empty trunks by the corresponding contacts in the master switch bank being provided with a permanent guarding potential by either connecting same to positive or to negative battery, as the relay 102 and those corresponding to it are so wound that they will respond to either. So it is seen that it would be impossible for the plungers to stop opposite these terminals. Upon the springs 56 and 57, 62 and 63 being pressed together, the line conductors 24 and 25 of the substation A are extended to the first selector S, which is in a position to receive the impulses for the first digit, when the dial has been pulled around as far as the finger stop will

permit. When the dial is released the impulses are then sent over the line to operate the first selector in a manner well understood, and the subsequent operations of the calling dial operate the second selectors and connectors, all in the manner well understood, to establish connection between the calling and called subscribers' lines. When the subscribers replace their receivers upon the hooks, the connector switch U and selector switches T and S are released in the usual manner. When the release magnet 37 of the selector S energizes, a circuit is closed through ground G⁷, springs 148, trunk-release conductor 185, relay 146, contact springs 149, conductor 68, winding 67 of the relay 64, springs 61 and 60 and the release magnet 52 of the line switch C to the battery lead 100. The release magnet 52, upon energizing, releases the line switch in the usual manner. The relay 146, upon energizing, places ground direct upon the conductor 68 and substitutes the resistance 175 for the winding 67 of the relay 64 and the release magnet 52. This action of the relay 146 insures a good release of the line switch C.

It will be seen that the winding 67 of the relay 64 is included in the circuit through the release magnet 52 of the line switch C. This relay is consequently energized upon the closure of this circuit when the switch C is released and operates to maintain a guarding potential upon the master switch contacts of the trunk from which the line switch C was just released, until the plunger of said switch is picked up by the plunger guide shaft. As has already been stated, this is to prevent the plungers engaging with a trunk line that has a plunger standing opposite said trunk in an off-normal condition.

In order to remove the guarding potential when the line switch is again picked up by the master switch I provide an auxiliary private bank represented by the common segment 150 and the wiper 151. This is accomplished by the auxiliary private wiper 151 oscillating back onto the contact which corresponds to the trunk terminal opposite which there is standing a plunger not yet picked up by the plunger guide shaft. This completes a circuit from battery B by way of the common segment 150, wiper 151, contact *b* and resistance coil 78 to ground G⁵, thus short-circuiting the coil 82 of the relay 64, which relay thereby de-energizes and removes the above-mentioned guarding potential from the contact *c*, thereby allowing idle plungers to come to rest opposite said trunks.

It will thus be seen that I have provided a very useful and efficient trunking scheme whereby various classes of service can be given to a number of subscribers without

necessitating the employment of selective signaling apparatus used in connection with party line service.

While I have illustrated my invention in connection with one particular type of telephone system, it is, of course, understood that my invention is of broader scope and that I do not wish to limit myself to the particular type of switches employed, or to the particular character of the system.

What I claim as my invention is:—

1. In a telephone system, a plurality of groups of subscribers' lines, a single group of trunk lines, means whereby certain of said subscribers' lines can connect with any one of said trunk lines, and means whereby certain other of said subscribers' lines can connect with a lesser number of said trunk lines.

2. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, means whereby certain of said subscribers can select the first idle trunk line out of all of said group of trunk lines, and means whereby certain other of said subscribers have access to a part only of said trunk lines and are provided with means for selecting an idle one of said trunk lines.

3. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, a switching mechanism for each subscriber's line for automatically selecting idle trunks, means whereby certain of said switching mechanisms have access to all of said trunks, and means whereby certain other of said switching mechanisms have access to but part of said trunks.

4. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, a line switch for each of said subscribers' lines, a master switch controlling a group of said line switches, whereby said line switches are adapted to connect with an idle trunk, and means whereby certain of said line switches have access to all of said trunk lines, while other of said line switches have access to but part of said trunk lines.

5. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, means whereby the subscribers of one of said groups can connect with any of said trunk lines, means whereby the subscribers in another of said groups can connect only with a lesser number of said trunk lines, means whereby the subscribers of a third group can connect only with a still lesser number of said trunk lines, and means for preventing subscribers of different groups from connecting with the same trunk line.

6. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, individual switching mechanism by which said subscribers can connect

with idle trunks, means whereby the switching mechanisms of the subscribers, in one group have access to all of said trunk lines, means whereby the switching mechanisms of the subscribers in a second group have access to but part of said trunk lines, and means for preventing the subscribers of one group from making connection with a trunk line with which a subscriber of the second group is connected.

7. In a telephone system, a plurality of groups of subscribers' lines, a group of trunk lines, a line switch for each of said subscribers' lines, a master switch in each of said groups for controlling the line switches, said line switches comprising a contact arm adapted to make connection with certain trunk lines, said arms being controlled by said master switch to enable them to automatically connect with an idle one of said trunk lines, means whereby the subscribers of one of said groups have access to all of said trunk lines, means whereby the subscribers of another of said groups have access to but part of said trunk lines, and means for preventing the subscribers of one group from making connection with a line with which the subscriber of another group is connected.

8. In a telephone system, a plurality of groups of trunk lines, a plurality of groups of line switches, one of said groups of line switches having access to all of said trunk lines and another group having access to but one group of trunk lines, a master switch for controlling each group of line switches, means for controlling said master switches to move said line switches opposite idle trunk lines, and means for then operating a line switch to connect with a selected trunk.

9. In a telephone system, a plurality of groups of trunk lines, a plurality of groups of line switches, one of said groups of line switches having access to all of said trunk lines and another group having access to but one group of trunk lines, a master switch for controlling each group of said line switches, means for controlling said master switches to move said line switches opposite

idle trunk lines, means for then operating a line switch to connect with a selected trunk, and means for placing a guarding potential on said trunk while in use.

10. In a telephone system, a plurality of groups of trunk lines, a plurality of groups of line switches, one of said groups of line switches having access to all of said trunk lines and another group having access to but one group of trunk lines, a master switch for controlling each group of said line switches, means for controlling said master switches to move said line switches opposite idle trunk lines, means for then operating a line switch to connect with a selected trunk, means for disconnecting a line switch from said master switches when it is operated, and means for placing a guarding potential on said trunk while said line switch is connected with the same.

11. In a telephone system, a plurality of groups of trunk lines, a plurality of groups of line switches, one of said groups of line switches having access to all of said trunk lines and another group having access to but one group of trunk lines, a master switch for controlling each group of said line switches, means for controlling said master switches to move said line switches opposite idle trunk lines, means for then operating a line switch to connect with a selected trunk, means for disconnecting said line switch from said master switches when said line switch is operated to connect with a trunk, means for releasing said line switch from said trunk, means for thereafter again connecting said line switch with said master switches, and means for placing a guarding potential on said trunk until said line switch has again been connected with said master switches.

Signed by me at Chicago, Cook county, Illinois, this 5 day of March 1913.

ALEXANDER E. KEITH.

Witnesses:

ARTHUR J. RAY,
EDWARD D. FALES.