E. R. HOBBS.

TELEPHONE SYSTEM.

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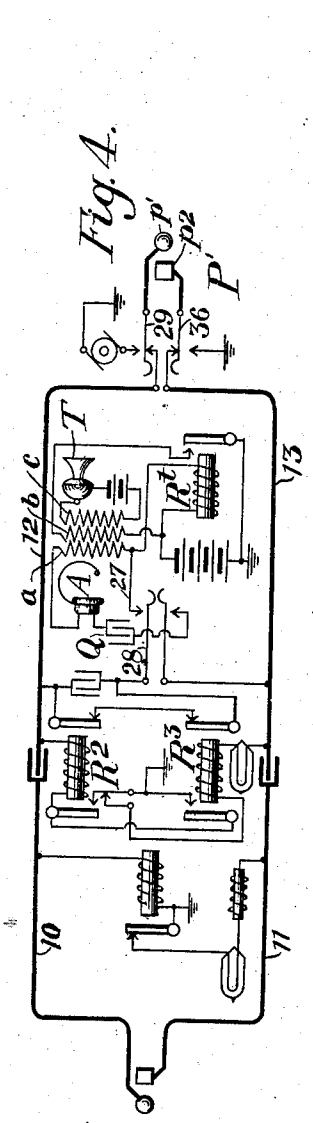

Fig. 4.

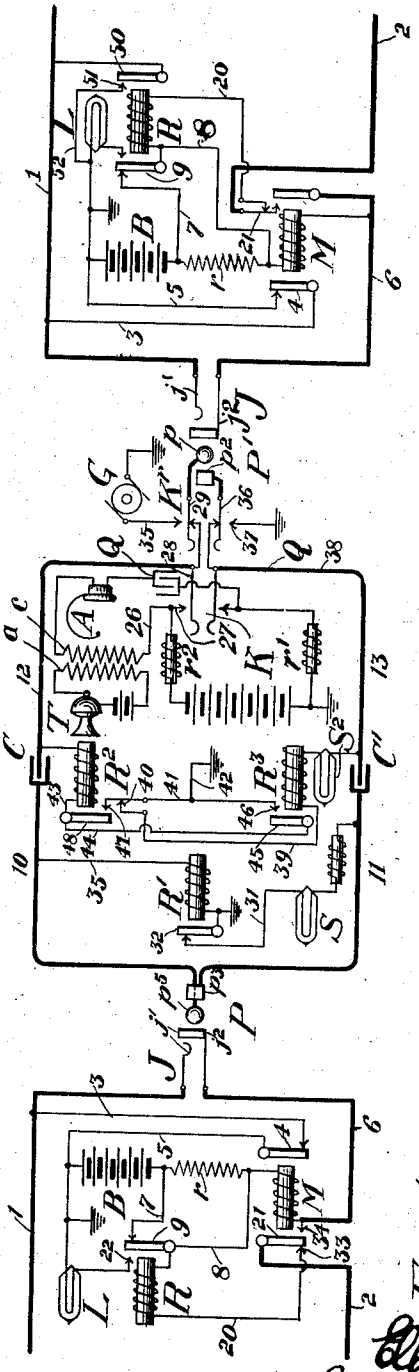

Fig. 2.

Fig. 3.

Fig. 1.

Witnesses

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TELEPHONE SYSTEM.

1,025,269. Specification of Letters Patent. Patented May 7, 1912.

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To all whom it may concern:

Be it known that I, ELBERT R. HOBBS, a citizen of the United States, residing at Buhl, in the county of Twin Falls and State of Idaho, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My invention relates to telephone systems, and has for its object the improvement of the two-wire multiple circuit systems used in connection with a common battery at the central station. In ordinary circuits of this kind there are numerous objections and it is my object to overcome these objections by a novel arrangement of the apparatus comprising the operator's cord circuit and the parts constituting the subscriber's line terminal apparatus.

An object of my invention is to provide an efficient testing means so that when a subscriber calls up the mere act of removing his receiver places his line terminals at once in condition for testing busy.

A further object of my invention is to improve the calling end of the operator's cord circuit by providing a supervisory control relay, these relays jointly controlling a test relay and the supervisory relay being so arranged that it can pull up and lock, thereafter being independent of the control relay.

A further object of my invention is to provide the line terminals with means whereby the positive operation of the calling supervisory relay is effected.

Other objects and advantages will appear in the detailed description of the system as hereinafter set forth.

My invention is illustrated in the accompanying drawings in which:

Figure 1 shows the terminal apparatus of a subscriber's line. Fig. 2 is an operator's cord circuit arranged to coöperate with either of the line terminals shown in Figs. 1 and 3. Fig. 3 is a modified arrangement of the subscriber's line terminal apparatus. Fig. 4 is a modified form of operator's cord circuit.

Referring to Fig. 1, I have shown therein the line wires 1 and 2 leading from a subscriber's substation (not shown), the sleeve side 2 of the line terminating in contacts of the cut-off relay M, the tip side 1 of the line being connected to the jack J and being normally connected to the battery B by the branch 3 through the contacts 4 of the cut-off relay M and conductor 5. One winding of the cut-off relay M is connected with the extension conductor 6 the other winding of the cut-off relay being connected to battery through the resistance *r*. A normally closed shunt circuit is provided around this resistance *r* through the conductors 7 and 8 and the armature 9 of the line relay R. The energization of the line relay breaks this shunt circuit and closes the circuit through the lamp L. The operator's cord circuit is provided with the usual plugs P and P′ connected on the tip side by the conductors 10 and 12 and on the sleeve side by the conductors 11 and 13. The condensers C and C′ are interposed on the tip and sleeve sides of the cord circuit to permit the passage of voice currents while cutting off battery currents. The answering supervisory relay R′ has one side of its winding connected to the tip conductor 10, the other side being grounded. The supervisory relay R′ controls the circuit of the answering supervisory lamp S. The calling supervisory relay R^2 is connected to the tip side of the cord and its circuit is controlled by the supervisory control relay R^3, the winding of the latter being in series with the calling supervisory lamp S^2. The operator's set consists of the usual parts and includes the transmitter T in circuit with the primary winding *a* of an induction coil. The receiver A is in circuit with the secondary winding *c* of the induction coil together with a condenser Q. This circuit is permanently connected to battery and ground through high wound impedance coils, whose function is to keep the condenser Q charged from the battery, thus providing a test by discharging therefrom through the tip side of the receiver circuit. As regards the busy test, after the operator has plugged into the answering jack, it is understood that the potential of the sleeve of an idle line is the same as that of battery; when the operator plugs in, current will flow through the cut-off relay M, sleeve, and supervisory lamp, in series, and as the jack sleeve is between the cut-off relay and the supervisory lamp, the potential of the sleeve would be lowered. A listening key K is provided by means of which the operator can listen in to get the number wanted when a connection is desired. The ringing generator G is connected on one side to ground and on the

other side to a contact adapted to be closed by a ringing key K^r onto the tip side of the cord circuit.

The arrangement shown in Fig. 3 is somewhat similar to that in Fig. 1. In this figure, however, the cut-off relay is provided with a make-before-break contact in order to render the system clickless. The cut-off relay M is normally connected with the battery B through the resistance r and on the other side to the extension 6. The line wires 1 and 2 terminate as in Fig. 1. The line relay R is provided with an extra contact for the purpose of keeping the circuit of the line wire 1 closed to ground until the relay R^2 is connected. The line relay controls the circuit of the signal lamp L as in Fig. 1.

The cord circuit shown in Fig. 4 is similar to Fig. 2, differing only in its test circuit which makes use of a test relay R^t. This relay is controlled by contacts on the supervisory and supervisory-control relays, it being connected at one end through these contacts in series, to tip of calling plug, and at the other end to battery, thus providing a test to ground.

The operation of the system will be readily understood from the foregoing explanation of the apparatus used. Referring now to Figs. 1 and 2, when a subscriber desires a connection he removes his receiver from the hook, thereby closing the circuit through the line wires 1 and 2. The line relay R is energized, the energizing current flowing from battery B, through 7, 9, R, 20, 21, 2, through subscriber's instrument, back on line 1, 3, 4, 5, to ground. The actuation of the line relay R closes the circuit of the line lamp L at 22 and the lamp is lighted. At the same time through the pulling up of the armature 9 the shunt around the resistance r is broken. On seeing the lighting of the signal lamp L the operator places the answering plug P in the jack J. If, however, before she has had time to insert the plug in its jack another subscriber should desire to communicate with the calling subscriber, a second operator before whom the line of the second subscriber terminates, on testing the first subscriber's line in the ordinary way, will find it busy even before the first operator has plugged in. The second operator will get a click in the ear due to a discharge from the condenser Q, through A, c, 26, 67, 28, 29, p, through the ring of the calling subscriber's multiple jack j^2, 6, M, 8, 9, 22, L, and ground. When the first operator plugs into the answering jack the cut-off relay M is at once energized, current flowing from battery B, through r, M, 6, j^2, p^3, 11, S, 31, 32 and to ground. The actuation of the cut-off relay places the line wire 2 onto its extension 6 and breaks the circuit through the line relay R at 33. On the retraction of the armature 9 of the line relay R the shunt circuit around the resistance r is again established. The energization of the cut-off relay permits the flow of current through the subscriber's instrument over the following path: battery 7, 9, 8, M, 34, 2, subscriber's telephone, 1, j', p^5, 10, 35, R′ and ground. Thereupon the relay R′ pulls up and breaks the circuit of the lamp S. After plugging in to answer the call the operator presses her listening key K and inquires the number wanted. Having obtained the number she tests the wanted line in the usual manner by touching the tip of the calling plug P′ to the ring of the jack. If the line is busy she will get a click through the test set in the manner already described. If the line is not busy she inserts the calling plug P′ in the jack, presses the ringing key K^r, ringing current being supplied to the line from the generator G over the following path: generator, 35, 29, j, 1, subscriber's ringer, 2, (and since the cut-off relay has pulled up) through the extension 6, j^2, p^2, 36, 37, and ground. It will be understood that the circuit just traced is through the called subscriber's line terminal apparatus. Since this is identical with Fig. 1 the latter figure is intended to suffice as an illustration for both the answering and calling subscriber, Fig. 3 being a modification of the subscriber's line terminal apparatus as before stated. The energizing circuit of the cut-off relay of the called subscriber's line is from battery B, 7, 9, 8, M, 6, j^2, p^2, 36, 38, 13, S^2, R^3, 39, 40, 41, 42 and ground. The lamp S^2 thereupon lights up. When the called subscriber answers the supervisory relay R^2 is energized, the energizing circuit being from battery B, 7, 9, 8, M, 2, through subscriber's instrument, 1, j', p, 29, 12, R^2, 43, 44, 45, 46, 42, ground. The actuation of the supervisory relay R^2 breaks the circuit of the lamp S^2 at 40, but before breaking the circuit it closes a locking circuit to ground at 47 through the armature 48. The battery supply circuit of the calling subscriber is through the cut-off relay, through his instrument, back on the tip side of the line and through the supervisory relay R′, that of the called subscriber being through his cut-off relay, over the line 2, through his instrument, back on the line 1 and through the relay R^2 to ground. When the subscribers hang up their receivers these circuits are broken. The supervisory relays R′ and R^2 let go, the supervisory lamps being lighted by a current over the sleeve side in the manner already shown. When the operator observes the lighting of the supervisory lamps he withdraws the plugs from their jacks, the cut-off relays thereupon let go and the whole system is restored to its normal condition.

Referring now to Fig. 3 I have shown

therein a modification of the subscriber's line terminal apparatus. In this figure, which is to be taken with the cord circuit shown in Fig. 2, the line relay R is operated when the receiver is removed from the hook, current flowing from battery through 7, 9, R, 20, 21, 2, subscriber's instrument, 1, 3, 4, 5 and to ground. This closes the lamp circuit in the manner described in connection with Fig. 1 and also puts a ground on the line wire 1 through the closure of the contacts 50—51 and through the shunt 52. When the operator plugs in in response to the call, the cut-off relay is energized and current flows from battery B over the sleeve side 2 of the subscriber's line and back upon the tip side 1 through the relay R′ of the answering end of the cord circuit, but since the relay M is provided with the make-before-break contact there ought to be no click when the plug is inserted. The testing and ringing are accomplished with the arrangement shown in Fig. 3 in the manner described in connection with Fig. 1. When the operator inserts the calling plug P′ in the jack, the cut-off relay M of the called subscriber's line, puts the line wire 2 onto its extension 6. At the same time the movement of the armature 4 cuts the line wire 1 off from ground. In order to keep ground on the line 1 until the relay R^3 has had time to pull up, I have provided the shunt circuit 52 already described. This shunt circuit is closed by the line relay R which is controlled by the cut-off relay M. Since the cut-off relay has the make-before-break contact and since there are two relays to operate before the ground is taken off from the line wire 1, it will be apparent that the supervisory relay R^2 will have time to act. When conversation has ended and the subscribers have hung up their receivers the supervisory relays are deënergized, the supervisory lamps light up and the operator withdraws the plugs, thereby restoring the system to its normal condition.

Having thus described my invention, what I claim and desire to secure by Letters Patent of the United States is—

1. In a telephone exchange system, subscribers' lines provided with terminals, an operator's cord circuit provided with an answering supervisory relay on one end thereof and a calling supervisory relay and a control relay on the other end, a test coil controlled by contacts on said calling supervisory relay and said control relay, means for testing by current in one direction by the cut-off relay and means for supplying current for talking purposes through the cut-off relay in the opposite direction.

2. In a telephone exchange system, subscribers' lines provided with terminals, an operator's cord circuit provided with an answering supervisory relay on one end thereof and a calling supervisory relay and a control relay on the opposite end thereof, and a test circuit controlled by said calling supervisory relay and control relay jointly.

3. In a telephone exchange system, a subscriber's line provided with a line and a cut-off relay the latter relay being normally connected to battery through a resistance coil, a shunt circuit around said coil controlled by said line relay, means for testing the lines by current through said cut-off relay in one direction and means for supplying current for talking purposes through said cut-off relay in the opposite direction.

4. In a telephone exchange system, subscribers' lines provided with terminals, an operator's cord circuit, answering and calling supervisory relays therefor, a control relay for the calling supervisory, a signal lamp arranged in series with said control relay and locking means on said calling supervisory relay.

5. In a telephone exchange system subscribers' lines provided with cut-off relays, line relays and signal lamps, an operator's cord circuit provided with a test coil, means for testing said lines by current through said test coil, said cut-off relay and said line lamp, together with means for supplying talking current in the reverse direction through said cut-off relay.

6. In a telephone exchange system, subscribers' lines provided with cut-off relays, line relays and line signals, an operator's cord circuit provided with answering and calling supervisory relays and a control relay for said calling supervisory relay, said control relay being normally grounded on one side, a test coil controlled conjointly by said calling supervisory relay and said control relay, and means for supplying current through said cut-off relay in one direction for test purposes and in the opposite direction for talking purposes.

In testimony whereof I affix my signature in presence of two witnesses.

ELBERT R. HOBBS.

Witnesses:
JOHN W. FARIS,
WALTER G. BISHOP.