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TELEPHONE SYSTEM

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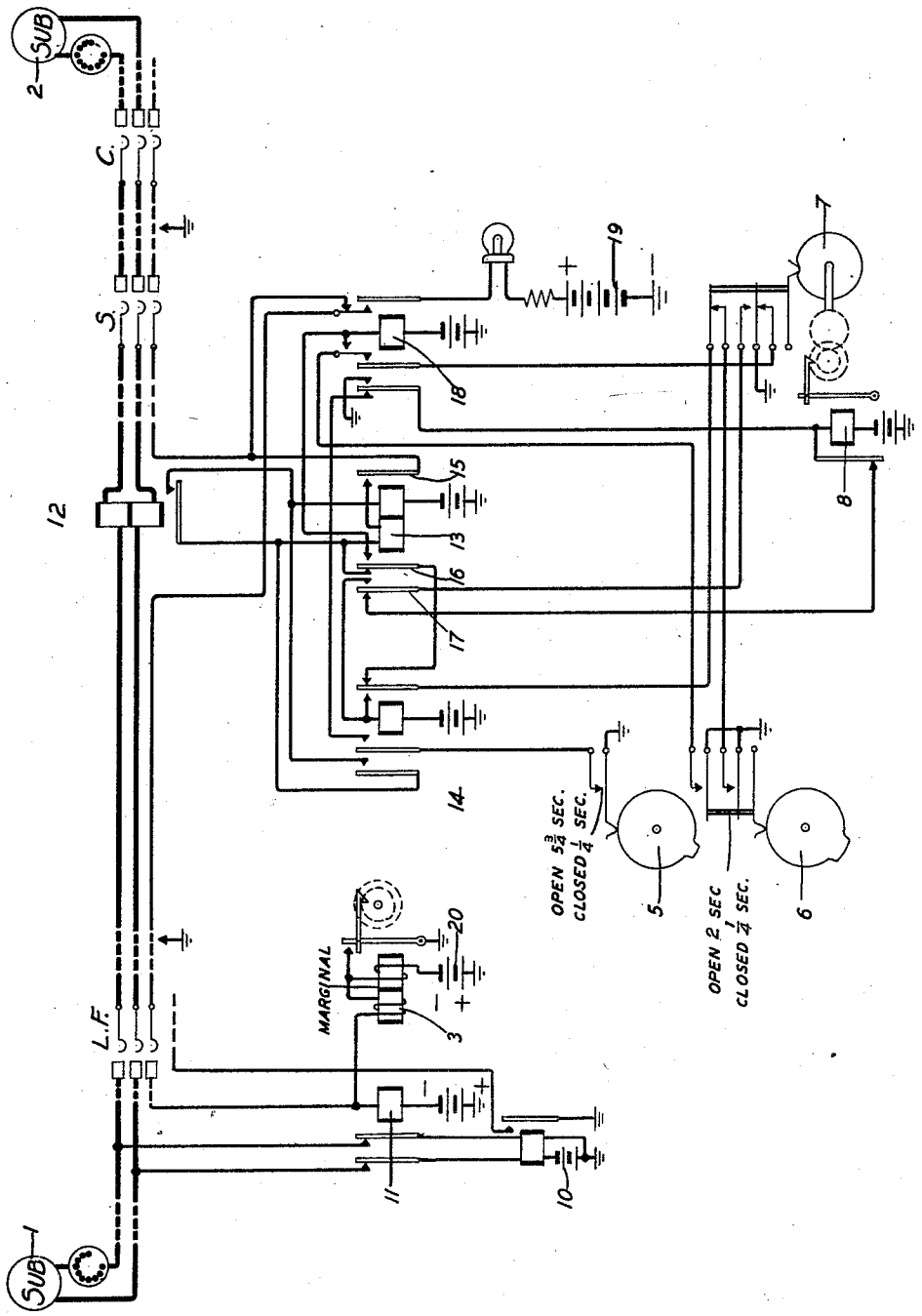

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TELEPHONE SYSTEM

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

The objects of the invention are to improve the control of service meters operating a plurality of times during a call to record charges in accordance with the duration of the call, and to simplify the circuit arrangements for the control of such meters in standard telephone systems.

Heretofore systems have been proposed, in which a meter and circuit arrangement are so arranged that the meter may be added directly in parallel with the cut-off relay to any standard line circuit and controllable over the sleeve circuit to remain in an inoperative condition, while ground is applied to the sleeve circuit for the operation of the cut-off relay, and to operate each time the booster battery is substituted for the ground connection.

A feature of this invention is an improved meter and circuit arrangement which may be added to and controlled over a single conductor in the above manner. According to this feature, the meter is provided with two windings differentially wound and marginal in character, and the circuit arrangement is such that when ground is substituted current in one winding becomes effective to cause the meter to release quickly. In this manner the release of the meter is assured after each charging operation without interfering with the operated condition of the cut-off relay.

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. The connection may be established from this subscriber's line through line finder LF, selector S and connector C to the called subscriber's line, whose set is indicated at 2. These switches and associated circuits 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. Control circuits for the service meter 3 have been shown associated with the line finder LF containing certain interrupting devices used in the control. 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 opertion 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 through the winding of relay 10 at the left hand armature and back contacts of the cut-off relay 11 and the tip and ring conductors through the subscriber's loop at 1. Relay 10 in operating closes a connection to ground at its armature and front contact to cause in the usual manner a line finder such as LF to connect with the call-

ing subscriber's line and establish the usual ground connection on the sleeve conductor.

This ground connection now causes the operation of cut-off relay 11 by closing the circuit from battery, winding of this relay to ground through the sleeve terminal and brush of the line finder LF. The circut for relay 10 is thereby opened at the left hand armatures and back contacts of relay 11 so that relay 10 releases and the connection is now under control of the ground on the sleeve of the line finder while relay 11 is held operated by this ground. The service meter 3 which is of a marginal character will not operate in this circuit closed from ground on the sleeve through its windings to battery 20.

The subscriber at 1 now dials 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 to the connector in the usual manner. When the called subscriber answers the usual automatic ringing, by lifting the receiver off the switchhook, the talking connection is estabiished through the tip and ring conductors between the two subscribers' lines.

This talking connection now causes the operation of relay 12 which has a winding in each conductor. Operation of relay 12 initiates the functions of the control circuits for 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 16 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. Such a 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 it is opened at the end of a one-quarter second period, the short circuit is removed. The circuit for relay 13 will then 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 15 and front contact to ground on the sleeve. Both windings are energized and the remaining armatures 16 and 17 of the relay are thereby attracted.

The contacts of interrupter 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 18 from battery, winding of this relay, inner left hand armature 16 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 18 in operating opens the connection to ground for the sleeve conductor, from 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: The windings of the service meter are in a series opposing connection with battery 20. When the booster battery 19, is connected through the inner right hand armature and front contact of relay 18, over the sleeve conductor of the line finder and the windings of the service meter 3 to battery 20 to ground the service meter 3 will operate as the battery 20 is of the opposite polarity to that of booster battery 19. The inductance of the right hand winding of service meter 3 is lower than that of the left hand winding so although the current in these windings produce opposing flux the meter will operate due to stronger flux in the left hand winding. The service meter in operating registers the first period of conversation. While booster battery 19 is applied by relay 18 the cut-off relay 11 will remain operated over the same circuit from the booster battery through the winding on relay 11 to the battery at the other end of this winding to ground, as this latter battery is of the same polarity as battery 20. Relay 11 will, therefore, operate regardless of whether ground or booster battery is connected to the sleeve.

Relay 18 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 18 to ground. The stepping magnet is thereby actuated and when it releases as hereinafter will become apparent it actuates the interrupter 7 for control of the associated 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 18 is released due to the opening of the connection to ground at the interrupter 6 after the one-quarter second period the service meter is deenergized and the ground on the sleeve is restored to maintain cut-off relay 11 operated. It should be noted that on the operation of the service meter 3 a circuit is completed at its armature and

front contact to ground. This completes a circuit from battery 20 through the right hand winding of the service meter 3 to ground. This circuit causes a current to flow in the right hand winding in a direction opposite to that flowing from booster battery 19 through the left hand winding of the meter to ground at the armature. The electrical characteristics of the meter are however such that the current through the right hand winding will not under these conditions produce sufficient flux in the meter to oppose or neutralize the flux produced by the left hand winding to cause the meter to release. This may be done as stated by having the inductance of the right hand winding lower than the inductance of the left hand winding. In fact the conditions may be such that very little if any change takes place in the relative flux characteristics in the meter from that produced by the batteries 19 and 20 alone. On the other hand when the booster battery 19 is removed by the release of relay 18 and ground substituted in the sleeve circuit, the current in the left hand winding of the meter will be discontinued and the current through the right hand winding which is in the opposite direction will remain for a short period to hasten the release of the meter. In other words, the flux produced by the right hand winding causes the flux produced by the left hand winding to be neutralized more rapidly than would ordinarily be the case in a relay having a single winding and the service meter will therefore be released quickly.

A circuit will now be completed, due to the operation of the contacts controlled by interrupter 7 when the magnet 8 releases on the release of relay 18, for the operation of relay 14 from battery, winding of this relay, outer left hand armature 17 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 second circuit to be completed for the stepping magnet 8 from battery, winding of the magnet, outer left hand armature and back contact of relay 18, inner right 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 7, 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 operated under these circumstances is to prevent the subsequent operation of relay 18 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 18 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. 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 18 cannot then be operated.

While this invention has been illustrated in connection with but a single telephone system, it should be understood that it may readily be applied to a number of other cir-

cuit arrangements without departing from the spirit thereof which should be limited only by the scope of the appended claims.

What is claimed is:

1. In combination, two sources of current, a magnet having two windings, a circuit for said magnet windings, means for closing said circuit from one source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet windings including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, and a third circuit closed by the operation of said magnet for shunting one winding and energizing the other winding of said magnet to hasten the release of said magnet when said first circuit is again closed.

2. In comibnation, two sources of current, a magnet having two windings, a relay, a circuit for said magnet windings and said relay, means for closing said circuit from one source to ground, said magnet remaining inoperative in said circuit and said relay operative in said circuit, a second circuit for said magnet windings and said relay including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit and said relay remaining operative in said second circuit and a third circuit closed by the operation of said magnet for shunting one winding and for energizing the other winding of said magnet to hasten the release of said magnet when said first circuit is again closed.

3. In combination, two sources of current, a magnet having two windings, a circuit for said magnet windings, means for closing said circuit from one source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet windings including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, and a third circuit closed by the operation of said magnet and including one of its windings and the first source for energizing said one winding and for shunting the other winding when said first circuit is again closed to hasten the release of said magnet.

4. In combination, two sources of current of different potential, a magnet having two windings, a circuit for said magnet windings, means for closing said circuit from the lower potential source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet windings including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, and a third circuit closed by the operation of said magnet for shunting one of its windings from the low potential source and for energizing the other winding from said low potential source when said first circuit is again closed to hasten the release of said magnet.

5. In combination, two sources of current of different potential, a magnet having two windings, a relay, a circuit for said magnet windings and relay means for closing said circuit from the lower potential source to ground, said magnet remaining inoperative in said circuit and said relay operative in said circuit, a second circuit for said magnet windings and said relay including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit and said relay remaining operative in said second circuit, and a third circuit closed by the operation of said magnet for shunting one of said windings from the lower potential source and for energizing the other winding from said lower potential source when said first circuit is again closed to hasten the release of said magnet.

6. In combination, two sources of current, a magnet having two windings, a circuit for said magnet including both windings in series with one source, means for closing said circuit to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet including both windings in series with both sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, a third circuit closed by the operation of said magnet for including said first source in series with one winding of said magnet to ground and for shunting the other winding to ground from said first source when said first circuit is again closed to hasten the release to said magnets.

7. In combination two sources of current, a magnet having a first winding of lower ampere turn characteristic and a second winding of higher ampere turn characteristic, a circuit for said magnet including both windings in series with one source, means for closing said circuit to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet including both windings in series with both sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, a third circuit closed by the operation of said magnet for including said first source in series with the lower ampere turn winding to ground and for shunting said higher ampere turn winding to ground from said first source when said first circuit is again closed to hasten the release of said magnet.

8. In combination, two sources of current, a magnet having two windings connected in series and differentially wound, a circuit for said magnet including both windings in series opposing relation and connected to one source, means for closing said circuit to

ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet including both windings in series opposing relation and in series with both sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, a third circuit closed by the operation of said magnet for including said first source in series with one winding of said magnet to energize said magnet and for shunting the other winding of said magnet when the first circuit is again closed to hasten the release of the magnet.

In witness whereof, I hereunto subscribe my name this 19th day of September, 1930.

RAY L. STOKELY.