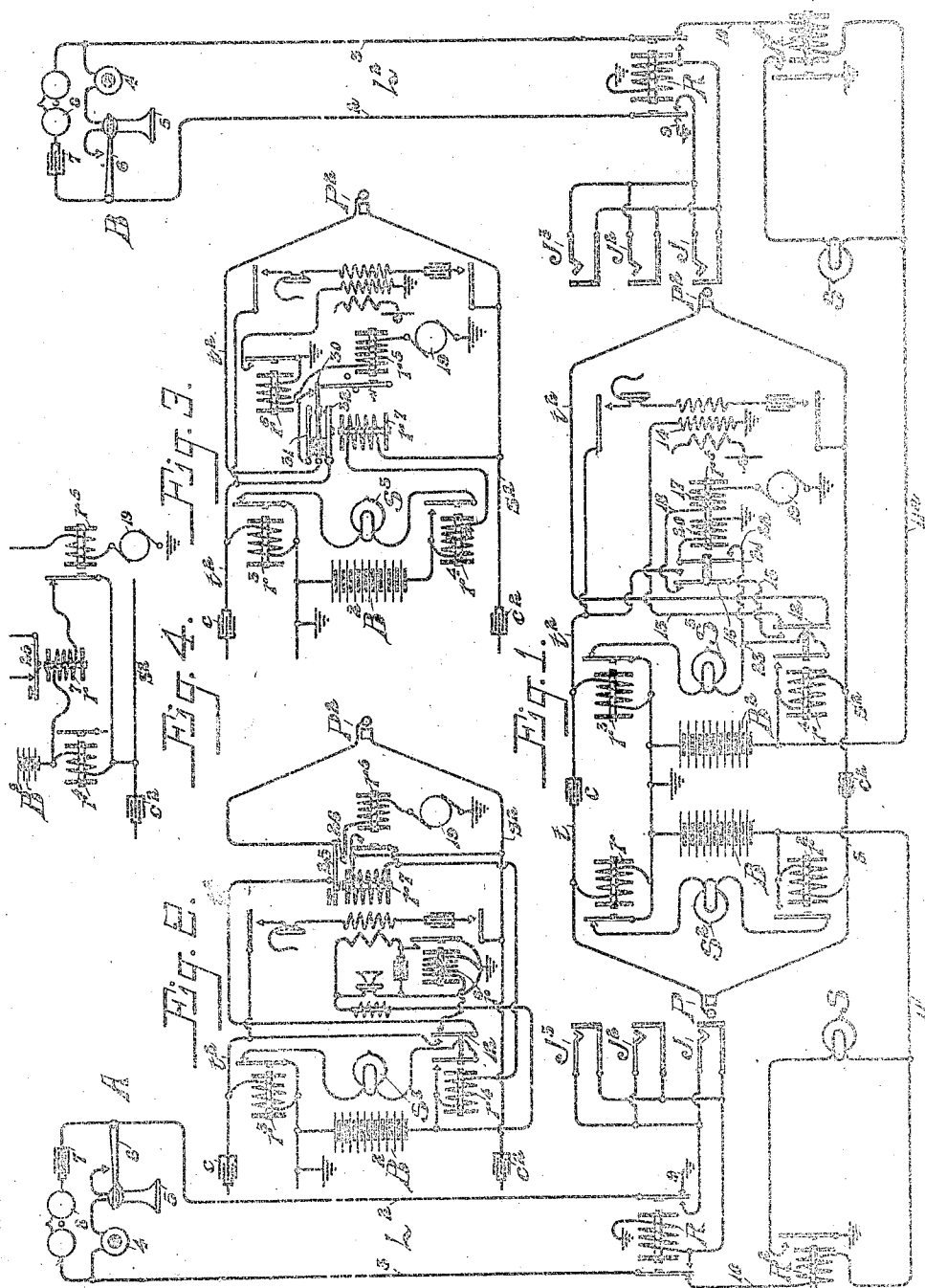


W. W. DEAN.
TELEPHONE SYSTEM.
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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

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To all whom it may concern:

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

My invention relates to telephone systems and particularly for means associated with lines of the two-wire type by which the subscribers located thereon are automatically called upon the connection being established at the central office.

It is desirable in telephone exchange systems to avoid the necessity of manually operating the ringing key to call the wanted subscribers. I therefore arrange mechanism automatically actuated so that upon the insertion of the connecting plug in the jack of the wanted subscriber, the ringing generator is automatically connected with the line and rings the subscriber without further act upon the part of the operator.

The apparatus is further arranged upon the response of the called subscriber to automatically disconnect the ringing generator.

In the accompanying drawing in which the same reference characters indicate like parts throughout the several views, Figure 1 is a diagram of a telephone system embodying my improvements; Fig. 2 is a diagram of a slightly modified arrangement; Fig. 3 is a second modification, and Fig. 4 is a diagram of a different arrangement.

Referring to Fig. 1, L and L² indicate two subscribers' lines extending in two limbs 2 and 3 from the respective substations to the central office. At the substation A a transmitter 4 and receiver 5 are adapted to be included in a bridge of the line by a switch-hook 6 when the receiver is removed therefrom, and a condenser 7 and call bell 8 are permanently connected in a bridge of the line. The same apparatus exists at the station B and at all the other stations of the system. Any other suitable sub-station outfit may be provided in place of that shown.

At the central office the lines are fitted with a calling signal S and with an answering jack J together with multiple jacks J², J³ in any number. A cut-off relay R is provided for each line, the winding of which is legged to ground from the sleeve conductor of the jacks. The springs of the cut-off relay serve to normally connect the line conductor 2 with the grounded branch 9 and the sleeve conductor 3 with the conductor 10 leading to the line relay R² which controls the circuit of the line signal S and the other side of which is connected by means of a conductor 11 with the live pole of a central and common source of current B. The forward contacts of the springs of said cut-off relay R serve to join the switchboard section of the line with the external line circuit during conversation.

The operator's outfit comprises a cord circuit having an answering plug P and a calling plug P² provided with tip and sleeve contact surfaces adapted to register with the corresponding surfaces of the spring jacks. The tip contacts of said plugs are joined by the strands t and t² and the interposed condenser c, while the sleeve contacts thereof are inductively united through the medium of flexible strands s and s² and the interposed condenser c². The battery B is bridged across the answering end of the cord circuit and includes upon either side the supervisory relays r and r², the former controlling through its normally closed contacts and the latter through its normally open contacts the local circuit of supervisory signal S², which is associated with the answering plug P. A similar battery B² is bridged across the calling end of the cord circuit and includes upon either side the supervisory relays r³ and r⁴ which control in a manner similar to the other pair of supervisory relays a local circuit of supervisory lamp S³ which is associated with the calling plug P².

Sleeve supervisory relay r⁴ is provided with an additional spring 12 serving normally to connect through conductor 13 with a tertiary winding 14 of the operator's induction coil, or with other test receptive device. The forward contact of said spring 12 is connected by means of conductor 15 with a spring 16 of a ringing relay r⁶ which has its main actuating winding 17 connected upon one side by conductor 18 with the normal contact of its said spring 16 and upon the other side with the ringing generator 19. The forward contact of said spring 16 is connected with the middle portion of the tip strand t² of the cord circuit. A locking winding 20 is provided upon the ringing relay r⁶ which is connected with spring 21 thereof while the forward contact of said spring is joined by conductor 22 to the point 23 located upon the local circuit of supervisory lamp S³.

The battery B² preferably serves many lines and is connected therewith by means of a branch 11^a.

In the operation of the system the subscriber A takes up his receiver and completes a path for current over his line circuit from the central battery B. The line-relay R² actuates and closes the local circuit of the signal S. Upon observing this signal the operator inserts the plug P of her cord circuit in the answering jack of the calling subscriber and connects her telephone in circuit to receive the order. The insertion of the plug P first closes a local circuit from the battery B through the supervisory relay r², over the sleeve strand s of the cord circuit, the sleeve conductor of the jacks and thence through the winding of the cut-off relay R. Both relays respond to this current, the cut-off relay serving to sever the normal connections of the line conductor and to connect the jacks with the

line, while the supervisory relay r^2 serves to close the local circuit of supervisory signal S^2 . Owing to the fact that the subscriber's telephone is off its hook, current from the battery B circulates in the metallic line as soon as the cut-off relay R is energized. The supervisory relay r , therefore, responds to this current and prevents the lighting of lamp S^2 . Upon learning the order the operator tests the condition of the wanted line by touching the tip of her calling plug P^2 to the test ring of the jack before her of the line wanted. In case the line is idle it is evident that the test rings are connected with ground through the cut-off relay of the line and since the tip of the plug is likewise connected with ground through the tertiary winding 14 of the operator's induction coil the said tip and test contacts are at the same potential and consequently no click is received. In case the line is busy the said test rings are connected with the live pole of the battery B or B^2 , through the sleeve strand of the inserted plug, so that when the grounded tip of the testing plug is touched to the said test rings a flow of current results and a click is received. The high resistance and impedance of the tertiary winding 14 serves to prevent too great or sudden a variation of current upon the connected lines so that they are not disturbed by noise in their instruments. Upon finding a line idle the calling plug P^2 is inserted in the jack of the line which results in energizing the sleeve supervisory relay r^4 over the sleeve conductors and through the cut-off relay of the line. The actuation of the latter serves to connect the two portions of the line together and to render the signals of the line inoperative, while the former completes the local circuit of the supervisory lamp S^3 which is lighted and disconnects through its spring 12 the said tertiary winding and engages with the conductor 15 leading to the ringing relay r^5 . This now connects the ringing generator in circuit which causes current to flow from generator through the winding 17 of said relay r^5 , conductor 18, spring 16, conductor 15, spring 12, the forward portion of tip strand t^2 , the tip side of the line, through the condenser and bell at the substation and thence back to the central office over the sleeve conductor of the line, the sleeve strand s^2 of the cord circuit and through the supervisory relay r^4 and talking battery B^2 to ground. This path is of sufficient resistance to prevent the actuation of relay r^5 but the current flow is enough to actuate the call bell 8 at the subscriber's station. Upon the response of the called subscriber a path for lower resistance is provided at the substation which permits a sufficient increase in the ringing current to energize said ringing relay r^5 which serves in the first instance to disconnect the generator 19 through its spring 16 and to complete the tip strand t^2 of the cord circuit through the forward contact of said spring which places the said cord circuit strand in condition for conversation, and secondly a locking circuit is established for said relay through its winding 20 by means of conductor 22 and spring 21. The ringing generator being now disconnected and the metallic circuit completed current from the battery B^2 flows thereover and actuates tip supervisory relay r^3 , thus opening the circuit of and extinguishing supervisory lamp S^3 to indicate to the operator that the called subscriber has responded and the parties are in communi-

cation. Should the lamp S^3 remain lighted for some time the operator will understand that the called subscriber has not responded and she will take down the connection. At the termination of the conversation the subscribers return their receivers to the hooks, thus cutting off current from the metallic lines and deenergizing tip supervisory relays r and r^3 . This lights the two supervisory lamps associated with the cord circuit, upon observing which the operator takes down the connection and restores all parts to normal condition. It will be observed that after the ringing relay is once locked it cannot be again energized until the withdrawal of the connecting plug.

Fig. 2 shows a modified arrangement in which the tip strand is normally completed through a key 25 and is thence connected by spring 12 of relay r^4 with a high resistance and high impedance test relay r^6 and serves when said relay is energized to complete through its spring 12, the tip strand t^2 of the cord circuit. The sleeve relay r^4 is in series with a relay r^7 in the branch leading from the battery B^2 to the sleeve strand s^2 of the cord circuit. A shunt of said latter relay is controlled through the normally open contacts of the ringing relay r^5 . In testing a wanted line in this arrangement, the testing circuit may flow over the tip strand and through the high resistance and high impedance test relay r^6 . The insertion of the plug of the cord circuit actuates sleeve relay r^4 to close a local circuit of supervisory signal S^3 and at the same time disconnects the test relay, and places the tip strand in condition for talking. The relay r^7 is likewise vitalized but the arrangement is such that the key 25 carrying an armature for said relay is out of the operating field of force of said relay so that the said key is not attracted. In order to connect the generator in circuit, the operator depresses the key 25 which engages contact 26 and establishes a path for the ringing current from the generator 19. The relay r^7 serves now to hold said spring depressed. The high resistance ringing path prevents the actuation of relay r^5 until the called subscriber responds, when the low resistance path permits a sufficient increase of the ringing current though alternating in character to actuate said relay r^5 and cause it to close the shunt about relay r^7 . The latter relay being deprived of current permits the return of key 25 to normal position which disconnects the generator and places the tip strand in condition for talking. Ordinarily the supervisory relays should have about 100 ohms resistance in which case the relays r^4 and r^7 should each have 50 ohms resistance.

In Fig. 3 the relay r^7 is also connected in series with the sleeve relay r^4 and each may have 50 ohms resistance. The forward portion of the tip strand t^2 of the cord circuit is connected to spring 30 of the relay r^7 which is normally connected to the high resistance and high impedance test relay r^6 . Upon the insertion of the connecting plug P^2 the relay r^7 is energized and attracts the armature carrying the said spring 30. This spring in its movement disconnects the test relay and then engages with the end of the armature of the ringing relay r^5 and is thereby held, while the further attraction of said relay r^7 brings the spring 31 suitably connected with spring 30 into engagement with said spring 30, thereby connecting the ringing generator 19 in circuit. This is the condition during the time of calling the wanted subscriber. The tip strand being still open at contact

32. Upon the subscriber's response a greater flow of current takes place through relay r^5 and causes it to withdraw its armature from the end of spring 30 which now springs forward out of contact with spring 31 thus cutting off the ringing generator and into contact with 32 thus completing the strand for talking.

In Fig. 4 the same arrangement as in Fig. 2 may be provided in connection with relay r^7 , but the latter is placed in parallel with the sleeve supervisory relay r^4 and the ringing relay r^5 is arranged to open the circuit thereof upon the response of the called subscriber. The operation will be readily understood. Relay r^7 may have 500 ohms resistance while relay r^4 has the usual 100 ohms.

Although I have described several modifications of my invention, it will be apparent that various alterations may be made therein and still be within the scope and principle of my invention.

Other types of line circuits in which the cut-off relays are actuated over portions of the talking circuits may obviously be employed and still be within the scope of my invention.

Any usual type of listening key may be employed.

I claim:—

1. In a telephone system, the combination with a telephone line, of a signal therefor, a relay actuated over a portion of the talking circuit when a connection is established with the line to render said signal inoperative, a ringing generator, means for connecting said generator in circuit to call the wanted subscriber, and means automatically controlled by the subscriber in his response to the call for disconnecting said generator at the central office, substantially as described.

2. In a telephone system, the combination with a plurality of telephone lines each having a cut-off relay actuated over a portion of the talking circuit, a ringing generator adapted to be connected with a line to call a wanted subscriber, means for maintaining said cut-off relay actuated during ringing, and automatic means controlled by the called subscriber for disconnecting said generator at the central office, substantially as described.

3. In a telephone system, the combination with a plurality of subscribers' lines, of signals for said lines, cut-off relays therefor adapted to render the signals inoperative during a connection, said relay circuits including portions of the talking circuits, a ringing generator adapted to be connected with the lines to call the wanted subscribers, means for maintaining the cut-off relays actuated during ringing, and automatic means controlled by the called subscribers in their response to the calls to sever the connection of the generator at the central office, substantially as described.

4. In a telephone system, the combination with telephone lines having line signals, of a cut-off relay for each line adapted to be actuated by current over a portion of

the talking circuit to render the line signal for the line inoperative, a ringing generator, means to automatically connect said generator with the called line by the act of establishing a connection therewith, means maintaining the cut-off relay actuated during ringing, and means to disconnect said generator automatically upon the response of the called subscriber, substantially as described.

5. In a telephone system, the combination with telephone lines having line signals, said signals being rendered inoperative when connections are established by current over portions of the talking circuit, of a source of ringing current adapted to be connected with the lines to call the wanted subscribers, and means to automatically disconnect the said source after the subscribers have been called, substantially as described.

6. In a telephone system, the combination with telephone lines having line signals, said signals being rendered inoperative when connections are established by current over portions of the talking circuit, of a source of ringing current adapted to be automatically connected with the called lines when a connection is established therewith, and means under the control of the subscriber for automatically disconnecting said source, substantially as described.

7. In a telephone system, the combination with telephone lines having line signals, said signals being rendered inoperative when connections are established by current over a portion of the talking circuit, of a source of ringing current adapted to be automatically connected with the called line when a connection is established therewith for conversation, and means for automatically disconnecting said source when the called subscriber responds, substantially as described.

8. In a telephone system, the combination with a pair of telephone lines, of a cord circuit adapted to connect said lines for conversation, a relay associated with the cord circuit and actuated over a local circuit including a portion of the talking circuit when the cord circuit is connected with a telephone line, a source of ringing current, means controlled by the actuation of said relay for connecting said source with the telephone line, and means actuated upon the response of the called subscriber for again severing said source from its connection with the telephone line, substantially as described.

9. In a telephone system, the combination with a cord circuit, of a relay therefor adapted to be actuated over a local circuit including a portion of the talking circuit when the cord circuit is connected for use, a source of ringing current, and means depending upon the actuation of said relay for connecting said ringing source with a strand of the cord circuit, and further means actuated upon the response of the called subscriber for again disconnecting said source from said cord circuit strand, substantially as described.

Signed by me at Chicago, county of Cook, State of Illinois, this 9th day of February 1903.

WILLIAM W. DEAN.

Witnesses:

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GAZELLE BEDER.