W. W. DEAN.

TELEPHONE SYSTEM.

APPLICATION FILED OCT. 14, 1909.

958,856. Patented May 24, 1910.

3 SHEETS—SHEET 1.

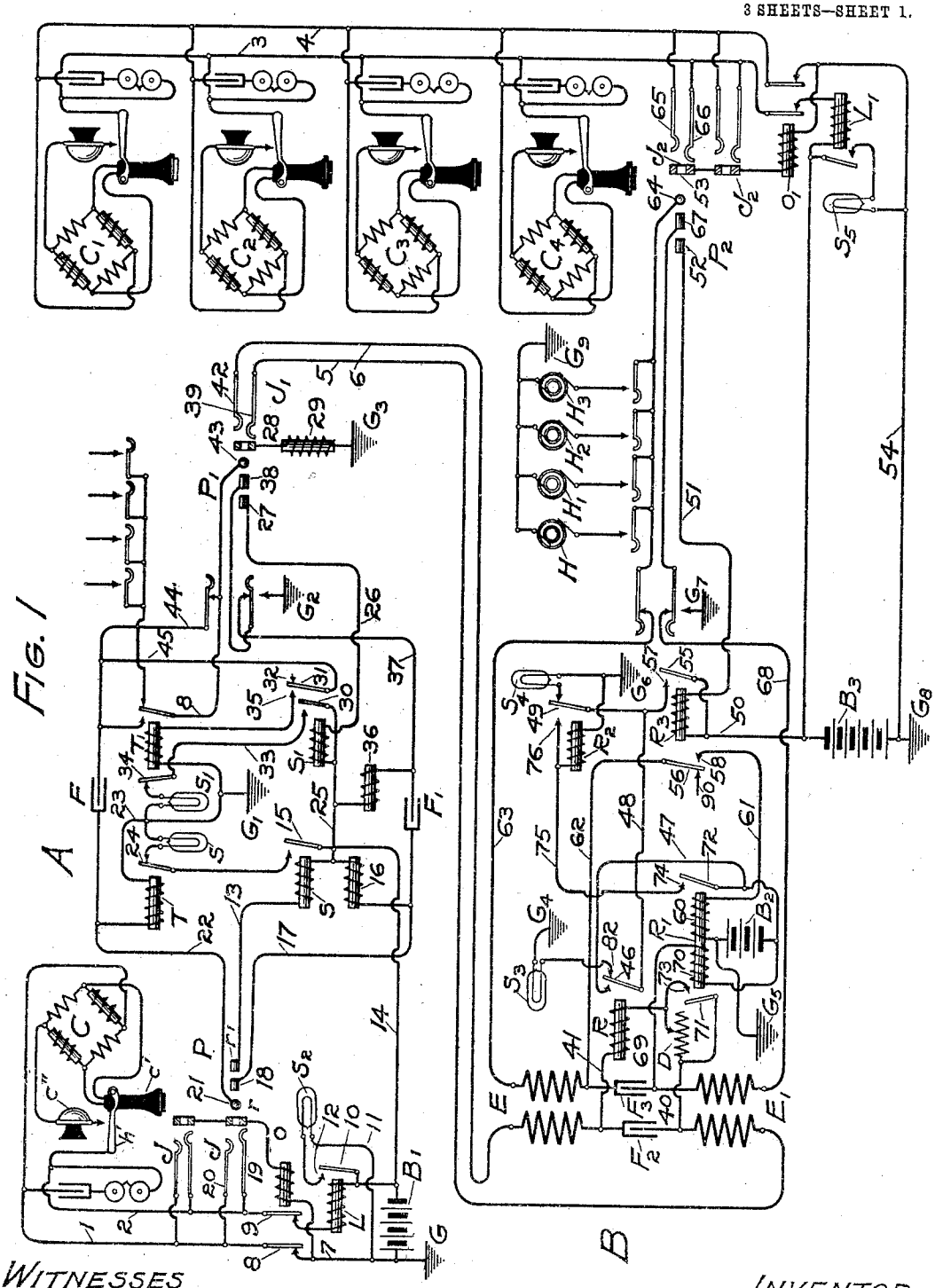

FIG. 1

WITNESSES

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3 SHEETS—SHEET 2.

FIG. 2

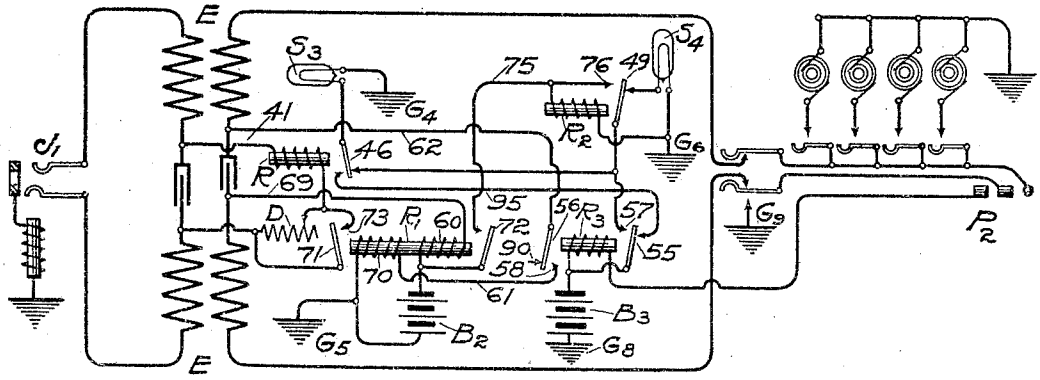
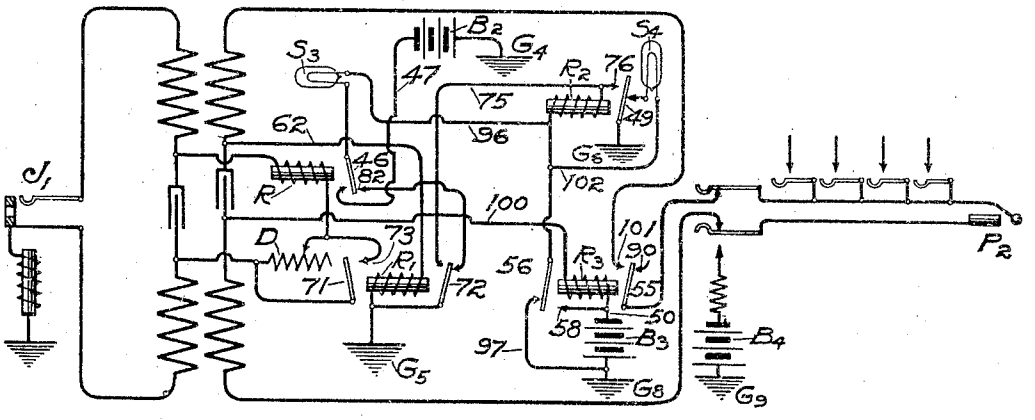


FIG. 3



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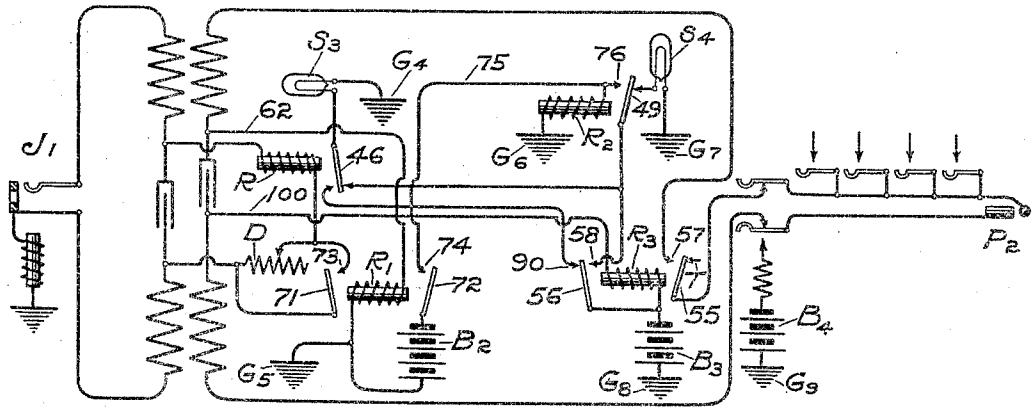
3 SHEETS—SHEET 3.

FIG. 4



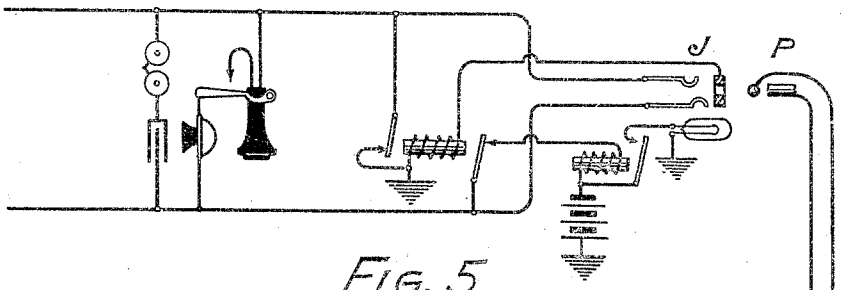
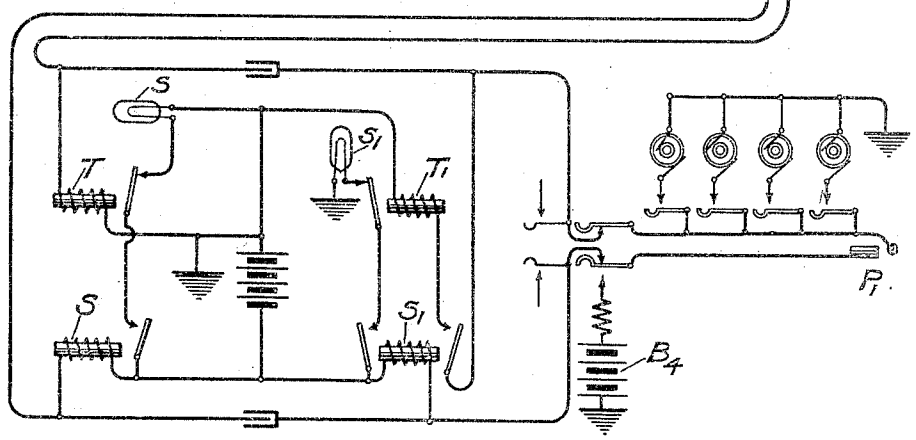


FIG. 5



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TELEPHONE SYSTEM.

958,856. Specification of Letters Patent. **Patented May 24, 1910.**

Application filed October 14, 1909. Serial No. 522,637.

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to telephone systems and more particularly to what are commonly known as trunking systems. In such systems there are two operators at different positions: the first, commonly known as the A operator, answers the call; and the second, or B operator, is notified by the A operator that a connection with a line under her jurisprudence is desired. The connection is made between the apparatus under the control of the A operator and the trunk and between the trunk and the called subscriber's line. In a general way, such systems are well known in the art.

One of my purposes is to produce a special arrangement of signaling between the various parties participating in these connections, and to so produce such arrangement that the information necessary to make the connection and disconnection will be conveyed to the participants by these signals without in any way endangering the connections being tied up by their misunderstandings.

My invention will be best understood by reference to the following description when taken in connection with the accompanying illustrations showing several specific embodiments thereof, while its scope will be more particularly pointed out in the appended claims.

Figure 1 is a diagrammatic illustration of the trunk circuit associated with the central station cord circuit and a pair of telephone lines. Figs. 2, 3, and 4 are modifications of the trunk circuit. Fig. 5 is an illustration of a 2-conductor cord circuit the use of which I contemplate with my trunk circuits.

Referring now to the drawings, I show a subscriber's line 1—2 on which there is a subscriber's station C and which terminates at the central station in the jacks J—J. The line signal relay and cut-off relay are shown associated with this line. At A I show a 3-conductor cord circuit terminating in the plugs P—P^1. The tip relays T—T^1 and sleeve relays S—S^1 controlling the supervisory signals s, s^1, are associated with this cord circuit. The source of current B^1 is also associated with the cord circuit. A trunk circuit 5—6 is shown extending from a jack J^1 at the central station A to a trunk operator's position at B and terminating in a plug P^2 associated with the jacks of a plurality of telephone lines. I show a disconnect signal at s^3 and a combined guard and ringing signal at s^4. I show a low resistance relay R adapted to be connected in circuit with a variable resistance D through the trunk and cord circuit. This relay is adapted to control the disconnect signal. I have endeavored to produce a disconnect signal which is under absolute control of the A operator in order that should the A operator interrupt the connection between the cord and trunk before the conversation is completed, no action of the subscriber can prevent the disconnect signal being given to the B operator. At R^1 I show a relay in the trunk circuit which is controlled by the called subscriber and which is adapted to complete a shunt around the variable resistance D for purposes to be later described. At R^2 I show a relay which is used to control the combined guard and ringing signal. At R^3 I show a relay which is controlled by the plug P^2 and which is adapted to control the circuits of the signals in the trunk. The trunk circuit is divided into two parts and these two parts are inductively connected through the repeating coils E and E^1. Between these repeating coils I place condensers F^2 and F^3. A plurality of signaling machines are shown at H, H^1, H^2 and H^3. A subscriber's line 3—4 on which are the substations C^1 C^2, C^3 and C^4 terminates in jacks J^2—J^2 at the B operator's position.

The parts of my invention and the purposes thereof can be best understood from a description of the operation of the system which is as follows: Assume that a subscriber C on the line 1—2 desires a connection with a subscriber C^1 on the line 3—4. The subscriber C removes his receiver c^1 from the hook h^1. A circuit is then completed from battery B^1—7— armature 8 of relay O— limb 1— substation set including the transmitter c^{11}— the hook h^1— limb 2— armature 9 of relay O— line relay L back

to battery B^1. This energizes the line relay L which pulls up its armature 10, completing the following circuit through the line lamp B^1—11—s^2—12—10— back to battery B^1. This indicates to the A operator that the substation C desires a connection, whereupon she inserts the plug P into the jack J of this line. A circuit is completed through the cut-off relay O and the sleeve supervisory relay S as follows: battery B^1—7—O—ring r—r^1—13—relay S—14— back to battery. The relay O is energized attracting its armatures 8 and 9, cutting off the line relay L from the line.

The relay S is energized to draw up the armature 15 which would complete a circuit from ground through the supervisory lamp s and battery B^1, were it not for the fact that the substation circuit C is completed, providing a circuit through the relay T as follows: ground G—battery B^1—14—coil 16—17— sleeve 18—19—2— the substation circuit—1— tip spring 20— tip of cord 21—22— the relay T—23— to ground at G^1. This energizes the relay T which pulls up its armature 24 interrupting the circuit of the lamp s and preventing its operation. The A operator now presses her listening key and listens in to ascertain from the subscriber C what party is desired. Having ascertained that he desires connection with a party whose line terminates at the position of the B operator, she then communicates with the B operator over a special order line (not shown) and informs her what party is desired and ascertains to which trunk she shall connect her cord circuit. The A operator then inserts the plug P^1 into the jack J^1 completing a circuit through the sleeve supervisory relay S^1 as follows: ground G—B^1—14—25—S^1—26—27—28— coil 29— ground at G^3. The relay S^1 is energized and pulls up its armatures 30 and 31, cutting off the test at 32 and completing a circuit through the lamp s^1 as follows: ground G—B^1—14—25—30—33—34—s^1— to ground at G^1. The armature 31 engaging front contact 35 completes a circuit through the relay T^1 as follows: G—B^1—14—25—36— sleeve side 37—38—39—5—40—D—R—41—6—42—43—44—45—31—35—T^1 to ground G^1. Resistance D is great enough to prevent a flow of current sufficient to energize the relay T^1, but insufficient to prevent the operation of the relay R. The lamp s^1 is now lighted. The relay R operates, pulling up armature 46 to complete a circuit through the guard lamp s^4 as follows: ground G^5—B^2—47—46—48—49—s^4— to ground G^6. The lamp s^4 is lighted, indicating to the B operator that the connection at the A board has been made. After testing the jack of the line, the B operator inserts the plug P^2 into the jack J^2 thereof, provided no busy signal is given. This completes a circuit through the relay R^3 as follows: B^3—50—R^3—51—52—53—O^1—54— back to battery B^3. The relay O^1 is energized to cut off the line from the line relay L^1. The relay R^3 is energized drawing up its armatures 55 and 56. 55 engages the contact 57 completing a second circuit through the lamp s^4 as follows: G^8—B^3—50—55—57—49—s^4— to ground G^6. The armature 56 is pulled up cutting off the test 90 and engaging the front contact 58 for a purpose to be described. The signal s^4 is now independent of the A operator and serves as a ringing signal, being lighted during the ringing. The B operator now presses down the button which connects the signaling machine H into circuit with the signaling device of the substation C^1. C^1 answers by removing the receiver from the hook completing a low resistance across the limbs 3—4 at the substation. This completes a circuit through the relay R^1 in which circuit the resistance is now low enough to permit a flow of current sufficient to actuate said relay. The circuit is as follows: B^2— coil 60 of relay R^1—61— now closed contacts 58 and 56 of relay R^3—62—63—64—65—limb 4—substation circuit-limb 3—66—67—68—69— coil 70 of relay R^1—back to battery B^2. The relay R^1 is energized and pulls up its armatures 71 and 72. The armature 71 engages the front contact 73, completing a shunt about the resistance D. The flow of current in the circuit through the tip relay T^1, the calling end of the cord, the jack end of the trunk and the relay R is sufficient to operate the relay T^1 which pulls up the armature 34 interrupting the circuit of the lamp s^1 which is extinguished, indicating to the A operator that the called subscriber has answered. The armature 72 is pulled up, engaging front contact 74 and completing the following circuit through the relay R^2: ground G^5— battery B^2—72—74—75—R^2— to ground at G^6. The relay R^2 is energized, pulling up the armature 49 completing a locking circuit from ground G^6—R^2—76—49—57—55—50—B^3— to ground at G^8. This interrupts the circuit of the lamp s^4 which indicates to the B operator that the called subscriber has answered. The relay R^2 is now independent of the called subscriber. The subscribers C and C^1 converse over the following circuit: through transmitter c^{11}— hook h^1—2—19—18—17— condenser F^1—37—38—39—5— through the induction coils E and E^1—68—67—66—3— substation circuit at C^1—4—65—64—63— by means of the induction coils to the other end of the trunk—6—42—43—80— condenser F—22—21—20—limb 1— back to the transmitter c^{11}.

When the conversation is completed, the subscribers return their receivers to the hooks. At the station C the substation cir-

cuit is interrupted, breaking the energizing circuit of the relay T and allowing the armature 24 to fall back, completing the circuit of the lamp s through battery B^1—14—15—24— to ground. The illumination of this lamp indicates to the A operator that the subscriber C is through talking. The interruption of the substation circuit at C^1 breaks the energizing circuit of the relay R^1, permitting the armatures 71 and 72 to fall back. This breaks the shunt around the resistance D which is again placed in circuit of the relay T^1, causing the deënergization thereof. The armature 34 falls back completing the circuit of the lamp s^1 which lights, indicating to the A operator that the called subscriber has finished talking. The interruption of the connection at 72—74 is without avail, as the relay R^2 is now energized through its locking circuit. Having perceived the illumination of the lamp s^1, the A operator pulls out the plug P^1, breaking the circuit of the relay R, whereupon the armature 46 falls back engaging its back contact 82 and completing a circuit through the disconnect lamp s^3 as follows: ground G^4—s^3—82—46—48—57—55—50—B^3— to ground at G^8. The operation of this signal indicates to the B operator that the connection at P^1—J^1 has been broken. She then pulls out the plug P^2 interrupting the circuit through the relays O^1 and R^3. The armature 55 being thus released, breaks the circuit of the disconnect signal s^3 and the locking circuit of the relay R^2 at 55—57. The armature 49 now falls back, leaving the system in normal condition.

The length of trunk lines in use varies, and I have made the resistance D variable in order to compensate for variations in length; or, in fact, in any variations in resistance. The disconnect lamp s^3, when the plug P^2 is inserted into the jack J^2, is under absolute control of the A operator.

In Fig. 2 I show a modified trunk circuit in which the same lamp is used for giving both the guard and disconnect signal. The change in circuit connections can be best illustrated by describing the operation of the system from the energization of the low resistance relay R prior to which the operation is the same as previously described in connection with the circuits of Fig. 1. When relay R is energized it attracts its armature 46 against the front contact, closing a circuit from ground at G^4— through the lamp s^3—46—95— front contact of armature 55—battery B^3— to ground at G^8. The signal s^3 is operated, indicating to the B operator that the A operator has inserted the plug into the jack J^1. The B operator then inserts the plug P^2 into the jack of the called line, whereupon a circuit is closed through battery B^3— through relay R^3— the plug and jack— the cut-off relay of the called line— to ground. This interrupts the circuit of the signal s^3, closing a circuit through the ringing signal s^4 as follows: ground at G^6—s^4—49—57—55—B^3— to ground. The lamp s^4 remains lighted during the ringing. When the called subscriber responds, removing his receiver from the hook and closing a low resistance bridge across the line, the relay R^1 is energized through the following circuit: B^2— winding 70—61— the now closed switch 58—56—62— to tip side of the trunk and line— through the substation set—sleeve side of line and trunk— 69— the coil 60 of relay R^1— back to battery. The relay R^1 draws up the armatures 71 and 72, shunting the variable resistance D and permitting the operation of the supervisory signal apparatus at the A position. The armature 72 closes a circuit through relay R^2 as follows: ground at G^5—B^2—72—75—R^2— ground at G^6. The armature 49 is attracted, breaking the circuit of the ringing signal s^4 and closing a locking circuit upon itself as follows: G^6—R^2—76—49—57—55—B^3—G^8. The subscribers now converse and at the termination of the conversation, the supervisory signals at the A position are operated, whereupon the A operator pulls out her plugs causing the deënergization of the relay R, the relay R^1 having been deënergized when the called subscriber hung up her receiver. The armature 46 drops back upon its back contact closing a circuit as follows: G^4—s^3—46—57—55—B^3—G^8. This causes the actuation of the signal s^3 which serves now as a disconnect signal. The B operator pulls out plug P^2 and the relays R^2 and R^3 are deenergized, and the system restored to normal. It will be seen that in this system I have also produced a disconnect signal which is without the control of the called subscriber.

I show another modified form in Fig. 3 in which the signal s^3 serves both as a guard and disconnect signal. The circuit arrangements shown here can best be described by a description of the operation which, beginning with the energization of the low resistance relay R, is as follows: The relay R being energized, pulls up the armature 46 closing the following circuit through the signal s^3: G^4—B^2—47—front contact of armature 46—46—s^3—96—56—97—G^8. This lights the lamp s^3 which serves as the guard signal. The B operator inserts the plug P^2 into the jack of the called line, closing a circuit through relay R^3 as follows: G^8—B^3—R^3—100—sleeve side of trunk through the cut-off relay—to ground. This energizes the relay R^3 which pulls up its armatures 55 and 56. The circuit of the guard signal is broken and the lamp extinguished. The trunk circuit is completed at 55—101. A circuit is completed through the ringing lamp s^4 as follows: ground G^6—49—s^4—102—56—58—B^3—G^8. When the called subscriber responds, the relay R^1 is energized

from the following circuit: G^5—R^1—62—to the tip of trunk and line—through the substation—back to sleeve of line and trunk 100—R^3—B^3—G^8. The armature 72 is attracted, closing a circuit through the relay R^2 and shunting the resistance D. The circuit through the relay R^2 is as follows: G^5—72—75—R^2—56—58—B^3—G^8. The relay R^2 pulls up its armature 49 breaking the circuit of the ringing signal and locking itself. When the called subscriber returns his receiver to the hook, relay R^1 is deenergized, permitting the disconnect signal at the A situation to operate, whereupon the cord circuit plug is pulled out, deënergizing the relay R and permitting the armature 46 to fall upon the back contact 82, completing a circuit through the signal s^3 which now serves as a disconnect signal. This circuit is traced as follows: G^5—72—82—46—s^3—96—56—58—B^3—G^8. The B operator then disconnects the trunk and called line, whereupon the circuit through the relays R^2 and R^3 is interrupted and the trunk restored to normal condition. In this modification I have shown a system in which the disconnect signal is within the control of the called subscriber.

In Fig. 4 I show still another modification. The lamp s^3 serves as both a guard and disconnect signal. Beginning with the energization of the low resistance relay R, the operation of this system is as follows: The armature 46 is attracted, closing a circuit from G^4 through s^3—46—90—56—B^3—G^8. This gives the guard signal at s^3, and the B operator plugs into the called line. The plug completes a circuit from G^8—through B^3—100—sleeve side of trunk cut-off relay to ground, energizing R^3 and completing the trunk at 55—57. The armature 56 is attracted, breaking the circuit of the guard signal and completing a circuit through the ringing signal s^4—49—58—56—battery B^3—ground G^8. When the called subscriber responds, a circuit is completed through R^1—from ground G^5—62—tip side of trunk and line—substation circuit—sleeve side of line and trunk—100—R^3—B^3—ground at G^8. The armature 71 is attracted, shunting the resistance D, and the armature 72 is attracted placing battery on the relay R^2 from G^5, through B^2—72—74—75—R^2—ground at G^6. The relay R^2 breaks the ringing signal circuit and locks itself on the battery B^3. When the called subscriber hangs up her receiver, the relay R^1 is deënergized breaking the shunt about the resistance D and giving the disconnect signal at the A situation. The A operator takes down the connection, whereupon the relay R lets go its armature 46 and a disconnect signal circuit is closed from s^3 as follows: G^4—s^3—46—58—56—battery B^3—G^8. This gives the disconnect signal and the B operator proceeds to take down the connection, restoring the system to normal.

In Fig. 5 I show a 2-conductor cord circuit which I may use with the trunk circuits in place of the 3-conductor cord shown in Fig. 1. This circuit is well known in the art and needs no description other than to state that the sleeve of the plug is long enough to engage both the sleeve spring 39 and the ring 28. The supervisory sleeve relays are then operated directly over the contacting spring. The batteries B^4 shown in Figs. 3, 4, and 5 are supplementary batteries used for signaling or other purposes, but do not constitute an essential part of this invention.

In all the trunk circuits shown the relay R is of low resistance, the resistance D being made high and preferably non-inductive. I may also make this a variable resistance. I have found this arrangement of separating the relay and the resistance to be of commercial advantage in that I do away with the induction of a high wound relay and substitute a cheaper, more convenient ohmic resistance which serves all the purposes of a high wound relay and which has the advantage of permitting the continued use of the relay R during the operation of the trunk. I regard this feature as being probably the essential feature of my invention, although I do not wish to be limited to this one feature, but contemplate claiming all the novel features of my improved system. I intend to use this arrangement of a low resistance relay and a non-inductive resistance in any and all trunk circuits of this general form, and regard such use as within the scope of my invention and claims. I have shown this particular arrangement of trunk circuits simply for the purpose of illustrating my invention and not with the intention of limiting its use thereto.

I claim:

1. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's circuit, a supervisory relay in said central station circuit, a low resistance relay and a high resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk circuit, said high resistance preventing the operation of said supervisory relay, and means for eliminating said high resistance when the called subscriber responds, permitting the operation of said supervisory relay.

2. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's circuit, a

supervisory relay in said central station circuit, a low resistance relay and a high non-inductive resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk circuit, said high resistance preventing the operation of said supervisory relay, and means for eliminating said high resistance when the called subscriber responds, permitting the operation of said supervisory relay.

3. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's circuit, a supervisory relay in said central station circuit, a low resistance relay and a high non-inductive resistance in series in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk circuit, said high resistance preventing the operation of said supervisory relay, and means for eliminating said high resistance when the called subscriber responds, permitting the operation of said supervisory relay.

4. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's circuit, a supervisory relay in said central station circuit, a low resistance relay and a high non-inductive resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk circuit, said high resistance preventing the operation of said supervisory relay, and means for shunting said high resistance when the called subscriber responds, permitting the operation of said supervisory relay.

5. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's circuit, a supervisory relay in said central station circuit, a low resistance relay and a high non-inductive resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk circuit, said high resistance preventing the operation of said supervisory relay, and a relay for shunting said high resistance when the called subscriber responds, permitting the operation of said supervisory relay.

6. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance preventing the operation of the supervisory relay, and a relay in the trunk circuit adapted to eliminate said high resistance when the called subscriber responds whereby the supervisory relay operates.

7. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in series circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance preventing the operation of the supervisory relay, and a relay in the trunk circuit adapted to eliminate said high resistance when the called subscriber responds whereby the supervisory relay operates.

8. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance preventing the operation of the supervisory relay, and a relay in the trunk circuit adapted to shunt said high resistance when the called subscriber responds whereby the supervisory relay operates.

9. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in series circuit with the low resistance relay adapted to be

connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance preventing the operation of the supervisory relay, and a relay in the trunk circuit adapted to shunt said high resistance when the called subscriber responds whereby the supervisory relay operates.

10. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance preventing the flow of sufficient current to operate the supervisory relay, and a relay in the trunk circuit adapted to eliminate said high resistance when the called subscriber responds, whereby sufficient current flows through the supervisory relay to operate the same.

11. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance normally preventing the flow of sufficient current to operate the supervisory relay, a normally open shunt about said high resistance, a relay in the trunk circuit controlled over a subscriber's circuit to close said shunt whereupon sufficient current flows to operate said supervisory relay.

12. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a low resistance relay in said trunk circuit adapted to be connected in circuit with said supervisory relay, a signal in the trunk circuit controlled by the low resistance relay, a non-inductive resistance in series circuit with the low resistance relay adapted to be connected in circuit with the supervisory relay when the trunk and central station circuits are connected, said resistance normally preventing the flow of sufficient current to operate the supervisory relay, a normally open shunt about said high resistance, a relay in the trunk circuit controlled over a subscriber's circuit to close said shunt whereupon sufficient current flows to operate said supervisory relay.

13. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected to said central station circuit and one of said subscriber's lines, switches for effecting said connections, a supervisory signal in the central station circuit, a low resistance relay in said trunk circuit, a combination guard and disconnect signal controlled by said low resistance relay, said signal operated when one only of said connections is made and eliminated when neither or both is made, a high non-inductive resistance in circuit with the low resistance relay adapted to prevent the operation of said supervisory relay when connected in circuit therewith, a relay controlled by the called subscriber to eliminate said resistance whereby said supervisory relay is operated substantially as described.

14. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected to said central station circuit and one of said subscriber's lines, switching mechanism to effect said connections, a supervisory relay in said central station circuit, a high non-inductive resistance in the trunk circuit adapted to be connected in circuit with said supervisory relay when connection is made between the central station circuit and the trunk circuit and to prevent the operation of said relay when so connected, a low resistance relay in circuit with the non-inductive resistance and the supervisory relay responsive to the current flow when in said circuit, a signal in the trunk circuit controlled by said low resistance relay to indicate the connection between said central and trunk circuits, said signal adapted to be eliminated when both connections to said trunk circuit are made and to be operated again when the first connection is interrupted and the second remains, a third relay in said trunk controlled by the called subscriber and adapted when the called subscriber responds to shunt said high resistance to permit a current flow sufficient to operate said supervisory relay.

15. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected to said central station circuit and one of said subscriber's lines, switching mechanism to effect said connections, a supervisory relay in said central station circuit, a high non-inductive resistance in the trunk circuit adapted to be connected in circuit with said su-

pervisory relay when connection is made between the central station circuit and the trunk circuit and to prevent the operation of said relay when so connected, a low resistance relay in circuit with the non-inductive resistance and the supervisory relay responsive to the current flow when in said circuit, a signal in the trunk circuit, two circuits in which said signal is located, a switch for connecting said signal in one of said circuits controlled by said low resistance relay to cause actuation of said signal when the connection between the central station circuit and the trunk is completed, a fourth relay in said trunk circuit controlling the second circuit of said signal and adapted to eliminate said signal when the trunk is connected to both the central station circuit and the subscriber's line, both said last named relays adapted to make connections in said circuits when the central station circuit is disconnected from the trunk and the subscriber's circuit is connected thereto whereby said signal is again actuated, a third relay in the trunk circuit adapted to be operated when the called subscriber responds to shunt said high resistance to permit a flow of current sufficient to actuate said supervisory relay.

16. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected to said central station circuit and one of said subscriber's lines, switching mechanism to effect said connections, a supervisory relay in said central station circuit, a high non-inductive resistance in the trunk circuit adapted to be connected in circuit with said supervisory relay when connection is made between the central station circuit and the trunk circuit and to prevent the operation of said relay when so connected, a low resistance relay in circuit with the non-inductive resistance and the supervisory relay responsive to the current flow when in said circuit, a signal in said trunk circuit controlled by said low resistance relay and adapted to be actuated when the trunk circuit is connected to the subscriber's line and disconnected from the central station circuit, a third relay adapted to be actuated when the called subscriber responds to shunt said high resistance whereupon the flow of current is sufficient to operate said supervisory relay.

17. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit connecting means for connecting a subscriber's line and said central station circuit to said trunk circuit, a supervisory relay in said central station circuit, a low resistance relay and a high non-inductive resistance in said trunk circuit arranged to be connected in a circuit with said supervisory relay when the central station circuit and the trunk are connected together, said high resistance obstructing the flow of current sufficient to prevent the operation of the supervisory relay when so connected but permitting sufficient flow to operate the low resistance relay, a signal in said trunk circuit controlled by said low resistance relay and adapted to be operated to indicate the disconnection between central circuit and trunk, and a third relay controlled by the called subscriber to eliminate said high resistance when said called subscriber responds whereby sufficient current flows in said supervisory relay circuit to operate said supervisory relay.

18. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit, circuit connecting devices adapted to connect said trunk circuit to said central station circuit and to a subscriber's line, a supervisory relay in said central circuit, a high non-inductive resistance in the trunk adapted to be connected in circuit with the supervisory relay when the central circuit and the trunk circuits are connected and by its resistance to impede the flow of current sufficient to prevent the operation of said supervisory relay, a relay in the trunk circuit controlled by the called subscriber to eliminate said high resistance from said supervisory relay circuit whereby sufficient current flows therein to operate said supervisory relay.

19. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit, circuit connecting devices adapted to connect said trunk circuit to said central station circuit and to a subscriber's line, a supervisory relay in said central circuit, a high non-inductive resistance in the trunk adapted to be connected in circuit with the supervisory relay when the central circuit and the trunk circuit are connected and by its resistance to impede the flow of current sufficient to prevent the operation of said supervisory relay, a relay in the trunk circuit controlled by the called subscriber to shunt said high resistance whereby sufficient current flows in said supervisory relay circuit to operate said supervisory relay.

20. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit, circuit connecting devices adapted to connect said trunk circuit to said central station circuit and to a subscriber's line, a supervisory signal in said central station circuit, a relay controlling said signal in said central circuit, a high non-inductive resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said trunk and central circuit are united to prevent flow of sufficient current to operate said relay, a shunt of said high resistance and a relay controlled by the called subscriber to close said shunt when said called subscriber responds whereupon sufficient current flows

in said supervisory relay circuit to operate said supervisory relay to extinguish the supervisory signal.

21. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected at one end to said central station circuit and at the other end to a subscriber's line, a supervisory relay in said central station circuit, a relay and a variable resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when said central circuit is connected with the trunk, said variable resistance being great enough to prevent sufficient current flow to operate said supervisory relay, and means for eliminating said resistance when the called subscriber responds whereupon sufficient current flows to operate the supervisory relay.

22. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected to the central station circuit and a subscriber's line, a supervisory relay in the central station circuit, a relay, and a variable non-inductive resistance in said trunk circuit adapted to be connected in circuit with said supervisory relay when the central station circuit and the trunk are connected, said resistance preventing current flow sufficient to operate said supervisory relay, and a third relay in the trunk circuit controlled by the called subscriber and operated on his response to shunt said resistance whereby sufficient current flows to actuate the supervisory relay.

23. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected with said central station circuit and a subscriber's line, a signal in the central station circuit controlled by current flowing over the trunk circuit when the central station circuit and the trunk are connected, a low resistance relay and a high non-inductive resistance in the trunk adapted to be placed in the path of the signal controlling current when said connection between trunk and central circuit is made and a relay controlled by the called subscriber to eliminate said high resistance from the signal controlling circuit to change the condition of said signal.

24. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected with the central station circuit and a subscriber's line, a signal in the central station circuit adapted to assume either an operative or inoperative condition, a circuit formed when said trunk and central circuit are united over which said signal is controlled, a low resistance relay and a high non-inductive resistance in said trunk adapted to be connected in said signal controlling circuit when the trunk and central circuit are united, a second signal located in the trunk and controlled by the low resistance relay, a second relay located in the trunk and controlled by the called subscriber to eliminate said high resistance from said signal controlling circuit whereby sufficient current flows therein to change the condition of said signal.

25. In a telephone system, a plurality of subscribers' lines, a central station circuit, a trunk circuit adapted to be connected with the central station circuit and a subscriber's line, a signal in the central station circuit adapted to assume either an operative or inoperative condition, a circuit formed when said trunk and central circuit are united over which said signal is controlled, a low resistance relay and a high non-inductive resistance in said trunk adapted to be connected in said signal controlling circuit when the trunk and central circuit are united, a second signal located in the trunk and controlled by the low resistance relay, a second relay located in the trunk and controlled by the called subscriber to shunt said high resistance from said signal controlling circuit whereby sufficient current flows therein to change the condition of said signal.

26. In a telephone system, a plurality of subscriber's lines, a central station circuit, a trunk circuit adapted to be connected with the central station circuit and a subscriber's line, a signal in the central station circuit adapted to assume either an operative or inoperative condition, a circuit formed when said trunk and central circuit are united over which said signal is controlled, a low resistance relay and a high non-inductive resistance in series in said trunk adapted to be connected in said signal controlling circuit when the trunk and central circuit are united, a second signal located in the trunk and controlled by the low resistance relay, a second relay located in the trunk and controlled by the called subscriber to shunt said high resistance from said signal controlling circuit whereby sufficient current flows therein to change the condition of said signal.

In testimony whereof I affix my signature in presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:
A. D. T. LIBBY,
F. O. RICHEY.