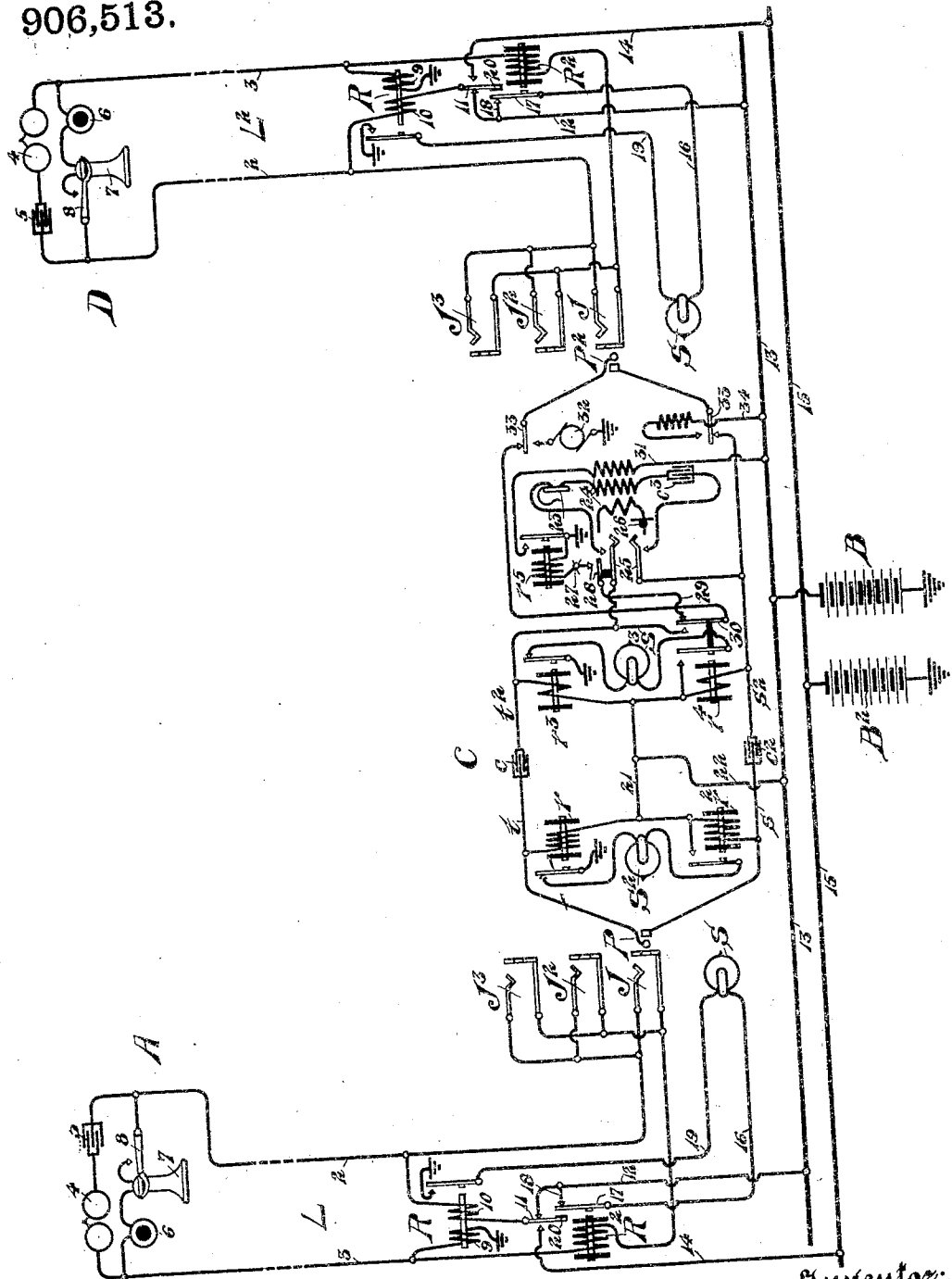


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906,513.



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TELEPHONE SYSTEM.

No. 908,513.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and 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 telephone systems of the common battery type, in which two batteries are provided at the central office for each conversation.

A common objection in common battery telephone systems is that current from the central battery must be present upon the telephone line when the subscriber is calling the central office to actuate his line signaling relay or device and when the operator answers the call the battery is disconnected from the subscriber's line and is again connected therewith through the cord circuit to furnish current over the line for conversation. This disconnection and reconnection of the current source results in a violent noise in the subscriber's receiver, which is annoying even under the most favorable circumstances and in some cases it is practically impossible to hold the receiver to the ear while the operator is thus connecting with the line at the central office.

My present invention relates to means for providing a so-called "clickless" line, that is, one in which practically no click or noise is caused in the waiting subscriber's receiver when the operator answers the call.

In carrying out my invention I preferably provide each line with a cut-off relay, which in the case of the calling subscriber's line is actuated in one manner to render the corresponding line signal inoperative but to permit the normal connection of the battery with the line to remain undisturbed while when connection is established with the called line the said relay of that line serves to both render the corresponding line signal inoperative and to sever the connection with the normal battery and complete connection with the other.

Other objects of the invention are to simplify the apparatus required and to provide an inexpensive and efficient system, through-

To the accomplishment of these objects and such others as may hereinafter appear, the invention consists in the parts and combinations of parts hereinafter described and

particularly pointed out in the appended 55 claims, reference being had to the accompanying drawing forming a part hereof in which the figure is a diagram of a telephone system embodying my improvements.

In the figure, L and L² indicate two subscribers' lines extending in two limbs 2 and 3 from the respective substations A and D to the central office C, where they are fitted, as usual, with individual line signals S, preferably in the form of small incandescent lamps, 65 and with an answering jack J and a plurality of multiple jacks, J² and J³ in any number, according to the size of the switchboard upon which they are placed.

At the substations, the lines are provided 70 with the usual call bell 4 and condenser 5 in a preferably permanent bridge of the line conductors, and a transmitter 6 and receiver 7 in a bridge that is normally open at the switch hook 8. This apparatus is intended 75 merely to typify any usual or desired common battery outfit.

A line relay R and a cut-off relay R² is provided for each line at the central office, the latter being included in said line conductor 3 80 between the connection of the line relay R with the line and the said spring jacks or connection terminals of the line, said relay having windings 9 and 10, the former being legged to ground from the sleeve line conductor 3, while the other is connected between the line conductor 2, and the spring 11 of the cut-off relay R², the normal contact of said spring being joined through the intermediation of a wire 12 with the common wire 13 90 connected with the live pole of the central common battery B. The forward contact of said spring 11 is joined by a branch conductor 14 with the common lead 15 connected with a second central common battery B². 95 The line signal is connected upon one side by a branch 16 with a second spring 17 of said cut-off relay R², the normal contact of which is joined by a wire 18 with said conductor 12, while the other terminal of said lamp is 100 united through the medium of a wire 19 with the spring of said line relay R, the forward contact of which spring is grounded. When the spring 17 of the cut-off relay is attracted, it engages the small block of insulation 20 105 carried by the said spring 11, and is consequently insulated therefrom.

Each operator is provided with a plurality

of cord circuits of the type shown in the drawing, each of which includes an answering plug P and a calling plug P² having tip and sleeve contacts adapted to be registered with the corresponding contacts of the spring jacks of the lines when inserted therein. The tip contacts of the plugs are united through the flexible strands *t* and *t*² and the interposed condenser *c*, while their sleeve contacts are similarly joined by the strands *s* and *s*² and the interposed condenser *c*². A pair of supervisory relays *r* and *r*² are bridged across the answering end of the cord circuit and together control the local circuit of the supervisory signal S² associated with said answering plug, the latter relay being adapted to close said local circuit when energized and the former to open the same. An intermediate point of the bridge of these relays is connected by conductors 21 and 22 with the said battery lead 13, and a second pair of supervisory relays *r*³ and *r*⁴ is bridged across the calling end of the cord circuit and is likewise connected with the said battery lead 13. These relays together control the local circuit of the supervisory signal S².

The operator's head telephone 23, the secondary of her induction coil 24 and a suitable condenser *c*³ are adapted to be bridged across the calling end of the cord circuit in the operation of any suitable listening key indicated by the springs 25; her transmitter 26 and the primary of her induction coil being charged from any suitable source of current. A test relay *r*⁵ of high resistance and high impedance and preferably common to all of the cord circuits at the operator's position as indicated by the branching lines from the point 27, is adapted to be connected by normally open contacts 28 of the listening key, conductor 29, the normal contact and extra spring 30 of the supervisory relay *r*⁴ with the forward portion of said strand *t*². The test relay is adapted when actuated to close a local circuit from said battery lead 13 through the conductor 31 including a tertiary winding of the operator's induction coil. A suitable ringing generator 32 is adapted to be connected with the tip side of the cord circuit in the operation of the ringing key 33, the sleeve strand at the same time being connected by conductor 34 with said battery lead 13.

The supervisory relays *r* and *r*² are preferably of high resistance, say 5000 ohms, while the other supervisory relays *r*³ and *r*⁴ are preferably of about 500 ohms resistance. The windings 9 and 10 of the line relay R are of about 100 ohms resistance, and the cut-off relay R² is of such dimensions as to not lift the spring 11 from its normal contact when energized through one of the 5000 ohm supervisory relays but to disconnect said spring from its normal contact and complete connection with its forward contact when

energized through the resistance of the 500 ohm supervisory relays. The other parts may be of the usual or desired dimensions.

In the operation of my invention, the subscriber takes up his receiver, thereby completing a path for current over conductors 13 and 12, spring 11, through the winding 10 of the line relay R, line conductor 2, thence to the substation devices and back to the central office over the line conductor 3 and through the winding 9 of the line relay R to ground. The current in this path is sufficient to energize the line relay R, which closes the signal S from the battery lead 13, over conductors 12 and 13, conductor 16, through the lamp, conductor 19 and the closed contacts of the line relay R to ground. Upon observing the signal the operator inserts the answering plug P of her cord circuit in the answering jack J of the line and depresses the listening key to connect her instrument with the cord circuit in use. The insertion of the plug P completes a path for current over conductors 13, 22, and 21, through the supervisory relays *r*³, the sleeve strand *s* of the cord circuit, sleeve conductor of the telephone line, including the cut-off relay R², thence through the winding 9 of the line relay R to ground. Owing to the high resistance of the supervisory relay in this path, the cut-off relay is actuated only sufficiently to separate its spring 17 from the conductor 18, thus retiring the line signal S, but insufficient to separate said spring 11 from its normal contact. Thus the flow of current from the battery B over the path just described is uninterrupted by the connection of the cord circuit with the line. The supervisory relay R² closes the local circuit of the signal S² and the supervisory relay *r* is energized by current from said conductor 21 over the tip strand *t* and the tip conductor 2 to the substation so that the said signal is prevented from glowing.

Upon learning the order of the calling subscriber, the line is tested in the usual manner to determine its idle or busy condition. Normally the test rings of the lines are grounded through the winding 9 of the line relay and at the time that it is desired to make the test the tip contact of the plug is likewise grounded through the spring 30 of the supervisory relay *r*⁴, conductor 29, contacts of the listening key, said key being operated at this time and through the test relay *r*⁵. Upon touching the tip of the plug to one of the test rings thereof, no flow of current takes place, and the operator knows that the line is idle. In case the line is busy, the said test rings are connected through the sleeve of the cord circuit in use with the live pole of the battery B, and consequently when the grounded tip of the plug is brought into contact therewith a flow of current results and the same is actuated to close the local circuit through the

tertiary winding of the operator's induction coil, thereby causing a click in the operator's receiver, and thus notifying the operator that the line is busy.

5 Assuming that the line is idle, the calling plug is inserted and the ringing key operated to call the wanted subscriber. Immediately upon the insertion of the plug, a path for current is provided from the battery B over
10 conductors 13, 22 and 21, through the supervisory relay r^1 , strand s^2 of the cord circuit, conductor 3 of the telephone line including the cut-off relay R^2 , thence through the winding 9 of the line relay R. Owing to the
15 lower resistance of the supervisory relay r^1 that is now included in this circuit, the cut-off relay is fully actuated, thereby not only opening the circuit of the line signal S to prevent its operation and causing false signals,
20 but also to move the spring 11 of said relay from connection with the conductor 12 into connection with the conductor 14 leading to the live pole of the battery B². In the operation of the ringing key, the cut-off relay is
25 maintained actuated from the battery B through the medium of conductors 13 and 34, and the sleeve spring 33 of the ringing key. The ringing current is sent out over the tip side of the line with return over the sleeve side and through said conductors 34
30 and 13 and the battery B to ground.

After the subscriber has been called but before his response, the sleeve supervisory relay r^1 is actuated over the path just traced
35 and closes the local circuit of the supervisory signal S² associated with the plug P², thereby lighting the said signal to indicate to the operator that the subscriber has not yet responded. The operation of the said supervisory relay also disconnects the conductor
40 29 leading to the test relay and completes the strand r^2 of the cord circuit for conversation. Upon the response of the called subscriber the supervisory relay receives sufficient current from the battery B flowing out
45 over the tip strand r^2 of the cord circuit to actuate the same to thereby open the local circuit of the supervisory signal S and retire the same.

50 During conversation, the battery B is feeding current to the telephone line L for the operation of the transmitter at the substation A, while the battery B² is feeding current to the line L² for the operation of the transmitter at the station D. Thus the potential
55 upon the calling line is practically constant during the operation of establishing the connection so that the waiting subscriber is not disturbed by noise in the receiver; and the
60 lines are supplied with current for conversation by the two batteries.

I claim:—

1. In a telephone system, the combination with a plurality of telephone lines, of a pair

of sources of electricity at the central office, 65 one of said sources being normally connected with the lines to furnish current thereover when the subscriber is calling the central office, a cut-off relay for each line, an operator's cord circuit to establish connections 70 with the lines for conversations, means whereby when the cord circuit is connected with a calling line the cut-off relay of said line is actuated in one manner to render the line signal inoperative, the normal connection 75 with said battery remaining undisturbed, and further means whereby when the connection is established with the called line to complete the connection for conversation the cut-off relay of the called line is actuated in 80 another manner to render the line signal inoperative and to disconnect the normal source and to connect the other source with the line, substantially as described.

2. In a telephone system, the combination 85 with a plurality of telephone lines, of a pair of sources of current at the central office to furnish current over said lines for conversation, one of said sources being normally connected with the said lines to enable the subscribers to call the central office, a cut-off relay for each line, a cord circuit to establish connections with the line for conversation, a high resistance device connected with the answering end of the cord circuit and a low 95 resistance device correspondingly connected with the calling end of the cord circuit, means whereby when the cord circuit is connected with a calling line the said high resistance device is connected in the circuit of 100 the cut-off relay of that line whereby said cut-off relay is actuated to such an extent only as to render the line signal inoperative, the normal connection of said source of current remaining undisturbed, and when the 105 connection is established with a called line said low resistance device is included in the circuit of the cut-off relay of that line to permit the latter to be completely operated to render the signal inoperative as well as to 110 disconnect said current source and to connect the other current source with the said line, substantially as described.

3. In a telephone system, the combination 115 with a plurality of telephone lines, of a pair of sources of electricity at the central office with one of which said lines are normally connected to enable the subscribers to call the central office, an operator's cord circuit, a cut-off relay for each line, means associated 120 with each end of the cord circuit to suitably control the operation of said cut-off relays when connections are established with the lines, whereby when connection is established with the calling lines the normal connection 125 of the first named source of current therewith remains undisturbed and when connection is established with the called

lines the said source is disconnected therefrom and the second source connected therewith, substantially as described.

4. In a telephone system, the combination
5 with a plurality of telephone lines each having a line signal and a cut-off relay, of a pair of sources of electricity at the central office with one of which said lines are normally
10 connected to enable the subscribers to call the central office, an operator's cord circuit, means associated with each end of the cord circuit to suitably control the operation of said cut-off relays when connections are established with the lines whereby when connection
15 is established with the calling lines the line signals are rendered inoperative but said normally connected battery remains in connection therewith and when connection is established with the called-for lines the
20 line signals are rendered inoperative and the said battery is disconnected therefrom and the second battery connected therewith, substantially as described.

5. In a telephone system, the combination
25 with a plurality of telephone lines, of a pair of sources of electricity at the central office with one of which said lines are normally connected to enable the subscribers to call the central office, an operator's cord circuit,
30 a cut-off relay for each line, a high resistance supervisory relay associated with the answering end of the cord circuit and a low resistance supervisory relay associated with the calling end of the cord circuit, said supervisory relays being included in circuit

with the cut-off relays when the cord circuit is connected with the lines whereby in the case of the calling lines the first named source of current remains connected therewith and in the case of the called lines said source is
40 disconnected and the second source is connected therewith, substantially as described.

6. In a telephone system, the combination with a plurality of telephone lines, of a cut-off relay for each line, said relays having two
45 degrees of actuation, a pair of sources at the central office having terminals associated with the contacts of said cut-off relays, and means to differently actuate said relays whereby either of said sources may be connected
50 with the telephone lines, substantially as described.

7. In a telephone system, the combination with a telephone line, of a line relay and a cut-off relay for the line, said cut-off relay
55 having two degrees of actuation, the circuit of the line relay being completed through one path when the cut-off relay is partially actuated and through another path when the cut-off relay is completely actuated and a separate source of current associated with each
60 of said paths, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this seventh day of November 1903.

WILLIAM W. DEAN.

Witnesses:

GAZELLE BEDER,
ROBERT LEWIS AMES.