

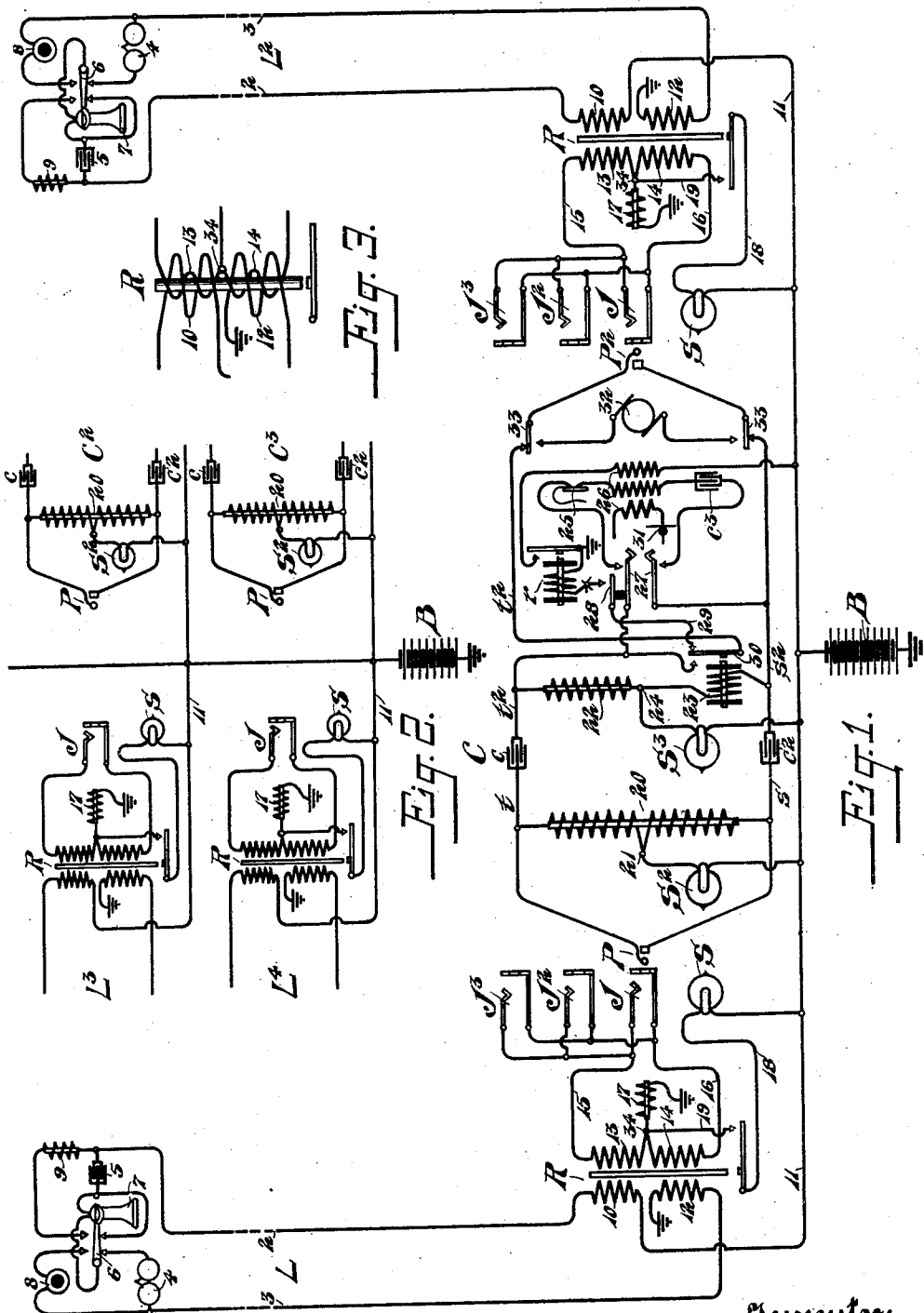
No. 897,723.

PATENTED SEPT. 1, 1908.

W. W. DEAN.

TELEPHONE SYSTEM.

APPLICATION FILED JAN. 22, 1904.



Witnesses:
R. H. Burfield
E. B. Ames

Inventor:
William W. Dean
 by *Robert Lewis Ames*,
 Attorney.

UNITED STATES PATENT OFFICE.

WILLIAM W. DEAN, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

No. 897,723.

Specification of Letters Patent.

Patented Sept. 1, 1908.

Application filed January 22, 1904. Serial No. 190,174.

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 new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to improvements in telephone systems of the common battery type, my object being to provide a system in which the signaling may be carried out without the provision of extra relays and other apparatus in connection with the operator's cord circuit.

In carrying out my invention, I prefer to provide each of the telephone lines with a relay, which under normal conditions controls the circuit of the line signal, and at other times, that is when connections are established with the lines for conversation, the said relays also control the operation of the temporarily associated supervisory signals. Thus, when a connection is established with a telephone line the supervisory signal which is associated with the cord circuit employed for the connection is placed in parallel with the line signal of that line, and the adjustment and electrical dimensions of the various parts are such that when the subscriber's telephone is off its hook neither the line nor supervisory signal receives sufficient current to operate the same but when the telephone of the subscriber is replaced upon its hook, then sufficient current is permitted to flow through the supervisory signal to cause the same to be operated. Likewise when no connection is established with the line, the closing of the circuit of the line signal, as when the subscriber calls the central office, permits a sufficient flow of current through the said signal to cause the same to operate. In prior systems of this general type, the parallel circuits for the two signals were completed over circuits which were entirely distinct from the talking circuits of the lines whereby extra wires in addition to the talking wires were required for each line throughout the multiple switchboard. But in my invention no additional wires to thus bring the signals into parallelism are required. There thus results a system which as a whole is simple in the amount of apparatus and wiring required, that is correspondingly inexpensive to install, and which is efficient in operation.

In the accompanying drawing in which an embodiment of my invention is illustrated and in which the same reference characters designate like parts throughout: Figure 1 is a diagram showing two telephone lines and the central office apparatus necessary to connect them together for conversation; Fig. 2 is a diagram showing a plurality of cord circuits as well as line circuits, and Fig. 3 is a detail view of one of the repeating coil relays.

Referring to Fig. 1, L and L² indicate two telephone lines extending in two limbs 2 and 3 from their respective substations to the central office. At the substations any suitable or desired common battery outfit may be provided, but that shown and which I prefer to employ comprises an ordinary signaling bell 4 and a condenser 5 in a bridge of the line conductors, which is normally closed by the switch-hook 6 when the receiver 7 is hung thereon, and which when the receiver is raised suitably connects the transmitter 8 and the retardation coil 9 together with said condenser and receiver in circuit to permit the subscriber to carry on conversation.

At the central office each line is provided with the usual signal S and a plurality of jacks such as J, J² and J³ in any desired number and suitably distributed throughout the answering and multiple sections of the switchboard. A repeating coil relay R is provided for each telephone line, the winding 10 thereof being included between the line conductor 2 and the battery lead 11, extending to the live pole of the central common battery B, while a second winding 12 is connected in the line conductor 3 which is joined to the earth connection of the exchange to which the opposite pole of the said battery B is similarly united. Thus the battery B is included permanently in the telephone line between the windings 10 and 12 of the said repeating coil. The inductively associated windings 13 and 14 of said repeating coil are connected by conductors 15 and 16 between the tip and sleeve contacts of the spring jacks of the line, a suitable retardation coil 17 being included in an earthed connection from the central point 34 of said windings 13 and 14. The windings of this relay are arranged as more clearly shown in Fig. 3, the windings 13 and 14 forming in reality a continuous coil wound throughout in the same direction on the core. The line signal S is connected upon one side with the said battery lead 11 and upon the

other side by conductor 18 with one of the normally open contacts of the said repeating coil relay R, the other of which contacts is united by means of conductor 19 with the said middle point 34 of windings 13 and 14 of the repeating coil. The said battery may be of 24 volts, the retardation coil 17 of 100 ohms and the coils 13 and 14 of 10 ohms each. The line signal S is preferably a ten volt lamp. Thus, when the subscriber's line is closed at the substation current from the battery B is permitted to flow thereover through the windings 10 and 12 of the repeating coil relay R, which attracts its armature, thereby closing its normally open contacts and including the 10 volt lamp S in a conductive path from the battery lead 11, the lamp itself, conductor 18, the normally open contacts of the relay R which are now closed, the conductor 19, point 34, retardation coil 17 and thence through the earth connection to the opposite pole of the battery B, thereby lighting the signal S to indicate the subscriber's call.

The operator's outfit comprises a plurality of cord circuits of the type shown in the drawing, each of which is 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 the said plugs are united by means of the flexible strands *t* and *t*² and the interposed condenser *c*, and their sleeve contacts are similarly joined by strands *s* and *s*² and the interposed condenser *c*². Across the answering end of the cord circuit, a suitable retardation coil 20 of about 20 ohms resistance is connected, the middle point 21 of its winding being connected upon one side with the supervisory signal S², which takes the form of a 10 volt incandescent lamp, and whose other terminal is joined to the battery lead 11. Across the calling end of the cord circuit the retardation coils 22 and 23 are connected, each of which has about 10 ohms resistance, the latter coil taking the form of a relay in order to suitably carry out the busy test, which will be hereinafter explained.

The middle point 24 of these windings is connected upon one side with the 10 volt lamp S³, which serves as a supervisory signal for the associated plug P², and the opposite terminal of which is likewise connected with the battery lead 11. The operator's head telephone 25, the secondary winding of her induction coil 26 and a suitable condenser *c*³ are adapted to be connected in a bridge of the calling end of the cord circuit by means of the springs 27 of any suitable listening key. The said key has an additional contact 28 connected by conductor 29 with the resting contact of said relay 23, the movable contact 30 of which is connected with the forward portion of the tip strand *t*² of the cord

circuit and serves to normally open said strand but during connections for conversation to close the same and to disconnect the conductor 29. The outer contact of this spring 28 of the listening key is connected with the test relay *r* which controls through its normally open contacts a local circuit including the tertiary winding of the operator's induction coil 26. The operator's transmitter 31 and the primary of her induction coil are adapted to be charged from any suitable source of current and which may be the battery B. A ringing generator 32 is adapted to be connected with the calling plug P² by the operation of the ringing key springs 33.

In the operation of the system, the subscriber upon the line L for example takes up his receiver and thereby completes a path for current over his metallic line from the battery B. This excites the relay R and closes the local circuit of the line signal S as before stated and causes it to light. Upon observing the signal the operator inserts the answering plug P of the cord circuit and connects her telephone with the cord circuit to receive the order of the subscriber. The insertion of the plug connects the supervisory lamp S² in parallel with the lamp S of the telephone line and owing to the voltage of the source of current and the resistances of the two parallel branches neither lamp receives sufficient current to light the same. The path for current through the supervisory lamp includes the battery lead 11; the lamp S²; point 21; thence in parallel over the two portions of the winding of the retardation coil 20, the two strands *t* and *s* of the cord circuit, the conductors 15 and 16 of the jack section *f* the line and the windings 13 and 14 of the repeating coil to junction point 34; and thence through the retardation coil 17 to ground. This path from the point that the lamp S² taps on to the battery lead 11 to the junction point 34 is in parallel with the path for current through the line signal S, and its resistance is slight as compared with the resistance of the retardation coil 17; hence sufficient current is not received in either the lamp S or S² to cause the same to light.

Upon learning the order of the calling subscriber the wanted line is tested in the usual manner by touching the tip of the plug to the test ring of the multiple jack of the wanted line that is located upon the initiating operator's section of the switchboard. It will be observed that normally the test rings are grounded through the retardation coil 17. Hence the application of the grounded tip of the plug P² results in no current flow and the operator knows that the line is idle. If the line is busy, however, said test rings are connected with the live pole of the battery B through the sleeve strand of the inserted cord circuit and in such case the application of the grounded tip of the plug results in

energizing the test relay *r* which closes a local circuit through the operator's induction coil and causes a click in her receiver, thus indicating that the line is busy. Assuming that the line is found idle, the calling plug *P*² is inserted and the ringing key 33 depressed. This ringing current flows through the windings 13 and 14 of the repeating coil which inductively act upon the external line circuit and cause the operation of the subscriber's bell 4. The repeating coil is not sufficiently excited by this ringing current to cause the line signal *S* to give false signals.

After ringing and before the subscriber's response, a path for current is completed from the live pole of the battery *B* through the supervisory signal *S*³, the relay 23, sleeve strand *s*², conductor 16 of the called line, winding 14 of the repeating coil through the retardation coil 17 to ground. As soon as current flows in this path it energizes the relay 23 which disconnects the test relay and completes the tip strand *t*² for conversation. Immediately upon the completion of this strand current flows likewise through the retardation coil 22, over the strand *t*², and through the repeating coil winding 13 to join the current flowing through the coil 17 to ground. The current in this path acts differentially upon the windings 13 and 14 of relay *R* which therefore remains unenergized, and the supervisory lamp *S*³ receives sufficient current to light the same. The lighting of this supervisory signal *S*³ indicates to the operator that the subscriber has not yet responded.

Upon the response of the subscriber current from the battery *B* flows through the windings 10 and 12 of the repeating coil thereby energizing the same and connecting the line signal in parallel with the supervisory signal *S*³ which, as before explained in connection with the other end of the cord circuit, does not permit either lamp to light, and the supervisory signal is thus retired. During conversation the battery *B* is furnishing current through the windings 10 and 12 of the repeating coils to the subscribers' stations upon the two lines for operation of the transmitters as well as for the operation of the relays *R*. Voice currents are repeated from the external line circuits to the switchboard sections of the lines by means of the repeating coils and are propagated from one end of the cord circuit to the other through the intermediation of the condensers *c* and *c*². At the termination of the conversation, the return of the subscribers' receivers to the hooks deenergizes the two relays *R* and causes them as before explained to open the local circuits of the line signals *S*. The supervisory signals now receive the entire current flowing through the associated retardation coil 17 and are lighted by it to indicate to the operator that the conversa-

tion has terminated. Upon observing these signals she takes down the connection and restores all parts to normal condition.

Fig. 2 is intended to clearly show the use of any cord circuit with any of the telephone lines. Thus the cord circuit *C*² may be used with the line *L*³ or *L*⁴ and the parts will operate in the manner heretofore described in connection with Fig. 1, and the cord circuit *C*³ may be used with either of the lines in the same way. This condition is present throughout the exchange.

While I have described one particular method of carrying my invention into effect, I would have it understood that it is not so limited in all respects but is capable of being embodied in various forms.

Having thus described the 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 relay therefor, a line signal the circuit for which is controlled by said relay, a source of current adapted to be included in said circuit with said signal, a two-conductor cord circuit for establishing connections with the line for conversation, a supervisory signal associated therewith and adapted to be included in a second circuit out of the path of voice currents when the cord circuit is connected with the line, said second circuit including a portion of the cord circuit and a portion of the line circuit and said source, said portions together with the supervisory signal being in parallel with said line signal whereby when the connection is established and the said relay is operated one signal receives insufficient current to operate the same but when said relay is deenergized the supervisory signal is operated, substantially as described.

2. In a telephone system, the combination with a telephone line, a line signal for the line, a differential relay controlling said signal a cord circuit to establish connections with the line, a supervisory signal associated with the cord circuit, and means for placing the supervisory signal and the line signal in parallel branches of a local circuit when the connection is established, substantially as described.

3. In a telephone system, the combination with a telephone line, of a cord circuit to establish connections therewith for conversation, a signal for the line, a supervisory signal associated with the cord circuit, means for including said signals in parallel branches in the same local circuit whereby said signals are retired and a differential relay in the line controlling one of said parallel branches and the other parallel branch being completed through contacts of the plug and line jack, substantially as described.

4. In a telephone system, the combination with a telephone line, of a two-conductor

cord circuit to establish connections therewith for conversation, a line signal, a supervisory signal normally in an open circuit out of the path of voice currents during conversation, means for including said signals in parallel branches of the same circuit whereby said signals are retired, one of said branches including a portion of the talking circuit whereby no extra wires are required for the same throughout the multiple switchboard and the other branch being controlled by the subscriber, substantially as described.

5. In a telephone system, the combination with a telephone line, of a two-conductor cord circuit to establish connections with the lines for conversation, a line signal for the line, a supervisory signal normally in an open circuit of the cord circuit, said signals being adapted to be connected in parallel whereby they become inoperative, and means whereby a subscriber is enabled to normally control the line signal and during connections to control the supervisory signal, substantially as described.

6. In a telephone system, the combination with a telephone line, of a relay therefor, a line signal the circuit for which is controlled by said relay, a source of current adapted to be included in the circuit of said signal, a cord circuit for establishing connections with the line for conversation, a supervisory signal associated therewith and adapted to be displayed by current over a path including portions of the talking strands of the cord circuit in parallel, a portion of the line circuit and a resistance, when the cord circuit is connected with the line, said circuit, excluding said resistance, being adapted to be placed in parallel with said line signal by the actuation of the line relay, whereby insufficient current flows through either of said signals to display it, substantially as described.

7. In a telephone system, the combination with a telephone line, of a relay adapted to be actuated by current in the line, a signal circuit controlled by contacts of said relay, a cord circuit adapted to be connected with said line for conversation, a signal associated therewith and adapted to be displayed by current over the talking strands of said cord circuit in parallel and adapted to be effaced by placing the line signal in parallel with said cord signal when the line is closed at the substation, substantially as described.

8. In a telephone system, the combination with a telephone line, of a relay associated with said line, a cord circuit to establish connections with said line for conversation, a line signal, a supervisory signal, means for

displaying said line signal over a path including a resistance, means for displaying the supervisory signal over a path including a portion of each of the talking strands of the cord circuit in parallel, a portion of the line circuit and said resistance, and means upon the actuation of said line relay for including said signals in parallel branches of the same circuit containing said resistance, whereby neither signal receives sufficient current to display it, substantially as described.

9. In a telephone system, the combination with a telephone line, of a relay for said line, a signal controlled thereby, a cord circuit adapted to connect with said line, differential windings upon said relay adapted to be supplied with current from said cord circuit, other windings on said relay adapted to be supplied by current over the line, and means whereby the actuation of the relay depends entirely upon current in the line, substantially as described.

10. In a telephone system, the combination with a telephone line, of a cord circuit adapted to be connected therewith, a signal associated with the cord circuit a third conductor at the central office, the circuit of said signal being completed over a local circuit including the two strands of the cord circuit in parallel and said third conductor when a connection is established with a line, substantially as described.

11. In a telephone system, the combination with a cord circuit of a line jack, a resistance connected between the two talking strands of said cord circuit, a source of current, a signal connected between an intermediate point of said resistance and one pole of said source, a third conductor at the central office normally connected with said line jacks, and means to complete the circuit of said source and said signal over a local circuit including said third conductor, when the cord circuit is connected with said line jack, substantially as described.

12. In a telephone system, the combination with a cord circuit, a source of current and a signal associated with the cord circuit, a third conductor and means to actuate said signal by current over a local circuit including the limbs of the cord circuit in parallel and said third conductor, substantially as described.

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

WILLIAM W. DEAN.

Witnesses:

E. A. GARLOCK,
ROBERT LEWIS AMES.