

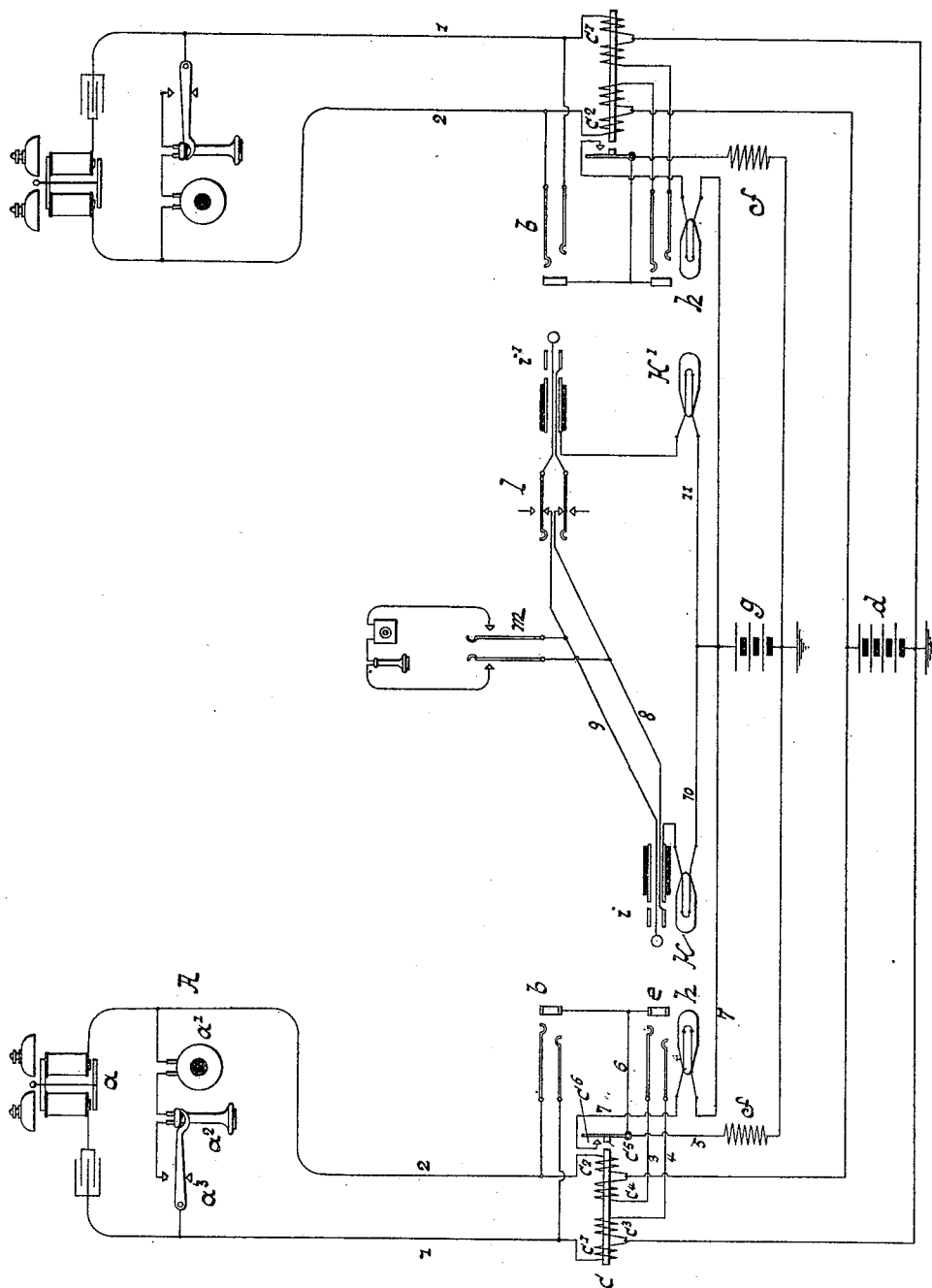
No. 641,721.

Patented Jan. 23, 1900.

F. R. McBERTY.
TELEPHONE EXCHANGE SYSTEM.

(Application filed Nov. 24, 1896.)

(No Model.)



Witnesses:

John H. Sinclair
John H. Sinclair

Inventor:

Frank R. McBerty

by *Barton Brown* attys

UNITED STATES PATENT OFFICE.

FRANK R. McBERTY, OF DOWNER'S GROVE, ILLINOIS, ASSIGNOR TO THE
WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS.

TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 641,721, dated January 23, 1900.

Application filed November 24, 1896. Serial No. 613,261. (No model.)

To all whom it may concern:

Be it known that I, FRANK R. McBERTY, a citizen of the United States, residing at Downer's Grove, in the county of Du Page and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 46,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

This invention applies to switching systems in which subsidiary signals in the switchboard are controlled through the agency of a relay connected with the line and responsive to currents therein determined by the position of appliances at the substation; and it concerns particularly the species of that system in which repeating-coils (one for each line) are employed for the purpose of rendering the signals associated with two connected lines independently responsive to currents in the corresponding lines, the repeating-coils themselves being furnished with moving parts to serve as relays. To describe this existing system more specifically, one winding of an induction or repeating coil is included, together with a source of current in a telephone-line, the continuity of the telephone-line being controlled at the substation by the telephone-switch there. The other winding of the repeating-coil is included in a circuit in the switchboard which terminates in the normally-open switch-contacts of spring-jacks in the switchboard. The repeating-coil is furnished with an armature which controls switch-contacts in local circuits including the subsidiary signals, one of which is permanently associated with the line and constitutes the line-signal, the other of which is temporarily associated with the line through the agency of the spring-jack and connecting-plug when connection exists with the line and constitutes a supervisory signal for the operator. The use of repeating-coils in the line-circuit in this manner for controlling the subsidiary circuits is demanded in some cases by certain practical considerations which are familiar to those versed in telephony and need not be mentioned. Their use in this manner is open to the objection, however, that a com-

pleted connection between two subscribers' lines involves two repeating-coils interposed in the circuit, whereby the efficiency of telephonic transmission is impaired.

One object of the present improvement is to so arrange the circuits of the lines and repeating-coils in connection with the line-jacks and answering-jacks of the lines that no more than one repeating-coil shall at any time be included in a telephonic circuit between two stations, although the repeating-coils of both lines remain effective for operating signals.

A further object is to so arrange the signals that one of them shall serve to call for disconnection only, the other indicating the condition of the substation appliances of the called line.

To this end the invention consists in leading the secondary winding of one of the repeating-coils directly to the answering-jack of a subscriber's line and in connecting the line circuit or terminals of the primary winding of the repeating-coil with the line-jacks of the subscriber's line, so that when two lines are united for conversation, such union being effected in the usual way by means of a plug inserted in the answering-jack of the calling-line and another plug in the line-jack of the correspondent line, the telephonic circuit involves only the repeating-coil associated with the calling-line. The repeating-coils of both lines remain in connection with their respective line conductors, however, and both retain their functions in controlling subsidiary signals.

The core of each repeating-coil may be furnished with a movable armature, which may serve to control a local signal-circuit. It is therefore proper to speak of the repeating-coil as a "signal-controlling electromagnet."

The primary and secondary windings of the repeating-coil are preferably each divided into two portions and each half of the primary connected with a corresponding half of the secondary. The two terminals of the primary are connected with the two limbs of the telephone-line, and the two terminals of the secondary are connected with contact portions of the answering-jack. The line-jack is tapped directly upon the line between the primary and the substation. The points of

junction of the two primary and two secondary portions of each repeating-coil are preferably connected together by a bridge-conductor which includes a source of current common to all the repeating-coils. Considering now that the answering spring-jack of one line is connected with the line-jack of another line through the usual pair of plugs and cord-circuit, we have a complete circuit made up of the united lines with switches at the substations for controlling the continuity of the circuit, a signal-controlling electromagnet (the repeating-coil of the calling-line) having a winding (made up of a primary and a secondary portion) included in series in the circuit of the united lines, a bridge-circuit including a source of current extending from a point within the winding—i. e., from the junction of the primary and secondary portions—to the other side of the circuit—as, for instance, to the junction of the other two parts of the primary and secondary windings of the repeating-coil—and a second signal-controlling electromagnet associated with the other line (in this instance the called line) having a winding connected in a branch of the bridge-circuit from the source of current, which branch connects such winding in parallel with a portion of the windings of the first-mentioned electromagnet. The repeating-coil of the calling-line, then, is controlled by both switches—that is, current will flow through one or more of the windings of such coil if either switch is closed and will be deprived of current only when both switches are open. The repeating-coil of the called line, however, is controlled only by the switch at the called station, since, as is evident, the primary winding of the called line is short-circuited, so far as the calling-line is concerned, by the bridge-conductor which connects the source of current directly with the junction of the primary and secondary windings of the repeating-coil of the calling-line. The improvement is illustrated in the drawing herewith, wherein two subscribers' lines are represented extending to a switchboard, including repeating-coils in the switchboard, together with the usual switching and signaling appliances at the central office.

Referring to the drawing, the appliances at the substation may comprise a signal-bell a , a transmitting-telephone a' , a receiving-telephone a'' , and a telephone-switch a^3 for closing a circuit through the telephones during their use. The circuit through the signal-bell should be of very high resistance, in order that an appreciable increase in the signaling-current in the line-circuit may be produced when the telephone is brought into circuit. These appliances are connected by the line conductors 1 and 2 with the apparatus in the switchboard at a central office. These line conductors are connected directly with one or more line-jacks or terminal-sockets b , several such terminal-sockets being employed in the case of a multiple board. The two line con-

ductors extend farther through two windings c^1 and c^2 of a repeating-coil c , and thence to the terminals of a source d of current which is common to the different lines of the exchange. Two other windings c^3 and c^4 of the repeating-coil have two of their terminals led to the poles of the same battery d and their other terminals connected by wires 3 and 4 with the switch-contacts of an answering-jack e in the switchboard.

The repeating-coil is provided with the usual core, and a pivoted armature c^5 is arranged in position to be attracted by this core. This armature is furnished with an alternate-contact c^6 , with which it makes contact when attracted. This switch controls the local circuit, which includes the subsidiary signals in the switchboard. The armature-lever is connected to earth by wire 5, which includes a resistance-coil f . The same part is also connected by a wire 6 with the ring or thimble contact in each of the spring-jacks b and e belonging to the same line. The contact-anvil c^6 is connected by wire 7 with the free pole of a grounded source g of current, a line signal-lamp h associated with the answering-jack e being interposed in the wire.

The switchboard is furnished with the usual pairs of plugs i and i' , each having contact-sections constructed to register with the corresponding parts of a spring-jack into which it may be inserted. The tips and shortsleeves of the plugs are united by conductors 8 and 9, respectively, which constitute the plug-circuit and form the link conductors which unite the lines into a telephonic circuit. The longer sleeves of the plugs, which make connection with the thimbles of the spring-jacks, form the terminals of wires 10 and 11, respectively, which lead to the free pole of battery g . In each of these wires is connected a supervisory lamp-signal associated with the corresponding plug, the two signals being designated k and k' , respectively. It will be observed that when one of the plugs is inserted into a spring-jack the supervisory lamp is brought into parallel circuit with the line-lamp h , the switch-contacts of the relay being assumed to be closed, the two being in series with the resistance-coil f and the battery g . This resistance-coil should have such resistance that the lamps under this condition shall not be illuminated. Then if the relay should permit its switch-contacts to separate the current through the resistance-coil would be diverted entirely through the supervisory lamp and would cause its illumination.

The plug-circuit is furnished with the usual appurtenances—a calling-key l for connecting a generator of signaling-current with plug i' and a listening-key m for connecting the operator's telephone with the plug-circuit.

In the normal condition of this system no current flows through the windings of the repeating-coils, since the circuits of the lines are interrupted at the substations. Accordingly, the relays being inert the local or sub-

subsidiary signal-circuits are also interrupted, the signals therein being inert.

The removal of the telephone from its switch at the substation permits the switch to close the line-circuit, whereby current is set up through the windings of the relay. Assume that such an act has been performed at station A. The core of the relay being excited, the armature c^5 is attracted and closes the local circuit 5 7, whereby the subsidiary signal h is lighted. Observing this signal the operator inserts the plug i into the answering-jack e of the line, at the same time bringing her telephone into connection with the plug-circuit 8 9. The act of inserting the plug into the answering spring-jack forms the telephonic circuit through conductors 1 2 and 3 4 of the line, this circuit being completed through the repeating-coil c . The operator is thus enabled to communicate with the subscriber and learn his order. The same act has brought the supervisory signal k into parallel circuit with line-signal h , whereby the latter is extinguished, the former remaining still dark. Having learned the order, the operator inserts the plug i' into a line spring-jack b of the corresponding line. The plug-circuit, which forms an extension of windings c^3 and c^4 of repeating-coil c , is now complete directly to the line conductors 1 2 of the correspondent line. The telephonic circuit thus formed between the substations, it will be observed, includes but one repeating-coil, that being coil c of the calling-line. The two windings c' and c^2 of the correspondent or answering line remain appended to the circuit, but on account of their impedance do not permit the loss of telephonic current through them. The insertion of plug i in the spring-jack b of the correspondent line completes a circuit made up of conductors 5 and 6 of that line and strand 11, connected with the plug. During the time between the establishment of the connection and the response of the called subscriber to the operator's signal the supervisory lamp k' will receive all the current through the resistance-coil f , the conductor 7 of the called line being interrupted at the switch-contacts of the relay of that line. When, however, the called subscriber answers, removing his telephone from its switch, the core of repeating-coil c of that line becomes excited through the action of current in its windings c' and c^2 . That relay then closes the conductor 7, which it controls, completing a shunt about the supervisory lamp k' , and thus bringing about its extinction. It will be noted that if the subscriber at the calling - substation should replace his telephone upon its switch supervisory lamp k would not become illuminated thereby, since current would still exist through windings c^3 and c^4 of the same repeating-coil. When, however, both subscribers replace their telephones upon their switches, the currents through both repeating-coils are interrupted

and both relays interrupt the conductors 7, which they control. Hence both supervisory lamps k and k' become lighted, and thus give the signal for disconnection. Thus the signal k serves only to call for a disconnection, becoming displayed only when both substation-telephones have been replaced. The supervisory signal k' on the other hand is independent of control by the calling-line and serves to indicate the position of the apparatus at the called substation at all times, and thus to signalize to the operator the response of the subscriber called.

I claim as new and desire to secure by Letters Patent—

1. The combination with two telephone-lines extending from substations and adapted to be connected together at a central office to form a complete circuit, of switches, one at each substation, for controlling the continuity of the circuit, a signal-controlling electromagnet associated with one of the lines, said electromagnet having a winding c' c^3 included in series in the circuit of the united lines, a bridge-circuit including a source of current, extending from a point within said winding to the other side of the circuit, and a second signal-controlling electromagnet associated with the other line and having a winding connected in a parallel branch of the bridge-circuit, whereby the first-mentioned signal-controlling electromagnet is controlled by the switches at both substations, and the other electromagnet is controlled by the switch of one substation alone, substantially as set forth.

2. The combination with two united telephone-lines forming a complete circuit and switches at the substations for controlling the continuity of such circuit, of a repeating-coil associated with one of the lines at the central office and having two windings c' c^3 and c^2 c^4 connected one in each side of the circuit, an armature for said repeating-coil controlling a signal, a source of current connected in a bridge-circuit between points within the said windings, and a signal-controlling electromagnet associated with the other line and having a winding connected in a branch of the bridge-circuit, forming a bridge including the source of current and connecting said electromagnet in parallel with one of the windings of the repeating-coil, substantially as described.

3. In combination, two telephone-lines, a repeating-coil for each line having its primary and its secondary windings united, a source of current and a bridge of each circuit from the point of junction of the said windings including the source of current, a spring-jack connected with the primary circuit of one line, a spring-jack connected with the secondary circuit of the other line, and plugs and a plug-circuit uniting the said spring-jacks, an armature and switch-contacts controlled thereby for each line, and a super-

visory signal for each line in a local circuit controlled by the corresponding switch-contacts, substantially as described.

4. In combination, two telephone-lines each
5 with a switch adapted to close the circuit at the substation during the use of the telephone, a repeating-coil for each line, the primary and secondary windings of the repeating-coil being united, a bridge of each line-
10 circuit, and a common source of current in the said bridge, a line spring-jack connected with the primary winding of each repeating-coil and an answering-jack connected with the secondary winding of each repeating-coil,
15 plugs and a plug-circuit for uniting any answering-jack with any line-jack, an armature and switch-contacts controlled thereby for each repeating-coil, a subsidiary line-signal for each line in a circuit controlled by the
20 corresponding switch-contacts, a supervisory signal for each plug, and means for bringing the supervisory signal into a circuit controlled by the corresponding repeating-coil when a plug is inserted into the spring-jack of that
25 line, substantially as described.

5. The combination with two telephone-

lines, of a switch at each station for closing the line-circuit to produce a flow of current in the line during the use of the telephone, an answering-jack and a line-jack for each
30 line, plugs for uniting any answering-jack with any line-jack, a signal-controlling instrument associated with each line, circuit connections between the instrument and one of said spring-jacks adapted to bring the sig-
35 nal-controlling magnet into circuit with both lines, and other circuit connections between the said instrument and the other spring-jack of the line adapted to bring it into circuit with that line alone, and a bridge of the plug-
40 circuit and a source of current therein adapted to operate the said signal-controlling instruments, as described, whereby one signal is controlled by currents in both lines and the other is responsive to current in one line only. 45

In witness whereof I hereunto subscribe my name this 13th day of August, A. D. 1896.

FRANK R. MCBERTY.

Witnesses:

ELLA EDLER,

LOLA J. BRINKERHOFF.