

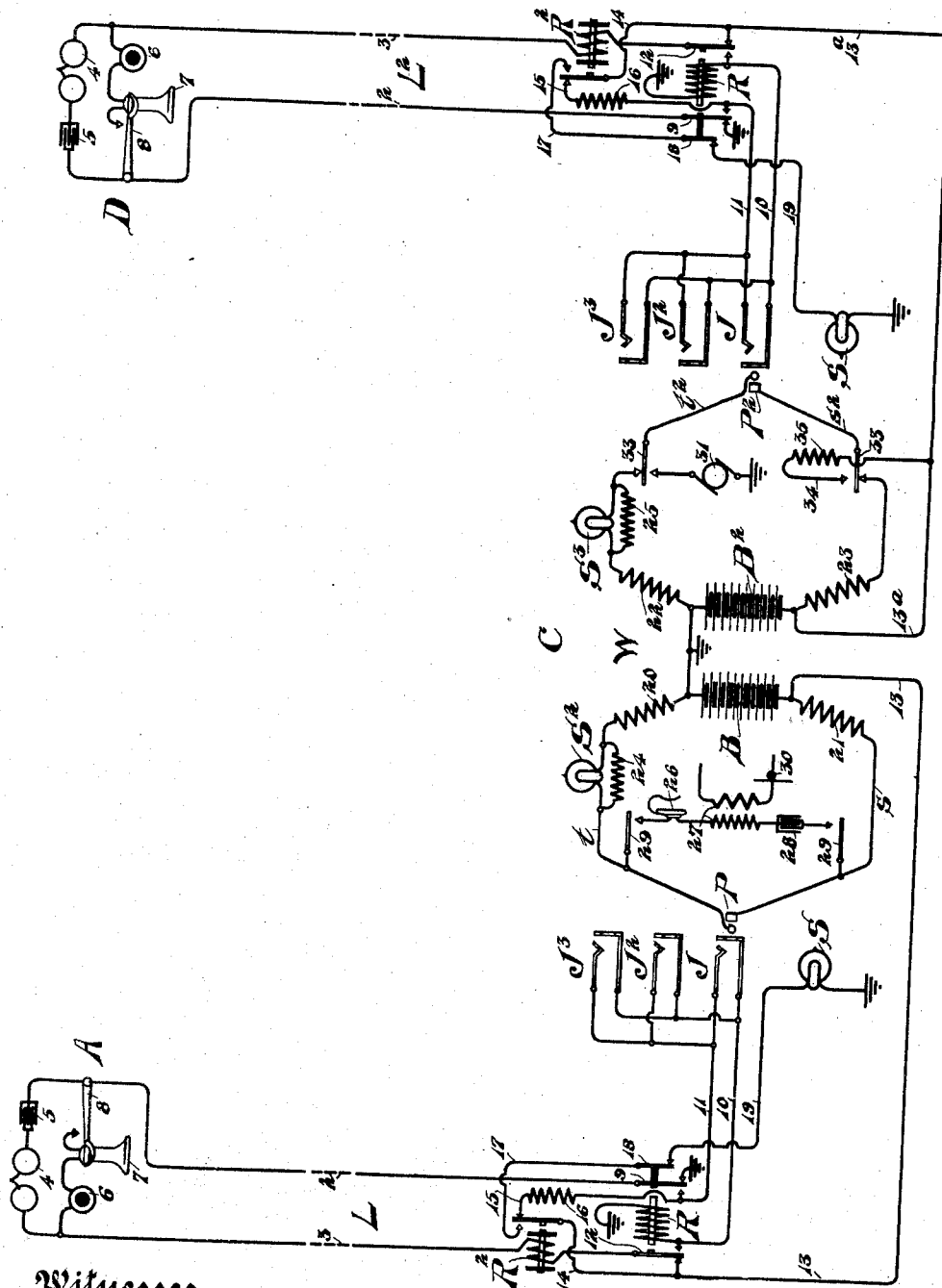
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W. W. DEAN.

TELEPHONE SYSTEM

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TELEPHONE SYSTEM.

No. 866,266.

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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 residing at Chicago, in the 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 of the common battery type and has particular reference to the supervisory signaling system associated with the cord circuit.

It has heretofore been common to associate several relays and other auxiliary mechanism with the cord circuits of the exchange to obtain supervision of the connections, such apparatus often requiring an additional or third strand in the cord circuit.

In my invention I may dispense with a large part of the auxiliary apparatus and in the preferred form may even dispense with all relays and similar devices and operate the signals direct. In order to accomplish these results in the preferred form of my invention, I place the signal in the form of a small incandescent lamp directly in one side of the cord circuit and arrange suitable controlling means in the line circuit to control the flow of operating current to said signal, whereby a minimum of apparatus is required for the complete operation of the exchange system.

My invention is illustrated in the accompanying drawing in which the figure is a diagram of a telephone exchange system embodying my improvements.

The subscribers' lines L and L² extend in two limbs 2 and 3 from the subscribers' stations A and D to the central office C.

At the substations any suitable common battery outfit may be provided, that shown consisting of a bell 4 and a condenser 5 in a permanent bridge of the line conductors, and the transmitter 6 and receiver 7 in a bridge of said conductors that is normally opened by means of the switch-hook 8. This apparatus is intended to typify any usual or desired subscriber's apparatus adapted for use in connection with a common source of current at the central office.

At the central office each line is fitted in the usual manner with a line signal S, preferably in the form of a small incandescent lamp, with an answering jack J and with a plurality of multiple jacks J² and J³ in any desired number. The line conductor 2 is normally grounded through a movable contact 9 of the cut-off relay R, whose winding is legged to ground from the sleeve conductor 10 of the jacks, said conductor 2 being connected with the tip conductor 11 of the spring jacks of the line when the said cut-off relay R is energized. The limb 3 of the telephone line is connected with movable contact 12 of said relay R, which normally connects

with a conductor 13 leading to the live pole of a central battery B that is common to a large number of lines of the exchange and the opposite pole of which is grounded. Upon the energization of cut-off relay R the said line conductor 3 is connected with the sleeve conductor 10 of the said jack section of the line. A line relay R² is included in the limb 3 of the telephone line and its movable contact is joined by conductor 14 with the said conductor 13, the back contact of said movable contact being connected through conductor 15 including a resistance 16 with the said tip conductor 11 of the switchboard section of the line. The forward contact of line relay R² is connected by means of a branch conductor 17 with the movable contact 18 of the cut-off relay R which normally completes a connection with conductor 19 including the line signal S of the telephone line.

The operator's outfit comprises a plurality of cord circuits of the type shown in the drawing, in each of which an answering plug P and a calling plug P² are provided with tip and sleeve contacts adapted to register respectively with the corresponding contacts of the telephone lines when the plugs are inserted therein. The tip contact of the answering plug is connected by strand t with the winding 20 of the repeating coil W and thence with the grounded pole of the battery B, while the sleeve contact of the plug is connected by flexible strand s and the winding 21 of said repeating coil with the live pole of said battery. In a similar manner the calling plug P² has its tip contact joined by strand t² and winding 22 of repeating coil W with the grounded pole of a second battery B² also preferably common to a plurality of lines, and its sleeve contact is connected by a similar flexible strand s² and winding 23 of repeating coil W with the live pole of this second battery. In the tip strand t I locate a supervisory signal S² which is preferably a small incandescent lamp and which is also shunted by non-inductive resistance 24. Similarly a supervisory signal S³ shunted by non-inductive resistance 25 is located in the tip strand t² connected with the calling plug.

The operator's receiver 26 together with the secondary of her induction coil 27 and a suitable condenser 28 are adapted to be bridged across one end of the cord circuit by means of the listening key springs 29, 29, while her transmitter 30 and the primary of her induction coil 27 are in a local circuit charged from any suitable source of current such as the battery B² or B. A ringing generator 31 is adapted to be connected between ground and the tip strand t² of the cord circuit by the operation of the tip spring of ringing key 33, while simultaneously the forward portion of the sleeve strand s² is connected with conductor 34 including a suitable resistance 35 and battery lead 13* with the live pole of the battery B².

In the operation of my system, the subscriber A desir-

ing a connection with the subscriber D takes up his receiver and thereby completes a path for current over the metallic telephone line from the central battery B, such current circulating over the lead 13, movable contact 12 of relay R, through the winding of relay R², the line conductor 3 to the substation where it passes through the substation instruments and thence back to the central office over the line conductor 2 and the movable contact 9 of relay R to ground. The current in this path operates the line relay R² causing it to close the local circuit of the signal S, said local circuit including the lead 13, conductor 14, armature and front contact of line relay R², conductor 17, spring 18 and normal contact of cut-off relay R and thence by way of conductor 19 through the signal S to ground. The lighting of this signal attracts the operator's attention, who inserts the answering plug P of her cord circuit into the answering jack J of the telephone line. The insertion of the plug completes a path for current from the battery B over the sleeve strand s of the cord circuit and over conductor 10 through the winding of cut-off relay R to ground. This relay is therefore operated and disconnects the line conductor 2 from ground and line conductor 3 from the battery lead 13 and connects them with the corresponding conductors of the switchboard section of the telephone line. The operation of the relay R also opens through its contact 18 the local circuit of the line signal S which is therefore rendered inert. Current now flows from the battery B over both sides of the metallic telephone line and both sides of the cord circuit. The signal S² must be so adjusted as not to be operated by the current in this metallic path and therefore remains unexposed. The operator connects her instrument with the cord circuit by means of the listening key 29 and receives the order from the calling subscriber.

Upon learning that subscriber D is wanted, the operator proceeds to test the idle or busy condition of the line. If the line is found idle the test rings of the jacks are connected with ground only and since the tip of the calling plug P² is likewise connected with ground no flow of current results over the strand t² of the cord circuit and the operator knows that the line is idle; but if connected with another subscriber for conversation the sleeve contacts of the line are connected with the live pole of either the battery B or B², since said batteries are common to all of the cord circuits, and the application of the tip of the testing plug to said test rings completes a path for current from said live pole of the battery to ground over the tip strand t². The flow of current over this path causes a change of potential at the terminals of the operator's bridge and the surge of current therethrough is sufficient to cause a click in her receiver. She is thus informed that the line is busy.

Assuming that the line is found idle the plug P² is inserted in the multiple jack of the said line that is upon the operator's section of the switchboard and the ringing key is operated. The insertion of the plug P² completes a path for current over the strand s² from the battery B² through the cut-off relay R of the called line which is thus operated to sever the local circuit of the signal S of the wanted line to thereby prevent its operation and to also connect the external line circuit with the switchboard section. The depression of the ringing key springs serves to connect

the ringing generator 31 with the tip side of the line which sends current out over the telephone line through the call bell at the substation and back to the central office over the sleeve conductor and thence through sleeve spring 33 of the ringing key, conductor 34, resistance 35, conductor 13^a through battery B² to ground. The current from the battery B² also circulates through the conductors 13^a, 34 and s², through the cut-off relay R to maintain the same actuated during ringing. After the subscriber has been called but before his response the supervisory signal S³ is operated. The path for this operating current is over the conductor 13^a, branch conductor 14, normal contacts of line relay R², conductor 15, resistance 16 and conductors 11 and t² to the other pole of the battery B². The signal is therefore operated and indicates that the subscriber has not yet responded. Upon his response current from the battery B² circulates over both sides of the cord circuit and both sides of the telephone line and serves to operate the line relay R². This relay in thus operating opens the local circuit of said supervisory signal S³ and therefore renders the same inert which indicates to the operator that the subscriber has responded.

During conversation the batteries B and B² are sending current over the lines for the operation of the substation devices. The voice currents are repeated from one line circuit to the other through the medium of the repeating coil W. The supervisory signals do not now operate since the amount of current they receive is not sufficient to cause them to glow. In case of rupture of the lamp filaments, conversation may still be carried on through the non-inductive resistance 24.

At the termination of the conversation when the subscribers' receivers are returned to their hooks the line relays R² are deenergized and the local circuits of said supervisory signals are closed through the back contacts of said relays. They are accordingly lighted and the operator knows that the conversation is finished and the plugs are accordingly removed, thus restoring all parts to normal condition.

It will be understood that the ground connections are preferably one and the same or the common office return, that the listening and ringing springs may be of any desired type, preferably of the kind in which the springs are simultaneously operated by manual means, and that various other modifications may be made in the invention without departing from the scope thereof.

I claim:—

1. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections with the line for conversation, a central common source of current adapted to be connected with the line to send current thereover for conversational purposes, a relay in the line under control of the subscriber, and a supervisory signal associated with the cord circuit and controlled by said relay, the operation of said signal being caused by current over one of the talking strands of the cord circuit during a connection and when a subscriber's telephone is not in use, and the said signal being prevented from operation by the lack of a sufficient flow of current over said strand during conversation, substantially as described.

2. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation, a central common source of current to supply current to the telephone line during conversation, and a supervisory signal placed in one of the talking strands

of the cord circuit, said signal being inert during conversation, but actuated over a circuit local to the central office during the connection when the subscriber's telephone is not in use, substantially as described.

- 5 3. In a telephone system, the combination with a metallic telephone line, of a cord circuit to establish connections for conversation, a central common source of current to supply current over the metallic telephone line for conversation during connections, and a supervisory signal placed in one of the talking strands of the cord circuit in the path of such current, said signal receiving insufficient current to operate the same during conversation but receiving sufficient current from said source to operate the same when the subscriber's telephone is not in use, substantially as described.
- 10 4. In a telephone system, the combination with a two-conductor telephone line, of a cord circuit to establish connections with the line for conversation, a central common source of current to send current over the said line during conversation, a signal in one of the talking strands of the cord circuit, and in the path of such current, means to prevent said signal operating during conversation but to operate the same from said source over a local circuit during the connections and when the subscriber's telephone is not in use, substantially as described.
- 15 5. The combination with a telephone line, of a cord circuit to establish connection for conversation, a central common source of current to send current over the telephone line during conversation, a relay in the telephone line under the control of the subscriber, a supervisory signal placed in one of the talking strands of the cord circuit, and means controlled by said relay to prevent the operation of said signal during conversation but to permit its operation during connections and when the subscriber's telephone is not in use, substantially as described.
- 20 6. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation, a central common source of current adapted to send current over the cord circuit during conversation, a supervisory signal located in one of the talking strands of the cord circuit in the path of current thereover to supply the subscriber's transmitter during conversation, said signal receiving insufficient current during conversation to operate the same, and means controlled by the subscriber to permit an operating flow of current through said signal when the subscriber's telephone is not in use to operate the same, substantially as described.
- 25 7. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections with the line for conversation, a common battery to send current over the strands of the cord circuit and to the substation during conversation, a supervisory signal located in one of the talking strands of the cord circuit, a relay in the telephone line under the control of the subscriber, said signal not receiving an operating current during conversation whereby it is at this time inert, and means controlled by said relay for permitting an operating flow of current from said source through said signal to operate it when the subscriber's telephone is not in use, substantially as described.
- 30 8. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation, a common source of current adapted to send current over the cord circuit and telephone line during conversation, an incandescent lamp placed in one of the talking strands of said cord circuit, said lamp being in the path of current during conversation and serving as a supervisory signal, and means to prevent said lamp operating during conversation but to cause its operation at other times during the connection, substantially as described.
- 35 9. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation, a central common source of current connected with the cord circuit and adapted to send current over the telephone line during conversation, an incandescent lamp in one of the talking strands of the cord circuit and serving as a supervisory signal, a relay in the
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receiving insufficient current to operate the same during conversation, and means controlled by said relay to include said lamp in a local circuit when the subscriber's telephone is not in use whereby the lamp receives sufficient current to operate it, substantially as described.

10. In a telephone system, the combination with a telephone line having two main line contacts at the switch sockets or connection terminals of the line, a cord circuit cooperating therewith to establish connections for conversation and having only two strands each forming part of the talking circuit, an incandescent lamp located in one of said strands and serving as a supervisory signal, a relay in the telephone line in the path of current from said source over the telephone line and therefore under the control of the subscriber during connections, said lamp being in the path of current over the telephone line during conversation but receiving an insufficient amount of current at such time to operate the same, and a local circuit closed by said relay when deenergized to include said lamp and source whereby it then receives sufficient current to be lighted, substantially as described.

11. In a telephone system, the combination with a telephone line, of a line signal therefor, a line relay to control said signal, a cord circuit to establish connections with the line for conversation, an incandescent lamp in one side of the cord circuit, and means controlled by said line relay for including said lamp in a local circuit during connections and when the subscriber's telephone is not in use to cause the same to be operated, substantially as described.

12. The combination with a telephone line, of a line signal therefor, a cut-off device for the line adapted when operated to render said signal inoperative, a cord circuit to establish connections with the line for conversational purposes, a common source of current associated with the cord circuit and arranged to send current over the line for talking purposes when a connection exists, and a supervisory signal associated with the cord circuit, said cut-off device being operated by current from said source over one side of said cord circuit and the supervisory signal by current over the other side of the same, the circuits of both said cut-off device and said supervisory signal being local to the central office, substantially as described.

13. The combination with a telephone line, of a line signal therefor, a cut-off device for the line adapted when operated to render said signal inoperative, a cord circuit to establish connections for conversational purposes, a common source of current associated with the cord circuit and arranged to send current over the telephone line for talking purposes when a connection exists, said cut-off device being operated by current from said source over one talking strand of said cord circuit, and a supervisory signal located in the other talking strand of the cord circuit and operated by a current thereover, substantially as described.

14. The combination with a telephone line, of a line signal therefor, a cut-off device for the line adapted when operated to render said signal inoperative, a cord circuit to establish connections with the line for conversational purposes, a common source of current associated with the cord circuit and arranged to send current over the line for talking purposes when a connection exists, a relay located in the telephone line in the path of such talking current, said cut-off device being operated by current from said source over one side only of said cord circuit, and a supervisory signal associated with the cord circuit and controlled by said relay in the line, substantially as described.

15. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections for conversation, a central common source of current to supply current over the limbs of the telephone line for conversation, and a supervisory signal for the cord circuit in the path of such supply current, said signal receiving insufficient current to operate the same during conversation, but receiving sufficient current from said source to operate the same when the subscriber's telephone is not in use, substantially as described.

16. In a telephone system, the combination with a telephone line, of a cord circuit to establish conversational

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- connections therewith, a central common source of current to supply current over the limbs of the telephone line to energize the transmitter, and a supervisory signal for the cord circuit in the path of such transmitter energization current, said signal receiving insufficient current to operate the same during conversation, but receiving sufficient current from said source to operate the same when the subscriber's telephone is not in use, substantially as described.
- 10 17. In a telephone system, the combination with a telephone line, of a cord circuit extending in two limbs adapted to be connected with the limbs of the telephone line for conversation, a central source of current to furnish current over the strands of said cord circuit and the limbs of the telephone line to energize the substation transmitter during conversation, a normally inert supervisory signal for the cord circuit in the path of such current during conversation, said signal receiving insufficient current to operate the same during conversation, but receiving current over a local circuit sufficient to operate the same during
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ing the connection when the subscriber's telephone is not in use, substantially as described.

18. In a telephone system, the combination with a telephone line, of a cord circuit to establish connection for conversation, a central common source of current to supply energy to the telephone line during conversation, and a normally inert supervisory signal for the cord circuit placed in the path of current from said source, said signal being inert during conversation but actuated over a circuit local to the central office and including a portion of the talking circuit during the connection when the subscriber's telephone is not in use, substantially as described.
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Signed by me at Chicago, county of Cook, State of Illinois, this 12th day of June, 1903.

WILLIAM W. DEAN.

Witnesses:

ROBERT LEWIS AMES,
EVA A. GARLOCK.