

No. 841,233.

PATENTED JAN. 15, 1907.

W. W. DEAN.
TELEPHONE SYSTEM.
APPLICATION FILED JAN. 23, 1904.

2 SHEETS—SHEET 2.

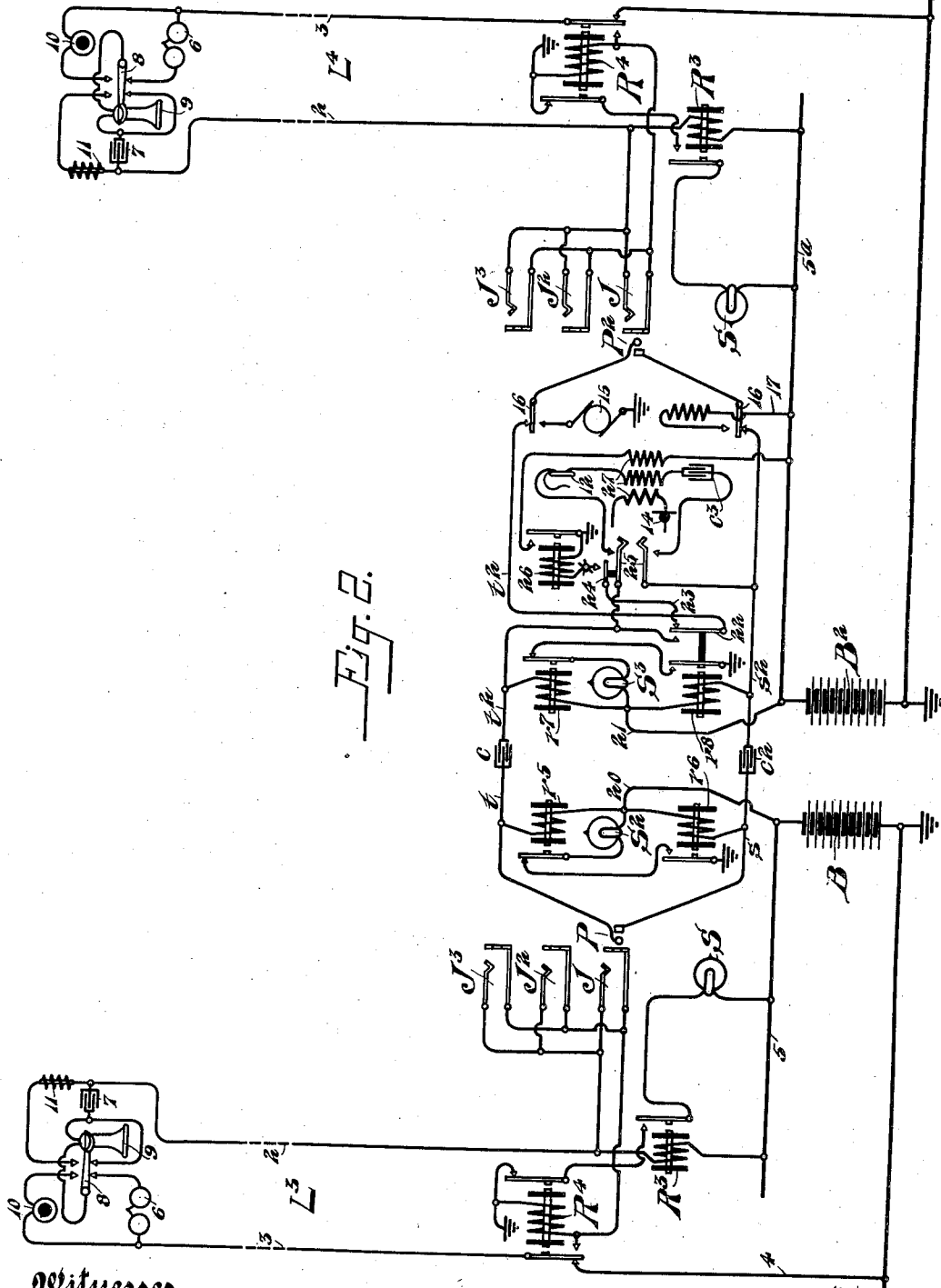


Fig. 2.

Witnesses.

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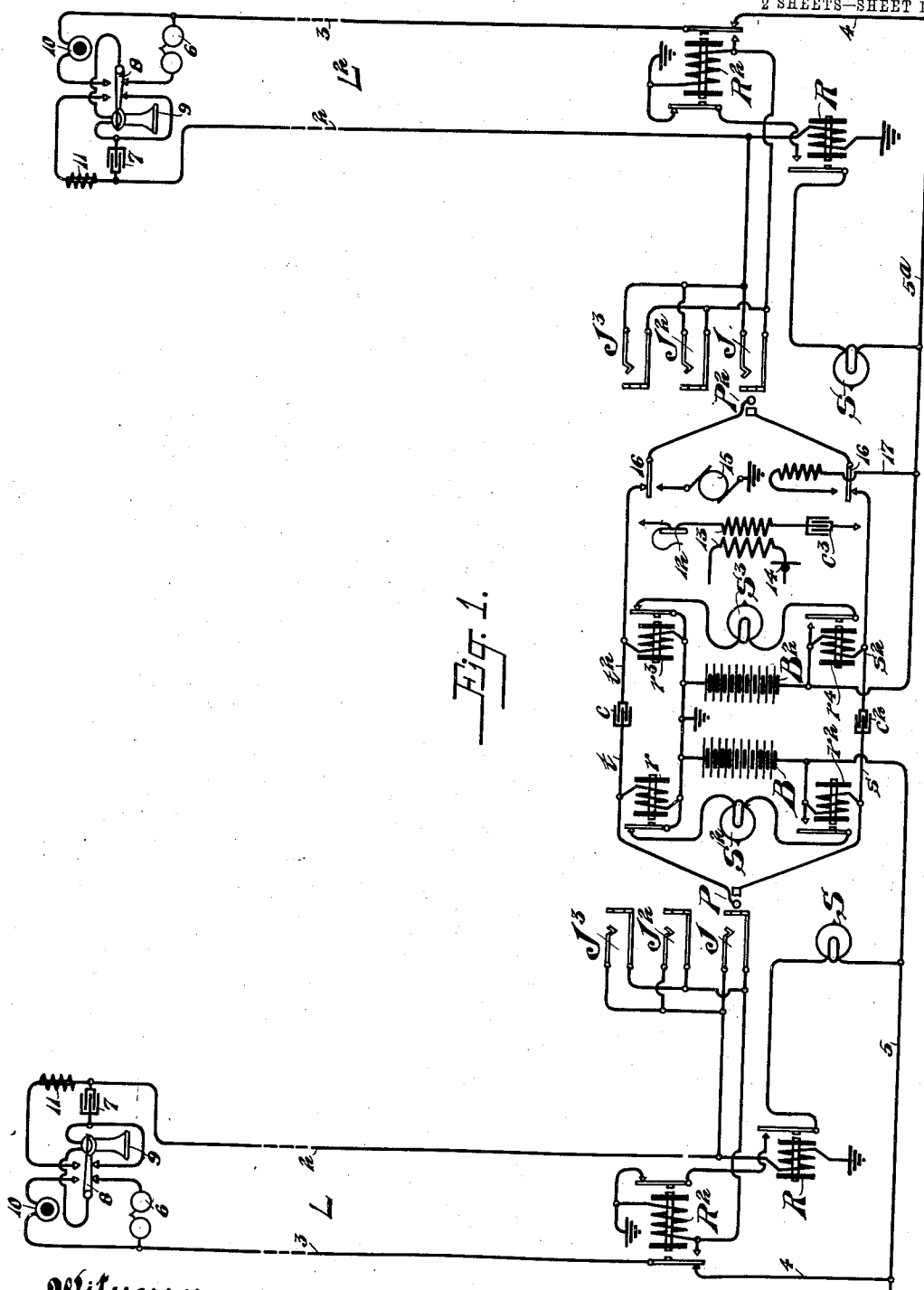


Fig. 1.

Witnesses.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

No. 841,233.

Specification of Letters Patent.

Patented Jan. 15, 1907.

Application file. January 23, 1904. Serial No 190,311.

To all whom it may concern:

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

My invention relates to improvements in telephone systems, and particularly to systems in which the subscribers' lines are of the two-wire type. In the systems of this type heretofore it has been common to provide the lines at the central office with line-relays which are adapted to be operated when a subscriber takes up his receiver to close the local circuit of the line-signal to operate the same. A second relay, known as the "switching" or "cut-off" relay, is also commonly provided for each line and is operated when the operator connects her cord-circuit with the telephone-line and serves when so operated to disconnect the said line-relay to thereby retire or prevent the operation of the line-signal.

In this invention the lines are provided, as usual, with line-signals and with line and cut-off relays to suitably control the signals; but the line-relays are preferably permanently connected with the telephone-line and are not disconnected during conversation. One side of the telephone-line may thus be permanently extended through the corresponding contacts of the spring-jacks instead of being normally disconnected, as in some prior systems. A cord-circuit having suitable supervisory apparatus associated therewith may be used to establish connections for conversation, an operator's telephone set and ringing-generator being arranged to be readily connected with such circuit.

The invention is illustrated in the accompanying drawings, in which—

Figure 1 is a diagram representing telephone systems embodying my improvements, and Fig. 2 is a similar view of a somewhat-different arrangement.

Like reference characters indicate like parts in both views.

Referring to Fig. 1, L and L² indicate two subscribers' lines extending in two limbs 2 and 3 from their respective substations to the central office, where they are fitted with the

usual line-signals S, normally controlled by the line-relays R, permanently connected between the line conductors 2 and ground. The line appurtenances include in addition the usual answering-jack J and a plurality of multiple jacks, such as J² and J³, in any desired number, suitably distributed throughout the multiple board, the tip-contacts of said jacks being permanently connected with the line conductor 2, while the sleeve-contacts are normally disconnected from line conductor 3, but are adapted during connections for conversations to be united therewith by means of the cut-off relay R², whose winding is legged to ground from the sleeve-conductor of said jacks and which controls normally closed contacts in the circuit of the signal S. The line conductor 3 is normally connected, through a spring of said relay R², with the conductor 4, branching from the omnibus-bar 5, leading from the live pole of the central or common battery B. At the substations each subscriber is provided with a call-bell 6 and a condenser 7 in a bridge of the line conductors that is normally closed by the switch-hook 8; but when the receiver 9 is lifted from said switch-hook for conversation the bridge of the bell is opened and the transmitter 10, retardation-coil 11, together with the condenser 7 and receiver 9, are suitably connected in circuit. This substation apparatus is intended merely to typify any usual or desired common-battery outfit. At the central office each operator is provided with a plurality of cord-circuits of the type shown in the drawings, each cord-circuit being provided with an answering-plug P and a calling-plug P², having tip-and-sleeve contacts adapted to register with the corresponding contacts of the spring-jacks when inserted therein. The tip-contacts of these plugs are united through the medium of flexible strands *t* and *t*² and the interposed condenser *c*, while their sleeve-contacts are joined by the similar strands *s* and *s*² and the interposed condenser *c*². The supervisory relays *r* and *r*² are included in a bridge of the answering end of the cord-circuit upon opposite sides of the said battery B and together control the local circuit of the supervisory signal S², which is associated with the answering-plug P, and preferably consists of a small incandescent lamp. A second pair of

supervisory relays r^3 and r^4 are similarly connected across the calling end of the cord-circuit, together with the battery B^2 , and likewise control the local circuit of the supervisory signal S^3 , that is assigned to the plug P^2 . The operator's set, including her head-receiver 12, the secondary of her induction-coil 13, and a suitable condenser c^3 , are adapted to be bridged across the calling end of the cord-circuit by means of any suitable listening-key, while her transmitter 14 and the primary of her induction-coil are charged from any suitable source of current, which may be either the battery B or B^2 . A suitable ringing-generator 15 is adapted to be connected between ground and the tip side of the cord-circuit by means of the tip-spring of the ringing-key 16, while the sleeve-spring of said key simultaneously connects the sleeve side of the cord-circuit with the live pole of the battery B^2 by means of conductors 17 and 5^a. In the operation of the system shown in this figure the subscriber—upon the line L , for example—takes up his receiver, thereby completing a path for current from the battery B over conductors 5, 4, and 3, thence through the substation devices and back to the central office over the line conductor 2 and through the line-relay R to ground. The current in this path suffices to actuate the said line-relay, with the result that the local circuit of the signal S is closed at its forward contacts, and the lamp is thus lighted to indicate the subscriber's call. Upon observing the signal the operator inserts the answering-plug P of her cord-circuit in the answering-jack J and depresses her listening-key to connect her set with the cord-circuit, to be thereby put in communication with the calling subscriber. The insertion of the plug P , in the first place, closes a path for current from the live pole of the battery B through supervisory relay r^2 , sleeve-strand s of the cord-circuit, and the sleeve-conductor of the jack-section of the line, and thence through the winding of the cut-off relay R^2 to ground. The cut-off relay is thus actuated and serves to open the local circuit of the line-signal S to automatically retire the same and also to disconnect the line conductor 3 from the branch 4 and connect it with the sleeve-conductor of the jacks to thus place the line in condition for conversation. The simultaneous actuation of the supervisory relay r^2 closes the local circuit of the supervisory signal S^2 ; but the instant the line conductor 3 is connected with the jack-section of the line, current from the battery B is permitted to circulate in the metallic circuit of the telephone-line, owing to the fact that the subscriber's telephone is now off its hook, and the supervisory relay is thus actuated to open the local circuit of said signal S^2 , which is accordingly prevented from operating. Upon learning the order of

the calling subscriber, which we will assume to be for the subscriber upon the line L^2 , the said line is tested in the usual manner by lightly touching the tip of the calling-plug to the test-ring of the multiple jack of the said line that is before the present operator. This test is carried out in the usual manner, an absence of noise in the operator's receiver indicating that the line is idle, while a click in her receiver indicates that the line is busy. Assuming that the line is found idle, the calling-plug P^2 is inserted in the said multiple jack of the line L^2 , and the ringing-key 16 is depressed. During the operation of the ringing-key the cut-off relay R^2 of this line is maintained actuated by current from the battery B^2 flowing over conductors 5^a and 17 and through said cut-off relay to ground. The ringing-current is sent out over the tip side of the telephone-line through the condenser and call-bell at the substation, with return over the sleeve side of the telephone-line and through said conductors 17 and 5^a and the battery B^2 to ground. After the subscriber has been called, but before his response, the battery B^2 is furnishing current over the sleeve strand s , to maintain said cut-off relay operated, and at the same time the supervisory relay r^4 is actuated by the current in this path, and the local circuit of the supervisory signal S^3 is accordingly closed to light the said signal, which indicates to the operator that the called subscriber has not yet responded. Upon his response it is apparent that current from the battery B^2 circulates in the metallic telephone-line, thereby furnishing current to the subscriber's transmitter and at the same time operating the supervisory relay r^3 to open the local circuit of the supervisory signal S^3 , which is retired, thus indicating to the operator that the subscribers are in communication. During conversation the batteries B and B^2 are independently supplying current to the substations for the operation of the transmitters and for the operation of the various relays at the central office. For instance, tracing the flow of current from the live pole of the battery B it will be seen that the winding of the cut-off relay R^2 is included in a local circuit with said source and that the line-circuit is in parallel therewith. In the return of the current sent out over the line a portion flows through the permanently-connected line-relay R , while the remainder passes through the supervisory relay r . Good results have been obtained with this type of line-circuit with the cut-off relays of five hundred ohms resistance and the line-relays likewise of five hundred ohms resistance. The supervisory relays in the cord-circuit may be of the usual dimensions. At the termination of the conversation the return of the receivers to their hooks opens the line-circuits and deenergizes the supervisory

relays r and r^3 ; but since the cooperating relays r^2 and r^4 are maintained actuated through the local circuits and are independent of the subscribers the signals S^2 and S^3 are lighted. Upon observing these signals the operator takes down the connection and restores all parts to normal condition.

In Fig. 2 the substation apparatus upon the lines L^3 and L^4 are the same. The line-circuit is likewise the same as in Fig. 1, except that the line-relay R^3 has preferably a resistance of about two hundred ohms and is connected between the line conductor 2 and the live pole of the central common battery B, while the opposite line conductor is connected with the ground. As before, the line-relay controls normally open contacts in the circuit of the line-signal, while the cut-off relay R^4 controls normally closed contacts of said circuit. The cord-circuit in this instance is provided with a pair of supervisory relays r^5 and r^6 , bridged across the answering end, with the middle point of their bridge joined by a conductor 20 with the live pole of the battery B, these relays controlling the local circuit of the supervisory signal S^2 . Similarly, a second pair of supervisory relays r^7 and r^8 are bridged across the calling end of the cord-circuit, and the middle point of said bridge is joined by conductor 21 with the live pole of the second battery B^2 . In this instance also the supervisory relay r^8 is provided with an additional contact 22, connected with the tip-contact of the calling-plug P^2 , which normally is connected, by means of a branch 23, with an additional spring 24 upon the listening-key 25. By means of said additional spring 24 a suitable high-impedance and high-resistance test-relay 26 is connected with said conductor 23 when the listening-key is operated. The operator's head-receiver 12, the secondary of her induction-coil 27, and the condenser c^3 may be bridged across the calling end of the cord-circuit by means of the listening-key springs 25, while her transmitter 14 and the primary of her induction-coil 27 may be charged from either the battery B or B^2 . A tertiary winding of said induction-coil is connected between the lead 5^a and the forward contact of said test-relay r^6 . The ringing-generator is the same as in the prior figure and need not be specifically described. The cut-off relays may be of two hundred ohms resistance. In the operation of the system the subscriber upon the line L^3 takes up his receiver, thereby completing a circuit through the line-relay R^3 , which is energized to close the local circuit of the line-signal S. Upon observing this signal the operator inserts the answering-plug P of her cord-circuit, thereby completing a path for current from the live pole of the battery B, through the conductor 20, supervisory relay r^6 , sleeve-strand s of the cord-circuit, sleeve-conductor of the jack-

section of the telephone-line, and through the cut-off relay R^4 to ground. The current in this path actuates the cut-off relay and causes it to open the line-signal circuit to retire the same and also to disconnect the line conductor 3 from the branch conductor 4 and to bring it into engagement with the sleeve-contacts of the jacks. Owing to the fact that the subscriber's telephone is off its hook, current from the live pole of the battery B^2 now also flows through the winding of the line-relay R^3 , as well as through conductor 20, the tip supervisory relay r^5 , the tip-conductor of the jack-section of the line, and thence from both these paths out over the tip line conductor 2 to the substation, with return through said sleeve-conductor 3 of the telephone-line and the winding of the cut-off relay r^4 to ground. Thus the supervisory signal S^2 is prevented from now operating. Upon learning the order of the calling subscriber the wanted line is tested in the usual manner, the application of the tip of the calling-plug to the test-ring of a busy line resulting in a flow of current through the test-relay 26, thereby causing a click in the operator's receiver. If the line is found idle, however, no click is received and the calling-plug P^2 is inserted in one of the multiple jacks of the line. The depression of the ringing-key calls the wanted subscriber in the usual manner, and after being called the supervisory relay r^8 is actuated to disconnect the test-relay and to place the cord-circuit in condition for conversation, as well as to close the local circuit of the supervisory signal S^3 , which is lighted. The response of the called subscriber permits the excitation of the relay r^7 , which retires the supervisory signal and indicates to the operator that the parties are in conversation. During conversation the batteries B and B^2 are feeding current to the respective lines mainly through the line and cut-off relays. At the termination of the conversation the return of the subscribers' receivers to their hooks deenergizes the tip supervisory relays r^5 and r^7 and causes the lighting of the corresponding supervisory signals, upon seeing which the operator withdraws the plugs and restores all parts to normal condition. The supervisory relays in this instance preferably are of about five hundred ohms resistance each, since the current is fed to the telephone-lines for conversation mainly through the line and cut-off relays. The line-relays are thus permanently connected with the telephone-lines and do not require disconnection during conversations. The tip line conductors may be extended directly to the tips of the jacks, and other advantages are apparent.

Having thus described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a telephone system, the combination with a telephone-line, of a line-relay for

said line, one terminal of the coil of said relay being connected to one limb of the line and to one contact of the line-jack, the other terminal of said relay-coil being connected to one pole of a central battery, a line-signal, a single pair of normally open contacts for said relay adapted to close the circuit of said signal, a cut-off relay having one terminal of its winding connected to the same side of the central battery with which the line-relay connects, and having its other terminal connected with the other contact of said line-jack and with a normally open contact of said cut-off relay, a pair of normally closed contacts for said cut-off relay adapted by their actuation to open the circuit of the line-signal, a movable contact of said relay adapted normally to connect one limb of said line directly to one side of the central source but in its actuated position to connect said limb to said normally open contact of the cut-off relay, substantially as described.

2. In a telephone system, the combination with a telephone-line, of a line-signal therefor, a line-relay permanently connected with the tip side of the line and controlling normally open contacts in the circuit of said signal, a cut-off relay for the line legged to ground from the normally disconnected sleeve-contacts of the jacks, said cut-off relay serving when operated to open the circuit

of said signal and to sever the normal connection of the sleeve side of the line and complete the connection between said sleeve side of the line and the jack-section of the same, substantially as described. 35

3. In a telephone system, the combination with a telephone-line, of a cord-circuit to establish connections therewith for conversation, a line-relay and a line-signal the tip line conductor branching to the tip-contacts of the spring-jacks and to one side of the line-relay, the sleeve side of the line being connected with one pole of the central battery, said line-relay being connected to the other pole of said battery, the test and sleeve contacts of said jacks being normally disconnected from the sleeve line conductor, a cut-off relay legged to ground from the said test-contacts and adapted when the cord-circuit is connected with the line to sever the normal connection of said sleeve line conductor and connected with the said test-contacts and also to open the circuit of said signal, substantially as described. 40 45 50

Signed by me at Chicago, county of Cook, State of Illinois, this 31st day of December, 1903. 55

WILLIAM W. DEAN.

Witnesses:

E. A. GARLOCK,
ROBERT LEWIS AMES.