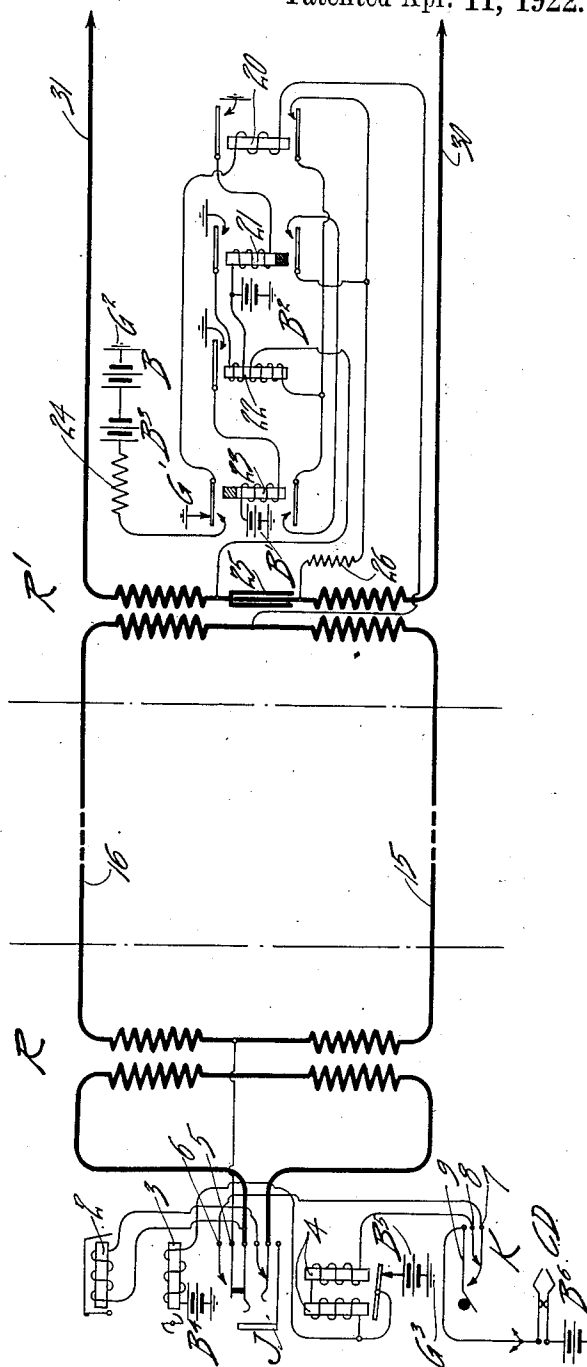


1,412,435.

J. WICKS.
TELEPHONE TRUNK CIRCUITS.
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TELEPHONE TRUNK CIRCUITS.

1,412,435.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, JOHN WICKS, a citizen of the United States of America, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Trunk Circuits, of which the following is a specification.

My invention relates in general to trunk circuits for telephone systems and more particularly to circuits of this character which are adapted for use in automatic telephone systems. More specifically, my invention has for its object the provision of improved trunk circuits for connecting a main automatic exchange with isolated manual branch exchanges subsidiary thereto, and is especially useful in those cases where the branch exchanges are of small size and are located at considerable distance.

In carrying out my invention I provide a two way trunk circuit over which a branch exchange operator may complete connections between local subscribers and subscribers in the main exchange; and which may also be used by the latter subscribers in extending connections to the branch. Means is provided for giving the operator supervision on the former class of connections. The control of the supervision and also the control of the automatic switches in the main exchange is exercised over a simplex circuit superimposed in the usual manner on the talking conductors of the trunk. The battery for the switch control circuit is preferably located at the branch exchange, as less trouble is experienced from line leakage in this way, and I provide also means for charging this battery from the main exchange during conversation.

These and other desirable features of my invention will be explained fully hereinafter, reference being had to the accompanying drawing, which shows diagrammatically a two way trunk circuit embodying the principles of my invention.

In the drawing, reference characters 15 and 16 indicate the two line conductors of the trunk circuit, which terminates at opposite ends in the windings of the repeating coils R and R'. At the branch exchange the trunk conductors 15 and 16 are inductively connected through the medium of repeating coil R with the tip and ring springs of the jack J. Associated with the jack J

there is shown a drop 2 for incoming signals, a supervisory signal 3, a polarized relay 4, and a calling device key K, all of which are individual to the jack J. There is also shown a calling device CD which may be of the general type of calling device disclosed in the British Patent to Dicker No. 29654 of 1910. The calling device CD may be common to a number of trunk circuits. The operator is, of course, provided with a number of cord circuits for interconnecting local lines, which may also be used for the purpose of connecting a local line with a trunk circuit. No cord circuit is shown in the drawing, but they will be understood to be of any suitable type, and since magneto substations are generally used in isolated branch exchanges such as the one now under consideration, they may be comparatively simple in design.

At the main exchange the truck conductors 15 and 16 are inductively connected through the medium of repeating coil R' with the conductors 30 and 31 which latter may terminate in an individual line switch of the type disclosed in the patent to Newforth No. 1,078,690, January 17, 1912, reissued on April 13, 1915, as No. 13,901. The main exchange is assumed to be of the well known two wire type such as is described in the patent above mentioned. Just to the right of the repeating coil R', there is shown a repeater comprising the relays 20 to 23, inclusive, whose functions will be described.

While I have shown throughout the drawing a plurality of batteries, there will be in practice but two principal batteries, one at the main exchange and the other at the branch exchange. Thus batteries B, B', and B² are one and the same battery which is the regular central battery at the main exchange. The batteries B⁴, B⁵, and B⁶, at the branch exchange likewise may be a single battery, which may be composed of small storage cells or dry cells. In addition to the batteries mentioned, there is also provided at the main exchange, a booster battery which is indicated by the reference character B³.

The manner in which connections are established over the trunk circuit will now be explained. For this purpose it will be assumed that a local subscriber in the branch exchange desires to obtain connection with a subscriber in the main exchange and has

signaled the operator in the usual manner. The operator will therefore connect the line of the calling subscriber through the medium of one of her cord circuits with an idle
 5 trunk line extending to the main exchange. Assuming that the trunk line to be used is the one shown in the drawing, when the calling plug of the cord circuit is inserted in the jack J, the drop 2 is disconnected in
 10 an obvious manner, and at the same time a circuit for the relay 20 at the distant main exchange is completed as follows: ground at G', resting contact of upper armature of relay 23 and the said armature, winding of
 15 relay 20, lefthand windings of repeating coil R' in parallel, conductors 15 and 16 in parallel, righthand windings of repeating coil R in parallel, contact springs 5 and 6, contact springs 7 and 8, winding of polarized relay
 20 4, and the armature of the said relay and its resting contact to battery B⁵. Upon the closure of the above circuit, the polarized relay 4 is not operated. At the main exchange, however, the relay 20 is energized
 25 and completes an energizing circuit for the slow acting relay 21. Upon attracting its armature, relay 21 completes a circuit through the upper winding of the electropolarized relay 22. The upper winding of
 30 relay 22 is of high resistance and few turns, being composed of German silver wire, and relay 22 therefore is not energized. When the relay 20 was energized, it also completed at its lower armature a conductive bridge
 35 across the conductors 30 and 31 which extends as follows: conductor 30, lower righthand winding of the repeating coil R', resistance 26, working contact of the lower armature of relay 20 and the said armature,
 40 lower winding of relay 22, and the upper righthand winding of the repeating coil R' to the conductor 31. Upon the closure of the above bridge, the line switch in which the conductors 30 and 31 terminate is operated
 45 in the usual and well known manner to extend the connection to an idle first selector switch in the main exchange, whereupon the line relay of such selector becomes energized over the conductors 30 and 31 in series.
 50 Although the lower winding of relay 22 at the repeater is included in this circuit, the energizing effects of the two windings of this relay now oppose each other and it is not energized.
 55 The foregoing operations have occurred in response to the insertion of the plug in the jack J. The operator will now throw her key K, with the result that the calling device CD is substituted for the polarized relay
 60 4 in the previously described circuit of the relay 20. The calling device CD is now operated in accordance with the first digit of the desired number, thereby causing a number of deenergizations of the said relay
 65 20 by producing a series of interruptions in its circuit. At each deenergization, relay 20 opens the bridge across the conductors 30 and 31 at its lower armature, thereby producing in the well known manner a series of deenergizations of the line relay of the
 70 first selector switch. The first selector is accordingly operated in the well known manner to select and connect with a trunk line extending to an idle second selector switch associated with the desired main
 75 group of subscribers' lines in the main exchange. Additional operations of the calling device will now be effective to bring about the operation of the selected second selector and a connector switch to complete
 80 the connection to the line of the called subscriber, the interruptions produced by the calling device being repeated to the line relays of these switches by the relay 20 of the repeater as before. The called subscriber is
 85 then signaled automatically from the connector switch in the usual manner.
 Having called all the digits in the wanted number, the operator will restore her key K to normal position thereby cutting out the
 90 calling device CD and again inserting the polarized relay 4 in the circuit of relay 20. When the called subscriber responds by removing his receiver, the usual answering bridge in the connector is operated to re-
 95 verse the direction of current flow in the conductors 30 and 31. By this operation the lower winding of relay 22 is energized in the proper direction to assist the upper winding and the said relay 22 is therefore
 100 operated. As a result a circuit is closed for the slow acting relay 23, which is so adjusted that its lower armature engages its working contact before its upper armature breaks away from its resting contact.
 105 The attraction of the lower armature of relay 23 closes a shunt path around the contact controlled by the lower armature of relay 20, and the foregoing adjustment is necessary in order to prevent relay 22 from
 110 being deenergized when the relay 20 falls back momentarily, due to the shifting of its circuit at the upper armature of relay 23. By this latter operation, the upper terminal of relay 20 is disconnected from
 115 'ground G' and is connected instead to the resistance 24. Current now flows in the simplex control circuit as follows: ground at G², battery B⁵, resting contact of the armature of the polarized relay 4 and the said
 120 armature, winding of relay 4, contact springs 8 and 7, contact springs 6 and 5, righthand windings of the repeating coil R in parallel, conductors 15 and 16 in parallel, lefthand windings of the repeating coil R' in par-
 125 allel, winding of relay 20, upper armature of relay 23 and its working contact, resistance 24, booster battery B³, and the battery B to ground G². The above circuit it will be observed, is similar to the one previously
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traced except for the fact, that by reason of the inclusion of batteries B³ and B in the circuit, the direction of current flow is reversed. The polarized relay 4 is now operated to remove the short circuit previously existing around the supervisory signal 3, whereupon the signal is operated to notify the operator that the called subscriber has answered.

Since the two batteries at the main exchange are now connected in opposition to the battery at the branch exchange, and since together they are of greater electromotive force, it is evident that the branch exchange battery will be charged during conversation.

When the subscribers are through talking they will replace their receivers, the replacement of the receiver at the called substation being effective to give the operator at the branch exchange a disconnect signal as follows: When the receiver is hung up, the answering bridge at the connector deenergizes and reverses the current in the conductors 30 and 31 back to normal. The electropolarized relay 22 is then deenergized, followed by the deenergization of the slow acting relay 23. The original energizing circuit of relay 20 is thereby restored and the polarized relay 4 at the branch exchange is operated to again short circuit the supervisory signal 3, and by the deenergization of this latter, the operator is notified that disconnection is desired. It may be mentioned that the target or other visual device controlled by the supervisory magnet 3 should be arranged preferably so as to be visible when the magnet is deenergized. Upon receiving the signal, the operator will take down her cord circuit thereby breaking the energizing circuit of the relay 20 at the main exchange. By the deenergization of relay 20 and the resulting deenergization of relay 21 the bridge across the trunk conductors 30 and 31 is permanently opened (whether the called subscriber has replaced his receiver or not) and the automatic switches involved in the connection are accordingly released as usual.

The establishment of a connection originating at the main exchange involves nothing new. The normal conductors of the line switch in which the conductors 30 and 31 terminate are accessible to connector switches, of the rotary type, although they may be similar to the connector switch shown in the above patent to Newforth, and are assigned a telephone number. A main exchange subscriber then by calling this telephone number is able to establish connection to the trunk line extending to the branch exchange, whereupon the drop 2 at the latter point will be actuated by ringing current projected over the trunk line from the connector switch. The operator will answer

the call by inserting a plug in the jack J and upon obtaining the name of the wanted party in the branch will complete the connection in the usual manner.

Having described my invention what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What I claim as my invention is:

1. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange for controlling said switches, and means for automatically charging said battery from the main exchange over said circuit during conversation.

2. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, and means at the main exchange for automatically charging said battery over said circuit during conversation.

3. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, and means controlled by the response of the called subscriber for automatically charging said battery during conversation.

4. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange for controlling said switches over said circuit, and means at the main exchange including a second battery of higher voltage than the said first battery for automatically charging the latter over said circuit upon response of the called subscriber.

5. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk

for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the
 5 branch exchange, means at the main exchange for automatically charging said battery over said circuit during conversation, and a supervisory relay at the branch exchange included in said circuit and responsive to the reversal of current therein during
 10 the charging operation.

6. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for
 15 operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, means controlled by the
 20 response of the called subscriber for automatically charging said battery during conversation, and a supervisory relay at the branch exchange included in said circuit and responsive to the reversal of current
 25 therein during the charging operation.

7. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 30 trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, and means for automatically charging said battery from the main
 35 exchange over said circuit after the connection is established.

8. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 40 trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, and means at the main exchange for automatically charging said
 45 battery over said circuit during conversation.

9. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 50 trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, and means controlled by the response of the called subscriber for automatically charging said battery during
 55 conversation.

10. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 60 trunk in parallel for operating switches in the main exchange to establish a talking

connection, a battery in said circuit at the branch exchange, and means at the main exchange including a second battery of higher voltage than the said first battery for automatically charging the latter over said circuit after the connection is established. 70

11. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 75 trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, means at the main exchange for automatically charging said battery over said circuit during conversation, and a supervisory relay at the branch exchange included in said circuit and response to the reversal of current therein during
 80 the charging operation.

12. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said
 85 trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, means controlled by the response of the called subscriber for automatically charging said battery during
 90 conversation, and a supervisory relay at the branch exchange included in said circuit and responsive to the reversal of current therein during the charging operation.

13. In a telephone system, a trunk line connecting two exchanges, means including said trunk for establishing a talking connection between subscribers in the respective
 100 exchanges, a simplex circuit superimposed on said trunk and including the two conductors thereof in parallel, a supervisory relay in said circuit at one exchange, and means for controlling said relay from the other exchange by reversals of current produced in said circuit. 110

14. In a telephone system, a trunk line connecting two exchanges, means including said trunk for establishing a talking connection between subscribers in the respective
 115 exchanges, a simplex circuit superimposed on said trunk and including the two conductors thereof in parallel, a supervisory relay and a battery in said circuit at one exchange, and means at the other exchange comprising a second battery of higher voltage than the said first battery for producing a reversal of current in said circuit to operate said relay. 120

15. In a telephone system, a trunk line connecting two exchanges, means including said trunk for establishing a talking connection between subscribers in the respective
 125 exchanges, a simplex circuit superimposed on said trunk and including the two conductors thereof in parallel, a polarized

supervisory relay at one exchange irresponsive to normal current flow in said circuit, and means at the second exchange including a second relay for reversing the direction of current flow in said circuit to operate said supervisory relay.

16. In a telephone system, a trunk line connecting two exchanges, means including said trunk for establishing a talking connection between subscribers in the respective exchanges, a simplex circuit superimposed on said trunk and including the two conductors thereof in parallel, a supervisory relay in said circuit at one exchange, and means for controlling said relay from the other exchange upon the response of the called subscriber by reversals of current produced in said circuit.

17. In a telephone system, an operator's position and a trunk line extending therefrom, an automatic switch control circuit superimposed on said trunk line and including the two conductors thereof in parallel, a supervisory signal at the operator's position, and means for reversing the direction of current flow in said circuit to control said signal.

18. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, a source of current at the main exchange and automatic means for applying said source by way of said circuit to said battery to charge said battery upon response of the called subscriber.

19. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, a source of current at the main exchange and automatic means for supplying said source by way of said circuit to said battery to charge said battery after the talking connection is established.

20. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, a source of current at the main exchange and automatic means for applying said source by way of said circuit to said battery to charge said battery when the main exchange subscriber answers.

21. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, a source of current at the main exchange and automatic means for supplying said source by way of said circuit to said battery to charge said battery when the main exchange subscriber answers.

22. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, a source of current at the main exchange and a relay for applying said source by way of said circuit to said battery to charge said battery after a talking connection is established.

23. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, a source of current at the main exchange and a relay for supplying said source by way of said circuit to said battery to charge said battery upon response of the called subscriber.

24. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including a conductor of said trunk for operating switches in the main exchange to establish a connection between the branch exchange and a subscriber in the main exchange, a battery in said circuit at the branch exchange, a source of current at the main exchange and a relay for applying said source by way of said circuit to said battery to charge said battery when the main exchange subscriber answers.

25. In a telephone system, a trunk circuit connecting a branch exchange with an automatic main exchange, a switch control circuit including the two conductors of said trunk in parallel for operating switches in the main exchange to establish a talking connection, a battery in said circuit at the branch exchange, a source of current at the main exchange and a relay for supplying said source by way of said circuit to said battery to charge said battery when the main exchange subscriber answers.

Signed by me at Chicago, Cook County State of Illinois, this 6th day of June, 1917.

JOHN WICKS.