Nov. 22, 1938. E. N. ANDERSON ET AL 2,137,793

TELEPHONE SYSTEM

Filed Jan. 26, 1938 2 Sheets-Sheet 1

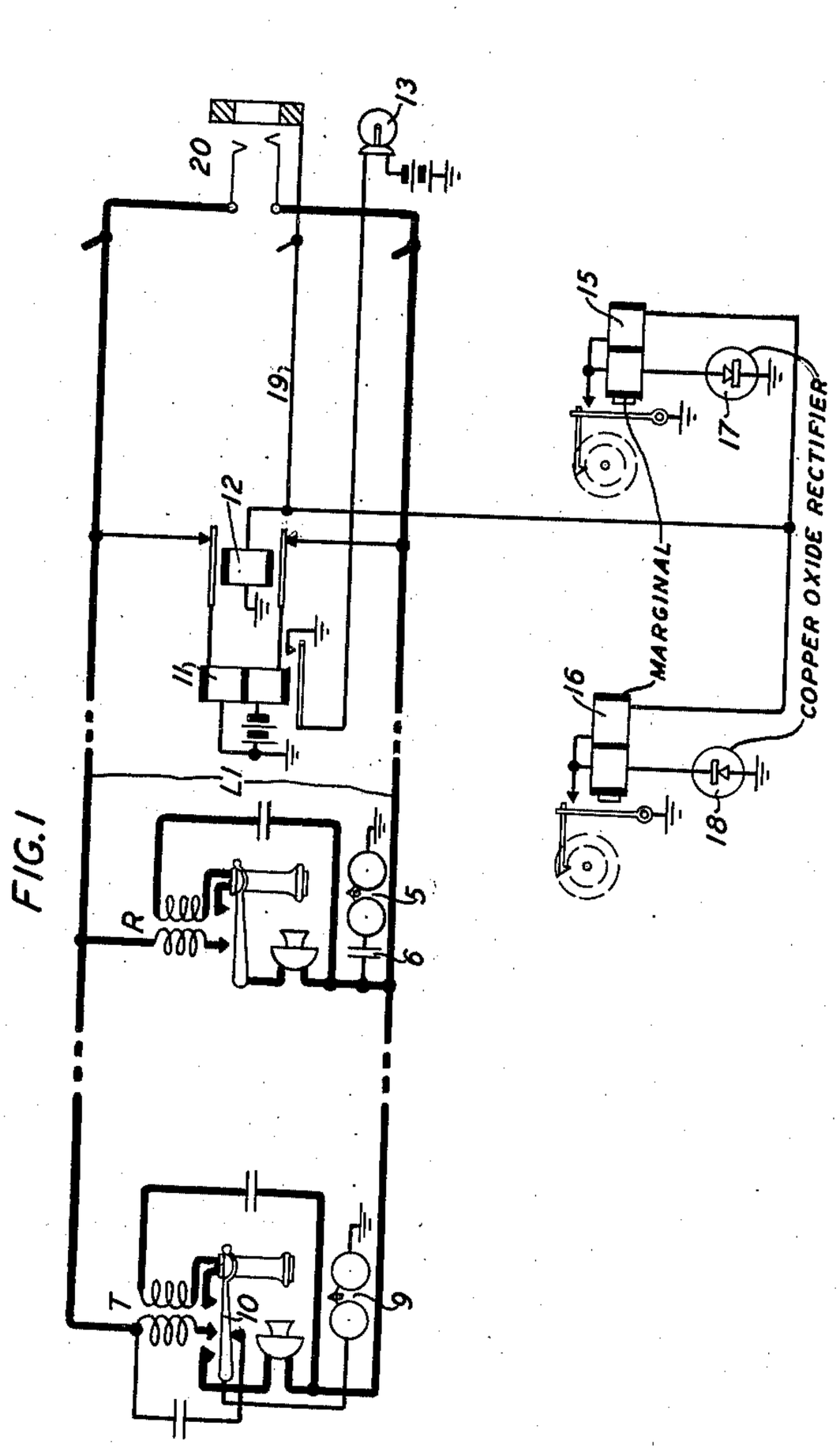

FIG. 1

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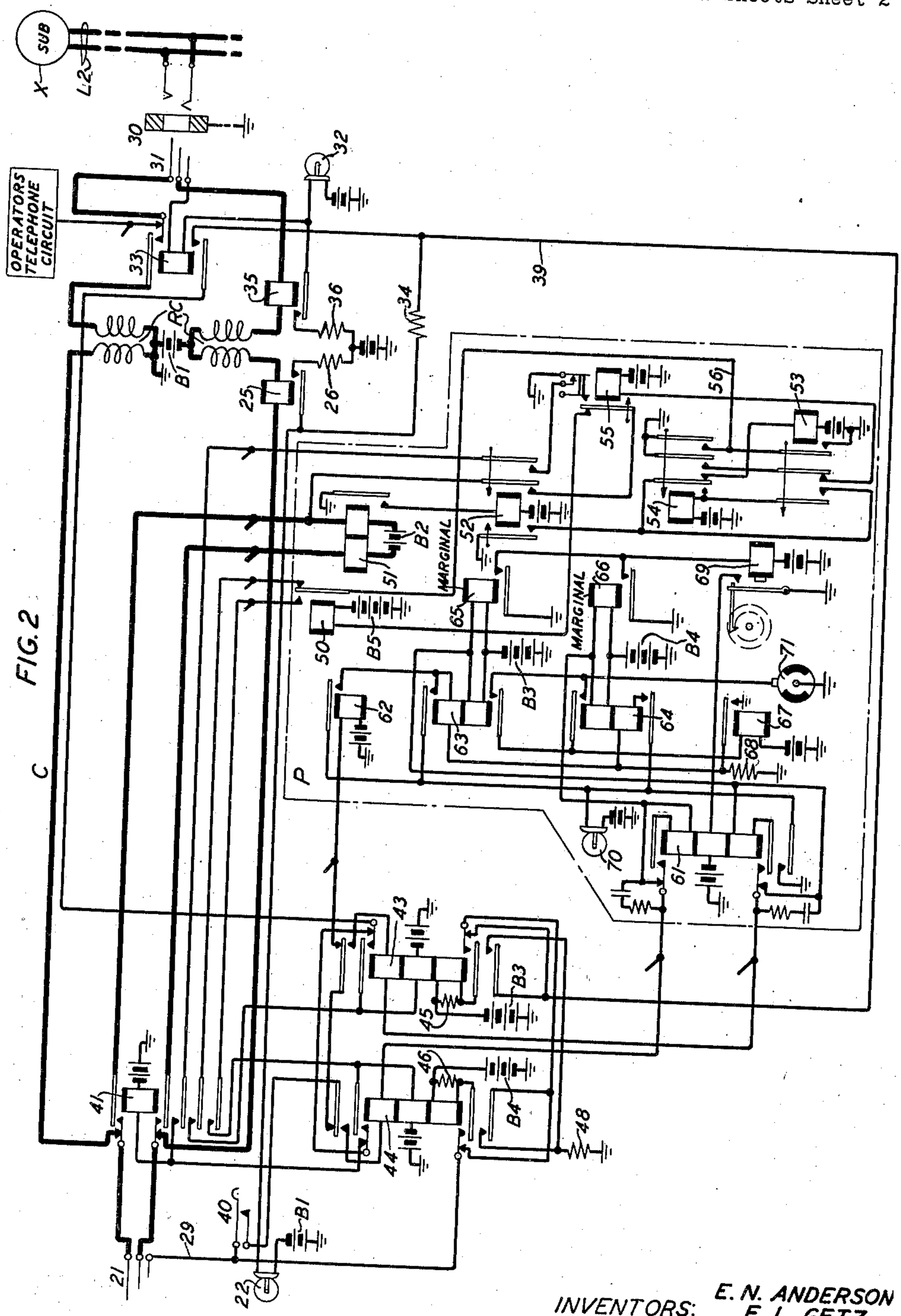

FIG. 2

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UNITED STATES PATENT OFFICE

2,137,793

TELEPHONE SYSTEM

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Application January 26, 1938, Serial No. 186,968

11 Claims. (Cl. 179—8.5)

This invention relates to telephone systems and particularly systems comprising message rate lines.

It is the object of the invention to provide a more efficient, economical, accurate and reliable arrangement for registering calls originated by party-line message rate subscribers.

In telephone systems arranged to provide measured service, it is well known to provide a meter or message register for each individual subscriber's line and to connect the meter to the sleeve or test conductor of the line equipment in the central office in parallel with the line cut-off relay. When a circuit is closed through the sleeve conductor, upon answer of a call originating over the line, the cut-off relay operates; but the meter is marginal and does not operate. When the desired connection is completed and the called subscriber answers the call, either manually or automatically operative switching means effects the temporary connection of a meter operating battery to the sleeve conductor of the line to cause the operation of the meter without releasing the cut-off relay.

This invention is a circuit arrangement for determining which of the subscribers on a two-party line has originated a call and for operating either one of two meters associated with the line, the meter for one of the two subscribers being connected to the sleeve conductor of the line in series with a rectifier poled in one direction, the meter of the other of the two subscribers being connected to the sleeve conductor in series with a rectifier poled in the opposite direction, and the line cut-off relay being connected to the sleeve conductor in parallel with both of the meters. A feature of the invention is means effective upon answer of a call originating over a two-party line for connecting the same polarity of operating potential to the sleeve conductor of the line to operate the line cut-off relay as is required to operate the meter of the subscriber who originated the call. A further feature is the momentary connection of a meter operating battery of the required polarity to the sleeve conductor of a two-party line to operate the meter of the calling subscriber without operating the meter of the other subscriber and without releasing the line cut-off relay.

Another feature of the invention is a two-party meter operating circuit arrangement comprising means for identifying the calling party on a two-party line and for operating one of two metering control relays dependent upon which of the parties originated the call, the operated control relay being held by the meter operating current to prevent its release while the meter is being operated. A further feature is the provision of a signal for indicating, upon operation of the metering key, failure to identify the calling party or failure to operate the meter in case the metering key was not held operated for a long enough interval or for any other reason.

These and other features of the invention will be better understood by considering the system shown schematically in the drawings which forms a part of this specification, this system being one arranged in accordance with the invention. It is, of course, understood that the invention is not limited to the particular telephone system and circuit arrangement shown in the drawing but is generally applicable to measured-service party-line systems.

Referring to the drawings:

Fig. 1 shows subscribers' stations R and T connected to a two-party line L1; and

Fig. 2 shows an operator's cord circuit C and position equipment P, a line L2 and station X.

The cord circuit C comprises an answering plug 21, calling plug 31, a repeating coil RC, supervisory relays 52 and 35 and supervisory lamps 22 and 32. The talking and ringing keys associated with cord circuit C are not shown in the drawing. The sleeve relay 33 completes the connection between repeating coil RC and plug 31 responsive to insertion of plug 31 in the jack of a trunk or line. A 24-volt central office battery B1 supplies talking current to calling and called stations, the positive pole being grounded. Battery B2 is a non-grounded battery of 24 volts which is used during test of the calling line to determine which of the two stations is the calling station, the test being made by relay 50 connected in series with a 48-volt battery B5. Batteries B3 and B4 are used to operate the meters of calling stations and have a high enough electromotive force, such, for instance, as 42 to 44 volts, for this purpose. Batteries B3 and B4 are oppositely poled, the positive pole of battery B3 and the negative pole of battery B4 being grounded. Any battery not otherwise identified in the drawing is the central office battery B1. Key 40 and relays 43 and 44 control the connection of meter-operating batteries B3 and B4 to the sleeve conductor 29 of the cord. Relays 50 to 55, inclusive, and 61 to 67, inclusive, are part of the operator's position equipment common to a plurality of cords.

The subscribers' stations R, T and X are of the usual type employed in common-battery, manually operated telephone systems. Stations R and

T differ in that the ringer 5 at station R is normally connected to the ring conductor of line L1 and the ringer 9 at station T is normally connected to the tip conductor of the line L1. Stations R and T also differ in that a direct current path is closed from ground through the ringer 9 and contacts of the switchhook 10 to the conductors of line L1 when the receiver is removed from the receiver hook at station T to originate a call; whereas at station R, condenser 6 is included in the connection between the ringer 5 and both conductors of the line when the receiver is removed from the receiver hook. The line L1 is connected in the central office to the tip and ring conductors of a jack 20 and through the back contacts of a line cut-off relay 12 to the windings of a line relay 11. An answering lamp 13, associated with jack 20, is controlled by relay 11. The line L1 is further provided with two meters 15 and 16, both of which are connected to the sleeve conductor 19 in parallel with the cut-off relay. The meter 15 is provided for registering calls originated by station R and is poled by rectifier 17 to operate when the negative pole of the battery B3 is connected to the sleeve conductor 19; and the meter 16 is provided for registering calls originated by station T and is poled by rectifier 18 to operate when the positive pole of battery B4 is connected to the sleeve conductor 19. Each of meters 15 and 16 are marginal so that the current resulting from connection of battery B1, B3 and B4 to the sleeve conductor 19 is insufficient to cause the operation of either of the meters until the metering key 40 is operated.

When one of the subscribers on line L1 removes the receiver from the receiver hook, the line loop is closed to energize and operate line relay 11. Relay 11 closes a circuit for lighting the answering lamp 13. When the answering plug 21 of cord circuit C is inserted in jack 20 to answer the call, a circuit is closed from battery B1 through lamp 22, resistor 34, conductor 39, back contacts of relays 43 and 44, conductor 29, sleeve conductors of plug 21 and jack 20, and through sleeve conductor 19 of line L1 to the windings of cut-off relay 12 and meters 15 and 16. Another circuit is closed from battery B1 through the left windings of repeating coil RC and the talking conductors of line L1, thereby operating the calling supervisory relay 25. Relay 25 connects resistor 26 in parallel with lamp 22 to prevent the lighting of the lamp as long as the loop over line L1 is closed. The electromotive force of battery B1 is sufficient to cause the operation of the cut-off relay 12; is of a polarity which causes substantially no current through meter 16 and rectifier 18; and although of the required polarity to cause a current through meter 15 and rectifier 17, this current is not strong enough to cause the operation of meter 15. Relay 12 disconnects the windings of line relay 11 from the conductors of line L1 and relay 11 releases, extinguishing the answering lamp 13.

After the answering operator is given the number of the station with which the calling subscriber desires connection, a busy test is made in the usual manner. If the called line L2 is idle, the calling plug 31 is inserted in jack 30, thereby closing a circuit from ground in the line circuit through the sleeve conductors of jack 30 and plug 31 winding of relay 33 and through a supervisory lamp 32 to battery. Lamp 32 lights and relay 33 operates. With relay 33 operated, a circuit is closed for operating relay 41; this circuit includes the inner upper back contacts of relays 44 and 43, the lower front contact of relay 33, conductor 39, lower back contacts of relays 43 and 44, sleeve conductors 29 and 19, and the winding of cut-off relay 12. With relay 41 operated, the windings of the repeating coil RC are disconnected from line L1 and the windings of relay 51 are connected in series with non-grounded battery B2 and the line loop. Relay 51 operates and closes a circuit for operating the slow-to-operate relay 52. Relay 52 closes a circuit for holding relay 41 operated; this circuit includes a front contact of relay 41, the right outer front contact of relay 52, and a back contact of relay 55. Relay 52 also closes a circuit for operating the slow-to-release relay 53 and completes a connection from the negative pole of grounded battery B5 through the winding of test relay 50, left back contact of relay 55, inner right front contact of relay 52, upper front contact of relay 41, through the tip conductors of plug 21 and jack 20, to the tip conductor of line L1. If the calling station is the station R, there is no ground connection thereat to cause operation of test relay 50; but, if the calling station is the station T, a circuit for operating relay 50 is completed through the middle upper contact of the receiver hook 10 and winding of ringer 9 to ground. A non-grounded battery is used for operating relay 51 so that test relay 50 will not be falsely operated in series with one of the windings of relay 51 in case the call originated at station R. Battery B2 also supplies talking battery to the calling station while the test is being made. The aforementioned operation of relay 53 closes a circuit for operating the slow-to-operate relay 54. Relay 54 locks under the sole control of relay 52 and opens the circuit through the winding of the slow-to-release relay 53. When relay 53 operated and as long as relay 54 is operated, ground is connected through conductor 56 to the armature of test relay 50; if station R is calling, a circuit is completed through the back contact of relay 50, a front contact of relay 41, and the middle winding of relay 43; if station T is calling, a circuit is completed through the front contact of relay 50, a front contact of relay 41, and the middle winding of relay 44. If relay 43 operates, it locks through its inner upper front contact, lower front contact of relay 33, conductor 39, outer lower front contact of relay 43, and through resistor 48 to ground. If relay 44 operates, it locks through its inner upper front contact, inner upper back contact of relay 43, lower front contact of relay 33, conductor 39, lower back contact of relay 43, outer lower front contact of relay 44, and through resistor 48 to ground. The operation of either of relays 43 or 44 opens the operating circuit of relay 41.

When the slow-to-release relay 53 closes its back contact, the slow-to-release relay 55 is energized. When relay 55 operates, it disconnects the test relay 50 and opens the holding circuit for relay 41. Relay 41 releases since its operating circuit was opened by operating either relay 43 or relay 44. The release of relay 41 causes the release of relay 51 and reconnects the conductors of line L1 to the repeating coil RC. The release of relay 51 causes the successive release of relays 52, 54 and 55; and relays 50 to 55 are ready for use with another cord. Relays 52 and 54 are slow in operating and relay 53 is slow in releasing to prevent false operation of test relay 50 while the upper contact springs of relay 41 are being actuated, to eliminate the possibility of false operation of relay 50 due to a capacity-discharge from line L1, and to give test relay 50 sufficient time to

operate, if the tip station is calling, before closing the circuit for operating the one or the other of control relays 43 and 44. Relay 55 is slow in operating to allow sufficient time for the operation of one of relays 43 and 44 before the release of relay 41.

If the call originated at station R and relay 43 operates and locks under control of relay 33 as hereinbefore described, relay 43 also closes a locking circuit from the negative pole of meter-operating battery B3, through the lower winding of relay 43 in parallel with resistor 45, inner lower front contact of relay 43, lower back contact of relay 44, conductor 29, and thence to ground through the winding of cut-off relay 12 and through the winding of meter 15 and rectifier 17. Relay 12 is held operated, but due to the resistance of the lower winding of relay 43 and resistor 45, the current through the windings of meter 15 is not strong enough to cause operation of this meter; and due to the polarity of battery B3 there is substantially no current through meter 16 and rectifier 18.

If the call originated at station T and relay 44 operates and locks under control of relay 33 as hereinbefore described, relay 44 closes a locking circuit from the positive pole of meter-operating battery B4, through the lower winding of relay 44 in parallel with resistor 46, inner lower front contact of relay 44, conductor 29, and thence to ground through the winding of cut-off relay 12 and through the winding of meter 16 and rectifier 18. The cut-off relay 12 releases, but is immediately reoperated, when the negative pole of battery B1 is disconnected and the positive pole of battery B4 is connected to sleeve conductor 19. Due to the resistance of the lower winding of relay 44 and resistor 46, the current through the windings of meter 16 is not strong enough to cause operation of this meter; and due to the polarity of battery B4 there is substantially no current through meter 15 and rectifier 17.

The called station is signalled by operation of a ringing key (not shown) in usual manner and when the subscriber at station X answers the call, the supervisory relay 35 operates. Relay 35 connects resistor 36 in parallel with lamp 32 to extinguish the lamp. The talking circuit includes the windings of repeating coil RC. To charge the calling station for the call, the non-locking metering key 40 is momentarily operated. If the call originated at station R, the metering circuit is traced from meter operating battery B3, through the lower winding of relay 63 in parallel with the winding of relay 65, lower back contact of relay 61, upper winding and outer upper front contact of relay 43, outer upper back contact of relay 44, contacts of key 40, conductor 29 and 19, through the winding of cut-off relay 12 and through the winding of meter 15 and rectifier 17. Relay 12 is held operated and meter 15 is operated; rectifier 18 prevents the operation of meter 16. Meter 15 short-circuits its left winding and rectifier 17 and locks through its low-resistance right winding. Although the lower winding of relay 43 is shunted by the windings of relays 63 and 65 while key 40 is operated, the energization of the upper winding of relay 43 insures the continued operation of this relay while key 40 is operated. Relay 63 is operated by the current through its lower winding in series with both windings of meter 15 but relay 65 is marginal and does not operate until meter 15 operates and short-circuits its left winding. Relay 63 closes a locking circuit from battery through lamp 70, upper front contact and upper winding of relay 63, through resistor 68 to ground. Resistor 68 limits the current sufficiently to prevent lighting of lamp 70. At its lower front contact, relay 63 connects interrupter 71 to the winding of relay 67 and relay 67 is thereby alternately operated and released under control of the interrupter. Each operation of relay 67 short-circuits resistor 68, thereby lighting lamp 70. If the meter 15 fails to operate lamp 70 continues to flash under the control of relay 67; but, if meter 15 operates, the short-circuiting of the left winding of meter 15 causes the operation of relay 65. Relay 65 closes a circuit for operating the position register 69; and register 69 closes a circuit through the middle winding of relay 61. Relay 61 operates, closes a holding circuit through its lower winding in series with meter 15 and meter operating battery B3, and closes at its outer lower front contact a circuit for lamp 70. Lamp 70 is thereby continuously lighted until key 40 is released. The upper winding of relay 63 is short-circuited when relay 61 operates and the resistance of the lower winding of relay 61 reduces the current through the lower winding of relay 63 and the winding of relay 65 to cause the release of relays 63 and 65 without causing the release of the meter 15. The release of relay 65 causes the release of register 69 and the release of register 69 deenergizes the middle winding of relay 61. When key 40 is released, relay 61 releases but the cut-off relay 12 is held in series with the lower winding of relay 43 and battery B3; and the meter 15 is held operated by its right winding in series with the lower winding of relay 43 and battery B3 to prevent a second operation of meter 15 in case the contacts of key 40 are closed a second time.

If the call originated at station T and control relay 44 is operated, the operation of metering key 40 closes a circuit from battery B4 through the lower winding of relay 64 in parallel with the winding of relay 66, upper back contact of relay 61, upper winding and outer upper front contact of relay 44, contacts of key 40, conductors 29 and 19, through the winding of meter 16 and rectifier 18. Relay 12 is held operated and meter 16 is operated; rectifier 17 prevents the operation of meter 15. Meter 16 short-circuits its left winding and locks through its low-resistance right winding. Although the lower winding of relay 44 is shunted by the windings of relays 64 and 66 while key 40 is operated, the energization of the upper winding of relay 44 insures the continued operation of this relay while key 40 is operated. Relay 64 is operated by the current through its upper winding in series with both windings of meter 16 but relay 66 is marginal and does not operate until meter 16 short-circuits its left winding. Relay 64 closes a locking circuit from battery through lamp 70, lower front contact and lower winding of relay 64, through resistor 68 to ground; and connects relay 67 to interrupter 71 to flash lamp 70 until the meter 16 operates. When relay 66 operates due to the short-circuiting of the left winding of meter 16, it closes a circuit for operating register 69 and register 69 causes the operation of relay 61. With relay 61 operated, lamp 70 is lighted continuously and relays 64 and 66 and register 69 release. When the key 40 is released, relay 61 releases and lamp 70 is extinguished. The cut-off relay 12 is held in series with the lower winding of relay 44 and battery B4; and the meter 16 is held operated in series with the lower winding of relay 44 and battery B4 to prevent a second operation of register 16 in case the contacts of key 40 are closed a second time.

If neither one of control relays 43 and 44 is operated when metering key 40 is operated, a circuit is closed over sleeve conductors 19 and 29, through key 40 and the outer upper back contacts of these relays for operating relay 62 of the position equipment P. Relay 62 closes a circuit through resistor 68, the upper winding of relay 63 and lamp 70. Relay 63 operates, thereby connecting relay 67 to interrupter 71. Relay 63 is locked through its upper winding independent of relay 62 and the lamp 70 continues to flash until the trouble is cleared and relay 61 is operated.

When the conversation is completed, the placing of the receiver in normal position at the called station X causes the release of relay 35 and the lighting of lamp 32; and the placing of the receiver in normal position at the calling station R or T causes the release of relay 25 and the lighting of lamp 22. When the operator removes plugs 21 and 41 from jacks 20 and 40, the cut-off relay 12 and the operated one of relays 43 and 44 releases.

What is claimed is:

1. In a communication system, lines including a two-party line, a relay for said line, a call meter for each of the stations of said line, a test conductor for said line, the windings of said relay and meters being connected in multiple to said conductor, a rectifier in series with one of said meters, an oppositely poled rectifier in series with the other of said meters, a link for use in interconnecting calling and called lines, a source of current effective upon interconnection of the link and said line to operate said relay but having insufficient electromotive force to cause the operation of either of said meters, other sources of current associated with said link, means for determining on a call originating on said two-party line the station at which the call originated, means effective upon identification of the calling station to connect to said test conductor to operatively energize said relay a source of current of the same polarity as is required for operating the meter of the calling station, and means comprising a key for operating the meter of the calling station.

2. In a communication system, lines including a two-party line, a relay for said line, a call meter for each of the stations of said line, a test conductor for said line, the windings of said relay and meters being connected in multiple to said conductor, a rectifier in series with one of said meters, an oppositely poled rectifier in series with the other of said meters, a link for use in interconnecting calling and called lines, a source of current effective upon interconnection of the link and said line to operate said relay but having insufficient electromotive force to cause the operation of either of said meters, other sources of current associated with said link, means for determining on a call originating on said two-party line the station at which the call originated, means effective upon identification of the calling station to connect to said test conductor to operatively energize said relay a source of current of the same polarity as is required for operating the meter of the calling station, the last-mentioned connection being ineffective to cause the operation of either of said meters, and means comprising a key for operating the meter of the calling station and for holding said relay operated while the meter is being operated.

3. In a communication system, lines including a two-party line, a relay for said line, a call meter for each of the stations of said line, a test conductor for said line, the windings of said relay and meters being connected in multiple to said conductor, a rectifier in series with one of said meters, an oppositely poled rectifier in series with the other of said meters, a link for use in interconnecting calling and called lines, a source of current effective upon interconnection of the link and said line to operate said relay but having insufficient electromotive force to cause the operation of either of said meters, other sources of current associated with said link, one of said other sources of current having sufficient electromotive force and the required polarity for operating one of said meters, another of said other sources having sufficient electromotive force and the required polarity for operating the other of said meters, means for determining on a call originating on said two-party line the station at which the call originated, means effective upon identification of the calling station to connect to said test conductor to operatively energize said relay a source of current of the same polarity as is required for operating the meter of the calling station, the last-mentioned connection being ineffective to cause the operation of either of said meters, and means comprising a key for operating the meter of the calling station and for holding said relay operated while the meter is being operated.

4. In a communication system, lines including a line having two stations permanently connected thereto, a link for use in interconnecting calling and called lines, a relay connected to the test conductor of said line, a meter for each of said stations, each of said meters being connected to said test conductor in parallel with said relay, a rectifier in series with each of said meters, said rectifiers being oppositely poled, means comprising a current source in said link for operating said relay upon interconnection of said link and said line without operating either of said meters, two oppositely poled sources of current in said link each of high enough electromotive force for use in operating the one or the other of said meters, means associated with said link for determining which of the two stations on said line is the calling station, means including the one or the other of said oppositely poled sources of current for operatively energizing the winding of said relay without causing the operative energization of either of said meters, and means comprising a key for connecting one or the other of said oppositely poled sources of current to the test conductor of said line to operatively energize the winding of said relay and the winding of the one or the other of said meters.

5. In a communication system according to claim 4, circuit means for preventing the connection of the first-mentioned current source to said test conductor while said key is operated.

6. In a communication system, lines including a two-party line, a first relay, a call meter for each of the stations of said line, a test conductor for said line, the windings of said first relay and meters being permanently connected in multiple to said conductor, a rectifier in series with one of said meters, an oppositely poled rectifier in series with the other meter, a link for use in interconnecting calling and called lines, a source of current effective upon interconnection of the link and said line to operate said first relay but having insufficient electromotive force to cause the operation of either of said meters, other sources

of current associated with said link, two metering control relays, means for determining on a call originating on said party line the station at which the call originated and for thereupon selectively operating the one or the other of said control relays, means comprising holding windings and contacts of said control relays for connecting to said test conductor to operatively energize said first relay a source of current of the same polarity as is required for operating the meter of the calling station, and means comprising a key for operating the meter of the calling station and for holding the operated one of said control relays while said meter is being operated.

7. In a communication system, lines including a two-party line, a first relay, a call meter for each of the stations of said line, a test conductor for said line, the windings of said first relay and meters being permanently connected in multiple to said conductor, a rectifier in series with one of said meters, an oppositely poled rectifier in series with the other meter, a link for use in interconnecting calling and called lines, a source of current effective upon interconnection of the link and said line to operate said first relay but having insufficient electromotive force to cause the operation of either of said meters, other sources of current associated with said link, two metering control relays, means for determining on a call originating on said party line the station at which the call originated and for thereupon selectively operating the one or the other of said control relays, means comprising holding windings and contacts of said control relays for connecting to said test conductor to operatively energize said first relay a source of current of the same polarity as is required for operating the meter of the calling station, the last-mentioned connection being ineffective to cause the operation of either of said meters, and means comprising a key for operating the meter of the calling station and for holding said first relay and the operated one of said control relays while said meter is being operated.

8. In a communication system according to claim 1, a signal, and means rendered effective upon operation of said key for operating said signal.

9. In a communication system according to claim 3, a signal, and means in the circuit for operating either of the meters for initiating and continuing the operation of said signal until the meter of the calling station is operated.

10. In a communication system according to claim 1, a signal device, means in the circuit for operating either of the meters for initiating the operation of said signal device, and means responsive to the operation of the meter of the calling station for operating said signal device in a different manner.

11. In a communication system according to claim 7, a signal device, means in the circuit for operating either of the meters for initiating the operation of said signal device, and means effective in case neither of said control relays is operated when said key is operated for initiating the operation of said signal device.

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