

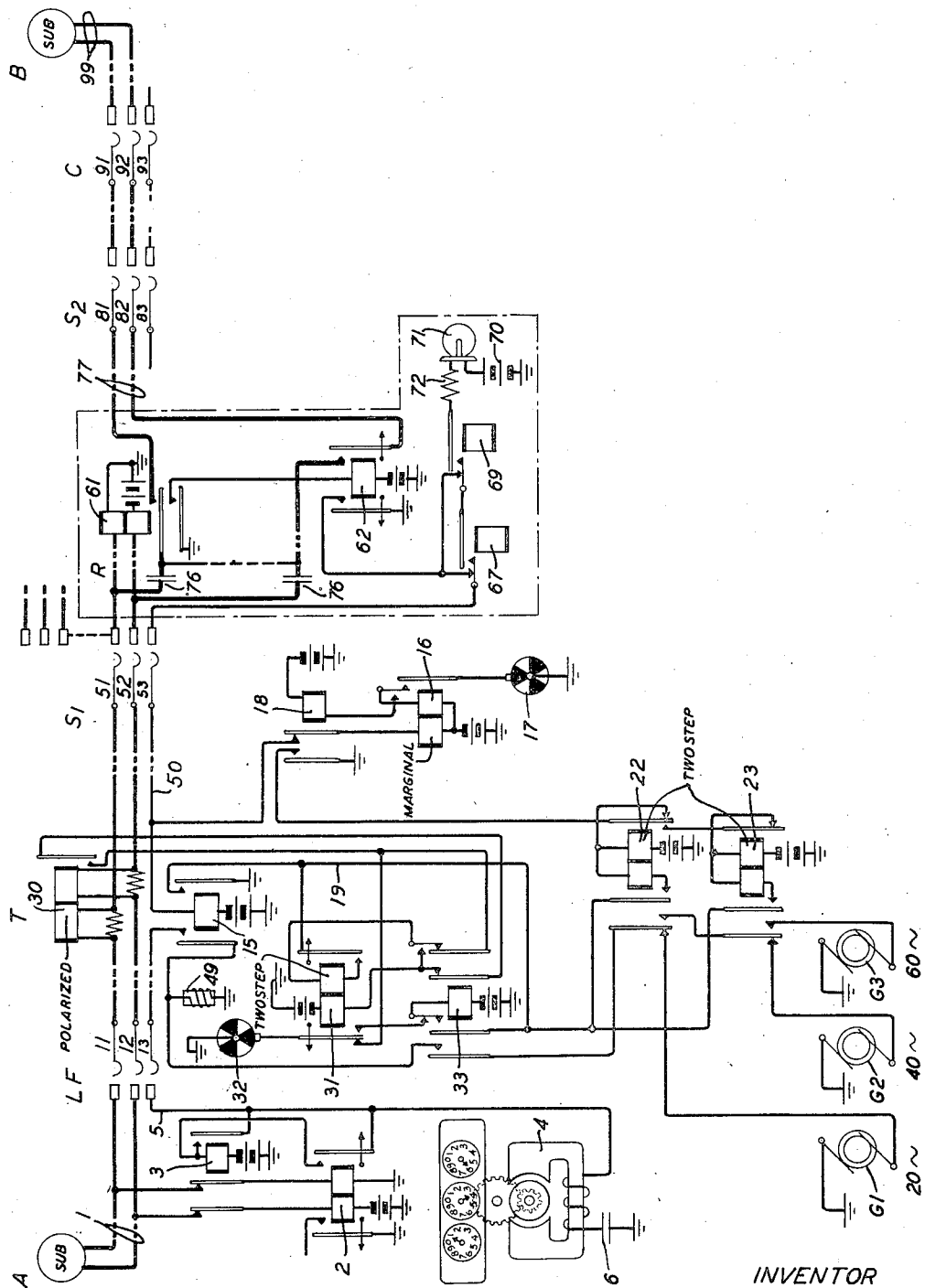
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone systems and more particularly to measured service systems.

The object of the invention is to provide an economical arrangement for registering the charges for telephone service rendered a subscriber.

In telephone systems arranged for measured service, it is usual to provide a meter or message register for each station. This meter may be operated once only for a call, may be operated periodically during the time that a talking connection is maintained, or may be continuously operated during that time. It is also known to vary the charge for an established connection in accordance with the location of the calling and called lines with respect to each other. According to this invention, a subscriber's meter, connected to the sleeve conductor of the line in parallel with the winding of the cut-off relay, comprises a synchronous motor and registering means driven thereby during the time the associated line is connected for conversation on a call for which the subscriber is to be charged.

A feature of the invention is the provision of a plurality of sources of current for continuously operating a subscriber's meter in accordance with the location of the calling and called stations with respect to each other during the maintenance of a talking connection.

Another feature of the invention is an arrangement whereby an alternating current source is connected to a synchronous motor driven register during the time the subscriber's line, with which the register is associated, is connected for conversation, the frequency of said source being dependent upon the location of the calling and called lines with respect to each other.

A system arranged in accordance with this invention is represented schematically in the drawing which forms a part of this specification. The invention is not, however, limited in its application to this particular system but may be applied to all measured service telephone systems.

Referring to the drawing, A and B represent subscribers' stations, LF represents a line-finder switch, S1 represents a first selector switch permanently associated with the line-finder switch LF, T represents the trunk and associated apparatus connecting switches LF and S1, R represents an impulse repeater associated with an outgoing trunk 77 which is selectable by the operation of switch S1 alone or by the operation of switch S1 and one or more intermediate selector switches (not shown), S2 represents an

incoming selector permanently associated with the trunk 77, and C represents a connector switch which has access to subscribers' lines and which is selectable by the operation of switch S2 alone or by the operation of switch S2 and one or more intermediate selector switches.

The subscribers' stations A and B are of the usual type employed in automatic telephone systems and include a dial or other impulse sending device for use in obtaining connection with the station of any other subscriber with whom conversation is desired.

Each of the switches LF, S1, S2 and C may be of the well-known Strowger type. For a description of the construction of such a switch and its operation, when employed as a selector or connector, reference may be had to pages 53 to 65, inclusive, of the second edition of "Automatic Telephony" by Smith and Campbell published in 1921. For a description of a Strowger type switch when used as a line finder, reference may be had to Patent No. 1,799,654 granted April 7, 1931 to R. L. Stokely.

Individual to the subscriber's station A and line 1 are the usual line and cut-off relays 2 and 3, the conductors of line 1 being connected to terminals in the bank of line-finder switch LF and other line finders in the same group and also to terminals in the banks of connector switches (not shown). In place of the usual message register there is provided a meter comprising a synchronous motor similar to the motors used in electric clocks. Such a motor is adapted to operate at various frequencies, for instance from 20 to 60 cycles, although not at maximum efficiency over the whole range.

The charging trunk T which is a modification of that disclosed in Patent No. 1,859,941 granted to R. L. Stokely May 24, 1932, comprises the polarized supervisory relay 30, release (holding) relay 15, zone signal receiving relays 18 and 16, zone relays 22 and 23, charge delay relays 31 and 33 and the three sources of alternating current G1, G2 and G3 which are provided for use in operating calling subscribers' meters. As far as possible the elements of trunk T are given the same reference characters as in the aforementioned Stokely patent. The sources G1, G2 and G3 replace the timing switch M and booster battery 40 which are provided in the aforementioned Stokely patent.

The repeater R is identical with that disclosed in the aforementioned Stokely patent and comprises, in addition to the impulse repeating relay 61 and release relay 62, the zone signaling relays

67 and 69 and booster battery 70 for use in transmitting a zone signal to the charging trunk through which a connection is extended to the repeater. The zone signal comprises the connection of the booster battery to the sleeve conductor in place of holding ground potential for a predetermined interval of time. The length of this interval depends upon the character of an interrupter (not shown) and is indicative of the particular zone into which the associated trunk 77 extends. The repeaters associated with trunks extending into other zones are similar to the repeater R except for the length of the interval during which booster battery is connected to the sleeve conductor. For a detailed description of the operation of the repeater R, reference may be had to the aforementioned Stokely patent, the same reference characters being used for like elements. Repeaters may be employed in completing interoffice calls within the local zone, where the local charging zone includes one or more distant offices in addition to the office of a calling station, but no zone signal is necessary and in such a repeater the zone signaling apparatus is omitted.

Assume that the subscriber at station A originates a call, that the line finder LF hunts for the terminals to which line 1 is connected and extends the line 1 to the selector S1, and that the selector S1 responds to the dialing of the first digit of the number of the subscriber's station with which connection is desired. If the called station is in an office outside of the local zone, the selected set of terminals in the bank of selector S1 are connected to an outgoing repeater such as R, the connection from the calling line being extended through brushes 11 and 12 of line finder LF, the windings of relay 30, brushes 51 and 52 of selector S1 to the windings of impulse relay 61 of the repeater. Being polarized, relay 30 does not operate at this time but relay 61 operates in series with the line and closes a circuit for operating release relay 62. Relay 62 connects holding ground potential through the back contact of relay 67 over the sleeve conductor through brush 53 to sleeve conductor 50 of selector S1 to operate release relay 15 of the charging trunk T and to hold the selector S1 in usual manner. Although the left winding of relay 16 is connected, through the back contact of relay 18, in parallel with the winding of release relay 15, relay 16 is marginal and does not operate until booster battery is connected to conductor 50. Relay 15 connects ground through coil 49 to brush 13 of line finder LF to hold the line finder LF and cut-off relay 3 in usual manner. Coil 49 has a high impedance but is of low resistance so that the holding and guarding potential will be satisfactory. The impulse relay 61 and release relay 62 close a bridge across the conductors of trunk 77 and the impulses created by the dialing or the succeeding digits of the called subscriber's number are repeated by relay 61 to control the operation of the incoming selector S2, intermediate selectors, if any, and a connector C to establish connection with the called line.

As soon as relay 61 receives the first impulse to be repeated, relays 67 and 69 are operated as set forth in detail in the aforementioned Stokely patent to connect booster battery 70 to the sleeve conductor, through brush 53 of selector S1, to the winding of release relay 15 and left winding of relay 16. Relay 15 is thereby held operated and marginal relay 16 is energized sufficiently to cause its operation. In operating, relay 16 con-

nects its right winding in parallel with the winding of relay 18 to interrupter 17. Interrupter 17 is arranged to connect its brush to ground for two-tenths of a second out of every four-tenths of a second. The operation of relay 18, as soon as the brush of interrupter 17 is connected to ground, closes a circuit for operating zone relay 22. Relay 22 locks through its left winding and front contact over conductor 19 to ground at the right front contact of release relay 15. As soon as the brush of interrupter 17 is again disconnected from ground, relay 18 releases and if the booster battery is no longer connected to brush 53, relay 16 releases. In this case the operation of zone relay 22 and non-operation of relay 23, indicates a call to zone 2. If the charging trunk is connected to a repeater which is associated with a trunk to zone 3, booster battery remains connected to sleeve conductor 50 and relay 16 is held operated, when relay 18 releases, long enough to cause a second operation of relay 18. The second operation of relay 18 causes the operation of zone relay 23; and relay 23 locks through its left winding to ground at relay 15.

On a local call, that is one not involving the use of a repeater, the release relay 15 of trunk T is operated by the holding ground connected to brush 53, this ground connection being under the control of the connector switch as soon as the connection is extended to a connector. Of course, no operation of the zone relays is effected on a local call or on a call involving a repeater if the called line is in the same zone as the calling line.

Connection having been established between the calling and called lines and the called line being idle, ringing current is transmitted over the line to signal the called station in usual manner. Upon removal of the receiver at the called station the ringing circuit is opened and the talking connection established, whereupon the connector effects the usual reversal of current over the conductors of the trunk 77 so as to cause the interchanging of the connections between the windings of impulse relay 61 of repeater R and the conductors of trunk T and line 1; so that the current is also reversed through the windings of the polarized supervisory relay 30 to cause its operation. On a local call, the reversal of current effected by the connector switch directly causes the operation of relay 30. The brush of interrupter 32 is connected to ground for two seconds out of every four so that the left winding of relay 31 is energized not later than two seconds after relay 30 operates. Relay 31 is thereby partially operated so as to close its right front contact; and, as soon as the brush of interrupter 32 is again disconnected from ground, relay 31 is completely operated by current through its two windings and right front contact in series. When ground is next connected to the brush of interrupter 32, relay 33 is operated and relay 33 locks through its inner left front contact to ground at relay 15. Relay 33 closes a locking circuit through the winding of relay 31 which is independent of the continued operation of relay 30, and closes a meter operating circuit which is maintained until the connection is released by the calling subscriber. If the called station is in zone 1, that is the same zone as the calling station, neither of the zone relays 22 and 23 would have been operated and the meter operating circuit is traced from ground through alternating current source G1, left back contact of zone relay 22, outer left front contact of relay 33, left front contact of relay 15, over the sleeve conductor and

brush 13 of line finder LF, conductor 5, winding of meter 4 and through condenser 6 to ground. The meter 4 is thereby operated by 20 cycle alternating current as long as the connection is maintained. If zone relay 22 is operated, the called station being in zone 2, the metering circuit is traced from ground through alternating current source G2, left back contact of relay 23, outer left front contact of relay 22, and the winding of meter 4, the meter being operated by 40 cycle alternating current. If zone relay 23 is operated, the called station being in zone 3, the metering circuit is traced from ground through alternating current source G3, the outer left front contacts of relays 23 and 22 and the winding of the meter 4, the meter being operated by 60 cycle alternating current. Thus the meter 4 is operated as long as a talking connection is established at a rate dependent upon the relative location of the calling and called stations.

When the receiver is replaced at station A to release the connection the impulse relay 61 of repeater R releases, if the connection includes a repeater. The release of relay 61, causes the release of relay 62 and opens the bridge across the conductors of trunk 77 to release the line relay of the connector switch, the switches in the terminating office being thereupon restored to normal in usual manner. The release of relay 62 disconnects holding the ground potential from the sleeve conductor thereby causing the release of relay 15 of trunk T and the return of selector S1 to normal. The release of relay 15 opens the metering circuit, causes the release of cut-off relay 3 and the line finder LF is restored to normal in usual manner.

On a local call the removal of the holding ground potential from the sleeve conductor at the connector switch causes the release of relay 15, the selector and connector switches being restored to normal in usual manner. The release of relay 15 opens the metering circuit and causes the return of the line-finder switch to normal.

What is claimed is:

1. In a telephone system, subscribers' stations, means for establishing a talking connection between a calling and a called station, a meter associated with one of said stations for continuous operation during the time said connection is maintained, and means for operating said meter at a rate dependent upon the relative location of said calling and called stations.

2. In a telephone system, subscribers' lines, means for connecting a calling one of said lines with any other line, a service meter associated with said calling line, said meter comprising an alternating current synchronous motor, a plurality of sources of alternating current, each source being of a different frequency, and means for connecting a desired one of said sources to operate said meter.

3. In a multi-zone telephone system, subscribers' lines in each of said zones, means for establishing a connection between a calling one of

said lines and any other line, a service meter for said calling line, said meter comprising an alternating current synchronous motor, a plurality of sources of alternating current, each source being of a different frequency, and selective means for connecting to said meter that one of said sources which is effective to operate said meter at the rate required for a call to the particular zone within which the called line is located.

4. In a multi-office multi-zone telephone system, a subscriber's line in one office, a service meter comprising a synchronous motor for said line, subscribers' lines in other offices, means including a charging trunk and automatic switches for completing both local and inter-office calls originating over said line, trunks from said one office to each of said other offices, said trunks being connected to terminals in the banks of one of said switches, means in said charging trunk operative upon extension of said line to one of said interoffice trunks for registering the zone into which the trunk extends, sources of alternating current of different frequencies, and means responsive to the answer of the called subscriber for connecting one of said sources in series with said meter, the particular source thus connected being controlled by said zone register means.

5. In a telephone system, a subscriber's line, a line relay, a line cut-off relay, a charging trunk, means responsive to the operation of said line relay for connecting said charging trunk and line and for connecting said cut-off relay to a conductor of said charging trunk, means in said charging trunk responsive to the connection of said line and trunk for connecting a holding potential to said conductor to operate the cut-off relay, a condenser and a service meter for said line connected in series to said conductor of the charging trunk, a source of alternating current, and means in said charging trunk for connecting said source of alternating current to said conductor to operate said meter without affecting the operation of said cut-off relay.

6. In a telephone system, subscribers' lines, means for establishing a talking connection between a calling one of said lines and a called line, a control conductor associated with the talking conductors of said calling line, a synchronous motor driven meter connected to said control conductor, a source of alternating current for operating said meter, and means for connecting said source of said control conductor.

7. In a telephone system, subscribers' lines, means for establishing a talking connection between a calling one of said lines and a called line, a control conductor associated with the talking conductors of said calling line, a synchronous motor driven meter connected to said control conductor, sources of alternating current of different frequencies, and means for connecting one of said sources to said control conductor in response to the answer of the called subscriber.

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