

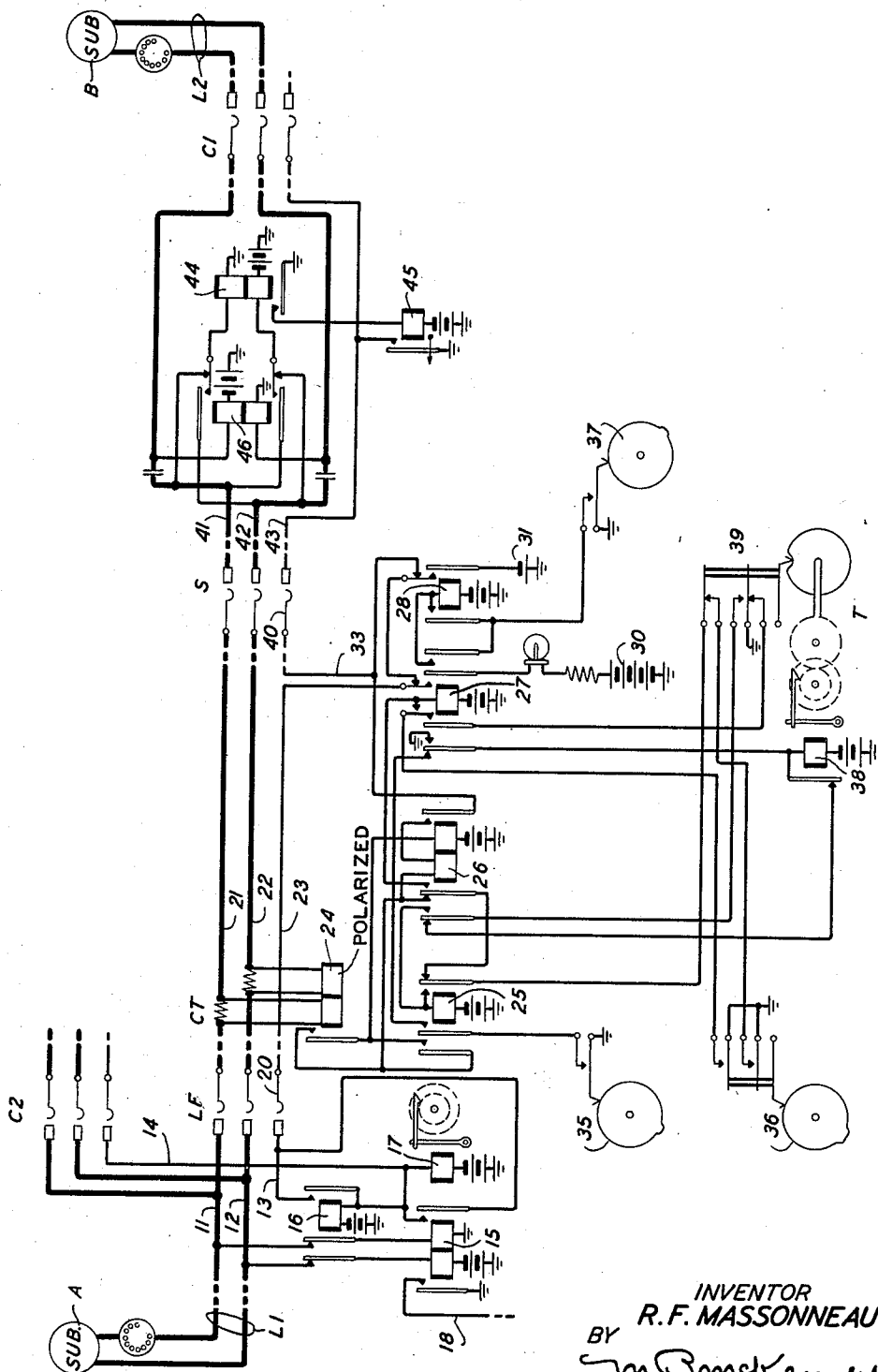
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to telephone systems arranged for metered service.

The object of the invention is to provide a more reliable circuit arrangement for operating the meter of a calling subscriber in a measured service telephone system.

In telephone systems in which dial-impulse controlled selector switches are employed in establishing connections between calling and called lines, it is usual to connect the meter of a measured service subscriber in parallel with the line cut-off relay to the sleeve conductor of the line, the ground potential, which is connected to this conductor upon extension of the line through a charging-trunk circuit arrangement to a first selector switch, being effective to operate the cut-off relay without operating the meter. Thereafter, upon answer of a called station, a booster-battery is temporarily connected to this sleeve conductor to operate the marginal meter, the cut-off relay being held operated. In case the charge to be made for a completed call depends upon the duration or destination of a call, or on both the duration and the destination, more than one operation of the meter may be required to charge for a particular call, the booster-battery being, in such a case, alternately connected to and disconnected from the sleeve conductor the required number of times for the purpose of operating the meter a corresponding number of times. The holding ground potential is reconnected to the sleeve conductor upon each disconnection of the booster-battery so that the cut-off relay is continuously held operated and the line is guarded against conversion to a second charging trunk and against seizure on an incoming call; but difficulty has been experienced in obtaining a meter which will not operate when ground potential is first connected to the sleeve conductor, which will operate when booster-battery is connected to the sleeve conductor, and which is certain to release when the holding and guarding ground potential is reconnected to the sleeve conductor. It is not practicable to employ a booster-battery of higher potential than that which is within the usual margin of safety with respect to fire hazard and several arrangements have heretofore been proposed for insuring the initial and repeated operation of a measured service telephone subscriber's meter.

This invention is a circuit arrangement in which the meter of a subscriber's line is connected in parallel with the line cut-off relay to the sleeve conductor of the line, the usual holding

and guarding ground potential connected to this conductor upon establishment of a connection originating over this line being effective to operate the cut-off relay without operating the meter; in which booster-battery is connected to the sleeve conductor in place of the holding ground potential to operate the meter and hold the cut-off relay; and in which, upon disconnection of the booster-battery potential, the minimum potential required for holding the cut-off relay operated is connected to the sleeve conductor for a short interval of time to effect the release of the meter, the usual holding ground potential being thereupon reconnected to hold the cut-off relay operated without reoperating the meter.

This invention will be readily understood by considering a specific embodiment. A telephone system in which means are provided for operating the meter of a subscriber's station in accordance with the features of this invention is shown schematically in the drawing which forms a part of this specification. The invention is not, however, limited in its application to the particular system shown but is, in general, applicable to all measured service telephone systems.

Referring to the drawing, A represents a subscriber's station connected by a line L1 to terminals in the bank of a line-finder switch LF, CT represents a charging trunk through which the brushes of line-finder LF are permanently connected to a first selector S, C1 and C2 represent connector switches having access to subscribers' lines for use in completing connections with called lines, and B represents a subscriber's station connected by a line L2 to terminals in the bank of connector switch C1. The apparatus at each of stations A and B is of the type usually employed in automatic telephone systems and includes a dial for use in completing desired connections. Individual to the line L1 is the line relay 15, cut-off relay 16 and message register 17. The corresponding apparatus associated with line L2 is not shown. The line-finder switch LF, selector switch S and connector switches C1 and C2 are of the well-known two-motion step-by-step type. For a description of such switches and their operation when used as selector and connector switches reference may be had to pages 53 to 67 inclusive of the second edition of Automatic Telephony by Smith and Campbell. For a description of the operation of such a switch when used as a line-finder reference may be had to Patent No. 1,799,654 granted to R. L. Stokely, April 7, 1931. The line-finder switch LF, selector

S and connector switch C2 are each represented by a set of brushes and a single set of terminals, the dotted lines leading to the brushes representing the associated apparatus which is not shown.

5 The connector C1 is represented by a set of brushes and one set of terminals and by relays 44, 45 and 46; other associated apparatus, which is not shown, is represented by the broken lines leading to the brushes. The charging trunk CT includes a supervisory relay 24 having its wind-
10 ings connected in series with talking conductors 21 and 22, relays 25, 26, 27 and 28, a source of booster-battery 30, a source of battery 31 which is of the same polarity but lower in potential
15 than the regular central office battery which is shown connected to each of the relays, interrupters 35, 36 and 37, and a time-operated switching mechanism comprising the contacts 39 and electromagnet 38. The contacts of interrupter 35
20 are closed once every six seconds, the duration of closure being a quarter of a second. The contacts of both of interrupters 36 and 37 are closed once every two seconds, the duration of closure being a quarter of a second; but the closure of
25 the contacts of interrupter 37 does not begin until about a twentieth of a second before the closure of the contacts of interrupter 36 ends. Each closure of interrupter 35 coincides with every third closure of interrupter 36. Each operation
30 of the magnet 38 rotates the cam shaft one step, a total of sixty steps constituting one revolution. The contact springs 39 are in the position shown only while the shaft and cam are in normal position.

35 The invention will be further explained by assuming a call to have been originated at station A, station B being the called station. Upon removal of the receiver (not shown) at station A, the line relay 15 is operated by the energization
40 of its windings in a circuit which includes the back contacts of relay 16 and the conductors of line L1. Relay 15 closes a circuit over conductor 18 for starting an idle line-finder which in this case will be assumed to be the line-finder LF. Relay 15 also connects the windings of the cut-
45 off relay 16 and service meter 17, in parallel, through the right-hand front contact of relay 15, over conductor 13 to the sleeve terminal of line L1 in the bank of the line-finder LF and the
50 corresponding terminal in banks of the other line-finders in the same group. When the brushes of line-finder LF engage the terminals to which conductors 11, 12 and 13 are connected, a circuit is closed, in usual manner, through sleeve brush
55 20 of line-finder LF and over conductor 13 to operate the cut-off relay 16. The service meter 17 being marginal is not operated until a booster-battery potential is connected to sleeve conductor 23 as hereinafter described. Relay 16 locks
60 through its right-hand front contact over conductor 13 and at its back contacts opens the circuit for operating relay 15. The closing of the circuit through brush 20 and the winding of relay 16 is effective to cause the brushes of switch LF
65 to stop on the set of terminals to which conductors 11, 12 and 13 are connected, thereby extending the line L1 over conductors 21 and 22 to the line relay (not shown) of selector S. Dial tone is thereupon transmitted to the calling station in
70 usual manner. When the calling subscriber dials the number of the station with which connection is desired, the selector S and a connector C1 are selectively operated in accordance with the digits dialed. Although not shown other selectors might
75 be included between the selector S and connector

C1. Relay 44 of connector C1 is the line relay which responds to dial impulses, created by the dialing of the last two digits of the called subscriber's number, to control the operation of the vertical and rotary stepping magnets which are not shown. The operation of relay 44, upon ex-
5 tension of the connection from line conductors 11 and 12, over conductors 21 and 22 and over conductors 41 and 42 to the windings of relay 44, causes the operation of the release relay 45. Re-
10 lay 45, in operating, connects holding ground potential through its front contact over conductor 43 through brush 40 of selector S, conductor 33 of the charging trunk CT, back contact of re-
15 lay 28, right back contact of relay 27, sleeve conductor 23, brush 20 of line-finder LF, conductor 13, and the front contact of cut-off relay 16 to the windings of relay 16 and service meter 17. This holding ground potential is effective to hold
20 relay 16 operated and to maintain the selector S and line-finder LF in their operated positions until the connection is released by the calling subscriber. The windings of the polarized super-
25 visory relay 24 of charging trunk CT are energized by the current over conductors 21 and 22 while the connection is being established, but this current is not in the operating direction. When the connector C1 establishes connection with the terminals to which the line L2 is con-
30 nected, the line is tested and, if line L2 is idle, ringing current is transmitted through the brushes of the connector C1 to operate the ringer at the called station B.

Upon removal of the receiver from the receiver hook at station B to answer the call, relay 46 is
35 operated, the connections between conductors 41 and 42 and the windings of relay 44 being thereby reversed to cause the operation of the polarized supervisory relay 24 of the charging trunk CT. The interrupting device 36 is arranged to close
40 its associated set of contact springs for a half second once every six seconds and, as soon as these contacts are next closed after the operation of polarized relay 24, relay 26 is operated by the
45 current in a circuit from battery through its right winding, contacts of relay 24, inner left back contact of relay 26, back contact of relay 25, upper contact of springs 39 of timing mechanism T, to ground at the lower contact of interrupter
50 36. Relay 26 is only partially energized, by the current through its right winding, so as to close its right front contact without affecting the left contacts. A circuit may then be traced from
55 battery through the right winding of relay 26, front contact of relay 24, left winding of relay 26, right front contact of relay 26, over conductor 33 through brush 40 of selector S, conductor 43 of connector C1 to ground at the release relay 45. As long as the lower contacts of interrupter 36
60 remain closed, the left winding of relay 26 is short-circuited; but as soon as the contacts of interrupter 36 are opened, both windings of relay 26 are energized in series in the circuit over sleeve conductor 33 to cause the complete operation of
65 relay 26. If the polarized relay 24 remains operated until the contacts of interrupter 36 are next closed, relay 27 is then operated by the current in a circuit from battery through its winding, the inner left front contact of relay 26, the right back
70 contact of relay 25, the upper contacts of springs 39 of timing mechanism T to ground at the lower contacts of interrupter 36. In operating, relay 27 connects booster-battery 30 through its inner
75 right front contact, over sleeve conductor 23, brush 20, conductor 13 and the front contact of

cut-off relay 16 to the windings of the cut-off relay 16 and meter 17 to cause the operation of meter 17 without releasing relay 16. Relay 27 also closes at its outer left front contact a circuit for operating the stepping magnet 38 of timing mechanism T. The operation of magnet 38 advances the timing mechanism T one step thereby moving the contact springs 39 out of normal position to close a circuit through the outer left front contact of relay 26, for operating relay 25. Relay 26 is effective, in combination with interrupter 36, to prevent the closing of the meter operating circuit and the advance of the timing mechanism T out of normal position in case supervisory relay 24 is only momentarily operated by a reversal of current due to the called line being busy. With relay 25 operated, the release of supervisory relay 24 is ineffective to cause the release of relay 26. Relay 27 is held operated through its inner left front contact and the upper contacts of interrupter 36 until the interrupter contacts are again opened, the meter operating circuit being thereby maintained for a long enough time to insure operation of meter 17. Just before the opening of the contacts of interrupter 36, the closure of the contacts of interrupter 37 causes the operation of relay 28. When the contacts of interrupter 36 are opened, relay 27 releases but relay 28 is held operated through its left front contact until the contacts of interrupter 37 are opened. The release of relay 27 causes the release of magnet 38 of timing mechanism T and connects magnet 38 to the contacts of interrupter 35 which are then open and which will not again be closed for approximately six seconds. The release of relay 27 disconnects sleeve conductor 23 from booster-battery 30 and connects conductor 23, through the right front contact of relay 28 to battery 31 thereby reducing the current through the windings of cut-off relay 16 and meter 17 sufficiently to cause release of meter 17 without releasing relay 16. When the contacts of interrupter 37 are opened, relay 28 releases, the sleeve conductor 23 being thereby disconnected from battery 31 and reconnected over sleeve conductor 33 to the usual holding and busy ground potential. The next succeeding closure of the contacts of interrupter 35 completes a circuit through the left back contact of relay 27 and inner left front contact of relay 25 for operating magnet 38. The energization of magnet 38, once every six seconds, by the current in this circuit advances the shaft of timing mechanism T, step-by-step. The fifty-ninth closure of the contacts of interrupter 35, after relay 27 releases, completes an interval of six minutes which it is assumed is the unit for which there is a charge of one meter operation, the timing mechanism having completed one revolution.

Upon the shaft of timing mechanism T reaching normal, the contact springs 39 resume their normal position. Relay 25 is held operated, through its right front contact and the upper contacts of springs 39 until the contacts of interrupter 36 are opened. If supervisory relay 24 is at that time operated, relay 26 does not release; and, as soon thereafter as the contacts of interrupter 36 are again closed, relay 27 reoperates to again close the meter operating circuit and reoperate magnet 38. The timing mechanism T is thus started on a second revolution, relay 25 being operated as soon as contact springs 39 are moved out of normal position. Relay 28 is operated to connect battery 31 to conductor 23 when relay 27 releases and conductor 23 is again

connected to busy and holding ground potential when relay 28 releases. Thus the charging and timing cycle of operations is repeated once every six minutes as long as supervisory relay 24 remains operated. A temporary replacement of the receiver on the receiver-hook at the called station is effective to stop further charging and the further advance of timing mechanism T as soon as it next reaches normal. Charging and timing would be resumed if the receiver were again removed at the called station before the connection were released by the calling subscriber.

When the receiver is replaced on the receiver-hook at the calling station, the line relay 44 of connector C1 releases followed by the release of relay 45. With both of relays 45 and 46 released, the connector C1 is restored to normal in usual manner. When relay 45 releases, holding ground potential is disconnected from conductors 43, 33, 23, and 13 thereby causing the release of cut-off relay 16 and the return of the line finder LF, selector S, and any other selectors involved in the connection, to normal in usual manner. Relay 26 releases when the holding ground potential is disconnected from conductor 33 and, if the timing mechanism T is not then normal and the contacts of interrupter 36 closed, causes the release of relay 25. If the timing mechanism is not normal, the release of relay 26 closes a circuit from battery through the winding and interrupter contacts of magnet 38, outer left back contact of relay 26 to ground at the middle contact of springs 39. The magnet 38 is thus alternately operated and released in rapid succession until the shaft of the timing switch reaches normal position.

A resistor may be substituted for battery 31 to temporarily reduce the current through the windings of relay 16 and meter 17 sufficiently to cause release of the meter without releasing relay 16.

What is claimed is:

1. In a telephone system, a subscriber's line, a relay and a meter connected in parallel to a conductor of said line, sources of potential, means for impressing a certain potential on said conductor sufficient to operate said relay but insufficient to operate said meter, means for changing the potential impressed on said conductor to operate said meter without releasing said relay, means for again changing the potential impressed on said conductor to release said meter without releasing said relay, and means for thereupon restoring the potential impressed on said conductor to said certain potential.

2. In a telephone system, a subscriber's line, a relay and a meter connected in parallel to a conductor of said line, a first source of current capable of operating said relay but insufficient to operate said meter, a second source of current capable of holding said relay and of operating said meter, a third source of current capable of holding said relay operated but insufficient to hold said meter operated, means for connecting said first source to said conductor, means for connecting said second source in place of said first source, and means for connecting said third source in place of said second source and for re-connecting said first source in place of said third source.

3. In a telephone system, a subscriber's line, a relay and a meter connected in parallel to a conductor of said line, means for closing a first circuit over said conductor to operate said relay without operating said meter, means for opening

said first circuit and for closing a second circuit over said conductor to operate said meter and hold said relay operated, means for opening said second circuit and for closing a third circuit over
 5 said conductor to release said meter without releasing said relay, and means for opening said third circuit and for again closing said first circuit.

4. In a telephone system, a subscriber's line, a
 10 line cut-off relay and a meter connected in parallel to a control conductor of said line, means including a charging trunk for completing calls originating over said line, a first control relay,
 15 means comprising said control conductor and normally closed contacts of said first control relay for operating said cut-off relay without operating said meter, means comprising said control conductor and normally open contacts of said first control relay for operating said meter without releasing said cut-off relay, a second control relay,
 20 and means comprising said control conductor and said normally closed contacts of said first control relay and normally open contacts of said second control relay for causing the release of said meter
 25 without releasing said cut-off relay.

5. In a telephone system, a calling subscriber's line, a called subscriber's line, a central-office battery having one pole grounded, a line cut-off relay and a meter connected in parallel between
 30 the non-grounded pole of said battery and a control conductor of said line, means including a charging trunk for completing a talking connection between said lines, a first control relay and a second control relay for said trunk, means comprising the normally closed contacts of continuity
 35 springs of said control relays for connecting ground potential to said control conductor, the

connection of ground potential to said conductor being indicative of the busy condition of said calling line and effective to cause the operation of said cut-off relay but ineffective to cause the operation of said meter, a booster-battery, means
 5 comprising said continuity spring of the first control relay for connecting the booster-battery to said control conductor in place of ground potential, a third battery having the same pole connected to ground as does said central-office bat-
 10 tery, the electromotive force of said third battery being less than that of said central-office battery, means comprising the normally closed contact of said continuity spring of the first control relay and the normally open contact of said continuity
 15 spring of the second control relay for connecting the non-grounded pole of said third battery to said control conductor in place of said booster-battery, means responsive to the completion of said talking connection for operating said first
 20 control relay and for holding said first control relay operated for a long enough interval of time to cause the operation of said meter, and means for operating said second control relay, after said first control relay has been operated long enough
 25 to cause the operation of said meter but before said first control relay releases, and for holding said second control relay operated long enough to insure the release of said meter without releasing said cut-off relay.

6. In a telephone system and combination according to claim 5, means for repeating the operation of said control relays at predetermined intervals while said talking connection is maintained.

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