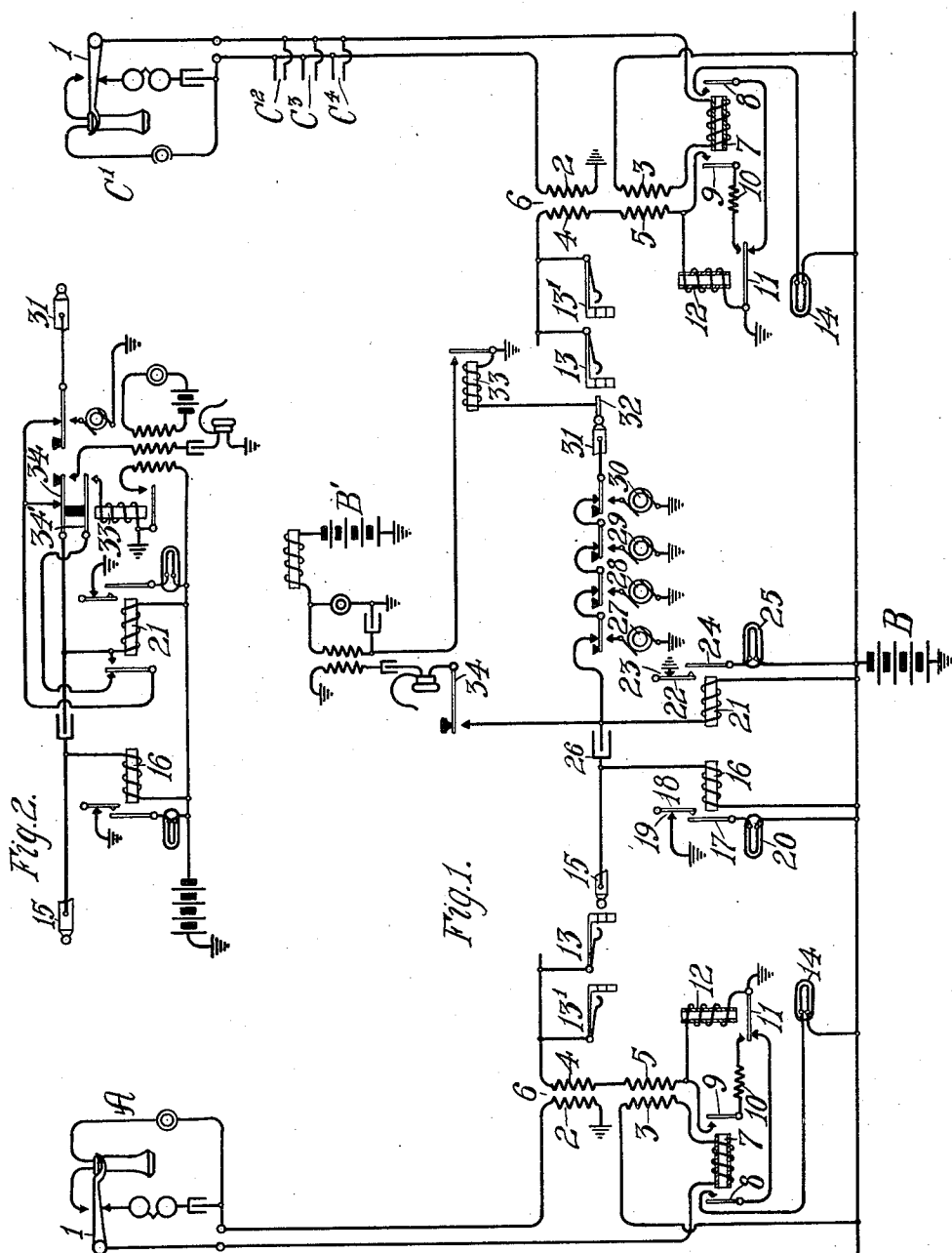


H. G. WEBSTER.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED DEC. 28, 1907.

1,022,522.

Patented Apr. 9, 1912.



Witnesses:

George E. Mueller
Wm Berghahn.

Inventor:

Harry G. Webster

UNITED STATES PATENT OFFICE.

HARRY G. WEBSTER, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

TELEPHONE-EXCHANGE SYSTEM.

1,022,522.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification.

My invention relates to manual telephone systems wherein the lines are provided with multiple connection terminals at the exchange, the terminals of each line being interconnected by but a single conductor, such a system being ordinarily known as "one-wire" system.

The present invention is directed more particularly toward an improved method of control of the supervisory signaling mechanism of an operator's cord-circuit, what are known as double-acting relays being jointly controlled by the subscribers and operators.

Other features of the invention will be more particularly pointed out in the detailed description and the claims.

In the drawing, Figure 1 is a diagram of line and cord-circuits constituting one embodiment of my invention, and Fig. 2 is a diagram of a modified cord-circuit.

In Fig. 1, a substation A is illustrated connected by its telephone with the exchange, whereat is shown an operator's circuit for connecting with the line. At C' is shown another station connected by another line with its line circuit at the exchange. This latter line is adapted for party-line service, the taps to three other subscribers' stations being indicated at C², C³, C⁴.

The substation and line at the left of Fig. 1 are similar to those at the right thereof, and a description of the mechanism associated with the line of A will suffice for both. At the substation, I have shown a well known arrangement of mechanism wherein hook-lever 1, when the receiver is on the hook, maintains the call-bell and the customary condenser in bridge of the line limbs, while on removal of the receiver, the hook-lever will rise to engage its alternate contact, thus connecting the transmitter and receiver operatively with the line limbs. At the exchange, a repeating coil is indicated as a whole at 6 whose windings 2 and 3 are connected with the two limbs of the line, the battery B being bridged between the said windings. The complementary windings 4, 5, of this repeating coil are con-

nected by a conductor having branches to the spring-jacks 13, 13', the opposite terminal of the said windings being connected through the cut-off relay 12 to earth. Serially included between the winding 3 and that limb of the line connected with it, is the line relay 7 controlling the customary call lamp 14. The non-inductive resistance 10 is connected to the armature switch mechanism of both relays 7 and 12 to the end that the joint energization of said relays may be effected to produce a low resistance connection from earth to the multiple spring-jacks 13, 13', for coöperation in the control of the supervisory mechanism.

The operator's cord-circuit may comprise the answering plug 15 and the calling plug 31, having a single talking conductor interconnecting them in which the condenser 26 is inserted. That portion of the talking conductor extending from condenser 26 to the calling plug 31 has four ringing key levers associated with it, one for each of the generators 27, 28, 28, 30, which are capable of delivering ringing current of different predetermined frequencies to selectively ring tuned bells at substations C', C², C³, C⁴, in the well known manner. Connected between the active side of battery B and the answering talking conductor is the double-acting relay 16 capable of a limited energization to cause its armature 17 to engage contact 18 without opening contact 18—19, said relay being adapted thereafter for further energization to complete a further attraction of armature 17 to open the contact 18—19, the supervisory lamp 20 being lighted by the limited energization and put out by the more complete energization, in an obvious manner. The supervisory relay 21 is connected between the active side of battery B and the calling talking conductor and is for partial energization to close a contact 23, 22, 24, to display supervisory calling signal 25 and for further actuation to cause the contacts 22, 23, to be opened to put out the said signal.

Assuming that substation A desires to be connected with the substation C, the removal of the receiver at the substation A closes a circuit from ground, winding 2, alternate contact 1, relay 7, winding 3 to battery B actuating relay 7, whose armature 8 closes a circuit from ground through contacts 11 and 8, call lamp 14, to manifest the

call. The operator answering, inserts plug 15 in the answering spring-jack 13 whereon current will flow from battery B, relay 16, contact 15—13, windings 4—5, cut-off relay 12 to ground, actuating the said cut-off relay, whereon a branch to ground about said relay 12 through contacts 9 and 11, and resistance 10 will be completed, sufficient current now passing through relay 16 to fully actuate its armature 17, whereby answering supervisory signal 20 remains undisplayed. The operator actuating lever 34 ascertains the number of the wanted subscriber, assumed to be C', and now touches the test contact 32 to a spring-jack of the called line to test the same. The test relay 33 being connected to contact 32 and ground will remain unoperated if an operator's plug has not been inserted within a jack of the called line, since under these circumstances, the potential at the tested jack will be that of ground. The armature of relay 33 thus remains unattracted and no click is produced in the operator's receiver. If, however, the called line has already been connected to by another plug, current would be flowing from battery B or from one of the generators to ground through relay 12. In such case, when contact 32 was touched to a spring-jack of the line, current would find its way to ground through the test relay 33, actuating the same to attract its armature and cause the customary click in the operator's head telephone in which case she would know that the other line was busy. Assuming that the called line is idle, the operator will insert plug 31 within the tested spring-jack at which time the contact 32 will not be engaging the spring-jack. The operator now actuates the ringing lever of that particular generator adapted to cause the bell at substation C' to ring, current from generator passing through contact 31—13, windings 4—5, and the cut-off relay 12 to ground, said cut-off relay being preferably rendered of relatively low resistance to the varying generator currents as by a copper shell about its core or by a non-inductive shunt, the former, however, being preferably employed. The current variations produced in windings 4 and 5 will be repeated to windings 2 and 3 and will pass over the calling line, ringing the call-bell, line relay 7 being preferably also non-inductive to varying currents not only to render the ringing circuit efficient but to avoid undue impedance in the path of voice currents.

The relays 12 and 7 of a line are to be adjusted so that both will respond to the ringing current and attract their armatures, or so that neither will respond to said current. Thus, whichever of these adjustments is provided, the application of ringing current will not cause the display of the line signal lamp 14. The operator, having rung

the bell of the called subscriber, allows the lever of her ringing key to be restored whereby current flows from battery B through relay 21, contact 31—13, windings 4—5, relay 12 to ground. This current is only of sufficient volume to permit partial actuation of relay 21, whereby calling supervisory signal 25 will be displayed by current through contact 24, 22, 23. When the called subscriber answers, by removing his receiver, the relay 7 will be energized, as in the case of the calling subscriber, its energization completing the branch circuit about the cut-off relay 12 including contact 9, resistance 10, and alternate contact 11, whereby greater current is passed through the supervisory relay 21 and a further attraction of its armature is produced to open contact 22—23 and put out the signal 25, the operator being thus advised that the called subscriber has answered.

At the conclusion of conversation, the replacing of the receivers at the substations will deenergize the relays 7 whose retracted armatures 9 will be effective to decrease the current flow through relays 16 and 21, respectively, sufficiently only to cause their armatures to be retracted to their intermediate positions (but not fully retracted, electromagnets having double-acting armatures adapted for employment of this character being known), whereby the signals 20 and 25 will be displayed and the operator advised to take down the connection. On withdrawal of the plugs 15 and 31, the apparatus employed will be in its normal quiescent condition.

In Fig. 2, the calling end of the cord-circuit has connections differing from those of the similar end of the cord-circuit of Fig. 1, whereby the employment of the test contact 32 for the calling plug is avoided. In Fig. 2, an additional lever 34' is provided for the operator's listening key whose associated contact has connection through the test relay 33 to ground so that when the listening key is first actuated, the calling plug 31 will be connected with ground through relay 33 and a busy potential at the spring-jack of a subscriber will develop into current circulating through closed contact 34' to ground actuating relay 33 to cause the customary click. To permit the operator to listen in upon the completed connection the supervisory relay 21 of Fig. 2 has a locking armature at the left so that when the operator shifts lever 34 to listening position after the insertion of a plug, the continuity of the calling end of the cord-circuit is not interrupted. It will be observed that the circuit of test relay 33 is traced through the back contact of the locking armature so that the actuation of the listening key, after the plug is inserted, no longer connects the test relay with the cord.

Various modifications of the invention may obviously be made. For instance, the operation of the line relay might be employed to increase the resistance of the circuit between the spring-jacks and their earth connection so as to produce the retraction of the armature of relay 16 to open the circuit of a supervisory signal rather than a further attraction thereof as herein illustrated. Other modifications will readily suggest themselves to telephone engineers, and I do not wish to be limited in this respect.

Assuming that the customary 24 volt battery is employed, the following resistances for the specified elements may be employed which, in conjunction with suitable mechanical adjustments, will give a satisfactory operation, although a wide variation of values is obviously possible and practical. The supervisory relays 16 and 21 may have windings of one hundred ohms each. The line relay 7 may be of ten or twenty ohms, the cut-off relay 12 of say, two hundred ohms, and the resistance 10 of fifty ohms. The test relay 33 is, of course, of very high inductance and resistance, the latter being preferably in the neighborhood of five thousand ohms.

What I claim as new and desire to secure by Letters Patent of the United States, is:—

1. A telephone system including a telephone line, multiple terminals therefor, an induction device connected between said terminals and said line, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, a supervisory relay adapted for connection in that portion of the circuit including the cut-off relay, switch contacts for said supervisory relay, and means whereby the subscriber solely controls the operative positions of said switch contacts while said supervisory relay is connected with said cut-off relay.

2. A telephone system including a telephone line, multiple terminals therefor, a repeating coil connected between said line and its terminals, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, a supervisory relay adapted for connection in that portion of the circuit including the cut-off relay, switch contacts for said supervisory relay, and a switch contact of said line relay for controlling the amount of current flow in said supervisory relay while it is connected with said cut-off relay.

3. A telephone system including a telephone line, multiple terminals therefor, an induction device connected between said

terminals and said line, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, a supervisory relay adapted for connection in that portion of the circuit including the cut-off relay, a switch contact of said line relay for controlling the amount of current flow in said supervisory relay while it is connected with said cut-off relay, and circuit-changing mechanism controlled by said supervisory relay and adapted to be altered thereby as the amount in said relay of current is varied.

4. A telephone system including a telephone line, multiple terminals therefor, a repeating coil connected between said line and its terminals, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, a supervisory relay adapted for connection in that portion of the circuit including the cut-off relay, a switch contact of said line relay for controlling the amount of current flow in said supervisory relay while it is connected with said cut-off relay, and circuit changing-mechanism controlled by said supervisory relay and adapted to be altered thereby as the amount in said relay of current is varied.

5. A telephone system including a telephone line, multiple terminals therefor, an induction device connected between said terminals and said line, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, a supervisory relay connected with said cut-off relay, and a switch contact of said line relay for controlling the amount of current flow in said supervisory relay while it is connected with said cut-off relay.

6. A telephone system including a telephone line, multiple terminals therefor, a repeating coil connected between said line and its terminals, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, an operator's link-circuit, a supervisory relay therefor connected in a closed path for current including said cut-off relay, switch contacts for said supervisory relay, and means whereby the subscriber solely controls the operative positions of said switch contacts while said supervisory relay is connected with said cut-off relay.

7. A telephone system including a telephone line, multiple terminals therefor, an induction device connected between said

terminals and said line, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, an operator's link-circuit, a signal for said link-circuit, a supervisory relay, means controlled by the operator for producing a limited energization of said supervisory relay to display said signal, and subscriber controlled apparatus for thereafter controlling the display or non-display of said signal.

8. A telephone system including a telephone line, multiple terminals therefor, a repeating coil connected between said line and its terminals, a line relay permanently controllable by the subscriber, a cut-off relay permanently controllable by the operator, said relays being connected in conductively disunited portions of the line circuit, an operator's link-circuit, a signal for said link-circuit, a supervisory relay, means controlled by the operator for producing a limited energization of said supervisory relay to display said signal, and line relay mechanism for producing an increased energization of said supervisory relay to efface said signal and thereafter altering the energization thereof to again display said signal.

9. A telephone system including a telephone line, multiple terminals therefor, a repeating coil connected between said line and its terminals, a line relay permanently controllable by the subscriber, an operator's link-circuit, a signal for said link-circuit, means controlled by the operator for producing a limited energization of said supervisory relay to display said signal, and line relay mechanism for producing an increased energization of said supervisory relay to efface said signal and thereafter altering the energization thereof to again display said signal, said mechanism being controllable from the substation.

10. A telephone system including a telephone line, multiple terminals therefor, an induction device connected between said terminals and said line, an operator's link circuit, a signal for said link circuit, a supervisory relay, means controlled by the operator for producing a limited energization of said supervisory relay, whereby the armature of said relay is partly attracted to display said signal, and subscriber controlled apparatus for thereafter causing a complete armature attraction of said relay for causing an effacement of said signal.

11. A telephone system including a telephone line, multiple terminals therefor, a re-

peating coil connected between said line and its terminals, an operator's link-circuit, a signal for said link-circuit, a supervisory relay, means controlled by the operator for producing a limited energization of said supervisory relay to display said signal, and line relay mechanism for producing an increased energization of said supervisory relay to efface said signal and thereafter altering the energization thereof to again display said signal, said mechanism being controllable from the substation.

12. A telephone system comprising a telephone line, a line relay therefor, a cut-off relay therefor, said relays being connected in conductively distinct but inductively united portions of the talking circuit of said line, a line signal for display responsive to said line relay, said relay being operable by currents over said line, a spring-jack contact connected with said cut-off relay, a conductor terminating in a connecting plug, a supervisory relay connected therewith, means for operating said supervisory relay over a circuit including said cut-off relay, and means controlled by the line relay for varying the resistance of said circuit to control said supervisory relay.

13. A telephone system including a subscriber's telephone line, a switching terminal therefor, a repeating coil connected between said line and said terminal, an operator's link-circuit, a signal for said link-circuit, a supervisory relay, means controlled by the operator for producing an energization of said supervisory relay to display said signal, and means controlled by the subscriber for producing a different energization of said supervisory relay to efface said signal.

14. A telephone system including a subscriber's telephone line, a switching terminal therefor, a repeating coil connected between said line and said terminal, an operator's link-circuit, a signal for said link-circuit, a supervisory relay, means controlled by the operator for producing an energization of said supervisory relay to display said signal, means controlled by the subscriber for producing a different energization of said supervisory relay to efface said signal, and means controlled by the subscriber for controlling the energization of said supervisory relay to efface and display said signal.

In witness whereof, I hereunto subscribed my name this 20th day of December, 1907.

HARRY G. WEBSTER.

Witnesses:

CAROLYN WEBER,
L. D. KELLOGG.