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TELEPHONY.

APPLICATION FILED APR. 24, 1911.

Patented May 13, 1913.

2 SHEETS—SHEET 1.

1,061,515.

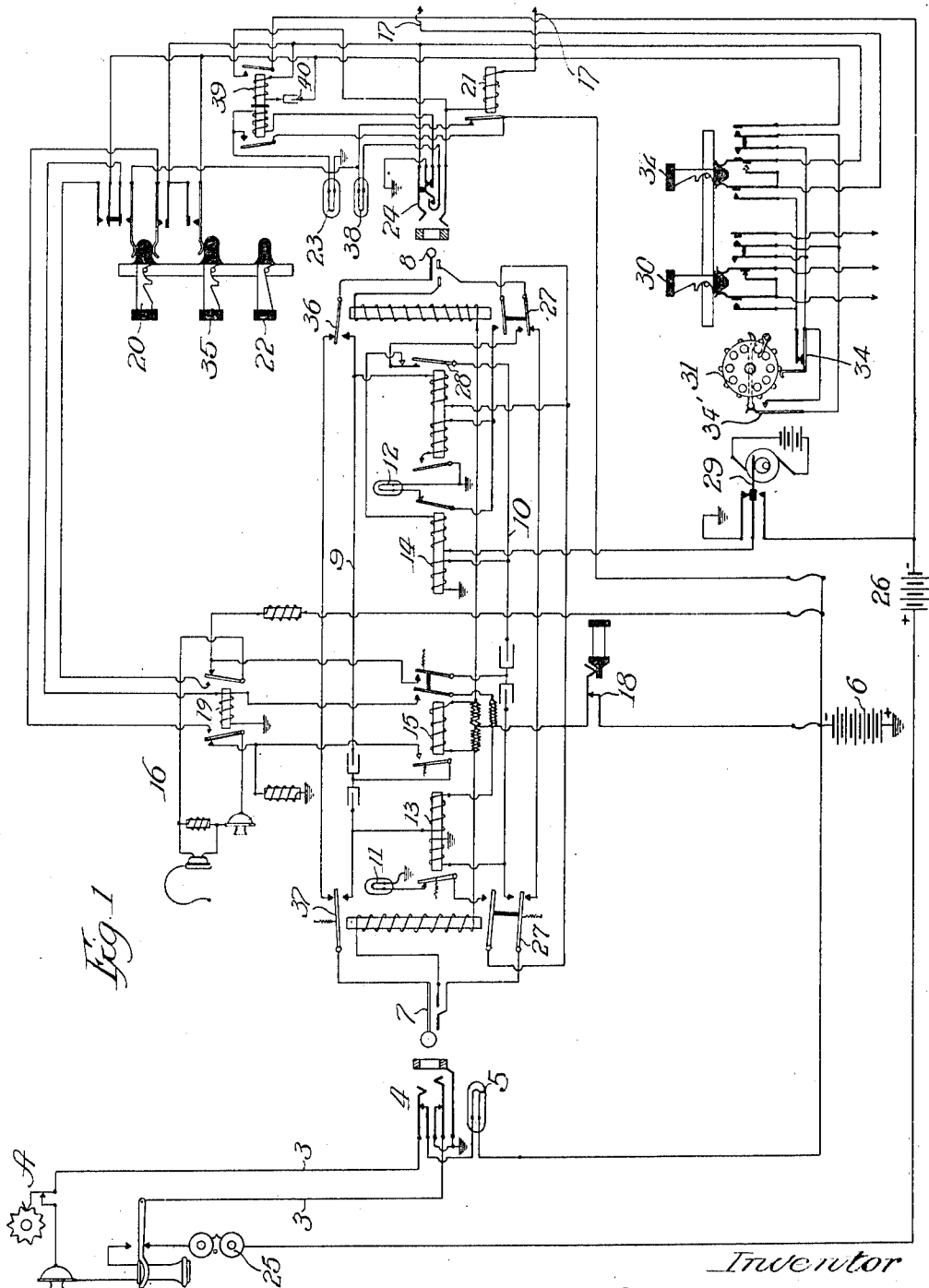


Fig. 1

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APPLICATION FILED APR. 24, 1911.

Patented May 13, 1913.

2 SHEETS—SHEET 2.



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# UNITED STATES PATENT OFFICE.

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TELEPHONY.

1,061,515.

Specification of Letters Patent.

Patented May 13, 1913.

Application filed April 24, 1911. Serial No. 623,043.

*To all whom it may concern:*

Be it known that I, CHARLES A. BALS, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephony, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems and in one of its aspects may be described as a telephone exchange system including a plurality of telephone lines extending between an exchange and a telephone station; extensions for said telephone lines having terminals at the exchange; electro-magnetic selecting mechanism for effecting connection between said extensions and said telephone lines; apparatus at said telephone station for setting said selecting mechanism into operation and for holding the same when a telephone line has had an extension selectively connected therewith at the exchange; and switching mechanism whereby said apparatus may be interchangeably associated with said telephone lines and whereby the selecting mechanism may be maintained in that condition in which a telephone line and an extension are connected together through the agency of said selecting mechanism when said apparatus is transferred from association with this latter telephone line to another telephone line.

My invention in another of its aspects may be described as a telephone system including telephone lines extending to different exchanges; a battery at each exchange common to equipment there located; a trunk line extending from one exchange to the other; link connecting mechanism at the latter exchange for connecting the trunk line with telephone lines extending to the latter exchange; circuit connections whereby the common battery at one exchange may be brought into operative association with equipment at the other exchange; and means at the latter exchange for disassociating the common battery thereat from the circuit established between lines by way of both exchanges and trunk line.

My invention in another of its aspects may be described as a telephone exchange system including telephone lines extending to one

exchange; link connecting mechanism at this exchange for uniting lines extending to this exchange; telephone lines extending to a second exchange; a trunk line intervening between the exchanges whereby connection may be established between telephone lines extending to both exchanges; an operator's telephone outfit; and switching mechanism whereby said operator's telephone outfit may be connected with the trunk line independently of the link connecting mechanism and may be connected with the link connecting mechanism independently of the trunk line.

My invention in another of its aspects may be described as a telephone system including telephone lines extending to two exchanges; a trunk line extending between the exchanges whereby lines extending to both exchanges may be connected for conversation; an operator's telephone outfit at the exchange to which the trunk line extends; mechanism for associating said operator's telephone outfit telephonically with the trunk line; mechanism for preventing the association of said operator's telephone outfit with the trunk line when connection has been established between lines extending to said exchange by way of said trunk line; and means for placing said mechanism beyond operator's control upon the establishment of connection between telephone lines extending to the exchanges.

I will explain my invention more fully by reference to the accompanying drawings showing the preferred embodiment thereof and in which—

Figure 1 illustrates a manual switch board system provided with link connecting mechanism adapted to unite lines extending to the manual exchange, the jack end of a trunk line being shown in Fig. 1, the balance of this trunk line being shown in Fig. 2 where it extends to an automatic exchange that is diagrammatically indicated in this latter figure.

The manual exchange indicated in Fig. 1 may, for example, be considered a private branch exchange. But one telephone line 3—3 is shown though it is to be understood that many other telephone lines are embodied in the exchange illustrated by Fig. 1. The telephone line 3 extends from a substation A that may be of any well known or suitable type and which termi-

nates at a spring jack 4 at the exchange, two talking jack springs constituting the terminals of the lines 3 which engage with suitable back contacts for looping in a line signal 5 in serial relation with the line and for permitting the exclusion of this line signal from circuit with the line when the jack springs are separated from their back contacts upon the insertion of a plug of a link circuit, it being understood that the line signal 5 is included in circuit with a common battery 6 when the telephone receiver at station A is removed from its switch-hook. Link circuits are desirably employed at the private branch exchange that have each a manually controlled plug 7 at the answering end, and the manually controlled plug 8 at the connecting end whereby lines extending from substations directly to the private branch exchange may be directly connected by means of link circuits thus provided with answering and connecting plugs 7 and 8. The cord circuit mechanism that is shown between the answering and connecting plugs 7 and 8 and which is illustrated between the strands 9 and 10 of the cord circuit is well understood by those familiar with the art and need not be described in detail, it sufficing to state that this includes supervisory signals 11 and 12 governed by supervisory relays 13 and 14 and a relay 15 directly governing the association of the operator's telephone outfit 16 with the cord circuit, said relay mechanism being adapted for inclusion in circuit with the common battery 6 when the link circuit is to be used in connecting lines extending directly to the private branch exchange, but all of which relay mechanism is to remain inert, in accordance with the preferred embodiment of my invention, when the link circuit is used in coöperation with the trunk line 17 in connecting telephone lines that extend to the exchanges shown in both views, for reasons which will appear and to which end a circuit opening key 18 may be employed for breaking the conductor that extends from the common battery 6 to the link circuit. It is to be understood that I do not limit myself to the type of link circuits shown. The relay 15 has three armature switches, the outer two armature switches serving when attracted to bridge the operator's telephone outfit 16 between the talking strands of the link circuit, when the apparatus is in such working condition as to permit of this association of said telephone outfit. Another relay 19 is employed to cut the operator's telephone out of circuit, the operator's telephone being cut in circuit when a calling subscriber is to be answered and being cut out of circuit when the connecting end of the cord circuit that is in circuit with the calling subscriber's line is manipulated to

connect the calling subscriber's line with a called line that extends to the private branch exchange.

If the operator at the branch exchange should for any reason desire telephonic connection with the exchange illustrated in Fig. 2, such operator will depress the button 20 to cause it to occupy its alternate position thereby to energize the relay 19 and transfer the connection of the uppermost contact of the key 20 and next to the lowermost contact of said key whereby these terminals are connected with the sides of the trunk line 17 owing to the depression of the key 20, these trunk line sides being connected with the contacts that are engaged with the aforesaid contacts of the key 20 when said key is thus depressed. The circuit that is established through the relay 19 as a result of the manipulation of the connecting end 8 of the link circuit need not be described as such is now well known to those skilled in the art. The circuit which is established through said relay as a consequence of the depression of the key 20 may be traced from the grounded terminal of the relay 19, through the winding of said relay, the two middle contacts of the key 20, the inert armature switch of the relay 21 and its contact, to the upper terminal of the battery 6. When the operator at the private branch exchange is through with her use of the trunk line 17 she will operate the restoring key 22 to release the key 20 and allow it to assume the normal position illustrated whereby the circuit for the relay 19 will be opened and the operator's outfit 16 has its circuit association with the link circuit at the private branch exchange restored.

If the party whose line extends to the automatic exchange (though it is to be understood that I do not limit myself to automatic exchanges) should desire telephonic connection with a party whose line extends to the private branch exchange a circuit will automatically be established through the signal 23 that is located at the private branch exchange in response to which signal the operator at the private branch exchange will manipulate her key 20 to bring her telephone outfit into circuit association with the trunk line 17 in the manner which has been described. After having ascertained the wants of the calling automatic subscriber the operator at the private branch exchange will disconnect her telephone outfit from the telephone line by pressing the releasing button 22, will insert the answering plug 7 in the trunk line jack 24 and will finally place the connecting plug 8 in the jack connected with the line of the wanted private branch party. The signal receiver 25 at the private branch station will thereupon be included in a circuit that may be traced from some suitable source of ring-

ing current as, for example, a battery 26, through said signal receiver 25, the switch hook at the wanted private branch station, the sleeve spring of the jack 4 belonging to the line of said wanted private branch station, the sleeve of the connecting plug in engagement with said sleeve spring, the now attracted armature switch 27 and its alternate contact, the normally positioned switch 28, the right hand winding of the supervisory relay 14, the ringing circuit interrupter switch spring 29 and the lower contact intermittently engaged therewith to battery 26. The rest of the operations that are to ensue when the wanted private branch party responds and when conversation has been concluded need not be described, such being clear to those skilled in the art.

If the party at a private branch exchange station should desire connection with the party at an automatic substation, such calling party will signal the private branch operator in the usual way and such operator will ascertain the wants of the calling party in the usual way and, in accordance with preferred practice, the calling party will temporarily restore his receiver upon his switch hook to await the signal conveyed by his receiver 25 which will indicate to him that the private branch exchange operator has secured the wanted line. The operator, in order to secure the wanted line, selects a trunk line 17 and operates a master switch key 30 individual to the selected trunk line for bringing the circuit interrupting or dial mechanism 31 into operative association with the selected trunk line in order that the wanted automatic station may automatically be selected, and while I have illustrated a well known dial mechanism for operating the selecting mechanism at the automatic exchange, I do not wish to be limited to such dial mechanism nor to the employment of selecting mechanism that will automatically connect the wanted line with the trunk line, as I consider certain features of my invention to be broadly new in connection with means whereby the extension is automatically provided for the trunk line whether or not such extension extends clear through to the calling station. As the invention is exhibited the dial mechanism 31 in its normal position serves to establish a direct connection between the sides of the trunk line for the purpose of holding the selecting mechanism in that position which it has been caused to assume in order to establish the desired extension for the trunk line and if the operator at the private branch exchange had no further use for the dial mechanism she would allow it to remain in association with the selected trunk line for the purpose of maintaining the connection between the sides of the trunk line for the purpose just stated. If, however, the private branch operator

should need the dial mechanism 31 for the purpose of selecting another automatic subscriber she will operate another key 32 individual to a second selected trunk line, said key being so mechanically inter-related with the first key 30 as to cause said key 30 to assume its normal position in which a connection is established across the sides of the trunk line 17 in substitution for the connection that was previously established between the sides of said trunk line by way of the contacts 34 that are closed when the dial mechanism is in normal position. The switch 34 that causes impulses to be transmitted over the trunk line 17 is included in a circuit connection that may be traced from the lower side of the trunk line 17, the right hand contact spring of the depressed key 32 individual to the trunk line, the contact engaged by this spring when the key 32 is depressed, the left hand switch 34<sup>1</sup> of the dial 31 when this dial is off normal position, the contacts of the switch 34, the left hand contact spring of the depressed key 32, the contact engaging the same, to the upper side of the trunk line 17. In this way but one dial mechanism may be employed for a group of trunks without disturbing the connections that have been automatically established between the trunks and the extensions therefrom.

If the operator should desire to hold a trunk independently of the dial mechanism 31 and with the key mechanism 30, 32 in normal condition she will depress the holding button 35 to establish a connection between the sides of the trunk line. It is understood that the keys 30, 32 are individual to different trunk lines and that the dial mechanism is made common to the trunk lines by way of the keys 30, 32. The holding circuit connection established for holding a trunk line is traceable from the lower side of the trunk line 17, the lower contact of the key 35, the upper contact of this key, the fourth and third contacts from the left of the key 32 individual to the trunk line when this key is normal, to the upper side of trunk line. It is not necessary to describe the operations which occur when the dial mechanism is actuated as such are well known to those skilled in the art of automatic and semi-automatic telephony.

After the wanted automatic subscriber whose line has become connected with the trunk line 17 has been signaled in the usual way the operator at the private branch exchange will insert the answering plug 7 into the trunk jack 24 and will insert the connecting plug 8 in the jack of the private branch exchange party originating the call whereupon a circuit will be established through the signal receiver 25 at the call originating station, which circuit has hitherto been traced. When a connection has thus

been established through both exchanges the cord circuit at the private branch exchange should be relieved of its association with its relay equipment in order that the extension of the trunk line established at the private branch exchange by means of the cord circuit connected with the trunk line may be a mere metallic continuation of the talking sides of the trunk line and in order that this condition may arise the key 18 is operated to disconnect the battery 6 from the cord circuit whereby the armature switches 27, 36 at the calling end of the cord circuit may remain normal, the armature switches 37 at the answering end of the cord circuit being then normally independent of the battery 6. The operator will manipulate the key 18 to disconnect the battery 6 when the supervisory lamp 12 ceases to glow. By thus stripping the battery 6 from the cord circuit a supervisory or disconnect lamp 38 may be associated with the trunk line so as to be under the control of the private branch exchange party connected with the trunk line, circuit through this supervisory lamp 38 being closed when the private branch exchange party, who has now virtually become an automatic exchange party by the removal of the battery 6, restores his receiver upon its switch hook, the armature of the relay 21 that is thereupon deenergized completing the supervisory lamp circuit, such circuit being traceable from the grounded battery 6 through the released armature switch of the relay 21 to the grounded terminal of the lamp 38. The relay 21 is not included in circuit with the battery 6 but is included in circuit with the common battery at the automatic exchange. The grounded terminal of the lamp 38 is disconnected from the lamp when the plug is withdrawn from the jack 24 so as to extinguish the light at 38. In addition to the advantages which have been cited as a result of the circuit opening operation of the key 18 I also prevent the battery at either exchange from discharging into the battery of the other exchange in the event of inequality in the voltages of these batteries. Where the private branch exchange party is a called party and an automatic subscriber is a calling party I provide novel means for governing the call signal device 23 at the private branch operator's position which includes electromagnetic mechanism 39 having one coil in bridge of the trunk line and in series with a condenser 40 in the same bridge and its remaining coil that is in serial relation with the left hand armature switch and its contact, the grounded battery 6 and ground by way of the contacts of the trunk jack 24. As is well known alternating current will be automatically directed through the coil 39 when thus connected in bridge of the trunk line as a con-

sequence of which the left hand armature switch will engage its contact and hold a circuit through the coil 41 thereby to maintain circuit through the signal lamp 23 that may be traced from the grounded battery 6 through said left hand armature switch and its contact to the grounded terminal of the lamp 23. The ringing current through the coil 39 is cut off when the operator responds, in a manner well known, whereupon circuit through the relay 41 is alone relied upon to hold the left hand armature switch attracted, this circuit being broken when the operator plugs in to the jack 24 thereby to open the circuit through the signal device 23.

In night time, or any other time when it is desired to dispense with the services of an operator at the private branch exchange for the purpose of connecting automatic and private branch exchange parties, cord circuits at the private branch exchange may be allowed to remain in connection with private branch lines and automatic trunk lines. As a result the signal devices 23 are excluded from circuit and the signal receivers 25 at the private branch exchange stations are subject to the control of the right hand armature switch associated with the element 39, this right hand armature switch engaging its contact to close circuit through the signal receivers 25 when the coils 39 are energized. The circuit thus established through a signal receiver 25 may be traced from the battery 26 through said right hand armature switch and its contact, a portion of the sleeve side of the associated trunk 17, the sleeve spring of the jack 24, the sleeve of the plug inserted within said jack, the armature switches 27, 37 and their normal contacts, the sleeve of the other plug, the sleeve spring of the jack receiving said other plug, the switch hook at the substation having said signal receiver 25, the lower contact of said switch hook, said signal receiver 25 back to the battery 26. It is understood that the key 18 is operated to disconnect the battery 6 from any cord circuit that is thus allowed to remain in connection with the jacks of a trunk line and a private branch exchange line. When cord circuits are allowed normally to connect trunk lines and private branch lines, a private branch party may be able to select an automatic subscriber's station by means of a dial in the well known way. Each private branch exchange party who is to have facility for automatically calling an automatic exchange party, in the absence of the operator at the private branch exchange, has a cord circuit plugged into his line and the key 18 individual to such cord circuit is depressed so as to remove the battery 6 from such cord circuit.

The automatic exchange equipment shown

in Fig. 2 is well known by those skilled in the art, the well known magnets having their names applied thereto on the drawing.

The prior art is exemplified by British patent 1298 of 1910. The mechanical nature of the selectors and connectors is well set forth in "*Telephony*" published in 1910 by Van Deventer, such mechanism being illustrated upon page 530.

While I have herein shown and particularly described the preferred embodiment of my invention I do not wish to be limited to the precise equipment, circuit arrangement, and telephone exchange systems shown as changes may readily be made without departing from the spirit of my invention, but Having thus described my invention, I claim as new and desire to secure by Letters Patent the following:

1. A telephone exchange system including a plurality of telephone lines extending between an exchange and a telephone station; extensions for said telephone lines having terminals at the exchange; electro-magnetic selecting mechanism for effecting connection between said extensions and said telephone lines; circuit breaking mechanism at said telephone station for setting said selecting mechanism into operation and serving when at rest to establish connection between the sides of the telephone line with which it is associated to hold the selecting mechanism in that position in which a telephone line is connected through the agency of said selecting mechanism with a telephone line extension; and switching mechanism whereby said circuit breaking mechanism may be interchangeably associated with said telephone lines and whereby a connection is established between the sides of the telephone line from which the circuit breaking mechanism is transferred in order to prevent that operation of the selecting mechanism associated with the line from which the circuit breaking mechanism is transferred that would cause the separation between the telephone line and extension previously connected by the selecting mechanism.

2. A telephone system including telephone lines extending to different exchanges; a battery at each exchange common to equipment there located; a trunk line extending from one exchange to the other; link connecting mechanism at the exchange to which the trunk line extends for connecting the trunk line with telephone lines extending to this exchange; circuit connections whereby the common battery at one exchange may be brought into direct operative association with clearing out or supervisory equipment at the other exchange; and means at the exchange having the equipment with which the common battery is brought into operative association for disassociating the common battery thereat from the circuit established

between lines by way of both exchanges and trunk line.

3. A telephone system including telephone lines extending to different exchanges; a battery at each exchange common to equipment there located; a trunk line extending from one exchange to the other; link connecting mechanism at the exchange to which the trunk line extends for connecting the trunk line with telephone lines extending to this exchange; circuit connections whereby the common battery at one exchange may be brought into direct operative association with clearing out or supervisory equipment at the other exchange; and means for disassociating the battery at one of the exchanges from the circuit established between lines by way of both exchanges and trunk line.

4. A telephone system including telephone lines extending to different exchanges; a battery at each exchange common to equipment there located; a trunk line extending from one exchange to the other; mechanism at the exchange to which the trunk line extends for connecting the trunk line with telephone lines extending to this exchange; circuit connections whereby the common battery at one exchange may be brought into direct operative association with clearing out or supervisory equipment at the other exchange; and means at the exchange having the equipment with which the common battery is brought into operative association for disassociating the common battery thereat from the circuit established between lines by way of both exchanges and trunk line.

5. A telephone system including telephone lines extending to different exchanges; a battery at each exchange common to equipment there located; a trunk line extending from one exchange to the other; mechanism at the exchange to which the trunk line extends for connecting the trunk line with telephone lines extending to this exchange; circuit connections whereby the common battery at one exchange may be brought into direct operative association with clearing out or supervisory equipment at the other exchange; and means for disassociating the battery at one of the exchanges from the circuit established between lines by way of both exchanges and trunk line.

6. A telephone exchange system including telephone lines extending to one exchange; link connecting mechanism at this exchange for uniting lines extending to this exchange; telephone lines extending to a second exchange; a trunk line intervening between the exchanges whereby connection may be established between telephone lines extending to both exchanges; an operator's telephone outfit; switching mechanism whereby said operator's telephone outfit may be con-

connected with the trunk line independently of the link connecting mechanism and may be connected with the link connecting mechanism independently of the trunk line; and  
5 a relay governed by the switching mechanism employed to connect the operator's telephone with the trunk line and serving to shift the operator's telephone terminals from the link connecting mechanism to the  
10 trunk line.

7. A telephone exchange system including telephone lines extending to one exchange; link connecting mechanism at this exchange for uniting lines extending to this exchange;  
15 telephone lines extending to a second exchange; a trunk line intervening between the exchanges whereby connection may be established between telephone lines extending to both exchanges; an operator's telephone outfit; switching mechanism whereby  
20 said operator's telephone outfit may be connected with the trunk line independently of the link connecting mechanism and may be connected with the link connecting mechanism independently of the trunk line; and  
25 relay mechanism adapted to be governed by the link connecting mechanism for controlling the association of the operator's telephone outfit with the link connecting mechanism and adapted also to be governed by the aforesaid switching mechanism for controlling the association of said operator's  
30 telephone outfit with the trunk line.

8. A telephone system including telephone lines extending to two exchanges; a  
35 trunk line extending between the exchanges whereby lines extending to both exchanges may be connected for conversation; link connectors at one of the exchanges for uniting lines extending thereto in telephonic  
40 connection; an operator's telephone outfit at this exchange adapted for telephonic association with said link connectors; mechanism whereby said operator's telephone outfit may be telephonically associated with the  
45 trunk line; mechanism for excluding the operator's telephone outfit from telephonic association with the trunk line; and means for placing said latter mechanism beyond  
50 the operator's control upon the establishment of connection between telephone lines extending to said exchanges by way of said trunk line and a link connector.

9. A telephone system including telephone  
55 lines extending to two exchanges; a trunk line extending from one exchange to the other whereby lines extending to both exchanges may be connected for conversation; an operator's telephone outfit at the exchange to which the trunk line extends;  
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mechanism for associating said operator's telephone outfit telephonically with the trunk line; mechanism for preventing the association of said operator's telephone outfit with the trunk line when connection has  
65 been established between lines extending to said exchanges by way of said trunk line; and means for placing said latter mechanism beyond the operator's control upon the establishment of connection between telephone  
70 lines extending to the exchanges.

10. A telephone system including telephone lines extending to two exchanges; a trunk line extending between said exchanges; a source of signaling current at  
75 one of said exchanges; electro-magnetic mechanism at said exchange for including said source of current in a signaling circuit, said electro-magnetic mechanism having a winding included in circuit relation with  
80 the trunk line; and means at the other exchange for energizing said winding whereby signaling current at said other exchange need not directly be included in the signaling circuit at the first exchange.  
85

11. A telephone system including telephone lines extending to two different exchanges, a trunk line extending between said exchanges; a cord circuit at one of the exchanges adapted to connect telephone lines  
90 with the trunk line, said cord circuit having electro-magnetically controlled cord circuit apparatus in association therewith; and means for disassociating said electro-magnetically controlled cord circuit apparatus  
95 from the cord circuit when such cord circuit is to be used in connection with the trunk line for establishing connection between lines extending to the exchanges.

12. A telephone system including telephone lines extending to different exchanges; a trunk line extending from one exchange to the other; link connecting mechanism at the exchange to which the trunk line extends for connecting the trunk line  
105 with telephone lines extending to this exchange and also for connecting telephone lines extending to this exchange; a battery; and switching mechanism for bringing the battery into direct association with the clearing out or supervisory signaling apparatus  
110 related to an established connection at both exchanges.

In witness whereof, I hereunto subscribe my name this eighth day of April A. D.,  
115 1911.

CHARLES A. BALS.

Witnesses:

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ETTA L. WHITE.