

A. H. DYSON.
TELEPHONE SYSTEM.

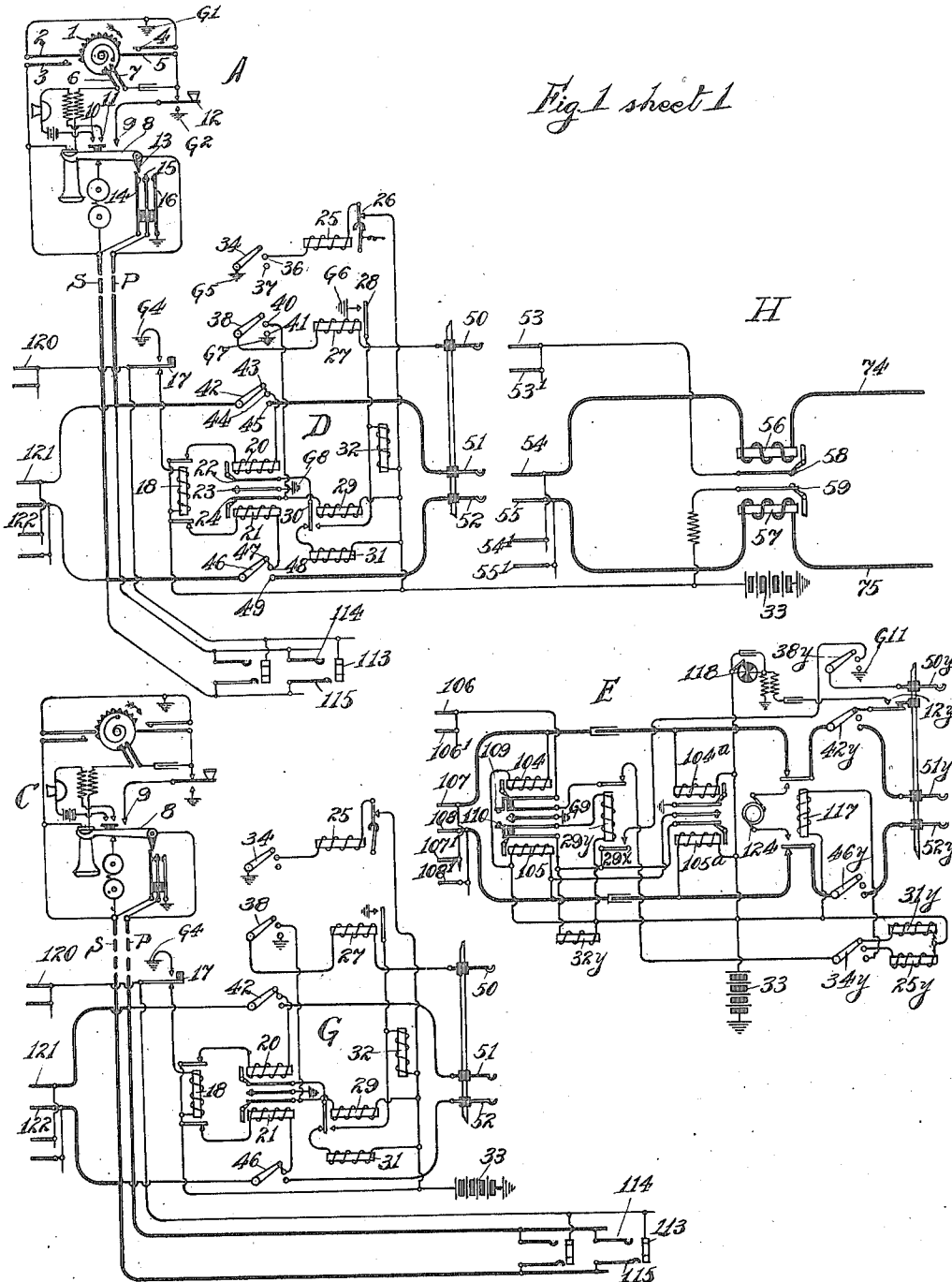
APPLICATION FILED DEC. 20, 1905.

Patented May 30, 1916.

5 SHEETS—SHEET 1.

1,184,933.

Fig. 1 sheet 1



Witnesses
G. E. Mueller.
J. H. Ferguson

Inventor
A. H. Dyson

A. H. DYSON.
TELEPHONE SYSTEM.

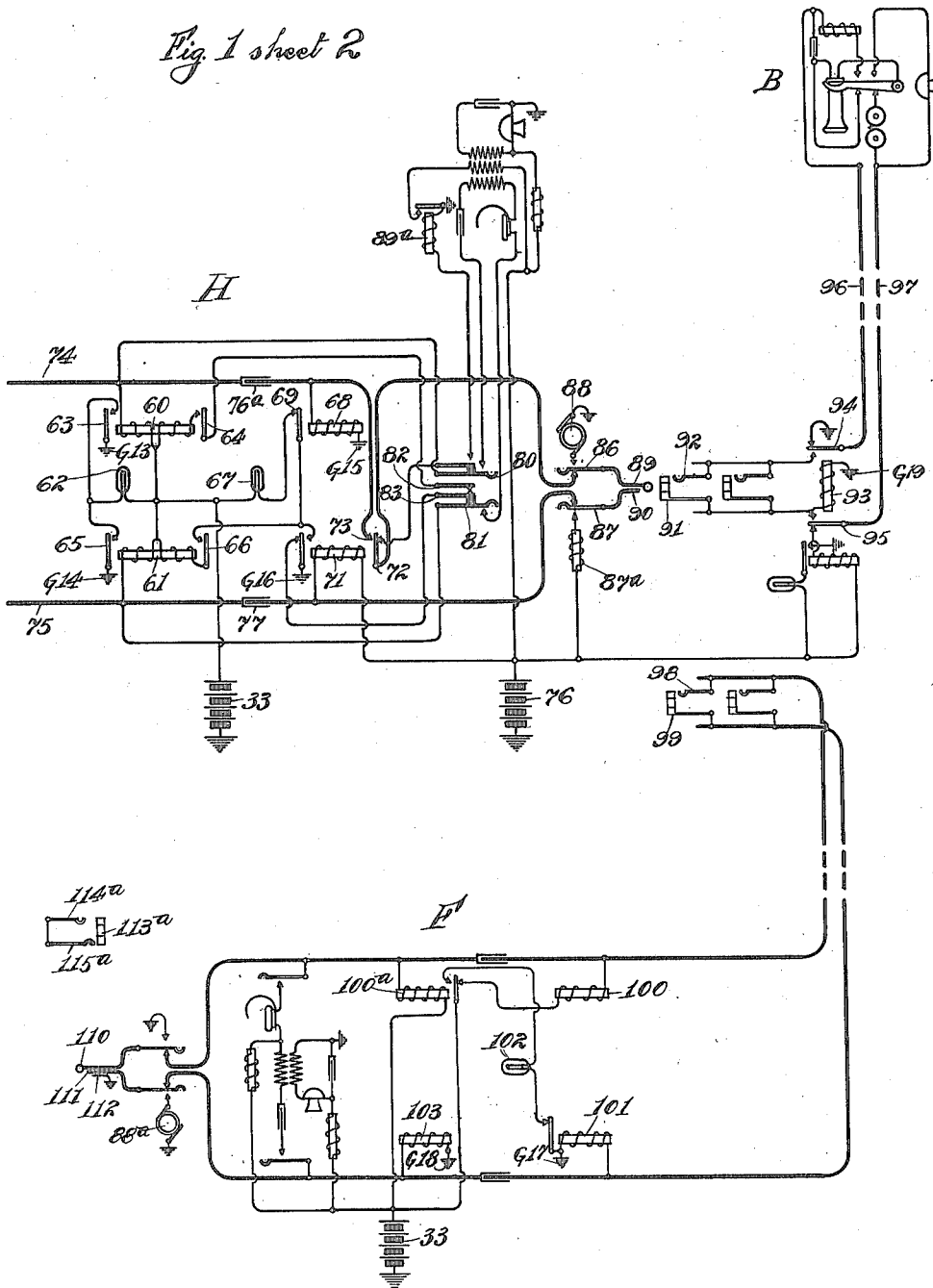
APPLICATION FILED DEC. 20, 1905.

1,184,933.

Patented May 30, 1916.

5 SHEETS—SHEET 2.

Fig. 1 sheet 2

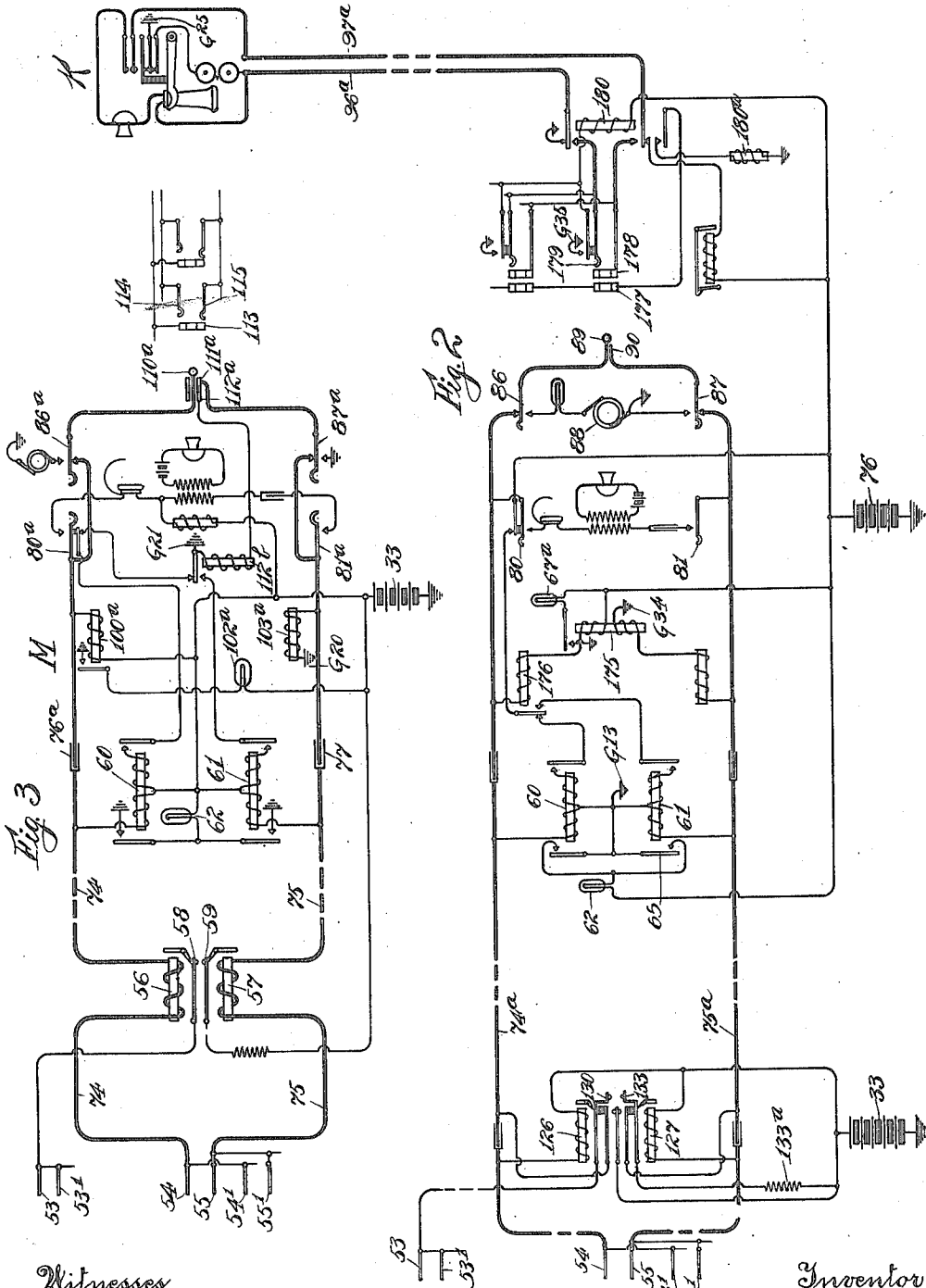


Witnesses
G. E. Mueller.
J. H. Ferguson

Inventor
Alfred H. Dyson

1,184,933.

Patented May 30, 1916.
5 SHEETS—SHEET 3.



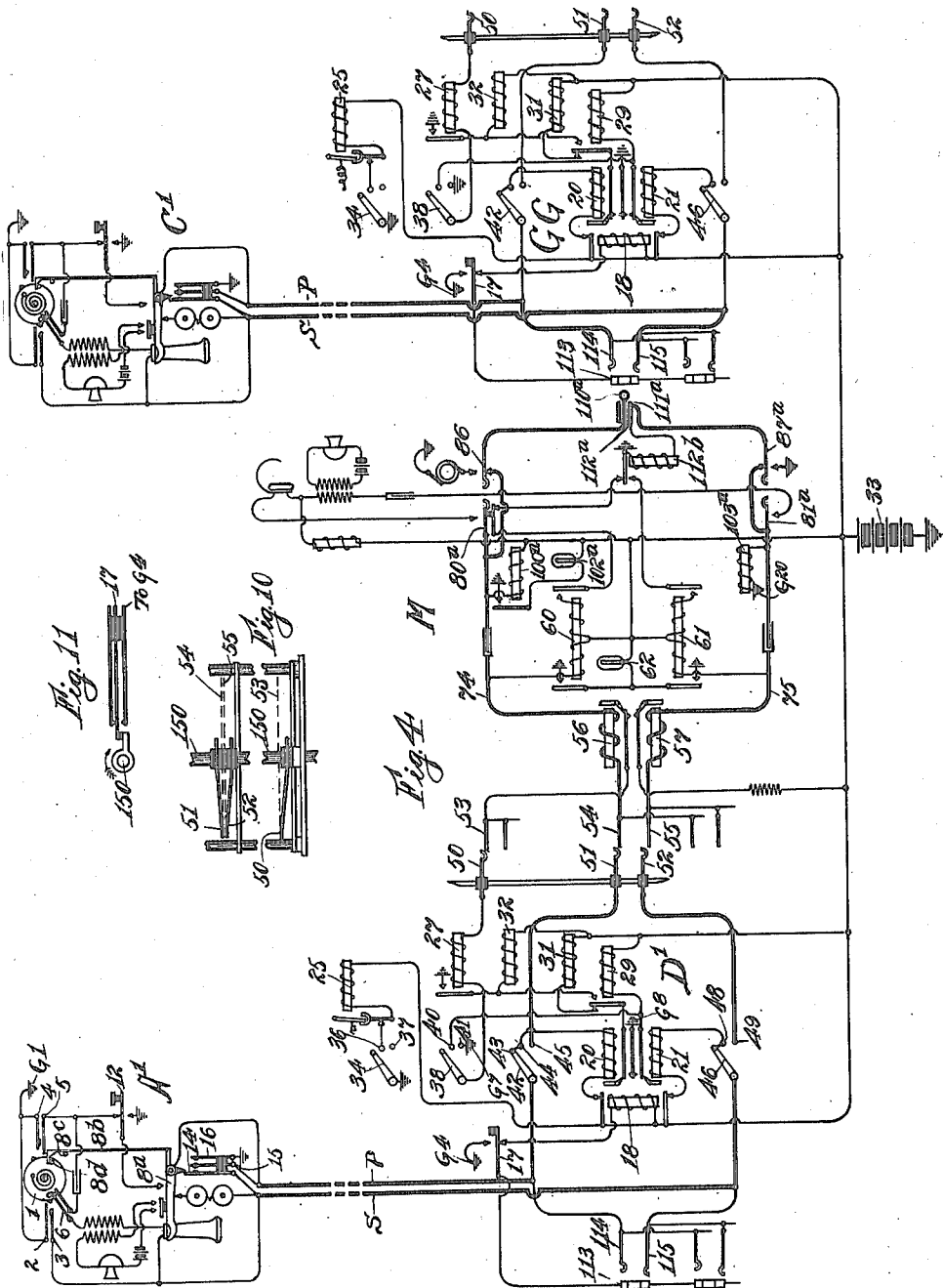
Witnesses
G. E. Mueller
J. H. Ferguson

Inventor
Alfred H. Dyson

A. H. DYSON.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 20, 1905.

Patented May 30, 1916.
5 SHEETS—SHEET 4.

1,184,933.



Witnesses
G. E. Mueller
J. H. Ferguson

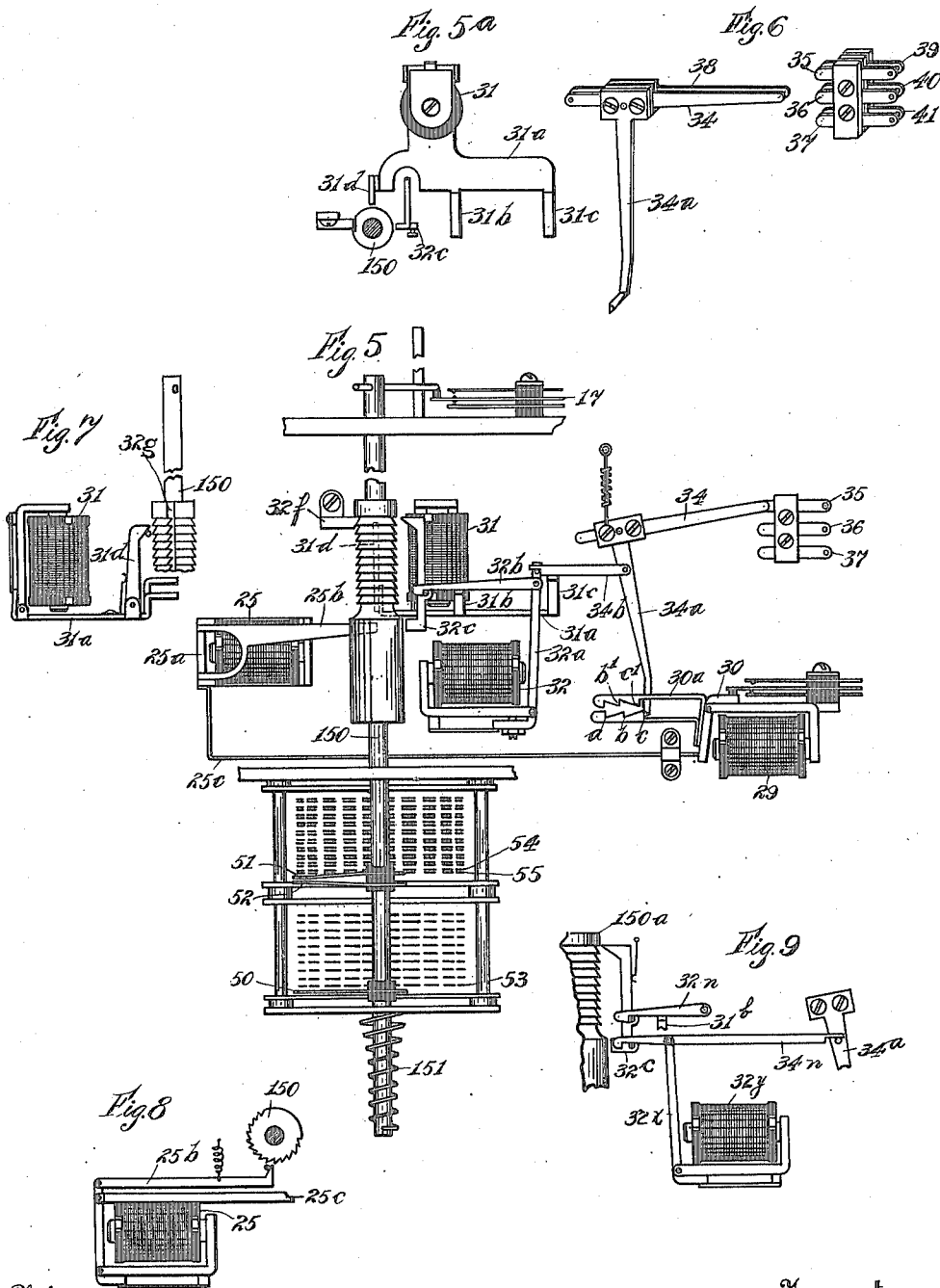
Inventor
Alfred H. Dyson

A. H. DYSON.
TELEPHONE SYSTEM.
APPLICATION FILED DEC. 20, 1905.

1,184,933.

Patented May 30, 1916.

5 SHEETS—SHEET 5.



Witnesses
G. E. Mueller.
J. H. Ferguson

Inventor
A. H. Dyson

UNITED STATES PATENT OFFICE.

ALFRED H. DYSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

1,184,933.

Specification of Letters Patent.

Patented May 30, 1916.

Application filed December 20, 1905. Serial No. 292,597.

To all whom it may concern:

Be it known that I, ALFRED H. DYSON, a citizen of the United States, residing at Chicago, county of Cook, and State of Illinois, have invented new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in which visual signals are employed to notify operators in regard to the condition of subscribers' lines.

The object of my invention is to provide improved signaling means and arrangements of apparatus for such systems.

I provide a switchboard having spring-jacks for subscribers' lines, together with single plug-cords for making connection therewith. I dispense with the other plug usually employed, and terminate the other end of the link-circuit in switching contacts of a traveling switch. Such a switch may comprise movable contact-arms and a plurality of switching contacts, forming switching terminals of link-circuits described above. The calling subscriber first causes the movable contact-arms to engage switching contacts, terminals of a first link-circuit. These terminals are multiplied to other traveling switches, and if the link-circuit connected with the first terminals is already in use, a series of local circuits are set up independent of the subscriber, whereby the movable arms move over busy terminals until they reach the first idle ones, when their motion is arrested. When this occurs, a signal in front of the operator is caused to be displayed and the operator listens in, ascertains the number of the desired subscriber and completes the connection with the plug forming the terminal of the selected link-circuit. She then rings the called subscriber in the usual manner. Double supervision is provided for each cord-circuit in consonance with the usual practice in telephone switchboards of the most approved character.

For the purpose of preventing interference with existing connections when the line-wipers of a switch are moving over terminals of busy cord-circuits, I preferably arrange the traveling switch structure in such a manner that the said wipers are disconnected from the calling line and, in fact, on entirely open circuits in the switch while moving over busy contacts and I provide means for instantaneously connecting them

with the calling line as soon as the switch comes to rest in engagement with an idle link or trunk-circuit. I also provide means for restoring to normal the switch when conversation ends, or at any other time under control of the calling subscriber.

My invention is equally adapted to multiple switch-board structures, as well as to non-multiple boards, as will be apparent in the following description.

A valuable feature of my invention is found in its adaptability to be employed for the purpose of providing connection between automatic telephone exchange subscribers' lines and manually operated telephone exchange subscribers' lines. It is, however, my desire not to be limited to this employment of my invention, as my invention is broader than this narrow application of it.

In the accompanying drawings, I show various applications of my invention, not limited to the narrower application thus briefly described.

Figure 1, consisting of Sheets 1 and 2, illustrates the circuit arrangement of a telephone exchange system, arranged in accordance with one application of my invention. Fig. 2 illustrates a link-circuit terminating in a single plug and an associated telephone circuit of well known character. Fig. 3 illustrates a varying form of link-circuit, adapted to make connection with an automatic line. Fig. 4 illustrates two substations connected by their lines with automatic switches and a link-circuit terminating in a single plug for interconnecting them. Fig. 5 illustrates a selector switch. Fig. 5^a is a plan view of a primary magnet, its armature and associated mechanism. Fig. 6 is a view in perspective of a side-switch pawl and its mechanism. Fig. 7 is a side view of a primary magnet. Fig. 8 is a side view of a secondary magnet. Fig. 9 illustrates a connector switch release magnet and its associated parts. Fig. 10 shows the relative normal positions of wipers and contact-levels when switch 5 is adjusted for circuit Fig. 4. Fig. 11 shows an off-normal switch combination for rotary motion only. Figs. 5 to 9 show all the mechanical combinations required for the various circuits, other than ordinary relay combinations, and will, therefore, be first described. The switch, shown in these figures, I do not claim as my invention.

Referring first to Fig. 5, in the lower portion of said figure I have shown two banks of insulated contacts, those of the upper bank being arranged in pairs and those of the lower bank being single contacts. These contacts are terminals of electrical conductors arranged in sets of three, any pair of contacts in the upper bank and a correspondingly located single contact in the lower bank constituting a set, each set forming connecting terminals of a trunk-circuit. Associated with the upper bank are wipers 51 and 52, and with the lower bank is wiper 50. Horizontally, the banks are concave, the arrangement being such that when shaft 150, to which the wipers are attached, insulated one from the other, is raised upward, the wipers select a row; and when the shaft, having been raised, is rotated, the extremities of the wipers engage successive sets of contacts of selected rows. Upon the upper portion of the shaft are provided two ratchets, the upper one being adapted to be engaged by pawl 31^a, its teeth being disposed horizontally, and the lower one by pawl 25^b, its teeth being disposed up and down. In Figs. 7 and 8 are illustrated the details of these ratchets, the pawls and the magnets controlling them.

Referring to Fig. 5, the lifting movement of the shaft is secured by means of current impulses caused to flow through magnet 31. The first of these causes pawl 31^a to engage the upmost tooth of its ratchet and lift the shaft one step upward. At the same time, arm 31^b, part of the magnet's armature, lifts arm 32^b to disengage detent 32^c, which moves toward the shaft and with its upper portion engages the tooth of the ratchet next below that upon which pawl 31^a acted, and holds the shaft in the raised position. With the first energization of magnet 31, arm 31^c, part of its armature, lifted arm 34^b out of engagement with the pin upon armature 32^a and the armature falls backward so that its pin no longer engages the off-set in arm 34^b. This releases side-switch pawl 34^a preparatory to its actuation, as hereafter described. Successive current impulses, sent through magnet 31, cause the shaft to be lifted successive steps, each step bringing wipers 51, 52 and 50 on a level with different horizontal rows of contacts, detent 32^c engaging successive horizontal position and holding the shaft in its raised position after each step. Contact-levels having been selected, the shaft 150 is caused to be rotated by current impulses sent through magnet 25. Each impulse causes it to attract its armature 25^a to which is attached pawl 25^b, which thereupon moves the shaft a step in a rotary clockwise direction by engaging its associated ratchet. The lower portion of detent 32^c engages successively the vertically disposed ratchet

teeth of the shaft and holds the shaft in its rotated position after each thrust of pawl 25^b. A stationary detent 32^f is provided which engages the ratchet shown associated with it with the first rotary movement of the shaft. While the shaft is being lifted, this detent is in the slot 32^e shown in Fig. 7, so that it does not prevent the lifting movement of the shaft. Each rotary step of the shaft causes the wipers to engage successive sets of contacts.

Referring now to private magnet 29, when its armature 30 is attracted, ratchet 30^a, attached thereto, is moved downward with respect to side-switch pawl 34^a, so that the extremity of the pawl leaves tooth *c* and engages tooth *c'*, this motion being too little to alter contact between arm 34 and contact 35. When, now, the magnet is deenergized, pawl 34^a slips down and engages tooth *b*. Pawl 34^a being pivoted as shown, and arm 34 being attached to said pawl, this movement causes the arm to disengage contact-point 35 and to engage contact-point 36. A second energization and deenergization of magnet 29 will cause pawl 34^a to move into engagement with tooth *a* by a similar operation, and arm 34 to move to engage contact-point 37. An arm 25^c, attached to armature 25^a, extends to armature 30 of magnet 29. This arm would, when magnet 25 is energized and deenergized, effect the circuit changes described in connection with pawl 34^a, if magnet 29 should remain deenergized, by thrusting in and allowing the retraction of armature 30 each time magnet 25 is energized. Should magnet 29 be energized, as long as it continues so, obviously no movement of its armature, under the influence of arm 25^c, is possible. This arm is provided for the purpose of causing pawl 34^a to engage tooth *a*, if the first contacts of selected levels are idle when engaged by the wipers, as will be more fully understood when the circuits are described.

In Fig. 6, I show associated with pawl 34^a a plurality of circuit changing arms and associated contact-points for them to engage, illustrating the manner in which each movement of pawl 34^a may be employed to effect a plurality of simultaneous circuit changes.

The return to normal of the switch shown in Fig. 5 is effected by the energization and deenergization of magnet 32. When the magnet is energized, it attracts armature 32^a, which moves arm 32^b toward the shaft, the said arm engaging with the tooth at its extremity the pin shown associated with detent 32^c. The pin associated with armature 32^a moves to such position that it again engages the off-set in arm 34^b. When magnet 32 is deenergized, its armature is retracted and moves arm 34^b to the right and with it

pawl 34^a to again engage tooth *c* so that the side-switch returns to normal. When the armature is retracted, arm 32^b withdraws detent 32^c from its engagement with the ratchets of the shaft. The rotation of the shaft is effected against the torsion of spring 151, and the shaft, being now free, is rotated counter clockwise until the wipers are beyond the left-hand or first contacts of the selected rows. When this occurs, stationary detent 32' has reached the slot in the ratchet shown in Fig. 7, and the shaft descends by gravity, aided by spring 151, to the position shown.

The structure above described is that employed in connection with the selector switch circuits shown at D and G in Fig. 1. Substantially the same switch may be employed in connection with the connector switch circuits shown at E in Fig. 1. When thus employed however, the arm 25^c is omitted. For certain operating reasons, it is preferable to release the connector switch with the forward stroke of its release magnet's armature. In Fig. 9, I show a connector switch release magnet 32^y and its associated mechanism. In the said figure, 31^b, part of the primary magnet's armature, with the first energization of said magnet, lifts arm 32^a to disengage the pin upon detent 32^c which thereupon moves forward and engages the shaft as described. Side-switch pawl 34^a is normally, as shown, free to move, and arm 31^c, shown in Fig. 5, is not required. When release magnet 32^y is energized and attracts its armature 32^x, arm 34^a, attached to the said armature, moves from left to right and, with its right extremity, restores side-switch pawl 34^a, and with the hook upon its left extremity withdraws the detent from engagement with the shaft ratchets, the shaft thereupon returning to normal as described. As the differences between the selector switch and the connector switch are so slight, I have deemed it preferable to illustrate such variations as exist by themselves rather than encumber the specification with additional drawings which would be substantially duplications of Figs. 5 to 8.

As is well known, two kinds of telephone exchange switchboards, widely differing in character, are in use in this country; namely, first, what are ordinarily called "manual" switchboards, in the employment of which the various connections are completed by telephone operators; and secondly, what are called "automatic" switchboards, in whose employment connections are established by means of step-by-step switches operated and directed by subscribers, no operators being employed at the exchange. It has become usual to refer to lines terminating in boards of the first character as "manual lines," and to the associated subscribers as "manual sub-

scribers." Conversely, "automatic lines" and "automatic subscribers" are commonly employed terms, and these terms will for convenience be employed in the specification.

Referring now to Fig. 1, consisting of Sheets 1 and 2, I show automatic telephone exchange apparatus, including a substation A connected by its telephone line with the circuits D of its selector switch at the exchange. I show a second substation C connected with similar circuits at the exchange. I also show at E circuits of a connector switch, adapted to be employed in interconnecting substations A and C. The above includes the circuits necessary in interconnecting two lines automatically, or without the intervention of a telephone operator. The apparatus above described I do not claim as my invention. At B, I illustrate a third substation connected, by its telephone line, with its line circuit at the exchange including the usual line signal for attracting an operators' attention, together with suitable relay combinations for controlling the signal. This structure is well known in the art, is in extended commercial use and need not be described in detail. At H, I have illustrated a link-circuit terminating at one end in contacts 53, 54 and 55, forming stationary contacts of a selector switch, and at the other end in contacts 89 and 90 of a manually operated plug. Contacts 53', 54' and 55' represent multiples at another selector switch. This circuit H also comprises signaling devices associated with its end terminating in the plug, of a character hereafter described. This circuit is for use in interconnecting automatic lines with manual lines, and I claim the same as my invention by itself and in combination. At F, I show another link-circuit, which I also claim as my invention, as in the case of circuit H. Circuit F is adapted to be used in connecting a manual line with an automatic line when the manual subscriber is the originator of the call. It is also employed in cases where an automatic subscriber has connected his line with circuit H, when desiring connection with another automatic line, in completing the call directly to the desired automatic line by manual means.

In Fig. 1, I have shown two batteries 33 and 76. The former appears at various positions in the drawing, being shown thus to avoid confusion. This is the battery employed in connection with automatic exchange apparatus, and in practice it is ordinarily a fifty-volt battery. The other battery 76 is employed in connection with the manual exchange and in practice is ordinarily a twenty-four-volt battery. Two batteries are, however, not necessary.

Referring now to Fig. 1, the operation of the automatic telephone system shown therein will be briefly described, it being well

known in the art and having gone into extensive commercial use.

Connection from an automatic line to an automatic line: In making an automatic connection, circuits A, D, E, G and C only, are brought into use. The system as shown is adapted for use in an exchange numbering about one thousand subscribers. For a larger exchange, second selector switches would be employed, of a character and arrangement well known in the art. Each subscriber's line would be provided with a selector switch, as D, comprising wipers and their associated banks of one hundred sets of contacts, as shown in Fig. 5.

Certain of the different contact-levels of the banks would be comprised of terminals of connector switches, the contact sets of each of said levels being terminals of trunk lines leading to connector switches assigned for connection to a particular one hundred lines. Each connector switch includes wipers and multiple contacts, terminals of one hundred subscribers' lines.

A subscriber, desiring to connect his line with another line, first causes the wipers of his selector switch to select the proper level of connector switch terminals. The selector switch then automatically selects the terminals of the first idle connector switch. The subscriber then causes the connector switch wipers to select multiple terminals of the desired line, which will be included in its banks, thus completing the connection.

In placing reference characters upon the connector switch circuits shown at E, I have supplied the same numbers to the operating magnets and side-switch parts as those supplied in Fig. 5, adding to the numbers a distinguishing letter "y." By this means, reference may be readily made to the mechanical drawing, when description of the connector switch circuit is given.

Assuming that the subscriber, whose substation is illustrated at A, desires to be connected with the subscriber at the automatic exchange whose number is assumed to be 627, whose substation is shown at C, he first removes his receiver from the hook, the hook-lever moving upward, closing contact 8-9 and connecting contacts 10 and 11, thus closing the substation transmitter circuit. He then rotates dial *l* from left to right until six teeth have passed below spring 5, and releases it. As long as the dial is in other than normal position, contact 6-7 is open. The dial returns to normal and in so doing closes and opens contact between springs 5 and 4 six times. Each closure causes an impulse of current to flow from ground G', through contacts 4-5, 9-8, limb P, 42-43, relay 20 to battery 33. Relay 20 is energized and deenergized six times, attracting its armature each time and causing current to flow from ground G', through contact 23-22,

armature 30, primary magnet 31 to battery 33. Associated with wipers 50, 51 and 52, are contact banks as described in connection with Fig. 5. The said wipers are now raised to positions level with the sixth rows of contacts from below, reference being had to said Fig. 5. The ten sets of contacts, comprising this level, are multiple terminals of ten connector switches, circuits of one of which I have illustrated at E. These connector switches are assigned for connection to subscribers' lines, numbered from 600 to 699 inclusive. In its return to normal, dial *l* closes contact a single time between springs 2 and 3 momentarily, and a current impulse flows from ground G', through contact 2-3, limb S, 46-47, winding of relay 21 to battery 33. Relay 21 is energized, attracts its armature, closing contact momentarily between springs 23 and 24, whereupon current flows from ground G', through 23-24, private magnet 29, to battery 33. Said magnet is energized and deenergized and side-switch arms 34, 38, 42 and 46, operated by said magnet as previously described, engage, respectively, contact-points 36, 40, 44 and 48. Current flows from ground G', through 36-34, secondary magnet 25, contact 26 to battery 33. Magnet 25 is energized and then deenergized, it being in vibratory circuit with contact 26, and wipers 50, 51 and 52 engage the first contacts of the selected levels. If these contacts are idle, arms 34, 38, 42 and 46 engage contact-points 37, 41, 45 and 49, respectively, under the influence of arm 25', shown and described in connection with Fig. 5. The contacts, terminals of connector switches, are multiplied to other selector switches, as indicated in the drawing at 106', 107' and 108', and if the first connector switch of the group is already in use when wiper 50 engages contact 106, shown at E, current will flow from ground G' of another selector switch rendering the connector switch busy, through contact 41-38 of said selector switch, its relay 27, its wiper 50 to some multiple contact 106', to contact 106, to wiper 50 of selector switch D of the calling subscriber, through its relay 27, its contact 38-40, through private magnet 29, to battery 33. This flow energizes magnet 29 and prevents temporarily the movement of the side-switch arms.

The resistances of magnet 29 and relays 27 are so proportioned that the said relays do not attract their armatures under these circumstances. Thus, if the first set of contacts of the selected levels is busy, the side-switch arms remain in engagement with their middle contact-points, and secondary magnet 25 is energized and deenergized a second time. This brings wipers 50, 51 and 52 into engagement with a set of contacts, terminals of the second connector switch of the selected group. If this is

busy, its contact 106 will be grounded at ground G' of some other selector switch, circuit will be continued through private magnet 29 of D, the side-switch arms of switch D remain immovable and secondary magnet 25 is again energized and deenergized, causing the wipers to engage the next contacts. As soon as an idle set is reached, its contact 106 will be insulated from ground G' of any other selector switch, as is apparent from an inspection of E. Current will be broken through private magnet 29 and, with the retraction of the armature of secondary magnet 25, arms 34, 38, 42 and 46 engage contact-points 37, 41, 45 and 49 respectively. The movement of arm 34 opens circuit through magnet 25, the wipers 50, 51 and 52 of the selector switch remaining in engagement with the idle connector switch terminals, assumed to be terminals 106, 107 and 108 shown at E. The movement of arm 38 connects ground G' through relay 27 and wiper 50 to terminal 106 of the selected connector switch and its multiples, rendering the connector switch busy. It will be noted that wipers 51 and 52, terminals of the line of subscriber A, were disconnected from the line while they were wiping over busy contacts, the movement of arms 42 and 46, described as occurring immediately upon the selection of idle contacts, connecting the said wipers through to the limbs of the line.

It should be noted that arm 17, with the first upward movement of the selector switch shaft, connected ground G' to contact 120, a multiple connector switch terminal of the line of subscriber A, rendering the line busy with respect to calling subscribers desiring connection with it, as will be hereafter described.

Operation of connector switch E.—Subscriber A, by rotating and then releasing dial Z, now causes two impulses of current to flow from ground G' over limb P of the line, through contacts 42—45, 51—107 (E), relay 104 to battery 33, the relay attracting its armature twice, causing two impulses of current to flow from ground G', through armature of magnet 29', through arm 34', primary magnet 31', to battery 33, raising the shaft of the connector switch two steps upward. Associated with the wipers of the said connector switch are one hundred sets of multiple terminals such as shown in Fig. 5, including those of subscribers numbered from 600 to 699 inclusive, the lowest rows including those from 610 to 619 inclusive, the second rows those from 620 to 629 inclusive, and so upward, the top rows including those from 600 to 609 inclusive. Thus, the two upward steps of the shaft referred to brought wipers 50', 51' and 52' level with the rows of contacts, terminals of lines numbered from 620 to 629 inclusive. A

single impulse of current flows from ground G', with the return of the dial to normal, through contact 2—3, limb S, 46—49, 52—108, relay 105 to battery 33, causing the attraction and release of the relay's armature and a flow of current from ground G', through private magnet 29' to battery 33. Side-switch arms 38', 42', 46' and 34' are, with the resulting energization and deenergization of magnet 29', moved to engage their intermediate contact-points. Subscriber A, by dial Z, now causes seven impulses of current to flow from ground G', over limb P, through relay 104 to battery 33, the operation of the relay resulting in seven impulses from ground G', through armature of magnet 29', through arm 34', through secondary magnet 25' to battery 33. The shaft of the switch is thereby rotated seven steps and, with the seventh step, its wipers engage contacts, multiple terminals of the line of subscriber 627, or subscriber C. This subscriber is provided with a selector switch circuit, shown at G. Wipers 50', 51' and 52' of the connector switch are now in engagement with contacts 120, 121 and 122 of the called-for subscriber's line, the said contacts having circuit connections as shown at G.

If the called-for line is busy, its contact 120 will be grounded at ground G', due to the movement of arm 17 (if a calling line), or at ground G'' of a connector switch (if it be a called-for line). Assuming that it is busy, a single impulse of current caused to flow from ground G' of the substation at A, with the return of the dial to normal, through contact 2—3 and through relay 105, effects circuit changes as follows: Current flows from ground G', through private magnet 29' to battery 33. The said magnet attracts its armature 29' and current flows from grounded contact 120, through wiper 50', through arm 38' to its intermediate contact-point, through armature 29', through release magnet 32' to battery 33. The release magnet is energized and the connector switch returns to normal. When, now, subscriber A depresses key 12 for the purpose of ringing the called subscriber, the shaft of the connector switch is stepped upward, just as though a single impulse had been sent over limb P by the dial, contact 12' is closed and subscriber A receives, from busy-back machine 118, the busy signal. Subscriber A thereupon replaces his receiver, arm 13 coöperating with springs 14, 15 and 16 to simultaneously ground limbs P and S for a moment. Relays 104 and 105 are simultaneously energized, closing current from ground G' at the selector switch, through relay 27, contact 50—106, through contact 109—110, release magnet 32' to battery 33. The connector switch is again released. Relay 27 of the selector switch is energized in

circuit with low resistance magnet 32^v and deenergized, momentarily closing circuit through release magnet 32 and the selector switch is released and returns to normal.

5 All apparatus is now at normal. Assuming now that the called line is idle, its contact 120 will be in the condition shown at G in Fig. 1; and the connector switch is not released in the manner described, the release

10 magnet remaining inert, but with the deenergization of private magnet 29^v the side-switch arms of the connector switch move to their third positions. Ground G¹¹ is then connected to wiper 50^v and 120, rendering

15 the called line busy. Also current flows from said ground G¹¹, through wiper 50^v, contact 120, cut-off relay 18 of the called line, to battery 33, energizing the said relay, which opens the circuits of the selector

20 relays 20 and 21. Subscriber A now grounds limb P of the line by means of key 12, relay 104 is energized, the attraction of whose armature closes circuit from ground G⁹, through ringing relay 117 to battery 33.

25 The energization of this relay puts generator 124 into circuit with the called subscriber's line and rings his bell. When the called subscriber responds, conversation proceeds, the conversational circuit being traced by

30 the heavy lines. When they have finished their conversation, they replace their receivers. If the called subscriber does this first, he causes simultaneous energization of relays 104^a and 105^a, thus energizing release

35 magnet 32^v, and the connector switch only is released, the other apparatus remaining to be released by the calling subscriber in the manner previously described. If the

40 calling subscriber replaces his receiver first, both selector switch and connector switch are released in the manner previously described.

Connection from automatic switchboard to manual switchboard.—I will now describe

45 the method of operation whereby the line of subscriber A may be connected for conversation with the line of subscriber B. I have shown a single link-circuit H and a single manual exchange line—that connect-

50 ed with substation B. It will, of course, be understood that as many manual lines may be brought to the operator's position, whereat circuit H terminates, as may be desired, subject only to the limitation of jack-space.

55 As all these lines would have circuits identical with those shown, but a single one is illustrated. It will also, of course, be understood that as many operators' positions will be provided as will be required to handle the traffic that may exist. Also a plu-

60 rality of link-circuits identical with H would, in practice, terminate at each operator's position, the number depending upon the amount of business which each operator

65 could handle. I have shown the link-cir-

cuit terminals provided with but two sets of multiple contacts 53, 54, 55 and 53', 54' 55'. Obviously, the number of selector switches to which they might be multiplied would depend upon the business transacted. Ob-

70 viously, also, the number of link-circuits accessible to any given line would be determined by the volume of business originating from the subscribers, and my invention is not limited to a switch having ten sets of

75 contacts upon each level. These general features are collateral to my invention, being matters of expediency obvious to those skilled in the art.

Referring to Fig. 1, 53, 54 and 55 are multiple terminals of one link-circuit extending

80 from bank-contacts of the first selector switch of subscriber A to an operator's position at a multiple switchboard, the said link-circuit there terminating in a manu-

85 ally operated plug, multiple spring-jacks of subscribers' lines being provided for making connection with said plug. Contacts 53, 54 and 55 may be located upon the lowest

90 levels of the selector switch, although, obviously, my invention is not restricted to such location or the employment of a single level. If the subscriber, whose line ter-

95 minates in the automatic switchboard, desires connection with a subscriber whose line terminates in the manually operated switchboard, he, by sending one impulse of current from ground G' over limb P of the

100 line, by rotating his dial, steps the shaft of his selector switch up one step, bringing the wipers level with contacts, terminals of ten link-circuits of the character described. These may all lead to one operator's position, or may be distributed among several.

A single impulse from ground at substa-

105 tion A, flowing (on the return of the dial to normal) over limb S of the line, energizes and deenergizes private magnet 29 as before described, the side-switch arms being caused thereby to assume their intermediate posi-

110 tions and secondary magnet 25 steps the shaft one step in a rotary direction, bringing wipers 50, 51 and 52 into engagement with terminals of the first link-circuit of the group. If this is idle, the side-switch arms

115 assume their third positions as before described under the influence of the armature of magnet 25. If the link-circuit, however, is busy, owing to connection having been made with a multiple terminal thereof at

120 some other selector switch, current will flow from ground G' at said other selector switch, through its contact 41—38, through its relay 27, its wiper 50, to a multiple of the con-

125 tact engaged by wiper 50 of the switch of subscriber A, then through relay 27 of said switch, its contact 38—40, its private magnet 29 to battery 33. In such case, the private magnet becomes energized (although relays 27 do not, as previously explained)

130

and the side-switch arms are held in their intermediate positions while successive energizations and deenergizations of secondary magnet 25 proceed, moving wipers 50, 51 and 52 to engage terminals of successive link-circuits until terminals of an idle one are reached. While the wipers pass over busy terminals, successive locking paths are established through private magnet 29 from successive selector switches, similar to that above described, a new path being closed, substantially, simultaneously with the interruption of a preceding one. For this purpose, the contacts, wiped over by wiper 50, may be made wider than the contacts wiped over by wipers 51 and 52, or the wiper 50 itself may be made broader than wipers 51 and 52. As soon as terminals of an idle link-circuit are reached, circuit is broken through magnet 29, and side-switch arms 34, 38, 42 and 46 engage contact-points 37, 41, 45 and 49 respectively, wipers 50, 51 and 52 remaining in engagement with the terminals of the idle link-circuit selected, assumed to be that shown at H in Fig. 1. The closing of contact 41—38 connects ground G^7 through wiper 50 to contact 53 and its multiples, rendering the selected link-circuit busy with respect to other selector switches having access to multiple terminals of said link-circuit.

It will be noted that wipers 51 and 52 are normally disconnected from the limbs and spring-jacks of their associated calling line and remain so disconnected as long as they are wiping over busy contacts. As soon as idle contacts are reached, the movement of side-switch arms 42 and 46 connects them through to the two line limbs and spring-jacks. Subscriber A may now depress key 12, and current flows from ground G^2 , through contact 9—8, the receiver being off the hook at this time, over limb P, through contacts 42—45, 51—54, over conductor 74, through the left-hand winding of relay 60 (Sheet 2) to battery 33. Relay 60 is energized, closing circuit through lamp 62 from ground G^{13} to battery 33 by the attraction of its armature 63. Its armature 64 is also attracted, establishing a locking path for the said relay 60 from ground G^{16} , through normally closed listening-key contact 83—82, through armature 64 and the right-hand winding of relay 60 to battery 33. The subscriber thus automatically makes connection to the first idle link-circuit H and then lights the signal-lamp associated with said link-circuit.

The illumination of lamp 62 notifies the operator that some substation is connected with that link-circuit and that the subscriber desires her attention. She throws over levers 80 and 81 of her listening-key, thus bridging her talking-set across the strands of the link-circuit, and ascertains the num-

ber of the subscriber wanted. In throwing over the levers of her listening-key, she opens contact 83—82, thus interrupting the locking-circuit described of relay 60, causing the relay's deenergization and the extinguishment of lamp 62. Having learned the number of the subscriber wanted, the operator touches tip 89 of the plug of the link-circuit to sleeve-contact 91 of a multiple spring-jack of the called subscriber's line. If the line is busy, she receives a "click" in her telephone, due to the actuation of test relay 89^a, occurring in the well-known manner, and notifies subscriber A, who, by replacing his receiver, simultaneously energizes, for a moment, relays 56 and 57 associated with the link-circuit H (Sheet 1). The resulting closing of contact 58—59 closes circuit through release relay 27 at the selector switch D, which in turn causes a momentary energization of release magnet 32, upon whose deenergization the selector switch is restored to its normal position, as previously described. If, however, the called line is idle, the operator, in testing, receives no "click" in her telephone, in which case, knowing that the line is idle, she inserts the plug into the spring-jack, closing contacts 89—92 and 90—91.

When the operator inserts the plug into the spring-jack as above described, current flows from ground G^{19} , through the cut-off relay 93, through contact 91—90, through the ringing-key lever to its normally closed contact, through relay 71 to battery 76. Cut-off relay 93 attracts armatures 94 and 95 to close their alternate contacts, cutting limbs 96 and 97 of the called line into direct connection with contacts 92 and 91 of the spring-jack. The energization of relay 71, resulting from the above described flow of current, closes current from ground G^{16} , through the relay armature's alternate contact, through armature 69 of relay 68, through supervisory lamp 67 to battery 33, causing the display of the said lamp. The energization of relay 71 also closes contact 73, establishing the taking circuit of the tip cord strand. The operator now restores her listening-in key and throws over levers 86 and 87 of the ringing-key, putting generator 88 into circuit with the line of the called subscriber B, causing his bell to ring. While the ringing-key levers are depressed, cut-off relay 93 of the called subscriber's line is maintained energized by a flow of current from ground G^{19} , through the relay, contact 91—90, ringing-key lever 87, via resistance-coil 87^a, to battery 76. Until the called subscriber answers the call by removing his receiver from the hook, this lamp 67 remains displayed, except during the ringing operation. When, however, the called subscriber removes his receiver, a path for the flow of current, from ground G^{15} , through the wind-

ing of relay 68, through contact 73—72 (relay 71) being at this time energized), ringing-key lever 86, contact 89—92, armature 94, limb 96, then through the substation, returning over limb 97, through armature 95, its alternate contact, contact 91—90, winding of relay 71 and to battery 76, is established, causing the energization of relay 68 and the attraction of its armature 69, which effects the effacement of lamp 67. The two subscribers A and B are now in conversation, the circuit being traced by the heavily lined conductors. It will be noted that in the structure shown in this figure, subscriber A at the automatic end has his transmitter energized by local battery, while subscriber B has his transmitter energized by common battery.

When the subscribers have finished their conversation, they replace their receivers. When subscriber B does so, he interrupts the flow of current through relay 68, whose armature 69 is retracted, again closing circuit through lamp 67, causing its display. When subscriber A replaces his receiver, the two limbs of the line are simultaneously grounded for a moment at the substation, and current flows from ground at the substation, through limb P, relay 56, relay 60 to battery 33, and from the same ground over limb S, through relay 57, through relay 61 to battery 33, causing the energization of all four relays. Relays 56 and 57, being simultaneously energized, close contact 58—59, which effects the energization of release relay 27. The latter attracts armature 28, closing current from ground G^a , through said armature and release magnet 32 to battery 33, energizing said magnet. When, with the return of the hook-lever to normal at substation A, ground is removed from the two line limbs, contact 58—59 will be broken, relay 27 will be deenergized, in turn deenergizing release magnet 32 and the selector switch returns to normal.

The energization described above of relay 61 establishes a locking-path for it from ground G^{10} , through alternate contact of armature of relay 71, the front contact of armature 66, winding of relay 61 to battery 33. The attraction of armature 65 closed a path for current from ground G^{14} , through lamp 62 to battery 33, causing the display of the lamp. The two lamps being now displayed, the operator knows that disconnection is desired and removes the plug from the spring-jack, and all apparatus returns to its normal condition.

The line-circuit associated with substation B is of a character well known in the art which has gone into extensive commercial use, and detailed description of it is therefore unnecessary.

Referring to Fig. 2, I there show a varying form of link-circuit which may be con-

sidered in connection with the selector switch shown in Fig. 1, connected to substation A. It is assumed that contacts 53, 54 and 55 in Fig. 2 are associated with wipers 50, 51 and 52, respectively, of the selector switch shown at D in Fig. 1 and that the said wipers have been brought to rest in engagement with the said contact-pieces in the same manner as that described in connection with Fig. 1, whereby they are placed in connection with similarly designated contacts in Fig. 1.

In considering Fig. 2, it should be superposed upon Sheet 1 of Fig. 1 so that contacts 53, 54 and 55 of Fig. 2 are adjacent to wipers 50, 51 and 52, respectively, of Fig. 1, Sheet 1, circuit D. When, now, subscriber A depresses key 12, relay 126 in Fig. 2 is energized by current flowing from ground at the substation to battery 33; the relay attracts its armature, operating its associated spring combination to close circuit from ground G^{13} , through the left-hand winding of relay 60, over conductor 74^a to battery 33. Relay 60 attracts its armatures, illuminating lamp 62 and establishing a locking circuit from ground G^{13} , through its right-hand winding to battery 76. The operator, throwing over levers 80 and 81, opens the locking circuit, which results in the extinction of call-lamp 62, learns the number of the desired subscriber and tests the called-for line by touching tip 89 of the plug to test-ring 177 of the spring-jack of the line. If the line is busy, she hears a "click," due to test-ring 177 being connected to ground through coil 180^a, advises the calling subscriber, and he, by replacing his receiver, simultaneously energizes relays 126 and 127, which results in the release of the selector switch, due to the resulting closure of contact 130—133, which closes circuit from ground G^7 , through relay 27, said contact, resistance 133^a to battery 33, said resistance being relatively low. If the called line is idle, the operator inserts the plug, closing contact 89—179, the sleeve 90 of the plug connecting with 178 only. With the insertion of the plug, circuit is closed from ground G^{25} , through cut-off relay 180, to battery 76, the cut-off relay attracting its armatures and extending the circuits of the line to the spring-jacks. With the energization of relay 180, current flows from ground G^{25} at the substation, over limb 96^a, armature of relay 180, through contact 179—89, through relay 176, the upper winding of relay 175 to battery 76. Relay 176 is energized and attracts its armature to engage the associated alternate contact. Relay 175 attracts its armature to close circuit from ground, through signal-lamp 67^a to battery 76. Lamp 67^a remains lighted, except during the ringing operation, until the called subscriber responds. The operator now throws over levers 86 and 87, putting

ringing generator into circuit with the called subscriber's line. current passing from generator 88, through contact 89—179, through armature of relay 180, over limb 96^a of the line, through the bell and to ground G²⁵ at the substation, ringing the bell. When the subscriber answers the call, the removal of the receiver operates to break the ground connection to limb 96^a and closes the metallic circuit of the line through the substation. Current thereupon flows from ground G³⁴ at the exchange, through the lower winding of relay 175, through contact 90—178, over limb 97^a, through the transmitter and receiver at the substation, returning over limb 96^a, through contact 179—89, through relay 176, the upper winding of relay 175 to battery 76. Relay 175 is differentially wound, and, equal current flowing in its two windings, its armature is released and returns to normal, opening circuit through lamp 67^a and extinguishing it. The two subscribers are now in conversation, the talking circuit being traced by the heavily marked conductors. When, at the end of conversation, subscriber K replaces his receiver, limb 96^a is connected to ground G²⁵, and current then flows through the upper winding of relay 175 only, as before described. It therefore attracts its armature and illuminates lamp 67^a. When the calling subscriber A replaces his receiver, relays 126 and 127 are energized, thus restoring the selector switch as before described, and causing also the energization of relay 61 by a flow of current from ground G¹³, through the left-hand winding of relay 61, closed contact of relay 127, to battery 33. The energization of relay 61 establishes a locking-circuit extending from ground G¹³, through the armature of relay 176 to battery 76. The energization of relay 61, attracting armature 65, closes circuit through lamp 62, and the two lamps 62 and 67^a being now illuminated, the operator withdraws the plug, deenergizing relay 176, and all remaining apparatus returns to normal.

Connection from an automatic line to an automatic line by means of manually operated cord circuits.—In Fig. 1, each automatic subscriber's line is provided with multiple spring-jacks consisting of contacts 113, 114 and 115, connected as shown. For making connection with these multiple jacks, are provided plugs with circuits as shown at F. If an automatic subscriber calls for a line of character similar to his own, by way of circuit H, he tells the operator at H the number of the line desired, she communicates in the well known manner, by order-wire, with another operator before whom the plug of circuit F appears and within whose reach are multiple jacks of the automatic lines, advising her of the line wanted. This second operator tests the called line

and, if found idle, completes the connection, the first operator placing the plug terminal of circuit H in the jack terminal of circuit F.

The multiple spring-jack terminal of circuit F is so connected as to give a test when the plug of circuit F is touched to the jack-thimble. This being so, it is possible to allow either operator to determine which one of a plurality of link-circuits, such as F, is to be used in completing a given connection. While I have above described this operation as employing the services of two operators, it will be understood by those skilled in telephony that the multiple spring-jacks of both automatic and manual lines can perfectly well be within the reach of a single operator, and this operator be provided with plugs having circuit connections as shown at H and F. In such case, the entire operation would be completed by a single operator. The circuits, illustrated in Fig. 1, are entirely adapted to either method of operation.

Assuming that the plug of circuit H is to be manipulated by one operator and the plug of circuit F by another operator, and that subscriber A is to be connected with subscriber C by the said circuits, the details of the operation are as follows: Subscriber A, having connected his line with circuit H in the manner previously described, advises the operator of the number of the line desired. She will, by order-wire, advise the operator at F of the number of the line wanted. The latter may designate a trunk to be employed and the operator at H will insert the plug of H into the spring-jack of the designated trunk assumed to be trunk F. Contacts 89—98 and 90—99 are closed thereby and current will flow from ground G¹⁷, through the winding of relay 101, through contact 99—90, ringing-key lever 87, winding of relay 71 to battery 76, energizing relays 101 and 71. The latter attracts its armatures, closing contact 72—73, completing the talking-circuit of the tip strand of the cord. Current also flows from ground G¹⁵ at circuit H, through relay 68, contact 73—72, contact 89—98, through impedance 100, armature of relay 100^a to battery 33. Relay 68 is thus energized, preventing the illumination of lamp 67. The operator at F tests by depressing the levers of her listening-key and touching tip 110 of the plug to sleeve contact 113 associated with the called line—that of subscriber C. If this line is idle, contact 113 will be in the condition shown—namely, connected to the active side of battery 33—and has no other ground connection. Tip 110 is at this time, by the depression of the listening-key levers, also connected to the active side of said battery and, there being no difference of potential between the tip of the plug and the sleeve

contact of the jack, the operator receives no "click" in her telephone. Should, however, the line of subscriber C be busy, sleeve 113 will be grounded at ground G⁴ of switch D, or at ground G¹¹ of a connector switch, if the line of subscriber C is then being employed and a connection established by automatic apparatus. Should the plug of another trunk-circuit, such as that shown at F, be inserted in a multiple jack of the line of subscriber C, the sleeve will be connected to ground through sleeve 112 of another plug. In any of these cases, there will be a difference of potential between tip 110 and sleeve 113, and current will flow from the said sleeve to battery 33, over the tip strand of circuit F and through the operator's receiver. A "click" is caused, notifying the operator that the line is busy, and she will so advise subscriber A. She thereupon inserts the plug of circuit F into a special jack including contacts 113^a, 114^a and 115^a, in which contacts 114^a and 115^a are directly connected, so as to cause the operation of relay 100^a and the consequent display of lamp 67 in link-circuit H, as will appear from the subsequent description. Lamp 62 in H will also be illuminated by subscriber A hanging up, as previously explained. The operator at H withdraws the plug. Lamp 102 at F is displayed, as hereafter described, and the operator at F withdraws the plug from the special jack, restoring circuit F to normal.

Should the line tested be found idle, the operator at F inserts the plug into the spring-jack, thereby closing contacts 110—114, 111—115 and 112—113, and restores her listening-key. The closing of the latter contact causes current to flow from ground, through the said contact, through arm 17 of selector switch G, through cut-off relay 18 to battery 33, energizing the relay which attracts its armatures to open the circuits of the selector switch relays. The operator at F now depresses the levers of her ringing-key, putting ringing generator 88^a into circuit with the line of subscriber C, causing his bell to ring. She thereupon releases the ringing-key and its levers assume the position shown. When in this position, current flows from ground G¹⁸, through coil 103, through contact 111—115, over limb S of the line, through the windings of the bell, through the hook-lever at substation C, over limb P, through contact 114—110, winding of relay 100^a, to battery 33. Relay 100^a attracts its armature to disengage the associated normal contact, and the circuit before traced, causing the energization of relay 68 at circuit H, is interrupted, the said relay 68 deenergized and its armature retracted to close circuit through signal-lamp 67. Relay 71 is at this time energized, and the lamp 67 will therefore be displayed and will remain so until the called subscriber answers. Thus, the operator at H will know that the called subscriber has not responded as long as the lamp remains lighted. When, however, subscriber C, in response to the call, removes his receiver, the hook-lever moves upward, opening the circuit through the bell and closing contact 8—9. The condenser, associated at the substation with the receiver circuit, is now interposed in the path of the current before described as energizing relay 100^a. The said relay therefore becomes deenergized, its armature again engages its normal contact, causing a second energization of relay 68 associated with circuit H. This causes the effacement of lamp 67, and the operator at H knows that the subscribers are in conversation. Subscribers A and C are now connected for conversation, the circuit being traced by the heavily marked conductors, from substation A, through switch D, link-circuit H, link-circuit F, to substation C. When they have finished, they replace their receivers, subscriber A causing the illumination of lamp 62 at circuit H in the manner previously described, and also restoring to normal switch D. Subscriber C, by replacing his receiver, again establishes the before-traced path from ground G¹⁸ at F, through relay 100^a, back to battery. The said relay attracts its armature, which results in the deenergization of relay 68 at circuit H and the illumination of the second supervisory signal 67. This circuit relation is the same as that established by the insertion of the plug of F into the special jack, as before mentioned. The operator at H, upon the display of the two signals, withdraws the plug of H from the spring-jack of F, the resulting deenergization of relay 71 extinguishing both lamps 62 and 67. Upon the withdrawal of the plug, relay 101 of circuit F is deenergized and its armature assumes the position shown. The plug of circuit F being still in the jack of line C, relay 100^a continues energized and signal lamp 102 is now lighted. The operator at F is thereby advised that conversation is finished and withdraws the plug from the spring-jack of the line of subscriber C, which places the circuits of switch G and circuit F in their normal conditions.

It will be observed that in the preceding, I have described the operations as occurring in such order that the operator at F designated the trunk to be used. It will be noted that if a plug, belonging to a circuit similar to that shown at H, is inserted in the jack of circuit F, the sleeve contacts of the multiples of said spring-jack will be at a potential other than earth, due to the winding of relay 101 being included in circuit. Thus, should the operator at H depress levers 80 and 81 of her listening-key

and touch tip 89 to the sleeve 99 of circuit F, the test-relay 89^a, associated with her operator's set, will be energized, causing a "click" in her receiver, advising her that the trunk is busy. Should, however, circuit F be idle, there will be no effective difference of potential, relay 101 and the test-relay being both connected to ground, no "click" will be heard and the operator will know that the trunk is idle. It is this feature of the structure that renders it feasible to have either operator designate a trunk to be employed and also renders it possible to have a single operator complete the whole operation above detailed by a suitable arrangement of apparatus, without any change in the circuits whatever.

Connection from manual lines to automatic lines: In Fig. 1, I have not shown the cord-circuit adapted to be used for inter-connecting two lines of the character of the line of subscriber B. Such cord-circuits are well known in the art, such a structure being disclosed in Fig. 2 of patent of H. G. Webster, Telephone Exchange, #795,872, patented August 1, 1905.

If subscriber B should desire connection with an automatic line, he, by removing his receiver, would cause the display of the signal of his line. An operator would respond by inserting the answering-plug of a cord-circuit, such as that specified above, into his answering-jack; and having learned the number of the subscriber wanted, the operator would insert the calling-plug of the said cord into a spring-jack of a circuit such as F. The detail of the operation from this point will be the same as that outlined in the preceding description, inasmuch as the circuit connections and method of operation of the calling-end of the cord-circuit, above referred to, are substantially identical with those of the plug or circuit H.

Connection from an automatic line to an automatic line by a single manually operated cord connector: Should it be desired to have a single telephone operator regularly complete connections in large numbers between automatic lines by employing plugs and using them to connect with spring-jacks of such lines, it would be preferable that the operator use a single plug in making such connections, rather than two plugs as mentioned above.

In Fig. 3, I have illustrated an obvious modification of circuits H and F of Fig. 1, whereby calls between automatic subscribers may be completed by manual means, a single operator and a single plug, manipulated by her, being employed. In the said Fig. 3, I have combined or added together circuits F and H, omitting such apparatus as would be superfluous where one operator only is employed. This circuit is adapted for trunking between exchanges, or may be employed

in a single exchange, the automatic lines having their multiple spring-jacks, shown in Fig. 1, appear before operators provided with the link-circuits, as shown in Fig. 3. In case a subscriber found himself unable to complete a call by the automatic apparatus, he would automatically connect his line to a first idle link-circuit and secure the aid of the operator to complete the call, or report trouble.

In considering Fig. 3, it should be placed upon sheet 7 in such a manner that its contacts 53, 54 and 55 will be practically superposed upon similarly designated contacts of circuit H. Contacts, forming terminals of circuits such as are shown in Fig. 3, may take the place of contacts forming terminals of circuits such as are shown at H, on the lowest levels of the selector switches, or they may be upon any desired level or levels.

The selections of a first idle circuit, such as it shown in Fig. 3, by subscriber A, will be accomplished in the same manner as that described in connection with circuit H. Assuming that the wipers of selector switch D have come to engagement with contacts 53, 54 and 55 of Fig. 3, lamp 62 is displayed as before described. The operator, throwing over levers 80^a and 81^a of her listening-key, ascertains the number of the line desired, by the same act retiring lamp 62, as before described. Associated with the plug of Fig. 3, are shown spring-jacks which are the multiple spring-jacks of the line of subscriber C, shown in Fig. 1. The operator will now test the line wanted, as described in connection with circuit F. The line being assumed idle, the operator inserts the plug, and current flows from ground G²¹ of Fig. 3, through relay 112^b, through contact 112^a—113, through the cut-off relay 18 of the selector switch of the called line, energizing it as before described, to battery 33. Relay 112^b will remain energized as long as the plug is in the jack. Having restored her listening-key, the operator throws over levers 86^a and 87^a of her ringing-key, causing the bell of the called subscriber to ring, and restores the levers as before described. Current then flows from ground G²⁰, through coil 103^a, through contact 111^a—115 over limb S of the called line, through the bell and hook-lever, returning over limb P, through contact 114—110^a and relay 100^a, to battery, as previously described. Relay 100^a attracts its armature to close circuit through signal-lamp 102^a, which remains lighted until the subscriber removes his receiver. When this is done, circuit through relay 100^a is interrupted, due to the substation condenser being interposed in the circuit, as previously described, the relay's armature is retracted, and lamp 102^a is extinguished.

At the end of conversation, the replacing,

by the called subscriber, of his receiver, re-establishes circuit through relay 100^a, causing the display of the associated lamp 102^a, as before described. When subscriber A replaces his receiver, he energizes simultaneously relays 56 and 57, releasing the selector switch. The flow from ground at the substation, through relay 57, also passes through the left-hand winding of relay 61, to battery 33, energizing the relay, which, by attracting its left-hand armature, effects the display of lamp 62 all as previously explained. The attraction of its right-hand armature closes a locking-circuit for the relay from ground G²¹, the armature of relay 112^b, its alternate contact, through the right-hand winding of relay 61, to battery. Both signals being displayed, the operator withdraws the plug, opening circuit through relay 100^a, whose deenergization puts out lamp 102^a. The withdrawal of the plug also opens the circuit of relay 112^b, whose armature thereupon disengages its alternate contact, opening circuit through relay 61, whose armatures return to normal, putting out lamp 62. All apparatus is now restored to normal.

Assuming that all connections are to be established by the automatic selection of manually operated link-circuits, it is obvious that the primary or vertical step-by-step motion of the automatic switch may be dispensed with, retaining only the secondary or rotary step-by-step mechanism, by means of which the automatic selection of a first idle link-circuit may be secured, as heretofore described.

In Fig. 4, I have illustrated this employment of my invention. In connection with Fig. 4, a mechanical switch, identical with that illustrated in Figs. 5-9, may be employed, with the exception that the pawl 31^a, associated with the armature of primary magnet 31, is omitted and that wipers 50, 51 and 52 are normally in line with the contacts to be selected, which may be the lowest contact-levels shown in Fig. 5. This change in position is indicated in Fig. 10. The contact-levels of the switch shown in Fig. 5, other than the lowest, are not used in connection with Fig. 4 and may be left disconnected. Spring 17, Fig. 11, is caused to be connected to ground G⁴ with the first rotary movement of the shaft, a simple way of accomplishing this being shown in said Fig. 11.

Referring to the circuit drawing, Fig. 4, I there show substation circuit A', connected by its telephone line with the circuits of the automatic switch D' at the exchange.

The substation mechanism is the same as that previously described in connection with the automatic lines, except that I prefer to send the impulses required to start the selection of the first idle cord, by the removal

of the telephone from its hook. To this end, I provide, in Fig. 4, a spring-lever 8^b, associated with the switch-hook and normally engaging a pin 8^a upon dial 1. When the telephone is removed from the hook, said lever causes the rotation of the dial in the same manner as though it were manually operated to send one primary and one secondary impulse upon its release, which is secured by the automatic disengagement of lever 8^b from pin 8^a by the stationary pin 8^c operating upon the lever 8^b as the hook-lever closes its alternate contacts.

The switching mechanism associated with the line at the central office therefore receives the same impulses, as previously described in connection with circuit H in this case, when the subscriber initiates a call by removing his receiver.

Obviously, my invention is not limited to such an automatic transmission of the required impulses, but includes also the manually actuated dial previously described. The circuit arrangement, shown at D', is identical with that shown at D, although the selector switch mechanism is now prevented from making its vertical movement. The removal, by the subscriber at A', of his receiver, therefore automatically secures the selection of the first idle link-circuit terminating before some operator, as before described.

At C', I have shown another substation similar to A', connected with the limbs of the telephone line to a switch circuit G G at the exchange, similar in all respects to circuit D'. The cord connector, shown at M in Fig. 4, is the same as that shown in Fig. 3.

In the exchange system comprised in Fig. 4, each subscriber's line terminates at the exchange in an automatic switch having circuits similar to D' and G G; said circuits being the same as the selector circuits of Fig. 1. In addition to being connected with the switch circuit, each subscriber's line, as before described, is provided with multiple spring-jacks, appearing before the various operators at the switchboard, in the well known manner.

In Fig. 10, I have shown a level of contacts, comprising ten sets. Obviously, the wipers of each subscriber's switch may, if it is found desirable, have more than ten sets of cord circuit terminals adapted to be engaged or selected by them. In practice, the number provided would be determined by considerations of expediency and expense. The cord circuits, leading from one subscriber's switch, may all terminate at one operator's position, or they may be divided—a part leading to one position, and a part to another.

The operation of the system, shown in Fig. 4, will be obvious from the description

already given of Fig. 3, it being the same. Moreover, it is apparent that the size of the groups of lines, and the number of link-circuits allotted to each group of lines, would be determined by considerations of expediency, it being now apparent that as many link-circuit connecting terminals, as expediency may determine, would be provided in the single selecting level shown in Fig. 10.

It is apparent that my invention is not limited to any particular grouping of lines and allotted link-circuits, but that many other obvious groupings of the link-circuits before the various operators may be employed. Moreover, it is apparent that my invention is not limited to the single level of automatically selected idle link-circuits, illustrated in Fig. 10, but I contemplate also the manual selection by the subscribers of particular levels provided with link-circuit terminals leading to various divisions of the same exchange switchboard, or to a plurality of switchboards.

It will be obvious that my invention is applicable to many other telephone exchange systems in which it is desirable that the subscriber shall cause an automatic selection of a first idle cord-circuit of a group of cords available for his service, and that my invention is not limited to the particular applications described and shown in this specification, but

What I claim as my invention is:—

1. A telephone exchange system comprising a plurality of telephone lines provided with spring-jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said selective switches, auxiliary selective switches for certain of said trunk lines adapted to be operated in completing connections with desired lines, manually operated link-circuit terminals for others of said trunk lines adapted to be used in completing connections with spring-jacks of desired lines, stationary contacts for said first switches, forming terminals of said trunk lines, selecting contacts for said first switches normally disconnected from said lines, means for rendering said trunk lines busy when in use, means for automatically moving said selecting contacts, while disconnected from said telephone lines, over the stationary contacts of said trunk lines, calling devices for said telephone lines at the substations for controlling election of said groups of trunk lines, other telephone lines provided with spring-jacks, means for causing said selecting contacts to select the first idle trunk line, provided with a manually operated terminal, and connect its associated line thereto, and means for restoring to normal said first selective switches at the conclusion of conversation.

2. A telephone exchange system compris-

ing a plurality of telephone lines provided with spring-jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said selective switches, auxiliary selective switches for certain of said trunk lines adapted to be operated in completing connections with desired lines, manually operated link-circuit terminals for others of said trunk lines adapted to be used in completing connections with spring-jacks of desired lines, stationary contacts for said first switches, forming terminals of said trunk lines, selecting contacts for said first switches normally disconnected from said lines, means for rendering said trunk lines busy when in use, means for automatically moving said selecting contacts, while disconnected from said telephone lines, over the stationary contacts of said trunk lines, calling devices for said telephone lines at the substations for controlling election of said groups of trunk lines, other telephone lines provided with spring-jacks, means for causing said selecting contacts to select the first idle trunk line, provided with a manually operated terminal, and connect its associated line thereto, means for restoring to normal said first selective switches at the conclusion of conversation, and calling signals associated with said trunk-circuits provided with said manually operated terminals to indicate when connection is made with an idle one thereof.

3. A telephone exchange system comprising a plurality of telephone lines provided with spring-jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said selective switches, auxiliary selective switches for certain of said trunk lines adapted to be operated in completing connections with desired lines, manually operated link-circuit terminals for others of said trunk lines adapted to be used in completing connections with spring-jacks of desired lines, stationary contacts for said first switches, forming terminals of said trunk lines, selecting contacts for said first switches normally disconnected from said lines, means for rendering said trunk lines busy when in use, means for automatically moving said selecting contacts, while disconnected from said telephone lines, over the stationary contacts of said trunk lines, calling devices for said telephone lines at the substations for controlling election of said groups of trunk lines, other telephone lines provided with spring-jacks, means for causing said selecting contacts to select the first idle trunk line, provided with a manually operated terminal, and connect its associated line thereto, means for restoring to normal said first selective switches at the conclusion of conversation, calling signals

associated with said trunk-circuits provided with said manually operated terminals to indicate when connection is made with an idle one thereof, and supervisory signals associated with said manually operated terminals adapted to indicate the condition of the called subscriber's line.

4. A telephone exchange system comprising a plurality of telephone lines provided with spring-jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said selective switches, auxiliary selective switches for certain of said trunk lines adapted to be operated in completing connections with desired lines, manually operated link circuit terminals for others of said trunk lines adapted to be used in completing connections with spring-jacks of desired lines, stationary contacts for said first switches, forming terminals of said trunk lines, selecting contacts for said first switches normally disconnected from said lines, means for rendering said trunk lines busy when in use, means for automatically moving said selecting contacts, while disconnected from said telephone lines, over the stationary contacts of said trunk lines, calling devices for said telephone lines at the substations for controlling election of said groups of trunk lines, other telephone lines provided with spring-jacks, means for causing said selecting contacts to select the first idle trunk line, provided with a manually operated terminal, and connect its associated line thereto, means for restoring to normal said first selective switches at the conclusion of conversation, calling signals associated with said trunk-circuits provided with said manually operated terminals to indicate when connection is made with an idle one thereof, and supervisory apparatus associated with said manually operated terminals adapted to indicate the condition of each connected subscriber's line.

5. A telephone exchange system comprising a plurality of telephone lines provided with spring-jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said selective switches, auxiliary selective switches for certain of said trunk lines adapted to be operated in completing connections with desired lines, manually operated link-circuit terminals for others of said trunk lines adapted to be used in completing connections with spring-jacks of desired lines, stationary contacts for said first switches, forming terminals of said trunk lines, selecting contacts for said first switches normally disconnected from said lines, means for rendering said trunk lines busy when in use, means for automatically moving said selecting contacts, while disconnected from said telephone lines, over the sta-

tionary contacts of said trunk lines, calling devices for said telephone lines at the substations for controlling election of said groups of trunk lines, other telephone lines provided with spring-jacks, means for causing said selecting contacts to select the first idle trunk line, provided with a manually operated terminal, and connect its associated line thereto, means for restoring to normal said first selective switches at the conclusion of conversation, and supervisory apparatus associated with said manually operated terminals adapted to indicate the condition of each connected subscriber's line.

6. In a telephone system, a switchboard, a subscriber's telephone line, a selective switch for said line, selecting contacts for said switch normally disconnected from said line, waiting contacts for said selecting switch, trunk lines leading from said waiting contacts to said switchboard, means outside of said switch for rendering some of said trunk lines busy, means for automatically moving said selecting contacts over the waiting contacts of said busy trunks while said selecting contacts are disconnected from said subscriber's line, other telephone lines, multiple jacks in said switchboard pertaining to said other telephone lines, connecting means in said switchboard whereby any trunk may be connected to a multiple jack of a selected line, and a trunk release circuit for said selective switch extending through its test wiper for restoring said switch to normal at the end of conversation.

7. In a telephone system, a switchboard, a subscriber's telephone line, a selective switch provided with release mechanism for said line, selecting contacts for said switch normally disconnected from said line, waiting contacts for said selecting switch, trunk lines leading from said waiting contacts to said switchboard, means outside of said switch for rendering some of said trunk lines busy, means for automatically moving said selecting contacts over the waiting contacts of said busy trunks while said selecting contacts are disconnected from said subscriber's line, other telephone lines, multiple jacks in said switchboard adapted to complete connection to said telephone line, multiple jacks in said switchboard pertaining to said other telephone lines, connecting means in said switchboard whereby any trunk may be connected to a multiple jack of a selected line, and a trunk release circuit for controlling said release mechanism extending through the test wiper of said selective switch.

8. In a telephone system, a switchboard, a subscriber's telephone line, a selective switch provided with release mechanism for said line, selecting contacts for said switch normally disconnected from said line, waiting contacts for said selecting switch, trunk lines leading from said waiting contacts to

said switchboard, means outside of said switch for rendering some of said trunk lines busy, means for automatically moving said selecting contacts over the waiting
 5 contacts of said busy trunks while said selecting contacts are disconnected from said subscriber's line, other telephone lines, multiple jacks in said switchboard pertaining to said telephone line, multi-
 10 ple jacks in said switchboard pertaining to said other telephone lines, connecting means in said switchboard whereby any trunk may be connected to a multiple jack of a selected line, and a trunk release
 15 circuit for controlling said release mechanism extending through the test wiper of said selective switch.

9. In a telephone system, subscribers' telephone lines, selective switches associated therewith, a multiple switchboard having a
 20 plurality of operators' positions, selecting contacts for said selective switches normally disconnected from said lines, stationary contacts for said selective switches, a series of
 25 trunk lines leading from said stationary contacts to several of the positions on said multiple switchboard, means for causing a selective switch to automatically move its selecting
 30 contacts into engagement with the stationary contacts of the first idle trunk line of its series, means for simultaneously connecting said selecting contacts with the associated subscribers' lines, and trunk release
 35 circuits for said selective switches extending through their test wipers for restoring said switches to normal at the end of conversation.

10. In a telephone system, a subscriber's line, a multiple switchboard in which
 40 said subscriber's line terminates, a selecting switch for said line, movable contacts upon said switch normally disconnected from said line, stationary contacts for said selecting switch, means under the control of
 45 the subscriber's line for causing said movable contacts to engage certain of said stationary contacts and to simultaneously connect said line to said selecting contacts, other subscribers' lines terminating in said multi-
 50 ple switchboard, trunks extending from said stationary contacts to said multiple switchboard, switching means in said switchboard whereby any trunk may be connected with any line, calling signals for said trunks to
 55 indicate when a connection is made therewith, and a trunk release circuit for said selective switch extending through its test wiper for restoring said switch to normal at the end of conversation.

60 11. In a telephone system, subscribers' telephone lines, selective switches associated therewith, a multiple switchboard having a plurality of operators' positions, selecting
 65 contacts for said selective switches normally disconnected from said lines, stationary con-

tacts for said selective switches, a series of trunk lines leading from said stationary contacts to several of the positions on said multiple switchboard, means for causing a
 70 selective switch to automatically move its selecting contacts into engagement with the stationary contacts of the first idle trunk line of its series, means for simultaneously connecting said selecting contacts with the associated subscribers' lines, trunk release
 75 circuit for said connected selective switch including its test wiper and a test contact of the trunk line for restoring said switch to normal and calling signals for said trunk lines to indicate when a connection is made
 80 to an idle one thereof.

12. In a telephone system, a subscriber's line, a multiple switchboard in which said
 85 subscriber's line terminates, a selecting switch provided with release means for said line, movable contacts upon said switch normally disconnected from said line, stationary contacts for said selecting switch, means under the control of the subscriber's line for
 90 causing said movable contacts to engage certain of said stationary contacts and to simultaneously connect said line to said selecting contacts, other subscribers' lines terminating in said multiple switchboard, trunks extending from said stationary
 95 contacts to said multiple switchboard, switching means in said switchboard whereby any trunk may be connected with any line, calling signals for said trunks to indicate when a connection is made therewith supervisory
 100 signals associated with said trunks adapted to indicate the condition of a called subscriber's line, and a trunk release circuit for controlling said release means extending through the test wiper of said automatic
 105 switch.

13. In a telephone system, subscribers' telephone lines, selective switches associated therewith, a multiple switchboard having a
 110 plurality of operators' positions, selecting contacts for said selective switches normally disconnected from said lines, stationary contacts for said selective switches, a series of trunk lines leading from said stationary contacts to several of the positions on said multiple
 115 switchboard, means for causing a selective switch to automatically move its selecting contacts into engagement with the stationary contacts of the first idle trunk line of its series, means for simultaneously connecting said selecting contacts with the associated subscribers' lines, calling signals
 120 for said trunk lines to indicate when a connection is made to an idle one thereof, supervisory signals associated with said trunks adapted to indicate the condition of a called subscriber's line, and trunk release circuits for said selective switches extending through
 125 their test wipers for restoring said switches to normal at the end of conversation.

14. A telephone system including telephone lines, springjacks at the exchange for certain of said lines, an automatic switch connected with each of certain of said lines, multiplied waiting contacts in each switch adapted for selection thereby, means whereby each actuation of a switch to select idle contacts causes the contacts of said switch to be engaged in the same succession until an idle contact is reached, manually operated terminals and trunks, one connecting each terminal with contacts in all said switches, and trunk release circuits for said automatic switches extending through their test wipers for restoring them to normal at the end of conversations.
15. A telephone system including telephone lines, springjacks at the exchange for certain of said lines, an automatic switch connected with each of certain of said lines, multiplied waiting contacts in said switches adapted for selection thereby, means for moving an actuated switch to engage its contacts in succession to select an idle contact, said contacts having a regular order of precedence among themselves with respect to a normal resting position of said switch, manually operated connection terminals, trunk lines, one connecting each of said terminals with contacts in a plurality of switches whereby each trunk is selectable by said plurality of switches, and means including a trunk release circuit extending through the test contact of an actuated switch for restoring said actuated switch to its normal resting position.
16. A telephone system including a pair of connected telephone lines, a selective switch and a manual link circuit through which a conversational circuit extends, multiple private or test contacts for said selective switch for preventing intrusion upon the talking circuit, and means including relays of said link circuit for altering the electrical condition of said contact to restore to normal said selective switch.
17. A telephone system including telephone lines, relatively movable switch contacts and an operator's link circuit through which a talking circuit between a calling and a called line may be completed, means including a test contact for determining the talking circuit, and means for restoring said switch contacts to normal including said test contact and a switch contact in said link circuit.
18. A telephone system including telephone lines, a selective switch at the exchange connected with said line, a manual link circuit connected with said switch, contacts of said switch and said link circuit forming part of the talking circuit, an additional contact piece for said switch in connection with a contact piece of said link circuit serving to protect the talking circuit against intrusion, means for altering the electrical condition of said contact piece when disconnection is desired, and release mechanism for said switch responsive to said altered electrical condition.
19. A telephone system including a pair of connected telephone lines, a selective switch and a manual link circuit through which a conversational circuit extends, a test contact for said switch for preventing intrusion upon the conversational circuit, release mechanism for said switch, and means including said release mechanism, said test contact and a relay of said manual link circuit for restoring to normal the said automatic switch.
20. In a telephone system, a subscriber's line, a switch individual to said line provided with a pair of line wipers and with a test wiper, a plurality of manual trunks one end of each of said trunks terminating in the banks of said switch, the other ends of said trunks terminating in terminal plugs, means for operating said switch to select one of said manual trunks, and release means for said switch operated over a circuit including said test wiper.
21. A telephone system including a telephone line, a selective switch at the exchange connected with said line provided with a test wiper and with normally disconnected line wipers, operators' link circuits provided with contacts terminating in the banks of said automatic switch, means for operating said switch to automatically select an idle one of said link circuits, a release circuit for said switch including said test contact and apparatus of said selected link circuit, and restoring means in said switch responsive to the closure of said release circuit.
22. In a telephone system, a subscriber's line, a step-by-step switch individual thereto provided with line wipers and with a test wiper, an operator's trunk line, one end terminating in a connecting plug and the other end terminating in bank contacts of said switch, means for operating said switch to connect with said trunk line, and means for releasing said switch from said trunk line including a release circuit extending through the said test wiper.
23. In a telephone system, a calling subscriber's line, a switch individual thereto provided with a pair of line contacts and with a test contact, a plurality of operators' trunk lines, means including said test contact for selecting an idle one of said operator's trunks, and means for releasing said individual switch including a release circuit extending through said test contact.
24. A telephone system including a telephone line, a selective switch individual thereto provided with a private wiper and with normally disconnected line wipers, an

operator's link circuit provided with a release relay, means for operating said switch to establish connection between said line and said link circuit and for connecting said normally disconnected wipers to said line, a release circuit for said switch including said private wiper and a contact controlled by said release relay, and means responsive to the closure of said release circuit for releasing said individual switch.

25. In a telephone system, a subscriber's line, a selective switch individual thereto, a plurality of manual link circuits terminating in the banks of said selective switch, means for operating said selective switch to establish connection with an idle one of said link circuits, and means controlled by the calling subscriber and operative after connection to said link circuit has been completed for operating a call signal associated with the selected link circuit.

26. In a telephone system, a subscriber's line, a step-by-step selective switch individual thereto, manually operated link circuits accessible to said switch, call signals for said link circuits, subscriber controlled means for operating said switch to select an idle one of said link circuits, and subscriber controlled means for thereafter operating the call signal associated with said selected link circuit.

27. In a telephone system, a subscriber's line, a selective switch individual therefor, a plurality of manual link circuits provided with call signals, means for operating said selective switch to establish connection with an idle one of said link circuits, means controlled by the calling subscriber and operative after a connection has been established with said idle link circuit to operate its associated call circuit, and means for completing connection to the line of a called subscriber.

28. A telephone system including a subscriber's line, a trunk selecting switch associated therewith provided with a plurality of groups of trunks, certain of said trunks terminating in manual link circuits others of said trunks terminating in automatic switches, means controlled from the said line for operating said trunk selecting switch to establish connection with a trunk line leading to an idle one of said automatic switches, means for then operating the selected automatic switch to complete connection with a called line, and means controlled from said calling line for operating said trunk selecting switch to establish connection with an idle one of said link circuits.

29. In a telephone system, a manual subscriber's line provided with a call signal, an automatic subscriber's line provided with an automatic switch and with manual equipment, means controlled by said manual line for operating said signal, means controlled by a central office operator for extending

connection from said manual line to the manual equipment of said automatic line, operators' trunks, means controlled by said automatic subscriber for operating said switch to select one of said trunks, and means controlled by a central office operator for then extending connection to said manual subscriber's line.

30. In a telephone system, an automatic subscriber's line terminating in an exchange in automatic equipment and in manual equipment, operator controlled means for seizing said line through its manual equipment and for making said automatic equipment test busy, and subscriber controlled means for seizing said line through its automatic equipment and for making said manual equipment test busy.

31. In a telephone system, a subscriber's line provided with automatic equipment and with manual equipment, operator controlled means for seizing said line through the medium of its manual equipment, and subscriber controlled means for seizing said line as a called line through the medium of its automatic equipment.

32. In a telephone system, a subscriber's line provided with spring jacks and with connector bank terminals, operator controlled means for seizing said line through its spring jacks and subscriber controlled means for seizing said line as a called line through its connector bank terminals.

33. In a telephone system a subscriber's line terminating in a step-by-step automatic selective switch, multiple contacts for said line terminating in the banks of other automatic switches and in manual equipment, and subscriber controlled means for seizing said line through one of said multiple contacts and for making the other of said multiple contacts test busy.

34. In a telephone system, a called subscriber's line, multiple contacts for said line terminating in automatic equipment and in manual equipment, and subscriber controlled means for seizing said line and for making all of said multiple contacts test busy.

35. In a telephone system, a subscriber's line, an automatic switch individual thereto, a cut-off relay for said automatic switch, multiple terminals for said line terminating in the banks of automatic switches and in manual equipment, and means for seizing one of said multiple terminals thereby making the other of said multiple terminals test busy and for energizing said cut-off relay to disconnect the controlling apparatus of said automatic switch from said subscriber's line.

36. In a telephone system, a subscriber's line, an automatic switch individual thereto, a cut-off relay for said automatic switch, connector switches, multiple terminals for said line terminating in the banks of said

connector switches and in manual equipment, and subscriber controlled means for seizing one of said multiple terminals thereby making the other of said multiple terminals test busy and energizing said cut-off relay to disconnect the controlling apparatus of said automatic switch from said subscriber's line.

37. In a telephone system, a subscriber's line, an automatic switch individual thereto, a line relay for controlling said automatic switch and a cut-off relay for disconnecting said line relay from said line, connector switches, multiple terminals for said line terminating in the banks of said connector switches and in manual equipment, and means for extending connections to said line through one of the multiple terminals and for energizing said cut-off relay to disconnect said line relay.

38. In a telephone system, a subscriber's line, an automatic switch individual thereto, a plurality of operators' trunk lines one end of said trunk lines terminating in bank contacts of said automatic switch, the other end of said trunk lines terminating in terminal plugs, release mechanism for said automatic switch, a release circuit for said release mechanism, said release circuit including a test contact of said automatic switch and a contact of a relay individual to said selected trunk circuit, and means controlled by the subscriber for closing said release circuit.

39. In a telephone system, a subscriber's line, a two-conductor link circuit adapted to be connected to said subscribers' line, a supervisory signal, means controlled by the calling subscriber over one strand of said link circuit for operating said supervisory signal to signal for a connection, and means controlled by the subscriber over the other strand of said link circuit for operating said signal to signal for a disconnection.

40. In a telephone system, a subscriber's line, a two-strand link circuit adapted to be connected thereto, a supervisory signal, subscriber controlled means operated over one strand of said link circuit for operating said supervisory signal to signal for a connection, and subscriber controlled means operated over the other strand of said link circuit for operating said supervisory signal to signal for a disconnection.

41. In a telephone system, a subscriber's line, a two-conductor link circuit adapted to be connected to said line, a supervisory signal individual to said link circuit, subscriber controlled means operated over one strand of said link circuit to operate said supervisory signal when a connection is desired, and subscriber controlled means operated over the other strand of said link circuit for again operating said supervisory signal when disconnection is desired.

42. In a telephone system, a pair of subscriber's lines, a two-conductor link circuit for connecting said lines, a supervisory signal associated with the answering end of said link circuit, subscriber controlled means operated over one strand of said link circuit for operating said supervisory signal, operator controlled means for effecting said signal, subscriber controlled means operated over the other strand of said link circuit for again operating said supervisory signal to signal for disconnection, and operator controlled means for again effacing said signal.

43. In a telephone system, a subscriber's substation provided with a pair of line conductors terminating in the central office in manual equipment, a link circuit provided with a calling terminal adapted to make connection with said manual equipment, a supervisory relay for said link circuit, a circuit for said supervisory relay including only one conductor of the said subscriber's line, and a second circuit for said supervisory relay including the two-conductors of said subscriber's line in series.

44. In a telephone system, a common battery manual subscriber's line provided with a pair of line conductors terminating in the central exchange in manual equipment, a link circuit provided with a terminal plug for connection to said manual equipment, a supervisory relay associated with said terminal, a circuit for said supervisory relay including only one conductor of said line, and a second circuit for said supervisory relay closed responsive to the removal of the receiver at the said substation including the two-conductors of the said line circuit in series.

45. A telephone exchange system comprising a plurality of telephone lines provided with spring jacks at the exchange, selective switches for said telephone lines, groups of trunk lines adapted to be selected by said switches, auxiliary selective switches connected to certain of said trunk lines adapted to be operated to complete connections to desired lines, manually operated link circuits connected to other of said trunk lines adapted to be used in completing connections with spring jacks of desired lines, stationary contacts forming terminals of said trunks, selecting contacts for said first switches, means for moving said selecting contacts over said stationary contacts for automatically selecting idle contacts, calling devices for said telephones for controlling the election of said groups of trunk lines, and means for releasing said first selective switches from connections with trunk lines.

46. A telephone system comprising a plurality of telephone lines provided with spring jacks, selective switches associated with said telephone lines, groups of terminals adapted to be selected by said se-

lective switches, auxiliary selective switches for completing connections to desired lines, manually operated link circuits for completing connections to desired lines, said link circuits and said auxiliary switches terminating in contacts of said first selective switches, calling devices for said telephone lines at the substations for controlling the election of said groups of trunk lines, means for automatically stopping a selective switch upon an idle trunk in the elected group of trunks, and means for restoring to normal said switches at the conclusion of conversation.

47. A telephone system comprising subscribers' lines provided with spring jacks and with bank terminals through which calls are received, selective switches associated with said lines, auxiliary switches for completing connections to desired lines through said bank terminals, manually operated link circuits provided with terminals for completing connections to desired lines through said spring jacks, terminals for said auxiliary switches forming a group of contacts in the banks of said first selective switches, terminals for said link circuits forming a second group of contacts in the banks of said selective switches, calling devices for said telephone lines at the substations for controlling the election of said groups of trunk lines, automatic means in said selective switches for selecting an idle trunk line in the elected group of trunk lines, and means for restoring to normal said selective switches at the end of conversation.

48. In a telephone system a plurality of subscribers' lines, automatic trunk release selective switches for said lines, A-operators' cord circuits terminating in the banks of selective switches, means controlled by a calling one of said subscribers for selecting an idle one of said A-operators' cord circuits, means for establishing connection between said A-operators' cord circuits and a B-operator's cord circuit, and means controlled by said B-operator for extending connection to a called one of said subscribers' lines.

49. A telephone system including a calling subscriber's line, an automatic numerical selector switch provided with a plurality of groups of contacts arranged in levels, manual link circuits connected to the contacts of one of said groups, means under the control of the said calling subscriber for operating said automatic switch to connect with an idle one of said link circuits, and means for extending a connection from said link circuit to a called subscriber's line.

50. A telephone system including a subscriber's line, a calling device for said subscriber's line, an automatic selector switch provided with a plurality of groups of con-

tacts, manual link circuits connected to the contacts of one of said groups, means for operating said calling device to cause said automatic switch to elect the group of contacts that are associated with said link circuits, automatic means for then selecting an idle link circuit in the elected group, and means for extending a connection to the line of a called subscriber.

51. A telephone system including a calling subscriber's line provided with an automatic calling device, a selector switch adapted to select any one of a plurality of groups of trunk lines, manual link circuits forming one of said groups of trunk lines, subscriber controlled means for operating said calling device to cause said automatic switch to elect the said group of manual link circuits, automatic means for selecting an idle link in the elected group, and manual means for completing connections to the line of a called subscriber.

52. In a telephone system, a calling subscriber's line, a called subscriber's line, a pair of normally open paths extending between said lines, means under the control of the calling subscriber for completing one of said normally open paths, and means under the control of a central office operator for completing the other of said normally open paths.

53. In a telephone system, a calling subscriber's line, a called subscriber's line, a pair of normally open paths extending between said lines, automatic means under the control of the calling subscriber for completing one of said normally open paths, and manual means under the control of a central office operator for completing the other of said normally open paths.

54. In a telephone system, a manual subscriber's line, an automatic subscriber's line provided with manual equipment and with automatic equipment, other automatic equipment adapted to be placed under the control of said automatic subscriber for automatically completing connection to other lines, and manual means including an operator's link circuit for completing connection between said manual line and said automatic line.

55. A telephone system including a pair of connected telephone lines, a selective switch and a manual link circuit through which the conversational circuit extends, a test contact for said selector switch for preventing intrusion upon the talking circuit, and means including a relay of the said link circuit for altering the electrical condition of said test contact to restore to normal said selective switch.

56. A telephone system including a calling subscriber's line, an automatic numerical selector switch provided with a plurality of levels or groups of contacts, manual link cir-

- cuits connected to contacts of one of said groups, automatic trunk lines connected to the contacts of another of said groups, means under the control of the said calling subscriber for operating said automatic switch to connect with an idle trunk in either of said groups, and means for extending a connection from the selected trunk to a called subscriber's line.
57. In a telephone system a subscriber's line, a switch individual thereto provided with a pair of line wipers and a test wiper, manual trunk circuits, means including said test wiper for selecting an idle one of said trunk circuits, and means for releasing said individual switch from a selected trunk circuit, the said release means including a release circuit extending through the said test wiper.
58. In a telephone system, a subscriber's line provided with incoming manual and automatic terminals, outgoing automatic equipment for said line for calling purposes, operator controlled means for seizing said line through its manual terminals, and subscriber controlled means for seizing said line through its automatic terminals.
59. In a telephone system, a calling subscriber's line, an automatic selector switch controllable from said line, a pair of line wipers and a test wiper for said switch, trunk circuits extending to a manual board, means including said test wiper for selecting an idle one of said trunk circuits, means for releasing said switch from said selected trunk, said last means including a release circuit extending through the said test wiper.
60. In a telephone system, a subscriber's line provided with an automatic trunk selecting switch, manual equipment and automatic equipment for said line, and means responsive to the operation of said trunk selecting switch for causing said manual and automatic equipment to test busy.
61. A telephone system comprising a subscriber's line, a selector switch provided with a pair of line wipers and a test wiper, manual link circuits terminating in the banks of said selector switch, means including said test wiper for selecting an idle one of said manual link circuits, and means for restoring the said switch, said restoring means including a release circuit extending through said test wiper.
62. In a telephone system, a subscriber's line provided with an individual automatic trunk selecting switch, multiple automatic and manual terminals associated with said line, and means responsive to the operation of said trunk selecting switch for placing a busy potential upon said multiple terminals.
63. A telephone system including a subscriber's line, an operator's trunk circuit, a selector switch for connecting said subscriber's line to said operator's trunk circuit, the said connection including a test contact associated with the said operator's trunk, and means including a release circuit extending through the said test contact for disconnecting the subscriber's line from the said operator's trunk circuit.
64. In a telephone system, a calling subscriber's line, and a called subscriber's line, a pair of normally open paths extending between said lines, subscriber controlled means including automatic switches for completing one of said normally open paths, and manual means including a manual link circuit for completing the other of said normally open paths.
65. In a telephone system, a calling subscriber's line, an operator's link circuit, a numerical automatic switch provided with line wipers and a test wiper, means controlled over said calling line for operating said switch to establish connection with the said operator's link circuit, and means for releasing said switch from said link circuit including a release circuit extending through the said test wiper.
66. A telephone system including a calling subscriber's line, an automatic numerical selector switch provided with a plurality of levels of groups of contacts, manual link circuits connected to contacts of one of said groups, and automatic trunk lines connected to the contacts of another of said groups, and means under the control of the said calling subscriber for operating said automatic switch to connect with an idle trunk in either of said groups.
67. In a telephone system, a calling subscriber's line, a step-by-step switch individual thereto provided with a pair of line wipers and a test wiper, an operator's trunk circuit, means for operating said switch to establish connection with an idle one of said trunk circuits, and means for releasing said switch from said trunk circuit including a release circuit extending through the said test wiper.
68. In a telephone system, a manual subscriber's line, an automatic subscriber's line provided with manual equipment and with automatic equipment, means including said automatic equipment and a manual operator's link circuit for extending connection from said automatic line to the said manual line, and means including a second manual operator's link circuit and said manual equipment for establishing connection from said manual line to the said automatic line.
69. In a telephone system, a subscriber's line, a switch individual thereto provided with a pair of line wipers and a test wiper, manual trunk circuits, means including said test wiper for selecting an idle one of said trunk circuits, and release means for said individual switch controlled through said test wiper,

70. In a telephone system, a manual subscriber's line, an automatic subscriber's line provided with manual equipment and with automatic equipment, a second automatic subscriber's line, automatic switches adapted to be placed under the control of said first automatic subscriber for completing connection to said second automatic subscriber's line, and manual means for completing connection between said manual line and said first automatic line.

71. In a telephone system, a common battery subscriber's line, a local battery subscriber's line, and means including an automatic switch and a manual link circuit for completing a connection between said subscribers' lines.

72. In a telephone system, a calling subscriber's line provided with an automatic step-by-step switch individual thereto, a called common battery manual subscriber's line, and means including said automatic switch and a manual link circuit for extending connection from the said first subscriber's line to the second subscriber's line.

73. In a telephone system, a subscriber's line provided with an individual automatic trunk selecting switch, a line relay for controlling said switch, a cut-off relay for disconnecting said line relay, a connector switch, multiple terminals for said line terminating in the banks of said connector switch and in manual equipment, and means for extending connection to said line through its manual equipment and for energizing said cut-off relay to disconnect said line relay.

74. In a telephone system, a calling subscriber's line provided with an individual automatic switch for extending calls, multiple contacts for said line terminating in automatic equipment and in manual equipment, an automatic switch for extending a connection to the said line, and means responsive to such connection for making all of said multiple contacts test busy.

75. In a telephone system, a subscriber's line terminating in a step-by-step automatic switch for extending connections from said line, multiple contacts for said line terminating in the banks of other automatic switches and in manual equipment, and means for seizing said line through one of its multiple contacts and for making the other of said multiple contacts test busy.

76. In a telephone system, a subscriber's line provided with means for initiating calls, multiple terminals for said line, operator controlled means for connecting with the said line, and subscriber controlled automatic means for connecting with said line as a called line.

77. A telephone system including a subscriber's line provided with means for initiating calls, multiple called terminals for

said line, operator controlled means for connecting with terminals of said line, subscriber controlled automatic means for connecting with terminals of said line as a called line, and a trunk release circuit for said automatic means separate from the talking circuit.

78. A telephone system including a calling subscriber's line provided with an individual automatic switch, multiple contacts for said line terminating in automatic equipment and in manual equipment, automatic means for connecting to said line as a called line, means responsive to such connection for making all of said multiple contacts test busy, and a trunk release circuit for said automatic means excluded from the talking circuit.

79. A telephone system including a calling and a called subscriber's line, a pair of normally open paths extending between said lines, subscriber controlled means including trunk release automatic switches for completing one of said normally open paths, and manual means including a manual link circuit for completing the other of said normally open paths.

80. A telephone system including a calling subscriber's line, an automatic numerical switch provided with a plurality of groups of bank contacts, manual link circuits connected to contacts of one of said groups, automatic trunk selecting switches connected to contacts of another of said groups, means under the control of the said calling subscriber for operating said first automatic switch to connect with an idle trunk in either of said groups, and a trunk release circuit for said numerical switch including contacts of the connected with trunk.

81. A telephone system including a subscriber's line, a trunking switch provided with a test wiper individual thereto, multiple automatic and manual terminals for said line, means responsive to an operation of said trunking switch for placing a busy potential upon said multiple contacts, and a trunk release circuit for said switch including said test wiper.

82. In a telephone system, a subscriber's line provided with incoming manual and automatic terminals, outgoing automatic equipment for said line for calling purposes, a test wiper for said automatic equipment, operator controlled means for seizing said line through its manual terminals, subscriber controlled means for seizing said line through its automatic terminals, and a trunk release circuit for said automatic equipment including said wiper.

83. In a telephone system, a calling subscriber's line, a called subscriber's line, a pair of normally open paths extending between said lines, automatic trunk selecting means under the control of the calling sub-

scriber for completing one of said normally open paths, means under the control of a central office operator for completing the other of said normally open paths, and a
5 trunk release circuit for said automatic trunking means.

84. A telephone system including a subscriber's line, a calling device for said subscriber's line, an automatic selector switch
10 provided with a plurality of groups of contacts, manual link circuits connected to the contacts of one of said groups, means for operating said calling device to cause said
15 automatic switch to elect the group of contacts that are associated with said link circuits, automatic means for then selecting an idle link circuit in the elected group, means
20 for extending a connection to the line of a called subscriber, and a trunk release circuit for said selector including a contact of the selected idle link circuit.

85. A telephone system including a calling subscriber's line, an automatic numerical selector switch provided with a plurality of
25 groups of contacts arranged in levels, a test wiper for said switch, manual link circuits connected to the contacts of one of said groups, means under the control of the said calling subscriber for operating said auto-
30 matic switch to connect with an idle one of said link circuits, means for extending a connection from said link circuit to a called subscriber's line, and a trunk release circuit for said switch including said test wiper.

86. In a telephone system, a subscriber's line, an automatic switch individual there-
35 to, a test wiper for said switch, a line relay for controlling said automatic switch and a cut-off relay for disconnecting said line relay from said line, connector switches, mul-
40 tiple terminals for said line terminating in

the banks of said connector switches and in manual equipment, means for extending connections to said line through one of the multiple terminals and for energizing said
45 cut-off relay to disconnect said line relay, and a trunk release circuit for said automatic switch including said test wiper.

87. In a telephone system, a subscriber's line provided with automatic equipment and
50 with manual equipment, operator controlled means for seizing said line through the medium of its manual equipment, subscriber controlled means for seizing said line as a
55 called line through the medium of its automatic equipment, and trunk release circuits for said subscriber controlled means.

88. In a telephone system a subscriber's line terminating in a step-by-step automatic selective switch, multiple contacts for said
60 line terminating in the banks of other automatic switches and in manual equipment, subscriber controlled means for seizing said line through one of said multiple contacts and for making the other of said multiple
65 contacts test busy, and a trunk release circuit for said subscriber controlled means.

89. In a telephone system, a called subscriber's line, multiple contacts for said line
70 terminating in automatic equipment and in manual equipment, subscriber controlled automatic trunking means for seizing said line and for making all of said multiple contacts test busy, and a trunk release circuit for said
75 automatic trunking means.

In witness whereof, I hereunto subscribe my name this 18th day of December, A. D., 1905.

ALFRED H. DYSON.

Witnesses:

THOMAS H. FERGUSON,
GEO. E. MUELLER.