

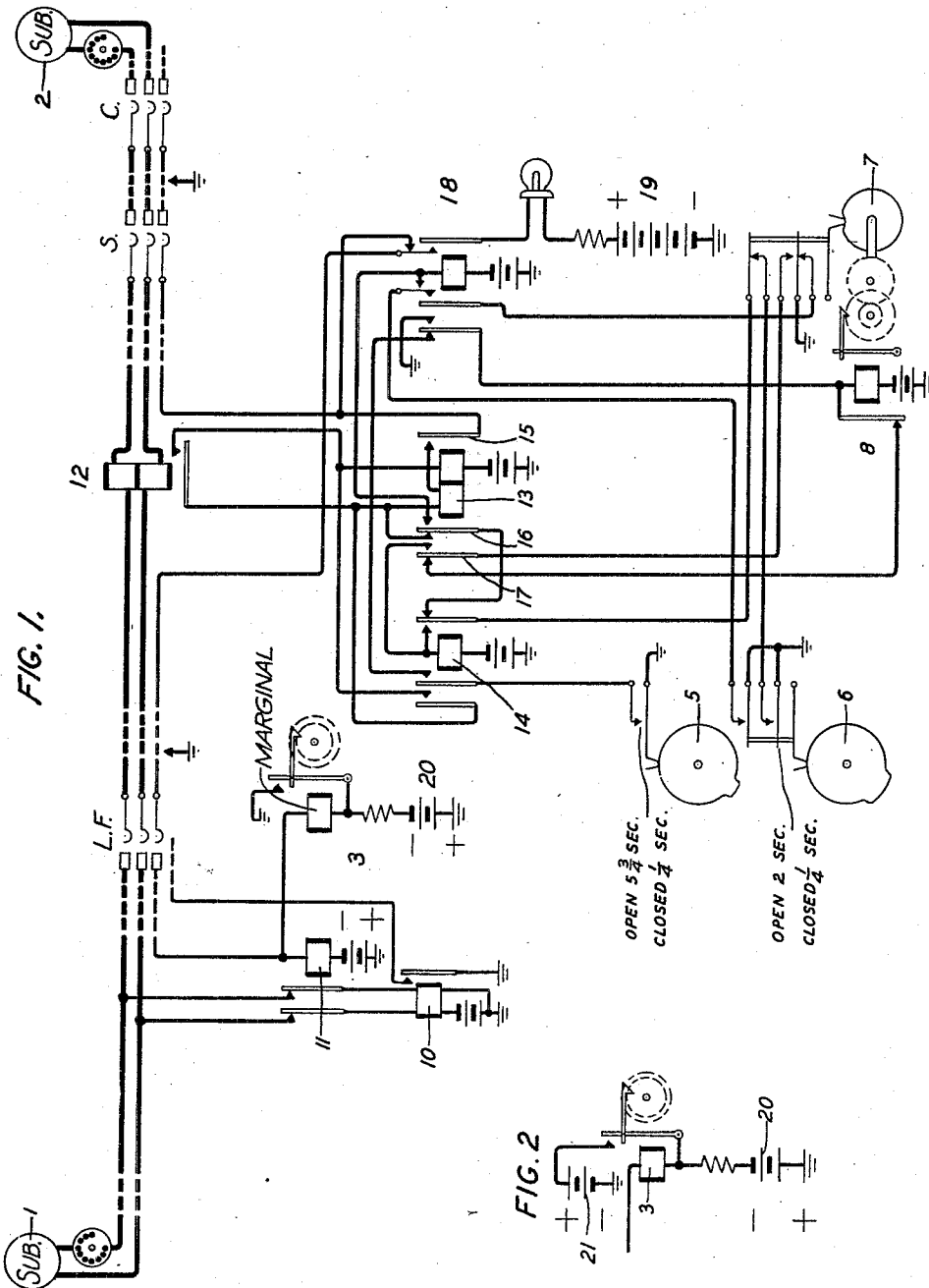
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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

The 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 used in which the meter and the cut-off relay are controllable over a single conductor, to wit, the sleeve conductor and in which the meter operates a plurality of times while the cut-off relay remains operated.

A feature of this invention is a meter and circuit arrangement so constructed that it can 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 unoperative 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.

Another feature is a meter and circuit arrangement whereby after the meter has been operated by booster battery and the ground is again applied, a momentary current reversal takes place in the meter circuit to cause it to release quickly.

This invention has been illustrated on the accompanying drawings in which, Fig. 1 shows the invention disclosed in an automatic connection established between a calling subscriber and a called subscriber through switches indicated in diagrammatic form, while Fig. 2 shows a circuit arrangement for a meter embodying a modified form of the invention.

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 a 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 through the winding of relay 10, lefthand 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 calling 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 circuit for relay 10 is thereby opened at the lefthand 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 and the sleeve through its winding 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 connectors 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' 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, righthand winding of relay 13, armature and front contact of relay 12, inner left-hand armature 16 and back contact of relay 13, righthand 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 lefthand winding through its righthand armature 15 and front contact to the ground on the sleeve conductor. As long as the original circuit for the relay 13 remains the lefthand 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 righthand winding, armature and front contact of relay 12, lefthand winding of relay 13 and its righthand armature 15 and front contact to ground on the sleeve at the connector. Both windings are now 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 lefthand armature 16 and front contact of relay 13, righthand 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 righthand make-before-break contacts and establishes a connection to a so-called "booster" battery 19 through the righthand armature and front contact over the sleeve through the line finder. The service meter 3 is thereby operated as follows: from the booster battery 19 through the inner righthand armature and front contact of relay 18, the sleeve conductor through the line finder, winding of the meter 3, a resistance to battery 20 of the opposite polarity, to battery 19, to ground. The service meter 3 in operating registers the first period of conversation. While battery is supplied from relay 18, the cut-off relay 11 will be maintained operated over the same circuit from the booster battery 19 and through the winding of relay 11 and the battery of the opposite polarity at the other end of this winding to ground. Relay 11 will therefore remain operated regardless of whether ground is connected to the sleeve or booster battery 19.

Relay 18 also closes a circuit for the operation of stepping magnet 8 from battery, winding of this magnet, the outer lefthand 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 service meter 3 is deenergized and the ground on the sleeve restored to maintain the 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. When the booster battery connection is removed and ground is supplied on the sleeve the ground at the armature and front contact of meter 3 shunts the winding of the meter 3 and partially short-circuits the battery 20. The release of the meter 3 is thereby greatly facilitated. 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 lefthand 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 18, a second circuit to be completed for the stepping magnet 8 from battery, winding of the magnet, outer lefthand armature and

back contact of relay 18, inner righthand 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 righthand 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 18 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 lefthand armature

17 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.

Fig. 2 shows a modified form of the circuit for the service meter 3. When the meter is operated a connection is completed to battery 21 and ground of a polarity opposite to that of battery 20. In this case when the meter operates through the current from the booster battery 19 the connection to battery 21 will have no effect as far as maintaining of meter 3 operated is concerned. However, when ground is substituted for battery 19 current will momentarily flow from battery 21 through the armature and front contact thereof and the winding of magnet 3 in the opposite direction to ground. This current will be in the opposite direction to the current from battery 19 and hence cause the flux in the magnet to decrease rapidly and thus greatly facilitate the quick release of the magnet.

While this invention has been illustrated in but two forms and in connection with but a single telephone system, it should be understood that it may readily be applied in a number of other forms and to a number of other circuit 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, a circuit for said magnet, means for closing said circuit from one source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet 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 rendering said first source ineffective to hold the magnet operative when said first circuit is again closed.

2. In combination, two sources of current, a magnet, a relay, a circuit for said magnet and relay means for closing said circuit from one source to ground, said magnet remaining inoperative and said relay operative in said circuit, a second circuit for said magnet and relay including both said sources, means for substituting said second circuit for said first circuit said magnet being operative and said relay remaining operative in said second circuit, a third circuit closed by the operation of said magnet for rendering said first source

ineffective to hold the magnet operative when the first circuit is again closed.

3. In combination, two sources of current, a magnet, a circuit for said magnet, means for closing said circuit from one source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative in said second circuit, a third circuit including a resistance and closed by the operation of said magnet from said first source through said resistance to ground for rendering said first source ineffective to hold the magnet operated when the first circuit is again closed.

4. In combination, two sources of current, a magnet, a relay, a circuit for said magnet and relay, means for closing said circuit from one source to ground, said magnet remaining inoperative and said relay operative in said circuit, a second circuit for said magnet and relay including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative and said relay remaining operative in said second circuit, a third circuit including a resistance and closed by the operation of said magnet from said first source through said resistance to ground for rendering said first source ineffective to hold the magnet operated and ineffective to release the relay which is held operated when the first circuit is again closed.

5. In combination, two sources of current of different potential, a magnet, a circuit for said magnet, means for closing said circuit from the lower potential source to ground, said magnet being inoperative in said circuit, a second circuit for said magnet including both said 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 rendering said lower potential source ineffective to hold the magnet operated when said first circuit is again closed.

6. In combination, two sources of current of different potential, a magnet, a relay, a circuit for said magnet and relay, means for closing said circuit from the lower potential source to ground, said magnet remaining inoperative and said relay operative in said circuit, a second circuit for said magnet and relay including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative and said relay remaining operative in said circuit, a third circuit closed by the operation of said magnet for rendering said lower potential source ineffective to hold the magnet operated when said first circuit is again closed.

7. In combination, two sources of current, a magnet, a circuit for said magnet, means for closing said circuit from said source to ground, said magnet remaining inoperative in

said circuit, a second circuit for said magnet including both said 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 shunting said first source from said magnet to hasten the release thereof when said first circuit is again closed.

8. In combination, three sources of current, a magnet, a circuit for said magnet, means for closing said circuit from a first source to ground, said magnet remaining inoperative in said circuit, a second circuit for said magnet including said first source and a second source, 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 to include the first source and a third source for rendering said first source ineffective in holding the magnet operative and for rendering said third source effective in hastening the release of the magnet when said first circuit is again closed.

9. In combination, three sources of current, a magnet, a relay, a circuit for said magnet and relay, means for closing said circuit from a first source to ground, said magnet being inoperative and said relay operative in said circuit, a second circuit for said magnet and relay including said first source and a second source, means for substituting said second circuit for said first circuit said magnet being operative and said relay remaining operative in said second circuit, a third circuit closed by the magnet in operating to include said first source and the third source for rendering said first source ineffective in holding the magnet and for rendering said second source effective in hastening the release of the magnet when the first circuit is again closed.

10. In combination, three sources of current, a magnet, a relay, a circuit for said magnet and relay, means for closing said circuit from a first source to ground, said magnet being inoperative and said relay being operative in said circuit, a second circuit for said magnet and relay including said first source and a second source, means for substituting said second circuit for said first circuit said magnet being operative and said relay remaining operative in said second circuit, a third circuit including a resistance closed by the operation of said magnet from said first source through said resistance to the third source for rendering said first source ineffective to hold the magnet operative and for rendering said third source effective to hasten the release of the magnet and without effecting the relay which is held operated when the first circuit is again closed.

11. In combination, two sources of current, a magnet, a resistance, a first circuit for said magnet, means for closing said first circuit

from a first source through said resistance to ground, said magnet remaining inoperative in said first circuit, a second circuit for said magnet, means for closing said second circuit in substitution of the first circuit from
5 said first source through said resistance to the other source, said magnet being operative in said second circuit, a third circuit, means responsive to the operation of said magnet for closing said third circuit from said first
10 source through said resistance to ground for rendering said first source ineffective to hold the magnet operated when the first circuit is again closed.

12. In combination two sources of current, a magnet, a relay, a circuit for said magnet and relay, means for closing said circuit from a first source to ground, said magnet remaining inoperative and said relay operative in
15 said circuit, a second circuit for said magnet and relay, including both said sources, means for substituting said second circuit for said first circuit, said magnet being operative and said relay remaining operative in said second circuit, a third circuit closed by the operation of said magnet for shunting said first
20 source from said magnet to render said first source ineffective to hold the magnet operated and ineffective to release the relay which is held operated when the first circuit is again closed.
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In witness whereof, I hereunto subscribe my name this 19th day of September, 1930.

LEWIS H. JOHNSON.

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