

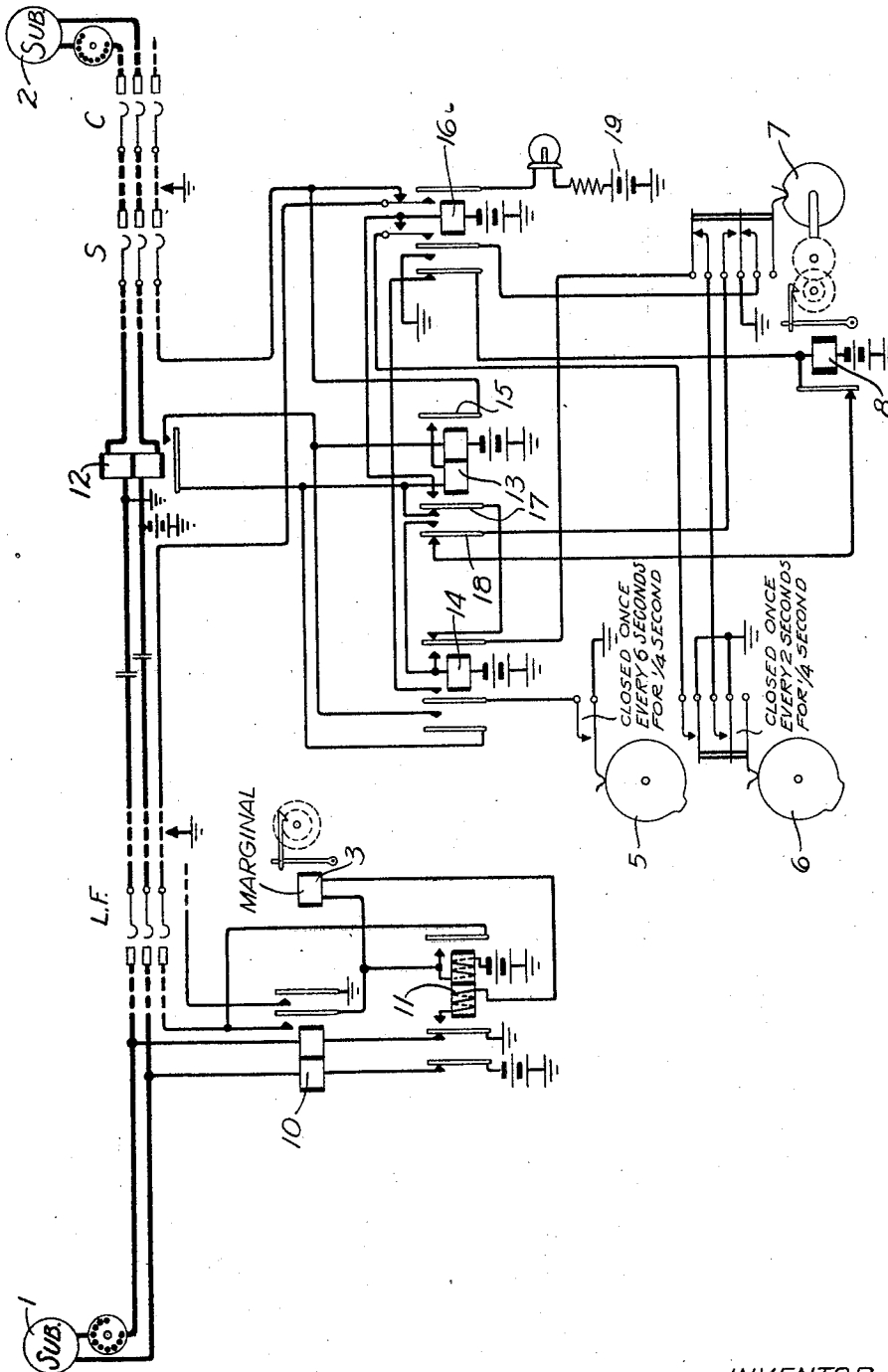
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to metering systems.

The object of the invention is to improve the control of service meters operated repeatedly during a call to record charges in accordance with the duration of the call.

Heretofore, systems have been used in which the meter is operated repeatedly during a call by connecting it in a circuit producing the operating impulses. Systems have also been used in which the meter is operated but once during a call. In the latter systems the meter is usually connected in a circuit in parallel with a calling subscriber's cut-off relay to battery, and is of such marginal characteristics that it will not operate when a ground connection is made to said circuit to operate the cut-off relay, but operates when booster battery is substituted for the ground connection. In systems of this kind the meter and the cut-off relay are usually controlled over the sleeve conductor.

A feature of this invention is to arrange the meter and the cut-off relay in a circuit controllable over a single conductor for the operation of the meter a plurality of times while the cut-off relay is maintained operated. The arrangement is such that when a connection to ground is made to this circuit, the cut-off relay is operated and the meter is short-circuited while each time booster battery is substituted for the ground, the meter is actuated and the cut-off relay is maintained operated. This circuit arrangement may be employed in a telephone system whereby when a calling subscriber's line is seized the circuit is connected to ground and when a called subscriber answers the call booster battery impulses are substituted for the ground connection at fixed interval throughout the duration of the call.

This invention has been shown in the accompanying drawing applied to an automatic connection between a calling subscriber and a called subscriber through switches indicated in diagrammatic form.

Referring to this drawing the service meter 3 has been shown associated with the circuits of a calling subscriber's line whose set is indicated at 1. A connection may be estab-

lished through line finder LF, selector S and connector C. These switches may be of the usual type employed in automatic telephone systems in which a ground connection is established over the sleeve conductors when the connection is extended therethrough. The control circuits for the service meter 3 are associated with the line finder LF and contain certain interrupting devices used in the control. Of these devices the interrupting device 5 may be arranged to close through spring contacts connection to ground once every six seconds. For example, the ground connections may be closed for one-quarter second and opened for five and three-quarter seconds. The interrupting device 6 may be arranged to close connections to ground, for example, for one-quarter second and leave these connections open for two seconds. The two interrupting devices 5 and 6 may be driven by any well known, time regulated, constantly driven power means. The interrupting device 7 may be arranged to operate spring contacts under control of the stepping magnet 8 so that the connections are shifted once every sixtieth operation of the stepping magnet 8.

The establishing of a connection between the calling subscriber at 1 and the called subscriber at 2 will now be described in connection with the control of the service meter 3 for recording the time the connection is established. When the subscriber at 1 lifts his receiver off the switchhook preliminary to the dialing of the number desired, a connection is established for the operation of the line relay 10 over a circuit as follows: From battery and ground at the left-hand armatures and back contacts of the cut-off relay 11 through the two windings of the line relay 10 and the tip and ring conductors through the subscriber's loop at 1. Relay 10 in operating closes a connection from the sleeve terminal of the line finder to battery through the right hand winding of the cut-off relay 11. This relay 10 also causes in the usual manner a line finder, such as LF, to connect with the calling subscriber's line and establish the usual ground connection on the sleeve conductor.

This ground connection now causes the operation of relay 11 from battery, right-hand winding of this relay, armature and front contact of relay 10 to the ground connections through the sleeve terminal and brush of the line finder LF. Relay 11 in operating closes a circuit to ground through its inner left-hand armature and front contact, through its left-hand winding, the winding of the service meter 3 to the battery through the right-hand winding of relay 11 and also a circuit from battery through the right-hand winding of relay 11 and its right-hand armature and front contact to the ground on the sleeve at the line finder. The circuit for relay 10 is also opened at the left-hand armatures and back contacts of relay 11 so that the original circuit for relay 11 is opened at the armature and front contact of relay 10. Relay 11 is now, therefore, held operated by its own locking circuit through the right-hand winding, whereas the service meter is short-circuited. No further actions take place at this time but it should be observed that the windings of relay 11 are so wound as to produce opposing magnetizing effects and this relay will therefore release when the ground from the sleeve is removed due to the circuit completed through both windings thereof. The ground from the sleeve will be removed when the connection between the subscribers is released. When this ground is removed it will be noted that the winding of the service meter will carry a current but as this winding is marginal, the service meter will not operate at that time.

The subscriber at 1 will now dial the number of the desired subscriber and the connection is thereby extended through the selector S and connector C to the called subscriber's line at 2 in the usual manner. While this connection is being extended the ground connection on the sleeve conductor is also extended through the switches in the usual manner. When the called subscriber answers the usual automatic ringing, by lifting the receiver off the switchhook, the talking connection is established through the tip and ring conductors between the two subscribers.

This talking connection now causes the operation of relay 12 which has a winding in each conductor. Operation of relay 12 initiates the function of the control circuit to operate the service meter 3, by closing a circuit for the operation of relay 13 as follows: Battery right-hand winding of relay 13, armature and front contact of relay 12, inner left-hand armature and back contact of relay 13, right-hand armature and back contact of relay 14, upper closed contacts of the springs controlled by interrupter 7 and to ground through the lower springs controlled by interrupter 6, when this latter interrupter closes this connection. This closure may occur any time within two seconds

after the operation of relay 12. This circuit for relay 13 only causes it to partially operate to close a connection for its left-hand winding through its right-hand armature 15 and front contact to the ground on the sleeve conductor. As long as the original circuit for the relay 13 remains the left-hand winding will be short-circuited, but when the circuit is opened at the end of a one-quarter second period, the short-circuit is removed. The circuit for relay 13 will now extend from battery through its right-hand winding, armature and front contact of relay 12, left-hand winding of relay 13 and its right-hand armature and front contact to ground on the sleeve. Both windings are energized and the remaining armatures 17 and 18 of the relay are thereby attracted.

The contacts of interrupted 6 will now remain open for two seconds. At the end of this period the connections to ground are again established and a circuit completed for the operation of relay 16 from battery, winding of this relay, inner left-hand armature and front contact of relay 13, right-hand armature and back contact of relay 14, upper normal contacts controlled by interrupter 7 and contacts controlled by interrupter 6 to ground. Relay 16 in operating opens the connection to ground for the sleeve conductor, for the line finder and the calling subscriber's line, at its right-hand make-before-break contacts and establishes a connection to a so-called "booster" battery 19 through the right-hand armature and front contact over the sleeve through the line finder. The service meter 3 is thereby operated as follows: It should be remembered that on the operation of cut-off relay 11 the short-circuit for the service meter 3 prevented it from normally operating at the time the cut-off relay operated. When now battery 19 is supplied over the sleeve conductor in place of the ground connection, the service meter will operate over a circuit from this battery 19 through the inner right-hand armature and front contact of relay 16, the sleeve conductor through the line finder, right-hand armature and front contact of relay 11, winding of relay 3, left-hand winding of relay 11 to ground at the inner left-hand armature and front contact of this relay. Service meter 3 in operating registers the first period of conversation. While battery 19 is supplied from relay 16 the cut-off relay 11 will be maintained operated as follows: It should be noted that the current through the right-hand winding of relay 11 from the battery thereat will be augmented by current from the battery 19 applied at relay 16, and the current in this winding will therefore produce a greater magnetizing effect on the relay than the opposing magnetizing effect produced by the left-hand wind-

ing by current from the battery 19 at relay 16 and thereby hold the relay 11 operated.

Relay 16 also closes a circuit for the operation of stepping magnet 8 from battery, winding of this magnet, the outer left-hand armature and front contact of relay 16 to ground. The stepping magnet is thereby actuated and when it releases it actuates the interrupter 7 which controls its spring contacts, to open the normal connection to ground through the lower contacts, to open the connection through the upper contacts and to close a connection to ground for its middle contact.

When relay 16 is released, due to the opening of the connection to ground at the interrupter 6, after the one-quarter second period service meter 3 is deenergized and the ground on the sleeve restored to maintain the cut-off relay 11 operated. Thus cut-off relay 11 will be maintained operated as long as the connection to ground from the sleeve remains. When this connection is opened which occurs when the subscribers release the talking connection, relay 11 will release as hereinbefore described. A circuit will now be completed due to the operation of the contacts controlled by interrupter 7 for the operation of relay 14 from battery, winding of this relay, outer left-hand armature and front contact of relay 13 to ground at the middle contact of interrupter 7. Relay 14 in operating causes, due to the release of relay 16, a circuit to be completed for the stepping magnet 8 from battery, winding of the magnet, outer left-hand armature and back contact of relay 16, inner left-hand armature and front contact of relay 14 to ground through the springs controlled by interrupter 5. As stated this interrupter causes a connection to be established to ground once every six seconds. The stepping magnet 8 will now, therefore, be operated once every six seconds for one-quarter second each time to control the interrupter, until sixty steps have been taken by the stepping magnet 8 when the interrupter 7 has been rotated to again restore the contacts to the normal condition. When this takes place the relay 14 will be released due to the opening of the circuits for this relay at the contacts controlled by interrupter 6, unless the contacts of interrupter 7 are restored at the time the contacts controlled by interrupter 6 are closed in which case relay 14 will be maintained operated until these latter contacts are again opened, which will always be within the one-quarter second period. The circuit for maintaining relay 14 operated will in this case be extended from battery, winding and right-hand armature and front contact of relay 14, upper contacts controlled by interrupter 7 to ground at the contacts controlled by interrupter 6. The maintenance of relay 14 oper-

ated under these circumstances is to prevent the subsequent operation of relay 16 to take place for less than one-quarter second. If on the other hand the closing of the connection by interrupter 7 occurs when the connections through the contacts controlled by interrupter 6 are open, relay 14 will be released immediately. In either case the subsequent operation of relay 16 will occur within the period of two seconds and be maintained operated for a period of one-quarter second.

It should be observed therefore that the time elapsed at this moment will be six minutes since the operation of the service meter plus a few seconds which may vary depending on the time the called subscriber lifts his receiver off the hook as compared with the positions of the interrupters 5 and 6 at that time. If the conversation is to be maintained beyond this first conversational period, the operations just described will be repeated. In other words, when relay 14 is released and a connection to ground is again established at the interrupter 6, relay 16 will be operated as heretofore described for one-quarter of a second to again cause the operation of service meter 3 to register a second conversational period. If the subscribers now release the connection during the second period, relay 12 will be released and thus cause the release of relay 13. Relay 13 in releasing will close the circuit for the operation of the stepping magnet 8 to return the interrupter 7 to normal position. This circuit may be traced from battery, winding, and self-interrupting contacts of magnet 8, outer left-hand armature and back contact of relay 13 and the middle closed contacts of interrupter 7 to ground. When interrupter 7 is returned to normal, this connection to ground will be opened and the stepping magnet will not be operated further, neither can relay 16 be operated to register another conversational period even though a connection may be partially established to the contacts of interrupters 6 and 7 as relay 16 is released. In case a subscriber maintains the connection until the second period of conversation is ended and then releases it, relays 12 and 13 will release and when relay 14 is released, no further actions take place in the circuit as relay 16 cannot then be operated. In this case of release there will be no circuit for returning interrupter 7 normal as it is already in normal position. In either case of release as described above a new conversational period cannot be registered regardless of whether or not the subscribers maintain the connection during the entire registered conversational period.

While this invention has been shown for the purpose of illustration in connection with a telephone system of the automatic type,

it is not so limited, but may be applied to telephone systems of the manual and semi-automatic types and in fact to other types of communication systems in which it is desirable to cause the operation of meters, registers or similar devices.

What is claimed is:

1. In combination, an operating magnet, a relay, circuit means for said magnet and relay including a battery, means for establishing a connection from ground to said circuit, a second battery, and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to cause the operation of the relay and to establish a short-circuit for the magnet and on the establishing of the substitute connection from said second battery to cause the relay to remain operated and the magnet to operate.

2. In combination, a marginal operating magnet, a differentially wound relay, circuit means for said magnet and relay including a battery, means for establishing a connection from ground to said circuit, a second battery and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to close an operative connection through one winding of said relay and a short circuit for the other winding and the winding of the magnet to cause the operation of the relay, and on the establishing of the substitute connection from said second battery to close an operative connection through both windings of the relay in parallel and through the winding of the magnet for maintaining said relay operated and to cause the operation of the magnet.

3. In combination, a differentially wound relay having two windings, a circuit means for said relay including a battery, a second battery, means for establishing a connection from ground to said circuit, and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to close an operative connection through one winding and a short-circuited connection through the other winding to cause the operation of said relay and on the establishing of the substitute connection from said second battery to close an operative connection through both windings in parallel to maintain said relay operated and on the opening of said connection to the second battery to establish a connection including said first battery through both windings to cause the release of said relay.

4. In combination, a differentially wound relay having two windings, circuit means for said relay including a battery, a second battery, means for establishing a connection from ground to said circuit, and means for

substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to close an operative connection through one winding and a short-circuited connection through the other winding to cause the operation of said relay, and on the establishing of the substitute connection from said second battery to close an operative connection through both windings in parallel to maintain said relay operated and on the opening of said connection to the second battery to establish a connection including said first battery through both of said windings in series opposing relation to cause the release of said relay.

5. In combination, a marginal operating magnet and a differentially wound relay, a circuit means for said magnet and relay including a battery, a second battery, means for establishing a connection from ground to said circuit, and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to close an operative connection for said relay and a non-operative connection for said magnet to cause the operation of said relay and on the establishing of the substitute connection from said second battery to close operative connections through the magnet and relay to maintain the relay operated and to operate the magnet and on the subsequent opening of said connections from the second battery to release said magnet and relay.

6. In combination, an operating magnet, a relay, circuit means including a battery for said magnet and relay, a second battery, a ground connection, and means for alternately establishing connections with said circuit from said ground and said second battery connections, said circuit means being responsive to operate the relay when the ground connection is first made and to thereafter maintain said relay operated and operate the magnet when connections are made to the second battery and to release and short-circuit the magnet when ground connections are made.

7. In a telephone system, a calling subscriber's line, a called subscriber's line, means for connecting said lines, a service meter, means responsive to the establishment of a connection between said lines for short-circuiting said meter, and means responsive when a connection has been established to the called subscriber for alternately operating and short-circuiting said meter at fixed intervals.

8. In a telephone system, a calling subscriber's line, a called subscriber's line, means for connecting said lines, a meter associated with the calling subscriber's line, means responsive to the seizure of the calling subscriber's line for short-circuiting the meter

winding, and means responsive when the called subscriber answers the call for alternately removing the short-circuit from said winding and operating said meter, the periods between the succeeding operations of the meter being of equal duration and the first operation taking place when the called subscriber answers the call.

9. In combination, an operating magnet, a relay, circuit means for said magnet and relay including a battery, means for establishing a connection from ground to said circuit, another battery, means for substituting for said ground connection a connection from said second battery to said circuit, said circuit means being responsive when the ground connection is made thereto to actuate said relay, means responsive to the actuation of the relay for short circuiting the magnet and said circuit means being responsive when the connection from the second battery is substituted for the ground connection to actuate the magnet.

10. In combination, a relay having two windings connected in series, circuit means for said relay including a battery, means for establishing a connection from ground to said circuit, a second battery, and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to close a connection through one winding of the relay to said ground to cause the actuation of said relay and to thereafter cause the short-circuiting of the other winding of said relay, and on the establishing of the substitute connection from said second battery to energize both windings to maintain said relay actuated, and on the removal of said connection to the second battery to establish a connection from said first battery to ground through both windings of said relay in series opposing relation to release said relay.

11. In combination, a relay having two windings connected in series, a magnet having a winding connected in series with said two windings of the relay, circuit means for said magnet and relay including a battery, means for establishing a connection to ground to said circuit, a second battery, and means for substituting a connection from said second battery to said circuit, said circuit means being operative on the establishing of a connection from ground to establish a connection from the first battery through one winding of the relay to cause the actuation of said relay, to thereafter short-circuit the other winding of said relay, and on the establishing of the substitution connection from said second battery to energize both windings of the relay and the winding of the magnet to maintain said relay actuated and to actuate the magnet, and on the removal of said second battery from said relay and magnet to estab-

lish a connection from said first battery to ground through both windings of said relay in series opposing relation and through the winding of the magnet to release said relay and magnet.

12. In combination, an operating magnet, a relay, circuit means for said magnet and relay, a battery of one polarity permanently associated with said circuit means, a ground connection, a second battery of the opposite polarity, means for establishing a connection to said ground from said circuit means, means for substituting for said ground connection a connection to said second battery from said circuit means, said circuit means being responsive in actuating the relay on the establishing of the ground connection and for maintaining said relay actuated and actuating the magnet on the substitution of the connection to the second battery.

13. In combination, an operating magnet, a relay, circuit means for said magnet and relay, a battery of one polarity associated with said circuit means, a ground connection, a second battery of the opposite polarity, means for establishing a connection to said ground for said circuit means, to substitute a connection to said second battery for said circuit means and to remove said second battery from said circuit means, said circuit means being operative on the establishing of the ground connection to actuate said relay, and on the substitution of the connection to the second battery to maintain said relay actuated and to actuate said magnet, and on the removal of the connection to the second battery to release said relay and magnet.

In witness whereof, I hereunto subscribe my name this 21st day of June, 1929.

RAY L. STOKELY.