A. H. DYSON.

TELEPHONE SYSTEM.

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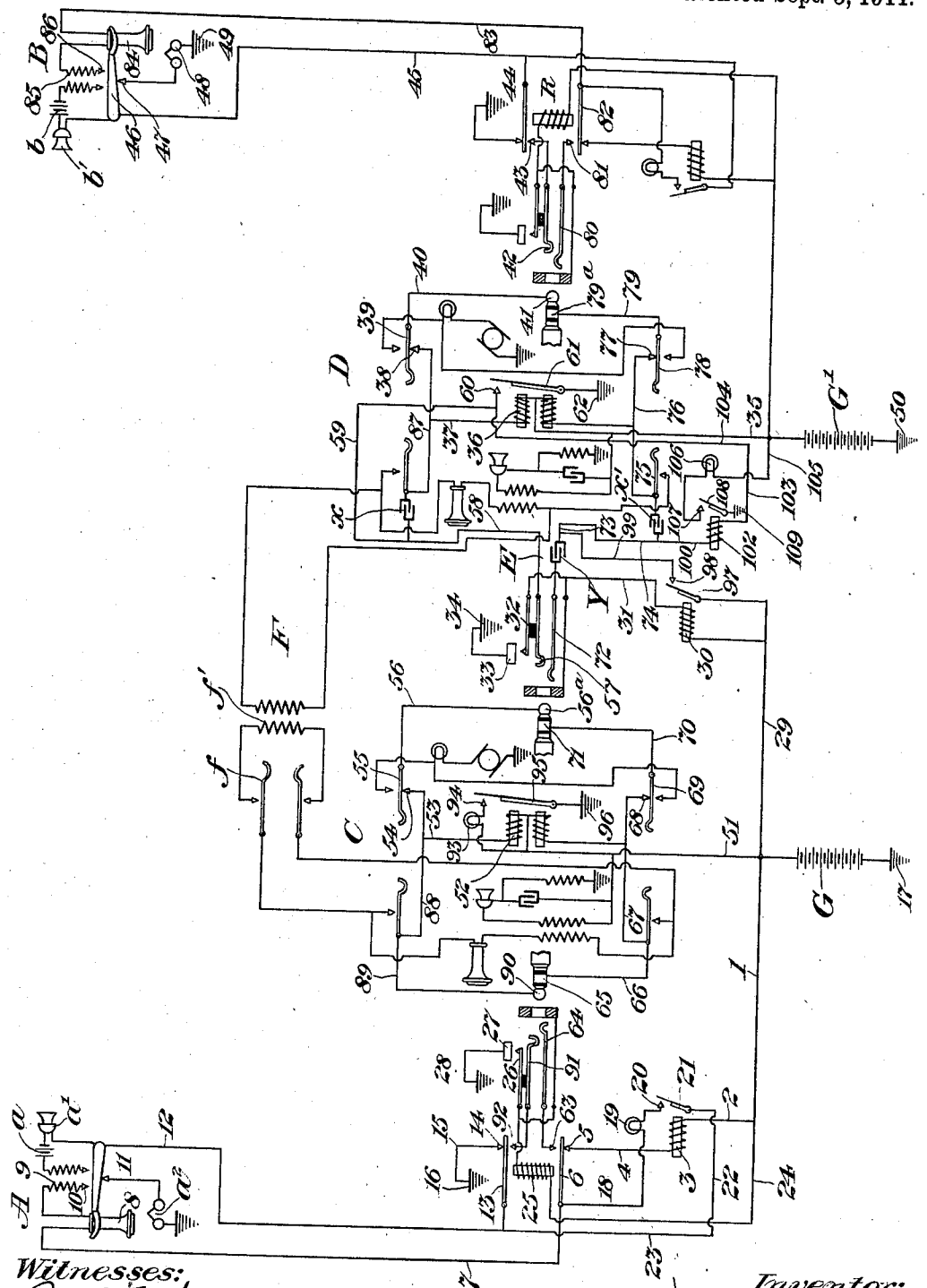

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TELEPHONE SYSTEM.

1,002,239. Specification of Letters Patent. **Patented Sept. 5, 1911.**

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To all whom it may concern:

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

My invention relates to telephone systems of that class in which the circuit arrangements are such that a subscriber of one exchange may be connected up for conversation with a subscriber of another exchange. Telephone systems of this character are known as trunking systems, the connections between the two exchanges consisting of what are usually termed trunk lines.

In a certain class of telephone systems the circuit arrangements are such that the current for talking purposes is furnished by local batteries at the substations, while the current for operating the various signals is furnished from a battery at the exchange or central station. Systems of this kind are usually known as centralized call systems, for the reason that only the current necessary for operating the calling and supervisory signals is supplied from a centrally located source. With this arrangement, when a subscriber sends in a call, a line signal is operated at the central exchange by current from a central source, so as to advise the central operator that the subscriber desires connection with some other substation. Also when the subscriber has finished talking, the act of hanging up the receiver causes a supervisory or clearing-out signal to be displayed on the switchboard in front of the operator, thereby indicating that the subscriber is ready to be disconnected. These clearing-out or supervisory signals, like the line or calling signals, are operated by current supplied from the battery at the central station. As stated, however, the current necessary for the operation of the microphone transmitters at the substations, or, in other words, the current necessary for talking purposes, is supplied from local batteries located at the different substations. For this reason, as explained, a telephone system of this character is known as a centralized call system.

Now one of the principal objects of my invention is to provide suitable circuit arrangements whereby trunking may be successfully and economically carried on between two of these centralized call exchanges.

A special object is to provide an improved circuit arrangement whereby the originating operator, or operator at the exchange where the call originates, may have complete control or supervision of the various connections.

Another object is to provide improved and suitable circuit connections whereby trunking may be carried on between two exchanges wherein the substation lines are normally disconnected from the spring jacks.

In addition, it is also an object to provide a simplified and improved trunking circuit adapted for use in connection with cut-out relays which not only serve to extinguish or restore the line signals, but which also operate, when energized, to establish connection between the lines and the normally disconnected jacks.

Another object is to provide certain details and features of improvement tending to increase the general efficiency and serviceability of a system of this character.

To the foregoing and other useful ends, my invention consists in matters hereinafter set forth and claimed.

The accompanying drawing is a diagram illustrating a trunking telephone system embodying the principles of my invention. In this diagram, two centralized call exchanges are shown connected by a trunk line, and two substations are shown connected with their respective exchanges. It will be understood that only such devices and circuit connections are illustrated as are necessary to a full understanding of the invention.

The substations A and B are, it will be seen, provided with local batteries a and b, suitably arranged for supplying current to the microphone transmitters a' and b'. The substation A is connected by parallel limbs or conductors with the exchange or central station indicated by C. In a similar manner, the substation B is shown connected with the central station or exchange indicated by D. The two exchanges, it will be understood, are supposed to be located some

distance apart, and are illustrated as being connected by a trunk line E. It will be readily understood, however, that in a system of this character it is desirable to have a number of trunk lines extending between the two exchanges. As illustrated, the call is supposed to originate at exchange C, the call having been sent in from substation A, and the subscriber at substation A is presumed to desire connection with the substation B. Hence the subscriber at substation A will be termed the calling subscriber, while the subscriber at substation B will be termed the called subscriber. The operator at exchange D is usually termed the trunking operator, while the operator at exchange C, as stated, is called the originating operator.

Assuming now, as stated, that the subscriber at substation A desires to carry on conversation with the substation B, the operations and circuit connections which then take place are as follows. The removal of the receiver from the hook-switch at substation A, operates to complete a line circuit from the centralized battery G, through the battery lead 1, thence through conductor 2 and the coil of line relay 3, through conductor 4 and the contact-point 5, thence through the armature 6 of the cut-out relay, through the line conductor 7, thence through the subscriber's receiver 8, through the secondary 9 of the induction coil, thence through the contact-point 10 and the hook-switch 11, through the other line conductor 12, through the other armature 13 of the cutout relay, thence through contact-point 14 and conductor 15, and finally through the ground or common connections 16 and 17 to said battery. This, it will be seen, energizes the line relay 3, causing it to attract its armature. The said armature, when attracted, completes a short local circuit from the battery G, through the conductors 1 and 2, through the said line relay 3, through the conductor 4 and contact-point 5, thence through the armature 6 and the conductor 18, through the line lamp 19, through contact-point 20 and the armature 21 of the line relay, thence through conductors 22 and 23, through armature 13 and contact-point 14, thence through conductor 15 and through the ground or common connections 16 and 17 to said battery. The flow of current through this local circuit causes the lamp 19 to glow, indicating to the originating operator at exchange C that the subscriber at substation A desires connection with some other subscriber. This local circuit, it will be observed, includes the line relay, which, it will be seen, is arranged to also form part of the line circuit. Consequently, when this local circuit is once closed it remains closed, whether the subscriber hangs up the receiver or not. As another advantage, this normally open connection across the line terminals which is controlled by the line relay 3, can be of such relatively low resistance as to completely short-circuit the substation when closed. In this way, when the operator plugs-in in answering a call, no change of potential takes place in the line circuit, and, consequently, no objectional sounds are produced in the subscriber's receiver. Acting on this signal, the originating operator then inserts the answering plug of the cord-circuit in the jack corresponding to the line at substation A. This, it will be seen, completes another local circuit from the battery G, through conductors 1 and 24, through the coil of cut-out relay 25, thence through the jack contacts 26 and 27, and through the ground or common connections 28 and 17 to battery. The current flowing through this second local circuit energizes the cut-out relay 25, causing it to attract its two armatures 6 and 13. These armatures, when attracted, it will be seen, move away from the contact-points 5 and 14, and, as these contact-points form part of the lamp circuit, the latter is thereby extinguished or restored. Furthermore, it will be seen that the cut-out relay not only thus enables the operator to automatically restore the line signal, but also serves as a means for establishing connection between the line and the normally disconnected jack. Thus connected with the subscriber through the strands of the cord-circuit, the originating operator then employs the talking set associated with the cord-circuit for the purpose of learning the number of the substation desired by the calling subscriber. Assuming, as stated, that the calling subscriber desires connection with substation B, the originating operator then gives the order for connection to the trunking operator at exchange D, over the private order line F. This order line is, it will be seen, permanently connected with the talking set or head telephone of the trunking operator, and is normally disconnected from the talking set of the originating operator. The latter, however, is enabled to establish connection over this line with the trunking operator by pressing the key *f*. It will also be seen that an inductive connection *f'* separates this order line into two parts.

Upon receiving the order for connection, the trunking operator then assigns a certain idle trunk line between the two exchanges, which, in this case, is assumed to be the trunk line E. If the line of substation B is not busy, the trunking operator also inserts the calling plug of the trunking cord-circuit into the jack allotted to said line. Complying with the trunking operator's instructions, the originating operator inserts

the calling plug of the cord-circuit in the trunking jack, it being observed that this jack is permanently connected with the trunking line, and that this line is also permanently connected with the cord-circuit employed by the trunking operator. The insertion of the originating operator's cord-circuit plug into the trunking jack completes a local circuit from the battery G, through the battery lead 29, through the coil of supervisory relay 30, thence through the conductor 31, through the contacts 32 and 33 of the trunking jack, thence through the common or ground connections 34 and 17 to said battery. Current flowing through this local circuit energizes the relay 30, and causes it to attract its armature. The insertion of the trunking plug in the jack corresponding to the line of substation B, completes a circuit from the battery G', through the conductor 35, through the coil of supervisory relay 36, thence through conductor 37 and contact-point 38, through the spring 39 of the ringing key, thence through the talking strand 40 of the cord-circuit, through the plug-tip 41 of the trunking plug, thence through the tip-spring 42 of the jack allotted to the line of substation B, through the contact-point 43 and the armature 44, through the line conductor 45 and the subscriber's hook-switch 46, thence through contact-point 47 and the bell 48, and thence through the ground from 49 to 50 and back to the battery. This, it will be seen, energizes the relay 36, causing it to attract its armature. This circuit, it will be seen, is possible for the reason that the trunking operator in plugging into the jack of the line extending to substation B, energizes the cut-out relay R in the same way in which the relay 25 of the other line was energized. The trunking operator then projects ringing current on to the line in any suitable manner, so as to ring the bell at substation B. Now before the subscriber at substation B has answered the call, it will be seen that the energizing of the relay 36 has completed a trunking line circuit from the battery G, through conductor 51, through the coil of relay 52, thence through the conductor 53 and the contact-point 54, through the spring 55 of the ringing key, thence through the talking-strand 56 of the originating operator's cord-circuit, thence through the plug-tip 56a, through the tip-spring 57 of the trunking jack, through the upper limb of the trunk line E, thence through the cord-strand 58 of the trunking cord-strand, through the conductor 59 and the contact-point 60, through the armature 61 of supervisory relay 36, and thence through the grounded connections 62 and 17. The flow of current through this grounded trunk line circuit energizes the relay 52, causing it to attract its armature. Said armature, when attracted, completes a short local-circuit from the battery G, through the conductor 51, through the supervisory lamp 93, thence through the contact-point 94, and through the armature 95, and the ground or common connections 96 and 17 to the battery. The flow of current through this local circuit causes the lamp 93 to glow, thereby indicating that the subscriber at substation B has not answered the call. It will be seen that this lamp 93 continues to glow until the called subscriber answers the call. When the subscriber at substation B answers the call, the grounded line circuit through the relay 36 is broken and the armature of this relay is released. This, it will be seen, operates to also break the grounded trunking line circuit including the relay 52, allowing this relay in turn to release its armature. When released, this armature of relay 52 opens the local circuit including the lamp 93, and the latter then ceases to glow. In this way, as stated, the answering of the call by the called subscriber extinguishes the lamp 93, advising the originating operator that the called subscriber has responded.

Both receivers being off the hook-switches at the two substations, the two subscribers are now connected up for conversation. The talking circuit includes the hook-switch 11, the coil 9 of the induction coil, the line conductor 7, the armature 6, the contact-point 63, the jack-spring 64, the plug-ring or sleeve 65, the talking strand 66 of the originating operator's cord-circuit, the conductor 67 and contact-point 68, the key-spring 69 and the talking strand 70, the plug-ring or sleeve 71 and the jack-spring 72 of the trunking jack, the limb 73 of the trunk line, the conductor 74, the key 75, and the conductor 76, contact-point 77, key 78, the talking-strand 79 of the trunking cord-circuit, the ring or sleeve 79a of the trunking operator's plug, the spring or sleeve contact 80 of the jack allotted to the line of substation B, the contact-point 81 and armature 82, the line conductor 83 and the subscriber's receiver 84, the induction coil 85 and the contact-point 86, the hook-switch 46, and the line conductor 45, the armature 44 and contact-point 43, the jack-spring or tip contact 42, the plug tip 41 and the cord-strand 40, the key spring 39 and contact point 38, the conductors 87 and 58, the upper limb of the trunk line E, the tip spring 57 of the trunking jack, the plug tip 56a and the cord-strand 56, the key-spring 55 and contact-point 54, the conductor 88 and talking-strand 89 of the originating operator's cord-circuit, the plug tip 90 and the tip-spring 91 of the jack, contact-point 92 and the armature 13, and the other line conductor 12. It will be seen that this talking circuit preferably includes the condensers X and X' arranged in the talking strands of

the trunking cord-circuit, and also a condenser Y arranged preferably in one limb of the trunk line.

When the subscribers have finished their conversation, and have hung up their receivers, the operations involved in disestablishing the connection between the two exchanges are as follows: Suppose the calling subscriber hangs up the receiver at substation A. This completes a grounded line circuit from the battery G, through conductor 51 and the coil of relay 52, through the conductors 53 and 88, through the cord-strand 89, through the plug-tip 90 and the jack-spring 91, thence through contact-point 92 and the armature 13, through the line conductor 12 and hook-switch 11, through the bell a^2 at substation A, thence through the ground and back to said battery. This energizes the relay 52 causing it to attract its armature. This armature, when attracted, completes a local circuit, as previously explained, through the lamp 93, causing the latter to glow. Observing this signal, the originating operator then withdraws the answering plug from the jack, corresponding to substation A, and also withdraws the calling plug from the trunking jack of the trunk line E. The withdrawal of the calling plug in this manner from the trunking jack breaks the local-circuit through the coil of relay 30, allowing the latter to release its armature. The said armature, when released, completes a grounded trunk line circuit from the battery G, through conductor 29, through the armature 97 of the supervisory relay 30, through the contact-point 98 and conductor 99, through the trunk-line limb or conductor 73, through the cord-strand 74, thence through conductor 100 and the coil of supervisory relay 102, thence through conductors 103 and 104, through contact-point 60 and armature 61, providing the latter has been attracted by the relay 36, thence through the ground connections 62 and 17 to said battery. This circuit, it will be seen, is only possible when the subscriber at substation B has replaced the receiver 8 upon the hook 46, so as to bring the latter into contact with the contact-point 47. This, as already explained, completes a grounded line circuit through the relay 36, causing the latter to again attract its armature. The flow of current through this grounded trunking line circuit, and through the coil of relay 102, causes the latter to attract its armature. The armature of this relay 102, when attracted, completes a short local circuit from the battery G′, through conductor 105, through the supervisory lamp 106, through the contact-point 107 and the armature 108, thence through the ground or common connections 109 and 50 to said battery.

Thus it will be seen that the removal of the calling plug from the trunking jack does not light the lamp 106 until the subscriber B has hung up the receiver 84, and, vice versa, hanging up this receiver 84 does not cause said lamp to glow until the calling plug has been withdrawn from the trunking jack. When this supervisory or clearing-out signal 106 is displayed, the trunking operator then withdraws the plug of the trunking cord-circuit from the jack allotted to the line of the substation B. In this way, even though the subscribers hang up their receivers at the same time, the originating operator has complete control and supervision of the disconnecting, and the trunking operator does not disconnect until the originating operator withdraws the plug from the trunking jack, so as to display the clearing-out signal 106. Suppose, however, that the subscriber at sub-station B should hang up his receiver first. In such case, a circuit would be closed from the battery G′ through the conductor 35, through the relay 36, through the conductor 87, thence through the contact point 38 and the spring 39, through the talking strand 40 and the plug tip 41, thence through the tip spring 42, through the contact 43 and the armature of the relay R, through the limb 45 of the line, through the switch-hook 46, and thence through the bell 48 and the grounded connection 49, and through the other grounded connection 50 to said battery. This energizes the relay causing it to attract its armature. Said armature when attracted closes a grounded trunk circuit from the battery G through the relay 52, through the conductor 53 and the contact point 54, through the spring 55 and the talking strand 56, through the tip spring 57 and one side of the trunk line, through the conductors 58 and 59, thence through the contact point 60 and the armature 61, and then through the ground or common connections 62 and 17 to said battery. This energizes the relay 52 and causes a local circuit from the battery G through the lamp 93, and through the contact point 94, the armature 95, and the ground connections 96 and 17. Thus the subscriber at substation B in hanging up his receiver causes the lamp 93 to glow.

Thus it will be seen that with my improved circuit arrangement trunking can be carried on satisfactorily between two centralized call exchanges, and that these circuit connections are adapted for use in connection with subscribers' jacks which are normally disconnected from the lines. In other words, these jacks are normally insulated both from the lines and from the ground. The cut-out relays 25 and 52 serve, however, when energized, to establish connection between the lines and their normally disconnected jacks. The subscribers' jacks are constructed, as shown, to mechanically

make and break the circuits through the cut-out relays. In a similar manner, the trunking jack is constructed to mechanically make and break the circuits through the supervisory relay 30. It will be readily understood that the resistance of the various relays and coils can be readily adjusted to secure the desired results by those skilled in the art, and in accordance with varying conditions.

The relays 36 and 52 are double-wound and bridged across the talking circuit. In each case, the non-grounded pole of the battery is connected between two windings of the relay, whereby the two sides of the line are balanced with respect to disturbances, etc. In other words, noise in the circuit is considerably reduced, and, in addition, either coil of either one of these relays is adapted to act as the supervisory relay coil, in the event that the line wires are crossed or reversed. For this reason, I find it preferable to use double-wound relays, as described and shown, although in the operation of the apparatus, one coil of each relay is used only as a balancing coil, it being evident that either subscriber can, by hanging up his telephone, energize the upper coil of a relay over a grounded circuit including the tip side of his line circuit. It will be understood, of course, that the plugs and jacks are so relatively formed that the testing rings of the jacks are not in contact with the sleeve contacts of the plugs when the latter are fully inserted. In other words, the thimbles or test rings of the jacks are used for testing purposes only, and are only included in circuits when the tip of a plug is braced against a testing ring for the purpose of making a busy test. In this connection, it will also be seen that the contact of a plug tip with a testing ring which is temporarily connected with the grounded pole of the battery results in the energizing of the supervisory relay in the cord circuit, thereby momentarily lighting the supervisory lamp. In this way, the busy test is made in the usual manner, and the test is visual, so to speak.

I claim as my invention—

1. In a trunking telephone system, the combination of two centralized call exchanges, local battery substations suitably connected with their respective exchanges, line relays normally connected with the lines of said substations, normally open short-circuit connections across the line terminals at the two exchanges, normally open switch-points in said short-circuit connections controlled by said line relays, suitable circuit connections whereby said line relays are adapted to form part of both line and local circuits, said local circuits including said short-circuit connections, and cut-out relays for disconnecting the line relays from the lines when connection is established between the substations and the exchanges or central stations.

2. In a trunking telephone system, the combination of a trunk line, a trunk-jack permanently connected with one end of said line, a trunking operator's cord-circuit permanently connected with the other end of said trunk line, an originating operator's cord-circuit having a plug adapted for insertion in said jack, a supervisory relay associated with the trunking operator's cord-circuit located in a normally open grounded circuit including one limb of the trunk line, a supervisory relay associated with the trunk-jack and arranged to control a normally closed switch-point in the circuit of said first-mentioned relay, a supervisory signal controlled by the relay associated with the trunking operator's cord-circuit, and suitable circuit connections whereby the withdrawal of the originating operator's cord-circuit plug from the trunk-jack opens the circuit of the supervisory relay associated therewith, thereby energizing the trunking operator's supervisory relay and displaying the latter's supervisory signal.

3. In a trunking telephone system, the combination of two exchanges, a trunk line extending between the two exchanges, substations having suitable connection with said exchanges, a supervisory relay at one exchange connected and arranged to be energized by current flowing through either the trunk line or the line of the substation connected with such exchange, a relay at the other exchange connected and arranged to control the flow of current through the trunk line circuit including said first-mentioned relay, a subscriber's hook-switch connected and arranged to control the flow of current through said last-mentioned relay, and a similar subscriber's hook-switch at the other substation connected and arranged to control the flow of current through said first-mentioned relay.

4. In a trunking telephone system, the combination of two centralized call exchanges, substations having local batteries and microphone transmitters suitably connected with said exchanges, a trunk line extending between the two exchanges, a supervisory or clearing-out signal at one exchange under the control of the operator at the other exchange, a supervisory signal at said last-mentioned exchange adapted to be controlled or brought into action by the subscriber at either exchange together with batteries located at the different exchanges, or at the different divisions of the same exchange, and connected for supplying current to the line circuits for signaling purposes only.

5. In a trunking telephone system, the combination of two centralized call exchanges, a trunk-line extending between the

two exchanges, two subscribers' substations connected respectively with one and the other of the two exchanges, a supervisory relay and supervisory signal at one exchange connected and arranged to be controlled by the subscriber connected with said exchange, a supervisory relay at the other exchange connected and arranged to be controlled by the subscriber at the other substation, said last-mentioned relay being also connected and arranged to control the flow of current through a grounded trunk line circuit including said first-mentioned relay, whereby the last mentioned subscriber may also control or bring into action said supervisory signal, and centralized call batteries located at the two exchanges and normally connected with the subscribers' lines together with batteries located at the different exchanges, or at the different divisions of the same exchange, and connected for supplying current to the line circuits for signaling purposes only.

6. In a trunking telephone system, the combination of a trunk line, a trunk-jack permanently connected with said line, a battery and a relay associated with said jack, an originating operator's cord-circuit provided with a plug adapted for insertion in said jack, a normally open local circuit including said battery and relay and also including the ring contacts of said jack and plug, a supervisory relay associated with the trunking operator's cord-circuit, a grounded circuit having normally closed and normally open switch-points and including the said supervisory relay associated with the trunking operator's cord-circuit, a second supervisory relay for controlling said normally open switch-point, said normally closed switch-point being controlled by the relay associated with the trunk-jack, and a supervisory signal associated with the trunking operator's cord-circuit and controlled by the said supervisory relay also associated therewith, the said signal being connected and arranged to be displayed or brought into action by the withdrawal of the said plug from the said jack.

7. In a trunking telephone system, the combination of subscribers' lines, jacks normally disconnected from the lines, originating and trunking operators' cord-circuits, batteries at the two exchanges connected with the subscribers' lines, a trunk line extending between the two exchanges, supervisory signal apparatus at the originating operator's exchange connected and arranged to be controlled or brought into action by either subscriber over circuits including normally severed connections between the jacks and the lines, and supervisory signal apparatus at the trunking operator's exchange connected and arranged to be controlled or brought into action by the originating operator.

8. In a trunking telephone system, the combination of subscribers' lines, means for connecting said lines comprising originating and trunking operators cord circuits, spring jacks and a trunk line, a supervisory lamp and a supervisory relay associated with the originating operators cord circuit, suitable circuit connections and means for supplying current, said supervisory relay being double wound and bridged across the conducting circuit with the battery connected between the windings and suitable means whereby either the calling or the called subscriber may operate said supervisory relay and lamp.

9. In a trunking telephone system, the combination of calling and called subscribers' lines, a trunking line, originating and trunking operators' cord circuits, double wound supervisory relays bridged across the cord circuits, together with grounded bells at the substations, and batteries at the central stations each having one pole grounded and the other pole connected between the windings of one of said relays.

10. In a system of trunking for telephone purposes, the combination of two centralized call exchanges, subscribers lines suitably connected with said exchanges, normally open connections across the line terminals at the exchanges, line relays for operating line signals and adapted to close said normally open connections when the line circuits are closed, line lamp signals located in local circuits including both the line relays and said normally open connections, the said line relays thereby forming part of both line and local circuits, a trunk line extending between the two exchanges, a supervisory signal at the trunking operator's exchange, a supervisory relay at the originating operator's exchange, suitable connections whereby the disconnecting of the originating operator's cord-circuit from the trunk line deënergizes said supervisory relay and thereby effects the operation of the supervisory signal at the trunking operator's exchange, batteries located at the different exchanges, and connected for supplying current to the line circuits for signaling purposes only, and centralized means for supplying current to the different lines for signaling the subscribers.

Signed by me at Chicago, Cook county, Illinois, this 8th day of April 1902.

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