

1,007,036.

Patented Oct. 24, 1911.

3 SHEETS-SHEET 1.

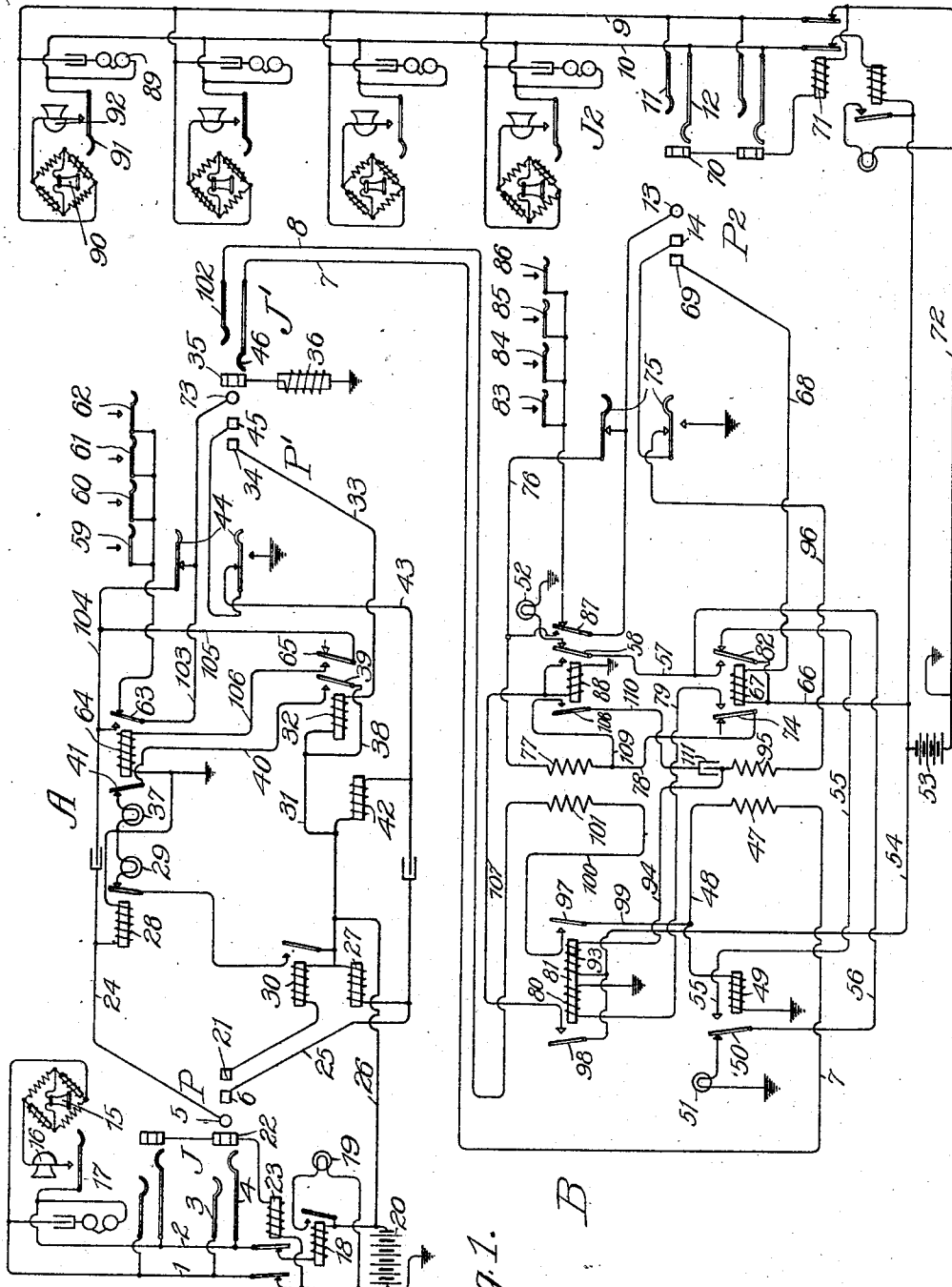


Fig. 1.

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TELEPHONE SYSTEM.

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3 SHEETS-SHEET 2.

Fig. 2.

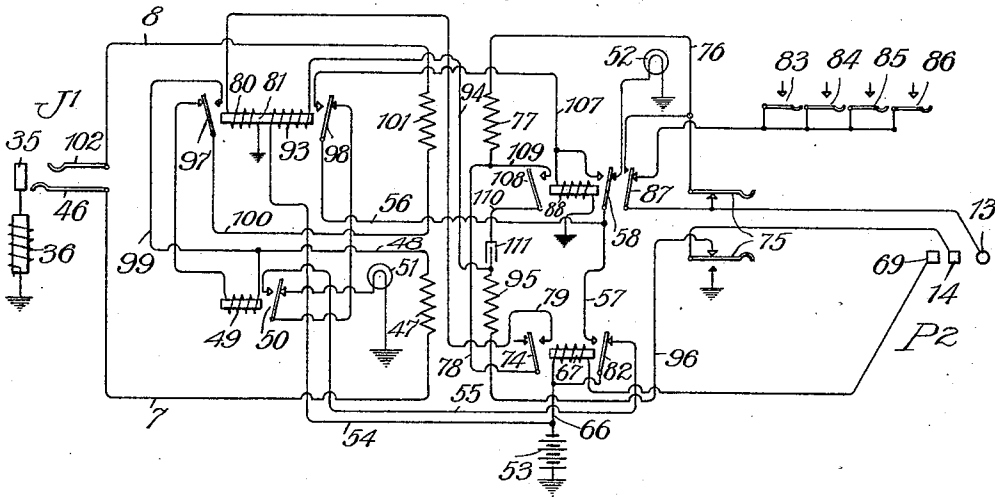
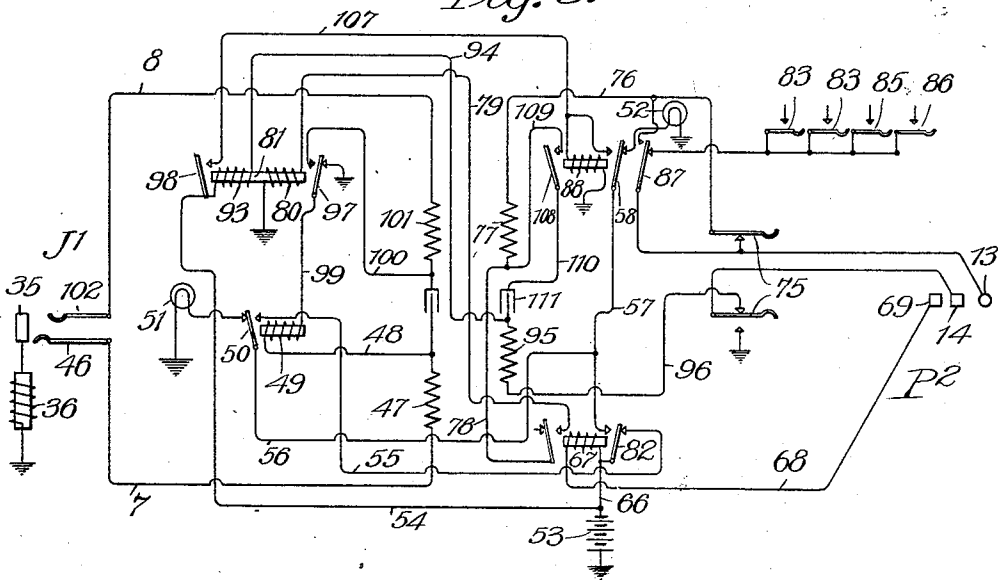


Fig. 3.



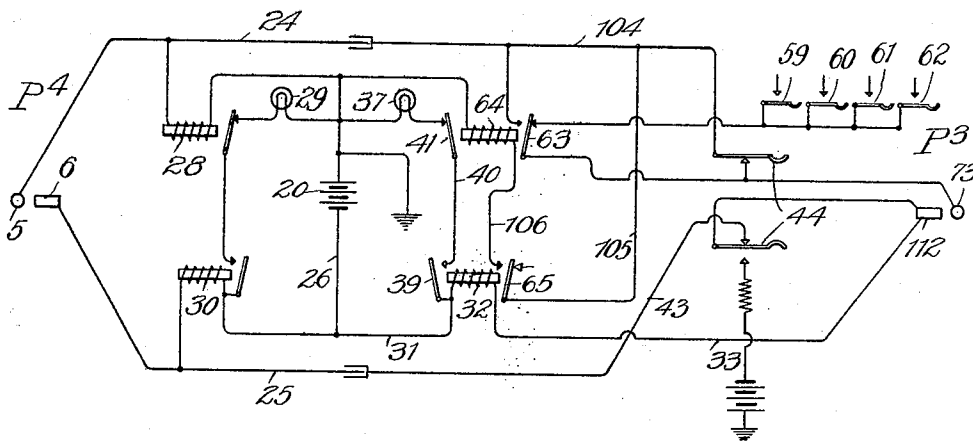
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Fig. 4.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,007,036.

Specification of Letters Patent.

Patented Oct. 24, 1911.

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To all whom it may concern:

Be it known that I, ALBION D. T. LIBBY, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented a certain new and useful Improved Telephone System, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to an improved trunking system for use in connection with telephone exchanges.

It is an object of my invention to produce an arrangement of circuits for connecting different exchanges of a telephone system, such circuit connections being so arranged that a signal associated with the incoming end of the connecting or trunk circuit, which heretofore in the art has commonly been caused to perform both the function of a disconnect signal and a guard signal, may be reserved entirely for the use of indicating to the operator at the incoming end of the trunk that the trunk connection is no longer desired. In order that this operator may have a guard indication concerning the condition of the outgoing end of the trunk if, by accident, she prematurely interrupts the connection at the incoming end of the trunk, I arrange the signal ordinarily used in connection with circuits of this class for indicating the ringing condition of the connection, so as to also serve as a guard indication. By the arrangement indicated above, I eliminate much of the confusion that has heretofore existed as a result of causing the disconnect signal at the incoming end of the trunk to perform two dissimilar functions, namely, when operated as a disconnect signal, to indicate that the connection at the incoming end of the trunk is to be taken down, and, if the trunk is in use and the connection is taken down at the incoming end, to indicate that it should be restored. In my improved circuit arrangement, the disconnect signal is caused to perform only the first of the functions described. By causing the ringing signal to also give a guard indication, less confusion is likely to result, since the operator is accustomed to regard the ringing signal as an indication that the connection is established, but that the called subscriber has not yet responded. The guard

indication is, in a general sense, of the same character, indicating, as it does, that the trunk connection is in use and should be maintained, although interrupted accidentally at the incoming end.

I have shown my improved circuit arrangement as adapted in one case for use with a standard three-conductor cord circuit, although it is equally adapted for use with a two-conductor cord circuit. There is also shown, in this application, a special form of three-strand cord circuit using two conductor plugs, which is particularly adapted for use in connection with the trunk circuits shown, in that the cord circuit arrangement is simplified, without sacrificing any of the advantageous features resulting from the three-conductor cord circuit arrangement.

The several drawings illustrating my invention are as follows:

Figure 1 shows in circuit diagram one form of my trunk circuit arrangement, a three-conductor cord circuit, and telephone lines terminating at two separate exchanges, adapted to be connected by the trunk circuit; Fig. 2 shows in circuit diagram a modified arrangement of trunk circuit, in which the signaling circuit established over the outgoing end of the trunk circuit is a metallic circuit both before and after the called subscriber answers, whereas the trunk circuit shown in Fig. 1 is a metallic signaling circuit only after the response of the called subscriber; Fig. 3 shows in circuit diagram a modified arrangement of my trunk circuit in which the signaling instrument controlled by current flowing over the outgoing end of the trunk circuit is first controlled by current flowing over one side of the trunk circuit, and, after the response of the called subscriber, by current flowing over both sides of the trunk circuit, whereas in the arrangement shown in Fig. 1 the signaling instrument thus controlled is energized by current flowing at all times over but one side of the trunk circuit; Fig. 4 shows in circuit diagram a cord circuit in which three strands are employed, which are connected to a two-conductor plug, instead of to a three-conductor plug, as is common in the art.

Similar numerals refer to similar parts throughout the several views.

Referring to Fig. 1, a line circuit 1—2

terminates at an exchange A in jack springs 3—4, with which tip and sleeve contacts 5—6 of plug P are adapted to register. The plug P is connected to the answering end of a cord circuit, which may be used to connect the line 1—2 with other lines at the exchange A, if desired, or, by means of the trunk circuit 7—8, with exchange B, and thus, by the plug P² connected to the trunk circuit, to the line 9—10 terminating at the exchange B in jack springs 11—12, adapted to register with the contacts 13—14 of the plug P².

The line 1—2 terminates in a substation provided with a receiver 15, transmitter 16 and hook switch 17, connected in a manner well known in the art, so that when the receiver 15 is removed from the hook 17, a circuit from the battery 20 will be closed through the line 1—2 and the line relay 18 in series therewith, the energization of such relay resulting in the lighting of the line signal 19. When the A operator responds, by inserting the plug P in the jack J, the ring contact 21 of the plug P engages the ring 22 of jack J, thus energizing the cut off relay 23, by which the circuit from battery 20 through the line 1—2 is interrupted. Current, however, is immediately supplied to the line 1—2 from battery 20, through the cord strands 24 and 25, as follows: battery 20, wire 26, impedance coil 27, cord strand 25, sleeve contact 6, sleeve spring 4, line wire 2, hook switch 17, transmitter 16, line wire 1, jack spring 3, tip contact 5, cord strand 24, tip relay 28 to ground, and thus back to battery 20. This causes the energization of the relay 28, which opens the circuit through the answering supervisory signal 29, which would otherwise be closed by the operation of the sleeve relay 30 by the engagement of the ring contact 21 with the ring 22 of the jack J, in the well known manner.

After inserting the plug P in jack J, the A operator learns the connection desired, and finding that a trunk connection to the exchange B is required, inserts the plug P¹ into the jack J¹ connected to the trunk line 7—8. By the insertion of the plug P¹ in the jack J¹, a circuit from battery 20 is closed as follows: battery 20, wire 26, wire 31, sleeve relay 32, cord strand 33, ring contact 34 of plug P¹, ring 35 of jack J¹, impedance coil 36 to ground, and thus back to battery 20. This energizes the relay 32, thus connecting a circuit through the calling supervisory lamp 37 as follows: battery 20, wire 26, wire 31, wire 38, armature 39, wire 40, armature 41, lamp 37 to ground, and thus back to battery 20. This indication shows that the trunk line is in calling, or ringing, condition, and that the desired talking condition has not been effected with the called line. A second circuit is also completed at

this time from the battery 20 through the trunk line as follows: battery 20, wire 26, impedance coil 42, cord strand 43, ringing key 44, sleeve contact 45 of plug P¹, sleeve spring 46 of jack J¹, trunk conductor 7, section 47 of the trunk repeating coil, wire 48, trunk relay 49 to ground, and thus back to battery 20. The circuit just traced causes the energization of the relay 49, which, by the attraction of its armature 50, interrupts the energizing circuit of the disconnect signal 51 and closes a circuit through the ringing and guard signal 52 as follows: battery 53, wire 66, armature 82, back contact of such armature through wire 55, armature 50, wire 56, wire 57, armature 58, lamp 52 to ground, and thus back to battery 53. The operator at the B exchange thus has an indication that connection is established between the outgoing end of the trunk at the A exchange and the calling end of the cord circuit there located. The operator at the B exchange further has an indication that a connection is wanted, because the disconnect signal 51 is not lighted.

The ringing key 44, used in the cord circuit at the A exchange, has associated therewith the selective ringing keys 59, 60, 61 and 62, by which the desired kind of ringing current may be selected to be applied to the calling plug P¹ when it is desired to call a line terminating at the A exchange. This ringing circuit is closed through an armature 63, operated by the tip relay 64, when the called subscriber answers, as a result of which ringing current cannot be applied to the called line when such line is in talking condition. The armature 65 is arranged to be operated by the energization of the sleeve relay 328, in order to in part close the energizing circuit of the relay 64 when the relay 32 is energized. This armature 65 may serve to close a test circuit from the tip 73 of plug P¹, when the relay 32 is not energized.

Having learned from the A operator the connection desired, by means of an order wire between the exchanges (which is not shown, since it is well known in the art), the B operator inserts the plug P² in the jack J² of the line wanted. This closes a circuit from the battery 53 as follows: battery 53, wire 66, relay 67, trunk strand 68, ring contact 69 of plug P², ring 70 of jack J², cut-off relay 71 of line 9—10, wire 72, back to battery 53. This results in the energization of relays 67 and 71, the latter of which serves to interrupt connection from battery 53 to line wires 9—10. The energization of the relay 67, by the attraction of its armature 74, interrupts a normally closed test circuit from the tip 13 of plug P², and closes a circuit from the tip 13 to one terminal of the battery 53, as follows: tip 13, ringing key 75, trunk strand 76, 130

portion 77 of the trunk repeating coil, wire 78, armature 74, wire 79 to winding 80 of relay 81, to ground, and thus to the grounded terminal of battery 53. By its operation, the relay 67 closes a circuit from battery 53 as follows: battery 53, wire 66, armature 82, wire 57, armature 58, lamp 52 to ground, and thus back to battery 53. This condition of the relay 67 causes the lamp 52 to indicate the ringing or calling condition of the line 9—10. The B operator now rings the desired station connected to the line 9—10 by operating one of the selective ringing keys 83, 84, 85 and 86, by which a circuit is completed through armature 87 of relay 88, to tip 13 of plug P², tip spring 11, line wire 9, ringer 89 at the called substation, line wire 10, sleeve spring 12, sleeve contact 14, ringing key 75 to ground and thus back to the ringing generator. The party at the called substation removes his receiver 90 from the hook switch 91, thereby closing a circuit through the transmitter 92 as follows: battery 53, wire 54, winding 93 of relay 81, wire 94, portion 95 of the trunk repeating coil, trunk strand 96, ringing key 75, sleeve contact 14, sleeve spring 12, line wire 10, hook switch 91, transmitter 92, line wire 9, tip spring 11, tip 13, ringing key 75, trunk strand 76, portion 77 of the trunk repeating coil, wire 78, armature 74, wire 79, winding 80 to ground, and thus back to battery 53. The relay 81 is thereby energized, and attracts armatures 97 and 98, the first of which closes a circuit as follows: battery 20, wire 26, impedance coil 42, wire 43, ringing key 44, sleeve contact 45, sleeve spring 46, trunk conductor 7, portion 47 of the trunk repeating coil, wire 48, wire 99, armature 97, wire 100, portion 101 of the trunk repeating coil, trunk conductor 8, tip spring 102, tip 73, wire 103, upper contacts of ringing springs 44, tip strand 104, wire 105, armature 65, wire 106, energizing winding of relay 64 to ground, thus back to battery 20. This results in the energization of the relay 64 and the interruption of the circuit through the calling supervisory signal 37, by the operation of the armature 41. It is to be noticed that although the operation of the armature 97 closes the circuit thus traced, thus energizing the relay 64, that the relay 49 is not deenergized at this time, but is maintained energized by the circuit already traced above from the battery 20. The armature 98 closes a circuit as follows: battery 53, wire 54, armature 98, wire 107, energizing winding of relay 88 to ground, thus back to battery 53. This results in the attraction of armatures 58, 87 and 108, the last of which closes a talking circuit as follows: tip 13, trunk strand 76, portion 77 of the trunk repeating coil, wire 109, armature 108, wire 110, condenser 111, portion 95 of

the trunk repeating coil, trunk strand 96, ringing key 75, to sleeve contact 14 of plug P². The attraction of armature 87 interrupts the ringing circuit from the keys 83, 84, 85 and 86, and the attraction of the armature 58 interrupts the circuit through the lamp 52, thereby extinguishing the same, and closes a circuit from battery 53 through wire 54, wire 66, armature 82, wire 57, armature 58, winding of relay 88 to ground, and thus back to battery 53. As a result of the circuit above described, it will be observed that the relay 88 is maintained in energized condition after the plug P² has been inserted in the jack J², and the called subscriber has answered, until the plug P² is withdrawn from the jack J², whether the relay 81 has been deenergized previous to the withdrawing of the plug P² from the jack J² or not.

From the circuits above described it is apparent that if the plug P² is removed from the jack J² prematurely, while the plug P¹ is still in the jack J¹, the lamp 52 will be lighted to give a guard signal, indicating this improper operation, as follows: The presence of the plug P¹ in the jack J¹ maintains the relay 49 in energized condition. The withdrawal of the plug P² from the jack J² interrupts the energizing circuit of the relay 88 from the battery 53, and also interrupts the energizing circuit of the relay 67 from the same battery. As a result, a circuit is established from battery 53 as follows: battery 53, wire 66, armature 82, wire 55, armature 50, wire 56, wire 57, armature 58, lamp 52 to ground, and thus back to battery 53. The lighting of the lamp 52 is an indication to the operator that the plug P² has been improperly removed from the jack J², and that this connection must be reestablished.

When the called subscriber has finished using the connection, he replaces the receiver 90 upon the hook 91, which opens the energizing circuit of the relay 81 above traced, as a result of which the circuit through the trunk conductors 7 and 8 is interrupted at armature 97. This causes an interruption of the circuit through the energizing winding of tip supervisory relay 64, the deenergization of which causes the lighting of the supervisory lamp 37 associated with the calling end of the cord. In response to this signal, the A operator withdraws the plug P¹ from the jack J¹, thereby opening the energizing circuit of the relay 49, as a result of which the armature 50 drops back and closes a circuit through the disconnect lamp 51 as follows: battery 53, wire 54, wire 66, armature 82, wire 57, wire 56, armature 50, lamp 51 to ground, and thus back to battery 53. In response to this signal, the B operator withdraws the plug P² from the jack J², which interrupts the

energizing circuits through the relays 67 and 88, as a result of which all of the apparatus is restored to its normal condition.

Referring to Fig. 2, use is made of both sides of the outgoing end of the trunk circuit for energizing the trunk relay 49, and upon the response of the called subscriber the energization of the relay 81, by the attraction of armature 97, opens the energizing circuit of the relay 49 and closes an alternative path of low resistance between the sides of the trunk circuit. In this arrangement, the trunk relay must preferably have a resistance high enough to prevent the operation of the relay 64 in series therewith. In this arrangement, the circuit for lighting the disconnect lamp 51 is closed through a back contact on armature 98, in order that the deenergization of relay 49, which occurs at the same time or immediately after the energization of the relay 81 and as a result of such energization, may not cause the lamp 51 to be lighted. In other respects, the operation of this modification is similar to that described above for the arrangement shown in Fig. 1.

Referring to Fig. 3, the trunk relay 49 is shown connected through the armature 97 to ground, when such armature is in its retracted position. This armature is adapted to be attracted by the energization of relay 81, to cut off the ground connection and include the energizing winding of the relay 49 in a closed circuit through the trunk conductors 7 and 8. In this modification, therefore, the resistance of the energizing winding of the relay 49 must necessarily be low enough to permit the operation of the relay 64 through it. The operation of the modification shown in this figure is, in other respects, similar to that already shown and described in connection with Fig. 1.

In Fig. 4 is shown a modified cord circuit arrangement, in which the cord strands 33 and 43 are connected to a common contact 112, of the plug P³. By this arrangement, a two conductor plug may be employed in connection with a three-strand cord for any purpose in which it is not necessary to have separate circuits through the sleeve and ring contacts of the plug and the cooperating contacts of the jack. In other respects, the arrangement and operation of the cord circuit shown in this figure is similar to the operation of the standard four relay two conductor cord circuit, which is well known in the art. By means of this arrangement, it is to be noticed that the signaling circuit through the sleeve relay and the jack connected to the outgoing end of the trunk circuit is maintained entirely separate and distinct from the talking circuit through the sleeve conductor of the trunk and the sleeve strand of the cord, which arrangement can-

not be secured in the standard four relay two conductor cord circuit.

While I have shown my invention in the particular embodiment herein disclosed, I do not, however, limit myself to this particular construction, but desire to claim broadly any equivalents that will suggest themselves to those skilled in the art.

What I claim is:

1. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a called line adapted to be connected to said trunk; a signal associated with the trunk line for indicating by its actuation the connection of such trunk to a called line, said signal operative when said switching means and trunk are connected together and means for actuating such signal when the trunk is disconnected from the called line, said means conditioned to operate when the trunk and switching connections are united.

2. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such switching means is connected through said trunk to a called line, means for retiring such signal when the called subscriber responds, and a second means for actuating such signal when the trunk is disconnected from the called line, said second means conditioned to operate while the trunk and switching means are united.

3. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk while connected to said switching means is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means operative only during the connection of the trunk with such switching means for actuating such signal when the trunk is disconnected from the called line.

4. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with

the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk while connected to said switching means is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means for actuating such signal when the trunk is disconnected from the called line, such two signal actuating means so related that the actuation of either of such means will operate such signal when the other means is not operated.

5. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk while connected to said switching means is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means operative only during the connection of the trunk with such switching means for actuating such signal when the trunk is disconnected from the called line, such two signal actuating means so related that the actuation of either of such means will operate such signal when the other means is not operated.

6. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated when the trunk and switching means are connected together by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, and a second relay operated by the connection of such switching means with the trunk, such second relay adapted by its operation to light such lamp.

7. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated when the trunk and switching means are connected together by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, a second relay operated by the response of the called subscriber and adapted by its operation to open such lamp circuit, and a third relay operated by the connection of such switch-

ing means with the trunk, such third relay adapted by its operation to light such lamp.

8. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, and a second relay operated by the connection of such switching means with the trunk, such second relay adapted by its operation to light such lamp, such lamp energizing circuits so related that the lamp is lighted when either or both of such relays are operated.

9. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, a second relay operated by the response of the called subscriber and adapted by its operation to open such lamp circuit, and a third relay operated by the connection of such switching means with the trunk, such third relay adapted by its operation to light such lamp, such lamp energizing circuits so related that the lamp is lighted when either or both of the first and third relays are operated.

10. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, a second relay operated by the connection of such switching means with the trunk, such second relay adapted by its operation to light such lamp, and a second lamp signal associated with the trunk line, such second relay also adapted by its operation to directly close the circuit of such second lamp signal.

11. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated

with the trunk line, a first relay operated by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, a second relay operated by the connection of such switching means with the trunk, such second relay adapted by its operation to light such lamp, such lamp energizing circuits so related that the lamp is lighted when either or both of such relays are operated, and a second lamp signal associated with the trunk line, such second relay adapted by its operation to so control such second lamp signal that one of such signals will be lighted for either condition of the second relay when the first relay is operated.

12. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a lamp signal associated with the trunk line, a first relay operated by the connection of the trunk to the called line, such relay adapted by its operation to light such lamp, a second relay operated by the response of the called subscriber and adapted by its operation to open such lamp circuit, a third relay operated by the connection of such switching means with the trunk, such third relay adapted by its operation to light such lamp, such lamp energizing circuits so related that the lamp is lighted when either or both of the first and third relays are operated and the second relay is not operated, and a second lamp signal associated with the trunk line, such third relay adapted by its operation to so control such second lamp signal that one of such signals will be lighted for either condition of the third relay when the first relay is operated.

13. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line for indicating the connection of such trunk to a called line, means for actuating such signal when the trunk is disconnected from the called line, said means conditioned to operate while the trunk and switching means are united, a relay at the sub-exchange in circuit with the trunk line for indicating the disconnection of the switching means from the trunk line, and means operated by the response of the called subscriber for interrupting the connection of the trunk relay and substituting in the trunk circuit in place of the trunk relay winding a conductor of low resistance.

14. In a telephone exchange system, a

main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, a second means for controlling the actuation of such signal when the trunk is disconnected from the called line, such second actuating means consisting in a relay at the sub-exchange in circuit with the trunk line for indicating the disconnection of the switching means from the trunk line, and means operated by the response of the called subscriber for interrupting the connection of the trunk relay and substituting in the trunk circuit in place of the trunk relay winding a conductor of low resistance.

15. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, a second means operative only during the connection of the trunk with such switching means for actuating such signal when the trunk is disconnected from the called line, such second actuating means consisting in a relay at the sub-exchange in circuit with the trunk line for indicating the disconnection of the switching means from the trunk line, and means operated by the response of the called subscriber for interrupting the connection of the trunk relay and substituting in the trunk circuit in place of the trunk relay winding a conductor of low resistance.

16. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, a second means for actuating such signal when the trunk is disconnected from the called line, such two signal actuating means so related that the actuation of either of such means will operate such signal when the other is not operated, such second actuating means consisting in a relay at the sub-exchange in circuit with the trunk line for indicating

the disconnection of the switching means from the trunk line, and means operated by the response of the called subscriber for interrupting the connection of the trunk relay and substituting in the trunk circuit in place of the trunk relay winding a conductor of low resistance.

17. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, switching means at the main exchange for connecting a calling line with the trunk line, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, a second means operative only during the connection of the trunk with such switching means for actuating such signal when the trunk is disconnected from the called line, such two signal actuating means so related that the actuation of either of such means will operate such signal when the other means is not operated, such second actuating means consisting in a relay at the sub-exchange in circuit when the trunk line for indicating the disconnection of the switching means from the trunk line, and means operated by the response of the called subscriber for interrupting the connection of the trunk relay and substituting in the trunk circuit in place of the trunk relay winding a conductor of low resistance.

18. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, an operator's cord circuit at the main exchange for connecting the telephone lines there terminating with the trunk line as desired, a two conductor plug connected to such cord, a supervisory signal associated with such cord, means for placing such signal in condition to operate when such plug is connected to a called line by a circuit independent of the talking circuit closed through such plug, a signal associated with the trunk line for indicating the connection of such trunk to a called line, and means for actuating such signal when the trunk is disconnected from the called line, said means conditioned to operate while said trunk and cord are connected.

19. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, an operator's cord circuit at the main exchange for connecting the telephone lines there terminating with the trunk line as desired, a two conductor plug connected to such cord, a supervisory signal associated with such cord, means for placing

such signal in condition to operate when such plug is connected to a called line by a circuit independent of the talking circuit closed through such plug, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means for actuating such signal when the trunk is disconnected from the called line, said second means conditioned to operate while the cord and trunk are united.

20. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, an operator's cord circuit at the main exchange for connecting the telephone lines there terminating with the trunk line as desired, a two conductor plug connected to such cord, a supervisory signal associated with such cord, means for placing such signal in condition to operate when such plug is connected to a called line by a circuit independent of the talking circuit closed through such plug, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means operative only during the connection of the trunk with such cord circuit for actuating such signal when the trunk is disconnected from the called line.

21. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, an operator's cord circuit at the main exchange for connecting the telephone lines there terminating with the trunk line as desired, a two conductor plug connected to such cord, a supervisory signal associated with such cord, means for placing such signal in condition to operate when such plug is connected to a called line by a circuit independent of the talking circuit closed through such plug, a signal associated with the trunk line, means for actuating such signal when such trunk is connected to a called line, means for retiring such signal when the called subscriber responds, and a second means for actuating such signal when the trunk is disconnected from the called line, such two signal actuating means so related that the actuation of either of such means will operate such signal when the other means is not operated.

22. In a telephone exchange system, a main exchange, a sub-exchange, telephone lines terminating at each exchange, a trunk line extending from the main exchange to the sub-exchange, an operator's cord circuit at the main exchange for connecting the telephone lines there terminating with the

trunk line as desired, a two conductor plug
connected to such cord, a supervisory signal
associated with such cord, means for placing
such signal in condition to operate when
5 such plug is connected to a called line by a
circuit independent of the talking circuit
closed through such plug, a signal associ-
ated with the trunk line, means for actu-
ating such signal when such trunk is connect-
10 ed to a called line, means for retiring such
signal when the called subscriber responds,
and a second means operative only during
the connection of the trunk with such cord

circuit for actuating such signal when the
trunk is disconnected from the called line, 15
such two signal actuating means so related
that the actuation of either of such means
will operate such signal when the other
means is not operated.

In witness whereof, I hereunto subscribe 20
my name this 25th day of May A. D. 1909.

A. D. T. LIBBY.

Witnesses:

C. A. SEVERCOOL,
W. P. MAUSON.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,
Washington, D. C."
