

W. W. DEAN.
TELEPHONE SYSTEM.
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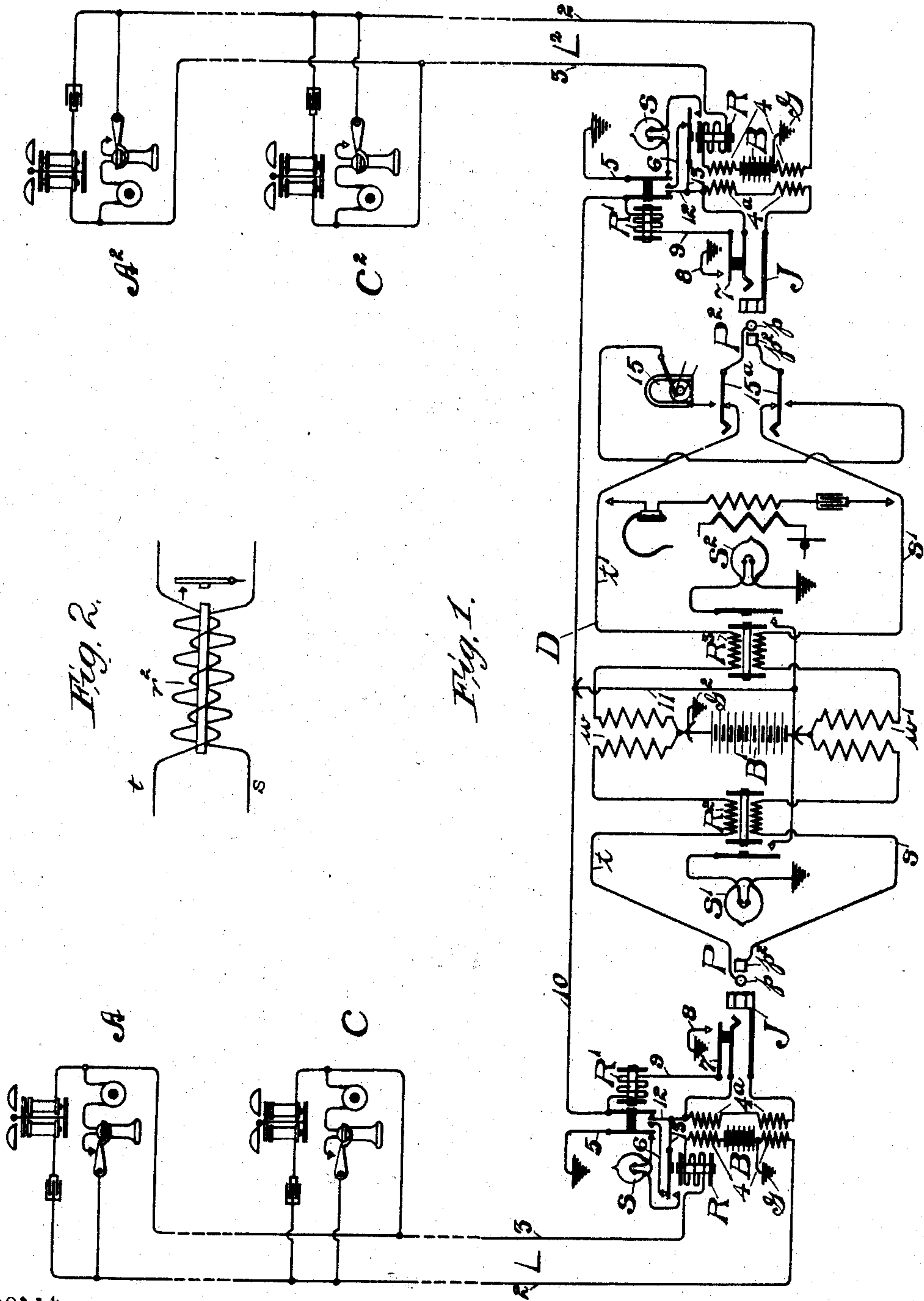


Fig. 2.

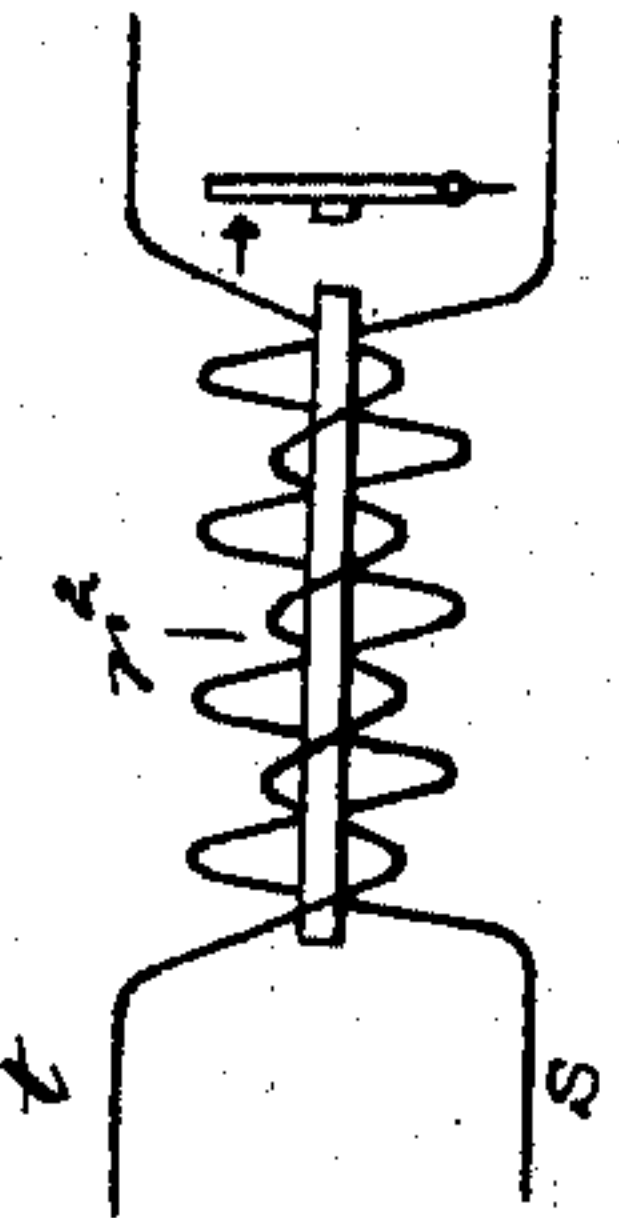


Fig. 1.

Witnesses
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 907,224.

Specification of Letters Patent.

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To all whom it may concern:

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

My invention relates to improvements in telephone systems and particularly to that class in which a plurality of subscribers may be located upon a single line. It will be apparent however, to those skilled in the art that in many of its features, the invention is of general application and may be readily applied to a great diversity of systems.

As is well known it is desirable to associate supervisory signals with operator's connective circuits to apprise the operators at all times of the condition of connected lines, that is, whether the called party has duly responded, or whether either or both have replaced their receivers upon the hooks at the termination of the conversation. In certain kinds of operator's connectors or circuits such supervisory apparatus is adapted to be operated by an excess of current over one side of the said connectors or circuits; and by the phrase "excess of current" is meant any substantial difference of current in the two sides, including the extreme case of zero current in one side of the circuit. One well known way of deriving this excess is to ground the proper side of the telephone line at the substation, which is handily accomplished by means of a ground tap containing the signal bell closed to one side of the line through the normal contact of the hook switch. Thus the subscriber unconsciously grounds the line to operate the supervisory apparatus at central by hanging up the receiver. When it is attempted however, to place several such subscribers upon the telephone line trouble is encountered for a ground is continuously present at some station with the result that an undesired operation of the supervisory apparatus is had.

My invention seeks among other things to provide a system and arrangement of circuits and devices to accomplish the desired result of placing any number of subscribers

upon a telephone line entering at an exchange where supervisory apparatus of the kind described is employed and to do so in a simple and convenient manner.

Further objects are the simplification of the circuits and arrangements of a telephone system whereby an economical and efficient system is obtained.

Referring to the accompanying drawing Figure 1 represents in diagram two party lines extending to a central office and the central office equipment, and Fig. 2 shows the differential windings of the supervisory relays.

Like reference characters indicate like parts throughout the drawing.

L and L² indicate party lines extending from their substations to the central office. On the line L stations A and C are located, while on line L² stations A² and C² are placed. At each station the line conductors 2 and 3 are bridged by the telephone instruments, the hook switch being adapted to maintain the normal discontinuity of such bridges. A call bell and condenser are in a parallel bridge at each station between the line conductors. These parts are intended to typify any desired common battery arrangement of substation devices, the essential feature being the closing of a bridge of the line during conversation. At the central office the line conductors are extended through the windings 4 of a repeating coil and through a battery B, the latter having one pole grounded as at G. In the conductor 3 a relay R is placed and is adapted to close the circuit of the line signal S through its armature and forward contact. The circuit of this lamp S is normally completed through the outer armature and resting contact of a cut-off relay R', and the ground tap 5 attached thereto. The branch conductor 6 leads from the resting contact of the armature of relay R to the forward contact of said outer armature of relay R'. The other windings 4^a of the repeating coil are connected with the line connection terminal or jack J, which is provided with the usual tip and sleeve contact surfaces. An additional spring 7 is provided for the jack, which is adapted to be thrown into contact with the ground tap 8 when a connecting plug is in-

serted in the jack. This spring 7 is connected with conductor 9, which includes the winding of relay R' and is extended by conductors 10 and 11 to the central battery B' , which has one pole grounded at G^2 . The inner armature of the relay R' is connected to said conductor 10 and its normal contact is joined to the portion of the line between the repeating coil windings 4^a and the jack J by conductor 12, which conductor is further connected by branch 13 with the armature of the line relay R .

At the central office the cord circuit D is provided with connecting plugs P and P^2 , each of which is provided with tip and sleeve contact surfaces p and p^2 , which are adapted to engage like contact surfaces in the jacks J when they are inserted. The tips of these plugs are connected by the cord strands t and t' , while the sleeves are likewise connected by the strands s and s' . Repeating coil windings w and w' respectively are interposed in the tip and sleeve strands respectively; and the battery B' is connected between the middle points of these windings and therefore in a bridge of the cord circuit. The strands s and t include the windings of the differential supervisory relay R^2 , which is inoperative when equal currents flow in opposite directions through its coils; it is adapted to control through its armature and forward contact the circuit of the supervisory signal lamp S' associated with the plug P . A similar relay R^3 has its windings included in the strands t' and s' and likewise controls the circuit of the supervisory lamp S^2 , which is associated with the connecting plugs P^2 . These relays, as shown in Fig. 2, have superposed differential windings, the proximity of these coils serving to secure absolute neutrality to the voice currents and hence no retardation thereof. The operator's telephone set is adapted to be bridged across the cord circuit by any suitable key, the said bridge including a head telephone, the secondary winding of an induction coil and a condenser. A local circuit, preferably charged from the battery B' , contains the operator's transmitter and the primary winding of her induction coil. A ringing generator 15 is adapted to be connected with the plug P^2 by means of any suitable ringing key typified in the drawing by the springs 15^a .

The line L^2 is of the same type as line L and is therefore not specially described. Its individual signaling device is energized from the common battery B' , while the battery B may be the same battery as that in connection with line L . A different battery may be used, however, or a portion or all of battery B' . By using a separate battery the voltage may be varied as is sometimes desired with toll lines to suit the resistance and other varying conditions thereof.

The operation is substantially as follows: A subscriber on the line L desiring a connection with another line, takes up his receiver thus completing the bridge of the line at his station. Current then flows from the battery B through the windings 4 of the repeating coil, the relay R , to the station and through the instrument bridge back to the central office. The relay R is operated and attracts its armature to close the circuit of the line signal S from ground thereat, through the conductor 5, the forward contact and armature of relay R , conductors 13 and 12, the inner armature and its normal contact of relay R' , and conductors 10 and 11 through battery B' to ground at G^2 . Upon seeing the signal the operator inserts the answering plug P in the jack of the calling line and connects her telephone with the cord circuit. The insertion of the plug closes the spring 7, upon the ground tap 8, which completes a circuit from the battery B' through the conductors 11, 10 and 9, thus operating the relay R' , which attracts its armature and extinguishes the line lamp S . At the same time, the outer armature of relay R' is connected with conductor 6 thus associating the ground tap 5 with the line, but as the relay R is energized nothing at this time occurs as the result of such association. Current from the battery B' is now flowing through the tip and sleeve strands of the cord circuit connected with the plug P in equal amounts so that the supervisory relay R^2 does not operate and the supervisory signal S' associated with plug P remains dark.

Upon learning the party wanted the calling plug P^2 is inserted in the jack of the proper line and the ringing key operated to connect the ringing generator 15 therewith. The ringing current is inductively transmitted through the repeating coil windings 4 and 4^a to the portion of the line leading to the substations, and is adapted to pass through the condensers and operate the call bells at the substation. Any suitable code of signals may be employed when there are a number of subscribers on the line, or any suitable system of selective signaling can be employed. The insertion of the plug P^2 in the jack of the subscriber has the effect of operating the cut-off relay R' associated with that line as just described. In the called line at this time however, the line relay R is not operated for the reason that the subscriber has not yet responded and its armature is in its normal position and therefore connected with conductor 6. The ground branch which is thus associated with the line by the operation of relay R' and which includes the conductor 5, the outer armature of relay R' , conductor 6, armature of relay R , conductors 13 and 12, is thrown upon the line. This has the effect of causing an increased flow of current over the sleeve

strand s' of the cord circuit from the grounded battery B over the sleeve side of the connection terminal J and through the repeating coil windings 4^a , and thence through the ground branch as just traced. It therefore passes through the sleeve winding of the differential relay R^3 , the armature of which is attracted to close the circuit of the supervisory signal S^2 associated with the plug P^2 . This indicates to the operator that the subscriber has not yet responded. As soon as the subscriber replies to the call and takes up his receiver, the metallic circuit is completed from the battery B connected with that line through the relay R, the armature of which is attracted and thereby opens the ground branch from one side of the line as just described, with the attending result that current from the battery B' flows equally through the windings of the supervisory relay R^3 and causes the lamp S^2 to be extinguished. The subscribers are now in communication during which the line relays R R, are operated by charging current from the batteries B B in the lines, at the same time the supervisory lamps associated with the cord circuit are both extinguished. Talking currents are repeated from one portion of a line to the other by the repeating coil interposed therein, and from one end of the cord circuit to the other by the repeating coil connected therewith. When either subscriber hangs up his receiver the complete circuit for the battery B is opened and the line relay R, which now becomes the disconnecting relay is deenergized, with the result that the ground tap is thrown upon one side of the line and the supervisory relay R^2 , or R^3 , is operated to light the corresponding disconnect lamp. The operator is thus notified of the end of the conversation, when the plugs may be withdrawn and the connection taken down, thus restoring all parts to normal position.

By the described apparatus, one means is provided for grounding the line at the central office that is adapted to be controlled from any substation of the line, and while the repeating coil windings are interposed in the lines of the specific embodiment of the invention so described, this feature thereof and the claims thereon are not so limited for other and many specific embodiments may be employed. It will be understood that the differential relays may be replaced by any other system of relays operating upon the principle explained, that is, upon current or excess of current in one side of the connection. In a multiple board the jacks J would merely be duplicated. The several grounds may be the common ground or office return. The term "ground branch" etc., used in reference to the branch connected with one side of the line, both in the description and claims, is intended to include any third conductor arranged to make the desired connec-

tions. In practice such a third conductor would preferably take the form of a common lead having taps off to the lines, though other arrangements could be employed. In installing lines of this type, only the spring jack and signal conductors are mounted on the switchboard, proper, while the repeating coils in the lines having windings 4 and 4^a , together with the lines and cut off relays are separately installed and may even be located in another room. I shall therefore refer hereinafter to the switchboard portion or switchboard side and to the line portion or line side of the subscribers' telephone line.

I claim—

1. In a telephone system, the combination with a telephone line, or a cord circuit to connect therewith, a relay and a battery permanently connected in the line, the said relay being under the control of the subscriber at all times, a ground tap adapted to be connected with the talking circuit and controlled by said relay, and telephonic apparatus associated with the cord circuit having its operation affected by current flowing over a circuit formed of a portion of the said talking circuit and said ground tap, substantially as described.

2. In a telephone system, the combination with a telephone line, of a line relay in the line under the control of the subscriber during an established connection, a direct ground branch of the line adapted to be connected with one side of the talking circuit to permit the passage thereover of current from the talking circuit, said branch being controlled by said relay, and telephone apparatus associated with the line and actuated by current over a portion of the said side of the talking circuit and said ground branch, substantially as described.

3. In a telephone system, the combination with a telephone line, of a relay in the line at all times under the control of the subscriber, a direct ground branch of the line adapted to be connected with one side of the talking circuit of the line and controlled by said relay, and apparatus associated with the line and having its operation controlled by current in the circuit formed by said ground branch and including a portion of said side of the talking circuit, substantially as described.

4. The combination with a telephone line, of a relay and a battery permanently in the line, the said relay being under the control of the subscriber, and a direct ground branch of the line adapted to be connected with the talking circuit to form an electric circuit therewith and controlled by said relay, and telephonic apparatus actuated by the current flowing in said electric circuit, substantially as described.

5. In a telephone system, the combination with a telephone line, of a line signal there-

for at the central office, a relay in the line to operate said signal when the subscriber calls the central office, a ground branch from one side of the line during an established connection with the line for conversational purposes and controlled by said relay during such connection, a cord circuit and supervisory apparatus associated therewith and adapted to be operated by an excessive current over one side of the cord circuit when the said ground branch is connected with the line, substantially as described.

6. The combination with a telephone line, of a plurality of substations thereon, a relay in the line at the central office controlled by any of the subscribers, a branch connection from the line controlled by said relay, a cord connector connected with the line, a differential supervisory relay associated therewith, and means for operating said supervisory relay when the said branch connection is completed, substantially as described.

7. The combination with a telephone line, of a plurality of substations located thereon, a relay in the line under the control of any of the subscribers, a ground branch from one side of the line controlled by said relay, a cord circuit connected with the line, a supervisory signal associated with said circuit and adapted to be operated by current over one side of the circuit, a battery connected between ground and said side of the circuit, whereby the connection of the ground branch with the line operates the supervisory signal, substantially as described.

8. The combination with a telephone line, of a plurality of substations on the line, a relay in the line under the control of any of the subscribers, a ground branch from one side of the line controlled by said relay, a cord circuit connected with the line, a supervisory signal in said circuit and adapted to be operated by an excess of current in one side of the circuit, and a battery grounded from the said side of the circuit, whereby the connection of the ground branch operates the supervisory relay, substantially as described.

9. The combination with a telephone line, of a relay and a battery in the line, a line signal having its circuit normally controlled by said relay, a cord circuit, means to render said signal inoperative and to associate a branch conductor with the line when a connection is established with the line by the cord circuit and adapted during such association to be connected with the talking circuit, and a differential supervisory relay associated with the cord circuit and capable of use with any line and having its operation controlled by current over said branch, said branch being controlled during the connection by the said first relay, substantially as described.

10. The combination with a telephone line,

of a line relay, a line signal normally controlled by said relay, a ground branch associated with one side of the line, a cord circuit adapted to be connected with the line, the said ground branch being controlled by said relay during a connection, a supervisory relay in the cord circuit adapted to be operated by an excess of current in one side of the line, and a grounded battery connected with the line, whereby when the ground branch is connected with the line by the relay the supervisory relay is operated, substantially as described.

11. The combination with a telephone line, of a line relay under the constant control of the subscriber, a line signal normally controlled by the relay, a cut-off relay actuated when a connection is established with the line to render said signal inoperative, a branch conductor associated with the line by the actuation of said cut-off relay, said branch being connected with the line upon the deenergization of said line relay, a differential supervisory relay, and means for sending an excess of current through one coil of said differential relay when the said branch is connected with the line, substantially as described.

12. The combination with a telephone line, of a line relay under the constant control of the subscriber, a line signal normally controlled by said relay, a cut-off relay actuated when a connection is established with the line to render said signal inoperative, a ground branch associated with the line by the actuation of said cut-off relay, said branch being connected with the line upon the deenergization of said line relay, a cord circuit and supervisory signal associated therewith, said signal being rendered operative by current over one side of the cord circuit and the ground branch when the latter is connected with the line, and inoperative by current over both sides of the cord circuit when the branch is disconnected from the line, substantially as described.

13. The combination with a telephone line having a plurality of substations located thereon, of a cord circuit at the central office to establish conversational circuit with the line, a supervisory signal associated with said cord circuit and depending for its operation upon an excessive current flow over one side of said cord circuit, and means controlled from any of said substations for thus governing the actuation of said signal, substantially as described.

14. The combination with a telephone line having a plurality of substations located thereon, of a cord circuit at the central office to establish conversational circuit with the line, a supervisory signal associated with the said cord circuit and placed in condition to operate by current over one side of the cord circuit when a connection is established with

the line and inoperative by current over both sides of the same during conversation, and means controlled from any of said substations for thus governing the actuation of said signal, substantially as described.

15. The combination with a telephone line, of a plurality of substations thereon, a relay in the line at the central office adapted to be actuated from any one of the substations, a cord circuit a differential supervisory relay associated with the cord circuit and temporarily associated with the line during an established connection, and a branch conductor to complete an auxiliary path for current for operating said supervisory relay, said branch being completed during the connection when the said first relay is unactuated, substantially as described.

16. The combination with a telephone line, of a relay in the line at the central-office actuated from the substation, a branch conductor connected with the talking circuit by the actuation of said relay, a cord circuit, and a relay actuated over a circuit independent of the talking circuit, when the cord is connected with the line to disconnect said branch conductor from the talking circuit, substantially as described.

17. The combination with a telephone line, of a relay in the line at the central office actuated from the substation, a branch conductor connected with the talking circuit by the actuation of said relay, a cord circuit, and a relay actuated over a local circuit not including any portion of the talking circuit to disconnect said branch conductor from the line, substantially as described.

18. The combination with a telephone line, of a plurality of sub-stations thereon, a relay in the line at the central office adapted to be actuated from any one of the sub-stations, a ground branch adapted to be connected with one side of the line and controlled by said relay, a cord circuit, a differential supervisory relay in the circuit and adapted to be operated over one side of the circuit, and a grounded battery connected with the same side of the circuit as the ground branch, whereby the supervisory relay is controlled by the first mentioned relay, substantially as described.

19. The combination with a telephone line, of a relay in the line at the central-office controlled from the substation, a cord circuit, a second relay associated with the line at the central-office and actuated over a circuit independent of the cord circuit when the cord is connected with the line, a branch conductor and means for connecting the branch conductor with the talking circuit by the actuation of either of said relays, and for disconnecting the branch conductor from the talking circuit by the actuation of both of said relays, substantially as described.

20. The combination with a telephone line,

of a repeating coil interposed in the line to divide it into two portions, a relay and a battery in one portion, a ground branch from the other portion having its continuity controlled by said relay and telephonic apparatus having its operation affected by current over said branch, substantially as described.

21. The combination with a telephone line, of a repeating coil interposed in the line and dividing it into two portions, a relay and a battery in one portion, a connection terminal and a branch conductor connected with the other portion, a cord circuit adapted to be connected with said terminal and a supervisory apparatus connected with said circuit and adapted to be operated over said branch conductor, the said relay serving to control the continuity of said branch and itself being controlled by the subscriber, substantially as described.

22. The combination with a telephone line, of a cord circuit to establish connections therewith, supervisory apparatus associated with the cord circuit and depending for its inaction during conversation on the balanced condition of the cord circuit and for its operation at other times upon the unbalanced condition of the same, a relay in the line controlled by the subscriber, and means controlled by said relay to throw said cord circuit out of balance to operate said apparatus, substantially as described.

23. The combination with a telephone line, of a cord circuit to establish connections therewith, supervisory apparatus associated with the cord circuit and depending for its inaction during conversation on the balanced condition of the cord circuit and for its operation at other times upon the unbalanced condition of the same, a relay in the line under the control of the subscriber, and a ground tap from one side of the line controlled by said relay to throw said cord circuit out of balance to operate said supervisory apparatus, substantially as described.

24. In a telephone system, the combination with a telephone line, of a central source of current in the line, a relay in the line operated by current from said source and controlled by the subscriber during conversation, a ground branch temporarily associated with the line and controlled by said relay during connections, the arrangement being such that when the relay is energized the said branch is opened and when the relay is deenergized the branch closed, a cord circuit to establish connections with the line for conversation, a supervisory signaling apparatus associated with the cord circuit and caused to operate to expose the signal by current over one side of the cord circuit and said branch when the latter is completed and rendered inoperative to retire the signal by current over the other side

of the cord circuit when the said relay is energized and the ground branch is severed, substantially as described.

25. The combination with a telephone line, of a cord circuit to establish connections therewith for conversation, a supervisory signal controlling electro-magnet associated with the cord circuit and having two differential windings in the path of current over both sides of the cord circuit and depending for its inaction during conversation on the balanced condition of the cord circuit, and for its operation at other times during the connection upon the unbalanced condition of the same, a relay in the line controlled by the subscriber, and means controlled by said relay to throw said cord circuit out of balance to operate said supervisory signal controlling electro-magnet, substantially as described.

26. The combination with a telephone line, of a cord circuit to establish connections therewith, a signal controlling electro-magnet associated with the cord circuit and having two differential windings included in the path of current over both sides of the cord circuit, said magnet depending for its inaction during conversation on the balanced condition of the cord circuit and for its energization at other times during a connection upon the unbalanced condition of the same, a relay in the line under the control of the subscriber, and a ground path from one side of the line controlled by said relay to throw said cord circuit out of balance to operate said electro-magnet, substantially as described.

27. The combination with a telephone line, of a line relay in the path of current in the line at all times, said relay having a movable contact and a forward and a back contact for said movable contact, said movable contact being connected with the telephone line, a cut-off relay for the line energized when a connection exists and having normally closed contacts and normally open contacts, a signal for the line in a local circuit including the forward and movable contacts of said line relay and the normal contacts of said cut-off relay, a branch conductor including said normally open contacts of said cut-off relay and the movable and back contacts of said line relay, a cord circuit to establish connections with the line for conversation, and a supervisory signal controlling magnet associated with the cord circuit and operated over said branch conductor when it is completed, substantially as described.

28. The combination with a telephone line, of a repeating coil interposed in the line and dividing it into two portions, a relay and a battery in one portion, a connection terminal and a branch conductor connected with the other portion, a cord circuit adapt-

ed to be connected with said terminal, and a supervisory apparatus connected with said circuit and adapted to be operated over said branch conductor, the said relay serving to control the flow of current over said branch and itself being controlled by the subscriber, substantially as described.

29. In a telephone system, the combination with a telephone line, of a relay responsive to current in the line during conversation, a cord circuit, a differential supervisory relay associated with said circuit and adapted to be operated by current over a local circuit including a portion of the talking circuit when a connection is first established, said relay in the line serving to control the flow of current in such local path, substantially as described.

30. In a telephone system, the combination with a telephone line, of a relay responsive to current in the line during conversation, a cord circuit, a differential supervisory relay associated with said cord circuit and adapted to be operated by current over a local circuit including a portion of the talking circuit when a connection is first established, said relay in the line serving when actuated to interrupt the local path for such current, substantially as described.

31. In a telephone system, the combination with a telephone line, of a relay responsive to current in the line during conversation, a cord circuit, a supervisory signal associated with the cord circuit and put in condition to be operated by current over a portion of one side of the talking circuit and ground when a connection is first established, said relay in the line serving when actuated to interrupt the flow of such current in the said ground connection, substantially as described.

32. In a telephone system, the combination with a telephone line, of a relay responsive to current in the line during conversation, a cord circuit, a supervisory signal associated therewith, said signal being placed in condition to be operated by current over a portion of one side of the talking circuit and ground when a connection is first established with the line and to be rendered inoperative by current over the metallic line when the subscriber responds, said relay in the line serving when actuated to interrupt the said ground connection and at other times to complete the same, substantially as described.

33. In a telephone system, the combination with a telephone line, of a relay permanently connected in the talking circuit and responsive to current therein during conversation, a cord circuit, a supervisory signal associated therewith to adapt it for use with any line and rendered operative by current over one side of the talking circuit and ground and inoperative by current over both sides

of the talking circuit, said relay serving when actuated to cut-off the ground connection for such operating current, substantially as described.

5 34. In a telephone system, the combination with a telephone line, of a relay connected in the talking circuit thereof, a branch conductor from one side of the line controlled by said relay, a cord circuit, a source of current and a pair of electro-magnet windings associated therewith, a supervisory signal controlled by said electro-magnet windings, one of said windings being energized by current over a portion of one side of the talking circuit and said branch when a connection is established with the line to render said supervisory signal operative, and the other being energized by current from said source over the metallic line to render the signal inoperative when the subscriber is talking and the said relay is actuated, substantially as described.

35. In a telephone system, the combination with a telephone line, of a relay in the talking circuit of the line and actuated by current therein during conversation, a branch conductor of the line controlled by said relay, a cord circuit to establish connection with the line for conversation, a differential supervisory relay associated therewith, said relay being operated by current over said branch when the said line relay is deenergized, substantially as described.

36. In a telephone system, the combination with a telephone line, of a central source of current in the line, a relay in the line operated by current from said source and con-

trolled by the subscriber during conversation, a branch conductor controlled by said relay during connections, the arrangement being such that when the relay is energized the said branch is opened and when the relay is deenergized the branch closed, a cord circuit to establish connections with the line for conversation, a supervisory signaling apparatus associated with the cord circuit and caused to operate to expose the signal by current over one side of the cord circuit and said branch when the latter is completed and rendered inoperative to retire the signal by current over the other side of the cord circuit when the said relay is energized and the said branch is severed, substantially as described.

37. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith, two relays associated with the line having alternate contacts, one relay being under the control of the subscriber, and the other under the control of the operator, a line signal having its circuit completed by the energization of the former relay and the deenergization of the latter, and a cord signal having its operation caused by said relays when they are in the reversed position, substantially as described.

In witness whereof, I hereunto subscribe my name in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:

J. C. BELDEN,
ROBERT LEWIS AMES.