No. 685,401. Patented Oct. 29, 1901.

A. S. HIBBARD.

UNIVERSAL CALL CIRCUIT AND APPARATUS FOR TOLL SERVICE.

(Application filed June 27, 1901.)

(No Model.) 2 Sheets—Sheet 1.

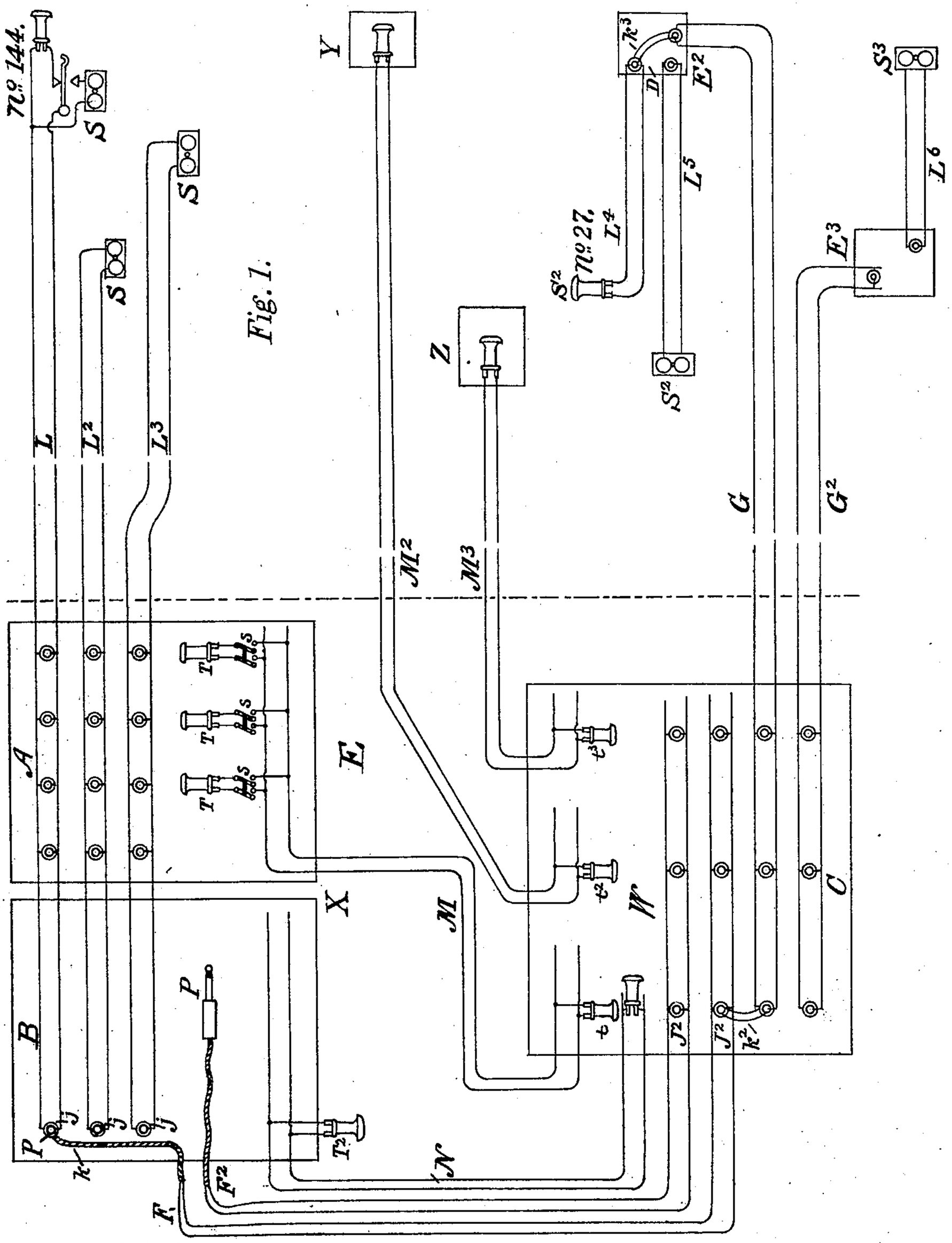

Fig. 1.

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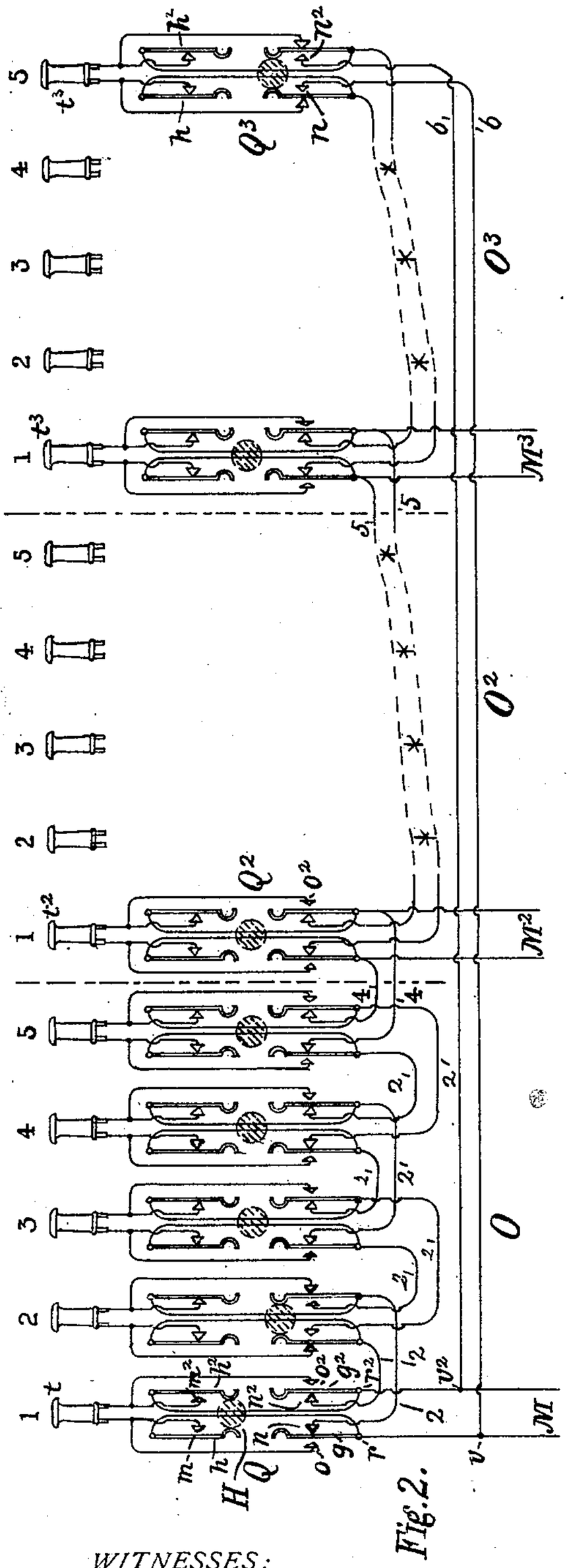

Fig. 2.

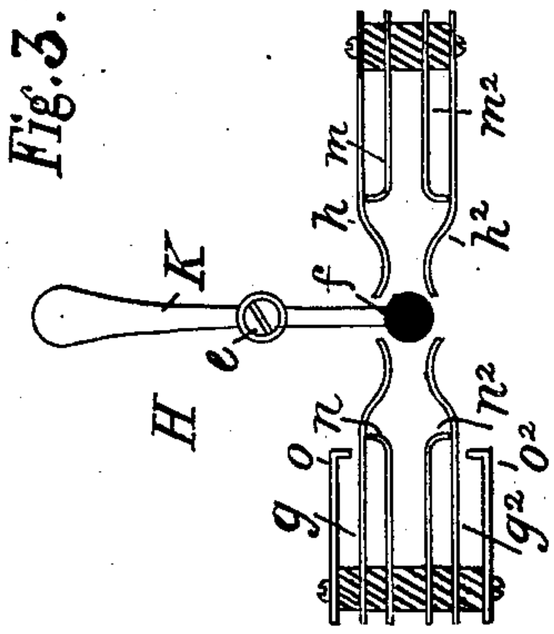

Fig. 3.

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UNIVERSAL CALL-CIRCUIT AND APPARATUS FOR TOLL SERVICE.

SPECIFICATION forming part of Letters Patent No. 685,401, dated October 29, 1901.

Application filed June 27, 1901. Serial No. 66,258. (No model.)

To all whom it may concern:

Be it known that I, ANGUS S. HIBBARD, residing at Chicago, in the county of Cook and State of Illinois, have invented certain Improvements in Universal Call-Circuits and Apparatus for Toll Service, of which the following is a specification.

This invention relates to telephone-exchange or long-distance central-station switchboard apparatus, and particularly concerns appliances for conveying between different switchboards instructions regarding the interconnection of substation-lines with lines leading to other central stations belonging to other exchanges.

A telephone-exchange organized for the transaction of the telephone business of a large city may comprehend several independent central stations serving different districts of such city, the substation-lines of each district converging to their own particular central station, where they connect with a switchboard by means of which they may be interconnected among themselves. There are also city trunk-circuits whereby the substation-lines primarily belonging to each central station may be interconnected when desired with those of any other central station. A very considerable part of the work of such a telephone-exchange is, however, attributable to the interchange of business between its substations and the substations of neighboring exchanges and the establishment by means of appropriate switching apparatus and interconnecting lines of through intercommunication, whereby for the transaction of such business the substations of different or distinct exchanges may engage directly in conversation. The business between the stations of any two such distinct exchanges—as, for example, between Boston and Lowell or between Chicago and Evanston—is known as "toll" business, and the lines extending between them are termed "toll-lines." For the transaction of toll business it has been found convenient to establish a special toll-line switch-station which may be a segregated section of a general operating-room or preferably an independent switch-room. This toll-station, again, may be in the same building with some particular one of the regular central stations, or, if desired, may be in any convenient place separate from all. At each of the said regular central stations there is ordinarily in addition to the general switchboard a trunk-line switchboard whereon each of the several substation-lines of such central station has a switch-socket whereby the said lines may be switched to any desired trunk, or instead of a special board a portion of the general board may be devoted to this part of the work. Trunk-lines extend between these trunk-line boards or sections of the several central stations of the exchange to the switchboard at the toll-station, and the toll-lines extend between the latter and the central stations of other and outside exchanges. Moreover, there is provided an order or instruction circuit from the toll-station to the trunk-operator's position at each central station of the home exchange and also an order or instruction circuit from the several answering-operator's positions of each central station to the switchboard at the toll-station.

Toll connections or toll-messages require special attention and care on the part of the operating force of the central station or the several central stations concerned, and a special charge is made for them. The conditions of practice render it necessary that the names and telephone-numbers of the call-originating and called-for substations, together with information as to the date, the time of day, and ultimately the time consumed in the exchange of conversation or the transmission of the message, shall be entered on a blank form termed the "ticket." This is done, first, to avoid the confusion and liability to error, which, as experience has shown, is apt to occur if the above-recited information be transmitted orally between the several operators, and, second, to furnish a record of the transaction for future reference.

In the toll business of exchanges as heretofore practiced a generally-adopted plan or arrangement for handling toll connections has been the following: The operator in an exchange central station receiving a call from

a substation for a substation in another exchange would by a call-wire or order-circuit announce the call to an operator at the toll-switchboard or toll-station end of said order-circuit, stating that a certain-numbered line desired a toll connection, and the toll-station operator was required to note the number of said calling-line on a ticket and pass the ticket to a second toll-station operator known as the "recording operator." This recording operator then would call for the line noted on the ticket and ascertain from the substation desiring communication the necessary details, such as the name and number of the person wanted, &c., then instructing the person who gave the call to hang up his telephone for the present, and stating that he would be notified when the connection of the several toll and other lines was complete. The recording operator then passed the ticket to a third "toll-room" or "toll-station" operator, whose business it was to secure connection, first, with the distant exchange, and, second, with the desired substation at such exchange, and this passing of the ticket has been accomplished in several ways—for example, by messenger, by a moving belt-line, or by pneumatic tube—and finally when the toll-line operator had reached the distant station wanted and had secured communication therewith she would again call the originating substation and switch the lines together. The operation thus carried out requires the services and passes through the hands of three or more operators in the toll-room.

The object of my present invention is to enable a single operator to take entire charge of each message passing through the toll-room and to carry out the various suboperations concerned in the establishment of the connection, thereby expediting the service, dispensing with the necessity of circulating the ticket, minimizing the chance of error, and in case of error readily determining the responsibility therefor. For the attainment of this object I provide that the order or instruction circuit extending from each central station to the toll-station (over which orders for toll connections are transmitted by the answering central-station operators) shall at its receiving end at said toll-station be associated with the telephones of a group of two or more operators, and a circuit-changer or switch capable of being placed in either of three positions and of determining by its position the relation of the order-circuit and the several telephones of the group, the reciprocal relation of the several members of such group and the relation of the several groups to the several order-circuits. The several telephones of each group are placed each in a corresponding loop, and the order-circuit may be regarded as being provided with an extension, whereby after reaching the switch of the first operator's telephone it is continued to the several other telephone-loops successively and through a series of separable contacts, the switch of each loop controlling the connection with the order-circuit not only of its own loop and telephone, but also of all following loops of the group. Each switch by its three positions, respectively, may connect its own telephone fully in the order-circuit, disconnecting all following telephones of the group and the loops containing them, may wholly disconnect its own loop and telephone from the order-circuit, leaving the said circuit continuous as far as it is concerned to all following telephones of the group, or may bridge its telephone across the order-circuit in parallel with any following telephone which is receiving an order; but when the circuit-changer of any loop is so positioned as to fully connect its associated telephone with the order-circuit it is also so placed as to sever all of the following loops of the group and their telephones from said order-circuit. Thus the operator's telephones of the group when there is no business going on may each and all have their switches so positioned as to connect the said telephones with the order-circuit when all preceding ones are disconnected and so as to sever all following ones. They are thus in line on the order-circuit waiting for orders, and as each preceding operator receives an order and disconnects to carry out the same the next following operator is switched in and takes the next order. Having fully attended to the order, each operator switches back to the order-circuit, first moving her switch to the bridge position to listen and ascertain whether at that moment any other operator is receiving an order, and if such is the case refraining from bringing the switch back to the full connecting position until the said order is fully given. It may occur that all of the operators of a group have received orders and are all disconnected from the order-circuit and engaged in completing the connections asked for. To give each call-wire access under such conditions to other operators, continuation-conductors extend from the separable contacts of the last switching device of a group to the main conductors of some one of the other order-circuits entering the toll-station from other central stations, and so that all groups may have like extension facilities like continuation-conductors may be extended from the separable contact of the last switch of the last group back to the main conductors of the order-circuit primarily serving the first group. By these means an operator to receive orders can at all times be reached on all order-circuits.

In the drawings which accompany this specification, Figure 1 is a schematic diagram of an exchange system comprising several central stations to each of which substation-lines converge and having also a toll-station, whereat trunk-lines leading from the said central station may be united with toll-lines leading to the central station of another exchange system. Fig. 2 is a diagram of the toll-station

terminal connections for three order or instruction circuits entering from three central stations, representing the essential features of the invention, the operators' telephones, their respective loops, their switches, and separable contacts being fully carried out in the first group of five operators' positions and indicated in the other two groups. Fig. 3 represents a form of switch or circuit-changer convenient for use in association with the telephone-loops and the order-wire.

In the drawings, and referring now particularly to Fig. 1, E represents a telephone-exchange comprising a number of central stations X Y Z, and E^2 E^3 are other and outlying telephone-exchanges having one or more central stations, as the case may be.

S represents the subscribers' stations of the central station X of exchange E, and S^2 S^3 the substations of the distant exchanges E^2 E^3.

L L^2 L^3 are substation-circuits uniting the stations S to the central station X. L^4 L^5 are lines similarly converging from substations S^2 to the central station of exchange E^2, and L^6 a circuit connecting substation S^3 with its appropriate central station at E^3.

W is a toll-switching station of exchange E and may be a separate room in the same building as one of the central stations or in a separate portion of a central station, or indeed at any preferred place—such, for instance, as a building separate from any of the other stations.

It has not seemed necessary to indicate the substation-circuits converging to central stations Y and Z; but it is of course to be understood that each of these has its quota of substations and substation-circuits arranged in the same manner as those of central station X.

At central station X, A is the general or answering switchboard, the lines shown as having jacks or switch-sockets at different operators' positions, and B is the trunk-board, where also the said lines are represented by a switch-socket and where they may be united by suitable trunk-circuits F F^2 to the switchboard C at the toll office or station W. The said trunk-circuits F F^2 are preferably fitted with switch-plugs P at the central-station end and terminate in sockets J^2 at the toll-board end, these, if desired, being multiplied to the several operators' positions of the board C. As many of these trunk-circuits are provided as are necessary for the proper conduct of the business.

G G^2 are toll-lines extending from the toll-station W to the outlying exchanges E^2 and E^3, respectively, and provided or associated at both ends with suitable switching devices, (shown at W as switch-sockets.) Two classes of order or instruction circuits are ordinarily employed in such a general system as this between the several central stations and the common toll board or room. These are the circuits M M^2 M^3, leading from the central stations X Y Z, respectively, over which the answering operators at the general switchboards A transmit orders for toll service to the toll operators, and the circuits N, extending between the toll-room and the trunk-boards B at the central stations, over which the toll operator who has received an order may repeat it back to B, to the end that the B operator may assign a disengaged trunk-line and connect the same with the B board switch-socket *j* of the line originating the call. It is with the order or instruction circuits M of the former type that my present invention is in particular concerned.

T T T represent the telephone outfits of the call receiving or answering operators at the several sections of the general switchboard A, T^2 at switchboard B represents the telephone of the trunk operator and is in the order-circuit N to constantly listen for communications from the toll operator at W, and *t* t^2 t^3 represent the telephones of the several groups of toll operators at the toll-station normally associated with the instruction-circuits M to receive toll-orders, but transferable at the will of said operators to any other circuits with which they become concerned in the transaction of business—for instance, the order-circuits N or the toll-lines leading to other exchanges. The telephone instruments T of the operators at the general board A are of course associated in a manner well known in the art with standard switch devices, whereby they may be switched about as required from one circuit to another, and their capability of being switched into the instruction-circuits M is indicated for the outfit of the several operators by the switches *s*.

The arrangement of the toll-operator's telephones *t* at the toll-board, as indicated in Fig. 1, is symbolic only, the same being shown in detail by Fig. 2, to which reference will now be made.

The instruction-circuits M M^2 M^3 are shown here as being respectively associated with a like number of groups O O^2 O^3 of operators' telephones *t* t^2 t^3. Primarily, therefore, it will appear that the operators of the first group O receive toll-orders from central station X and those of the second and third groups from the central stations Y and Z, respectively, of exchange E. Each group, as shown, consists of five operators' telephones, and this may be considered as representing general operative conditions. It is, however, conceivable that as few telephones to the group as two might under certain conditions be sufficient, and in such a case the invention would be employed in its simplest form, while under other conditions a greater number than five for any particular instruction-circuit may temporarily be required, and for this the invention makes provision, as will be hereinafter explained.

Q, Q^2, and Q^3 represent loops, in which the operators' telephones of the groups O O^2 O^3 are respectively connected, and the contact-points *o* o^2 and *m* m^2 are double terminals of the said loops, *m* and *o* branching from one

terminal of the telephone instruments and m^2 o^2 from the other. Associated with each telephone-loop Q are terminal contacts g g^2 and h h^2 of the corresponding instruction-circuit, these also being in parallel, g and h branching from the point r on one conductor of said circuit and g^2 h^2 branching from r^2 on the other conductor thereof, and in a manner presently to be described the circuit-terminals g g^2 h h^2 may make contact with the loop-terminals o o^2 m m^2, respectively, or be disconnected therefrom. The circuit-terminals g g^2 of the loops Q are also provided with alternative separable contacts n n^2, connecting by continuation-conductors 2 with the two sets of circuit-terminals g g^2 and h h^2 of the next telephone. It is obvious that in any case where there might be but two telephones in a group, and if one group only has to be considered, the circuit-terminals g g^2, associated with the first telephone-loop, would alone require the alternative separable contacts g g^2, as these are required merely for the extension of the instruction-circuit from one loop to another and to insure that following loops shall be severed therefrom when any particular telephone is in active connection with the circuit.

I provide for each loop Q and for the telephone t contained therein a circuit-changer or switching device H, controlling the terminals of the instruction-circuit, the telephone-loop, and the continuation of said circuit to the next telephone-loop, the said switching device being so organized as to be capable of being placed in three distinct positions, thereby establishing three different relations of the said terminals and the circuits to which they belong. In Fig. 3 is shown a form of switch well adapted to such a purpose. As therein indicated, the circuit-changer II is provided with a hand-lever K, fulcrumed at e and having at its inner end a spherical expansion f. In line with the said expansion in either direction are pairs of springs g g^2 h h^2, adapted to rest by their own resiliency on inner contact stops or springs n n^2 m m^2, respectively. Outer contact-stops o o^2 are also arranged, with which the terminal springs g g^2 are adapted to engage when forced apart. These springs and stops, it will be seen, constitute, respectively, the two sets of circuit-terminals, the two sets of loop-terminals, and the contact-terminals of the continuation-conductors of the circuit. By moving the handle K of the switch to the right the sphere f thereof moves between the ends of the terminal springs g g^2, which thereupon are separated from the contacts n n^2 of the circuit extension and are brought into contact with the loop-terminals o o^2. In this position of the switch of any loop the extension of the instruction-circuit—say M—to all following loops is severed, and the operator's telephone of the said loop is introduced directly into said circuit. By moving the hand-lever K to the left the spherical expansion is brought between the terminal springs h h^2 and separates them more widely from one another. They are thus caused to separate from the loop-terminals m m^2. In this position the telephone associated with the switch is totally disconnected from the instruction-circuit, and as the circuit-terminals g g^2 rest on their front contacts n n^2 the said instruction-circuit is continued to the next member of the group, who can receive orders from it. The circuit-changer is shown in Fig. 3 as occupying its third or central position, wherein both sets of circuit-terminals are permitted to rest on their inner contacts. In this position the associated telephone-loop Q is bridged across the circuit by the contact between the circuit-terminals h h^2 and the loop-terminals m m^2, while at the same time the said circuit extension to following telephones remains unbroken in the switch, whose lever is in its central position, by reason of the contact existing between the circuit-terminals g g^2 and the extension-terminals n n^2. When the lever is in this position, by listening at the bridged telephone the operator may ascertain whether any other operator is taking an order from the circuit. If so, she waits until the conclusion of said order. If not, she at once moves her switching device to the first position, her telephone again taking its place directly in the circuit, and all following telephones being cut off. The order-circuit M thus comes directly to the terminals g g^2 of the first member of the first group O and from thence is extended by continuation-conductors 2 to the last member of said group through the separable contacts g n and g^2 n^2 of the several members of said group, and there is thus constituted an order or instruction circuit having a group of receiving-telephones, each of which when connected in such circuit cuts off any which follow or are beyond, so that when the circuit is at rest and all of the telephone-switches are in position to connect their telephones therewith they will come into active employment in the order of their relative precedence, each operator as she receives an order and switches her telephone out to execute it giving place to the next in line.

The illustrations of the circuit-changers and their connections for the second, third, fourth, and fifth members of group O^2 and the second, third, and fourth members of group O^3 have not been carried out in Fig. 2; but their positions are indicated by stars.

It will be seen that the contacts n n^2 of the last member of group O are shown as being united by continuation-conductors 4 to the main conductors of the instruction-circuit M^2 at the first member of the primary group O^2 of said circuit and that the contacts n n^2 of the last member of the group O^2 are in like manner united by further continuation-conductors 5 to the main conductors of the instruction-circuit M^3 at the first member Q^3 of its primary group O^3; also, that the contacts n n^2 of the last member of group O^3 are united

by return continuation-conductors 6 with the main conductors of the first instruction-circuit M at points v v^2. By these expedients the several central stations X Y Z can each (if all of the operators of their own primary groups are busy) transmit orders to the several operators in succession of the other groups, all groups being thus made available on emergency to all order-circuits. Thus the business originating at the several central stations may be divided as evenly as possible among the three groups during the busiest hour of the day and during the less busy hours may be put upon the circuits of one or two groups, or the number of operators in each group may be lessened. Any operator receiving an order at once throws the circuit-changer to the position indicated for the first member of the first group O, disconnecting her telephone from the order-circuit, and then proceeds to do all of the work required in the execution of the order until the station giving the call at X for a station of the distant exchange E^2 has obtained through communication and does not throw her switch over and reconnect with the instruction-circuit until this is done. When No. 1 telephone is thus disconnected, No. 2 becomes first, and when No. 2 receives an order No. 3 succeeds, and so on through the groups. No. 2 of group O and No. 5 of group O^3 are shown as having their switches so positioned as to fully connect their telephones with their respective instruction-circuits. No. 1 of group O has the switch placed to disconnect its own telephone, leaving the circuit connected with No. 2, and the remaining switches are shown as occupying the middle position, so that their telephones are in the bridge positions, where the operators can listen in at their respective circuits without severing the connection of said circuits to following loops. The electrical connections of the five members of the group O are all shown in full, comprising the telephone-loops, the telephones connected therein, the switch-contacts, and the mode of carrying out the extension of the order-circuit through the several sets of separable contacts in series, and as each group is constructed and arranged on the same general plan it will be understood that while the first member only of group O^2 and the first and fifth members only of group O^3 are shown the other members, which are merely indicated, are to be connected precisely as those of group O.

In describing the operation of the system we may assume that X represents the main central station at Chicago and that E^2 represents the outlying city of Evanston. No. 144 main wishes to connect and talk with No. 27 Evanston. 144 calls and his call is received by the answering operator at the regular switchboard A. Being informed that 144 wants a toll connection, the operator at A connects a telephone T with the instruction-circuit M and transfers the order to any toll-room operator who happens to be first in line, saying, for example, "144 wants a toll connection." The toll operator, hearing this, at once moves over her switch H to the position shown at telephone No. 1 of group O, thus disconnecting her telephone from the instruction-circuit and causing the said circuit to be extended to the next following operator of the group. By means of the usual switch apparatus she connects with the return order-circuit N and asks the operator at the trunk-board to connect 144 main to a trunk-circuit. B does so and says "144 is connected to trunk F." This brings substation 144 main into direct communication with the toll operator, who at once receives the details of the order, enters the same on a ticket, and having a switch-socket J^2 of the toll-lines in front of her proceeds to signal and advise Evanston of the number wanted and complete the connection. In Fig. 1 substation 144 main of Exchange E is shown as being connected through with substation 27 of Exchange E^2 by means of the switchboard k, forming the terminal at trunk-board of the trunk-line F, the switch-cord k^2 uniting the toll-board terminal of said trunk with the toll-line G and the switch-cord k^3 of board D at Exchange E^2 uniting the E^2 end of the toll-line to the substation-circuit L^4. The toll operator No. 1 having thus fully attended to the call and having supervised the same until the foregoing connection has been completely established returns her telephone to the instruction-circuit, first placing the switch H at the middle position to listen, so as not to interrupt any order which is being at the moment transmitted. Hearing nothing, the telephone is brought directly into the circuit and No. 1 again has the first place, all of the following ones being cut off. Meanwhile the second, third, and all following telephones of the group may successively have been first in line and may have received and attended to toll-calls, and it may also have happened that all of the primary telephones of a group having received an order and having disconnected from their instruction-circuits to attend to it some telephone on the next or third group has become the first in line on the said circuit and receives an order or call therefrom.

The invention is of course not restricted to cases where a trunk-board B and trunk-lines extending therefrom intervene between the calling substation-line and the toll-line, it being obviously adapted equally well for systems wherein switch-sockets of the exchange-lines are placed directly in the toll-room, dispensing with such intermediate connections.

By this invention the order or call, the making and handling of the ticket, and the toll-switch connections are all under the charge of a single operator, there is no passing of tickets by machinery or otherwise from one operator to another, and the number of operators may at any time of the day be readily proportioned to the amount of work presenting itself.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a telephone-exchange switching-station, the combination of an order or instruction circuit; two loops therefor, each containing a separate receiving-telephone; and a three-position circuit-changer or switch at the junction of said circuit and loops adapted to unite either telephone-loop alone, or both at once in parallel to said order-circuit, according to the position in which it may be placed.

2. In a telephone-exchange switching apparatus, the combination of an order or instruction circuit; a loop therefor containing or leading to an operator's telephone; another loop or extension-circuit therefor including or leading to an independent telephone; and a circuit-changer or switch comprising two sets of terminal contact-springs for said circuit, forward and back contact-stops for one of the said sets of contact-springs constituting terminals of the said two telephone-loops respectively, forward contact-stops only for the second set of contact-springs forming terminals (in parallel with the said back contact-stops of the springs of the first set) of the first-mentioned telephone-loop, and a lever controlling the relation of the said circuit and loop terminals and adapted to sever the terminal springs of either set from their forward contacts and to unite the springs of the first set when so severed to their back contact-stops, or to allow the springs of both sets to rest on their forward contact-stops; substantially as described.

3. In a telephone-exchange switchboard apparatus, the combination of a plurality of independent loops each including a different operator's telephone; an order or instruction circuit; a series of successive sets of separable contacts in the said order-circuit extension, one set associated with each of the loops to control the extension of said circuit to following loops; and a circuit changing or switching device associated with each loop, and controlling the connection of said loop and the telephone included therein with the said order-circuit, and also the separable contacts of the order-circuit extension to the following loop or loops, the said switch being capable of assuming three positions and adapted thereby at will to introduce the associated telephone into the order-circuit all following loops being severed, to bridge the said telephone across the circuit without severing the said following loops, or to wholly disconnect the said associated telephone, and to establish the order-circuit extension to the following loop or loops; substantially as set forth.

4. In the toll-line switchboard of a telephone-exchange system, the combination of a series of groups of operator's telephones, each telephone being in an independent loop-circuit; a series of order or instruction circuits extending from different switchboards primarily to the said groups of telephones, respectively, and successively through separable contacts to each of the said telephone-loops of the group; a switching device for said telephone loop-circuit, interposed between the terminals of said loop, the terminals of the associated order-circuit, and terminals of the extension of the said order-circuit leading to the following telephone-loops of the group, and controlling the relations of said terminals; and continuation-conductors extending from the last switching device of the group primarily associated with each order-circuit to the main conductors of some one of the other order-circuits; substantially as described.

5. The combination substantially as hereinbefore described at the toll-line switchboard of a telephone-exchange system, of a series of groups of operator's telephones each in an independent loop; a series of order or instruction circuits each extending from another switchboard or central station to some one of the said groups, and from the first telephone-loop of the group to the other loops of the group successively, through a series of separable contacts between each loop and the next following loop; a circuit changing or switching device for each telephone-loop controlling the connection of said loop with the associated order-circuit and adapted to include the telephone of said loop in said circuit, to disconnect it therefrom, or to bridge it across the conductors thereof, and in the two latter positions to close the said separable contacts and extend the said order-circuit to the next following telephone-loop; circuit connections extending from the separable contacts of the last switching device of all of the groups except the last, to the main conductors of the order-circuit of a following group; and continuation-conductors or circuit connections leading from the separable contacts of the last switching device of the last group to the main conductors of the order-circuit of the first group.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 6th day of June, 1901.

ANGUS S. HIBBARD.

Witnesses:
HENRY C. HALL,
CHAS. CHEVLY HYDE.