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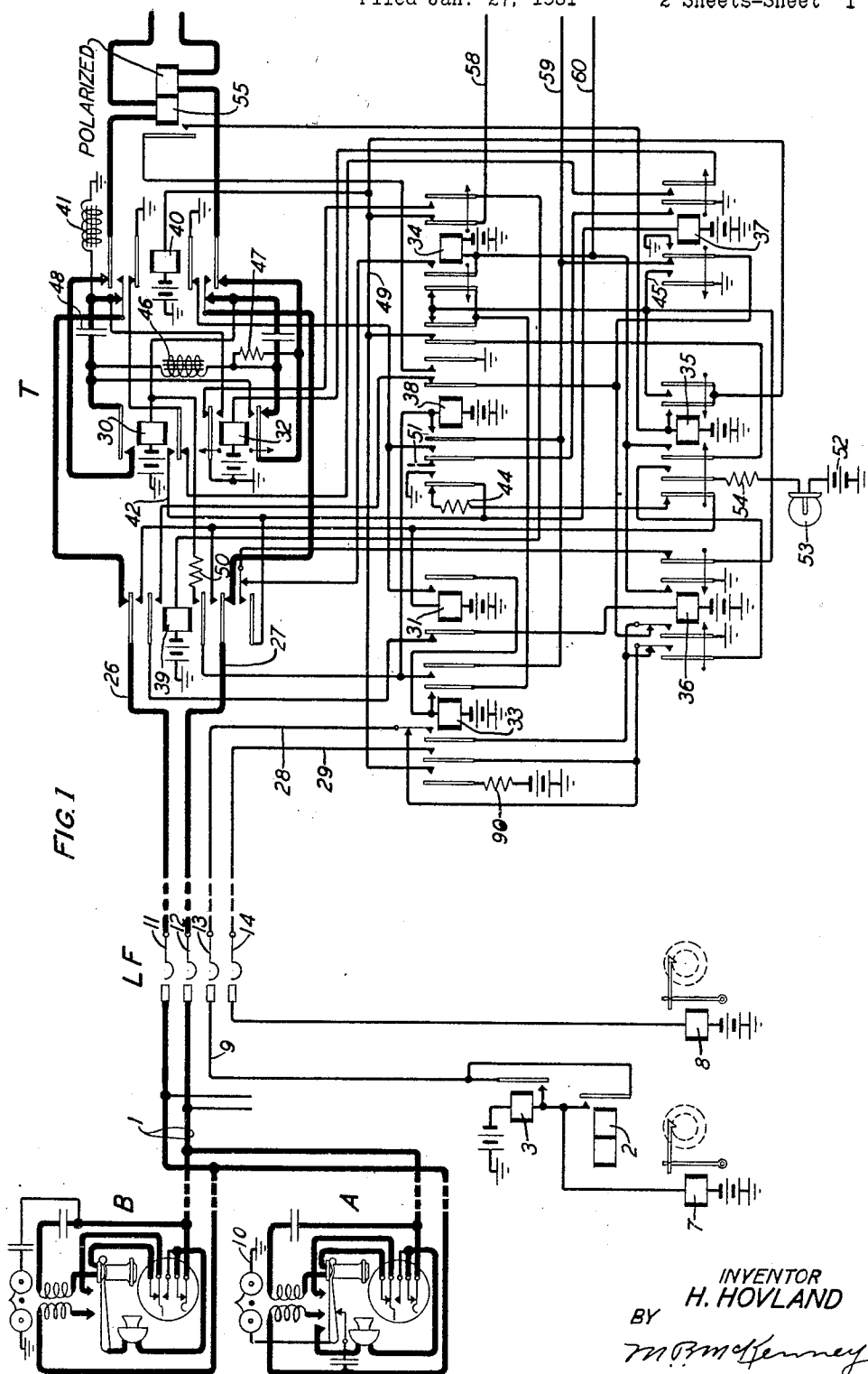
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1,863,307

TELEPHONE EXCHANGE SYSTEM

Filed Jan. 27, 1931

2 Sheets-Sheet 1



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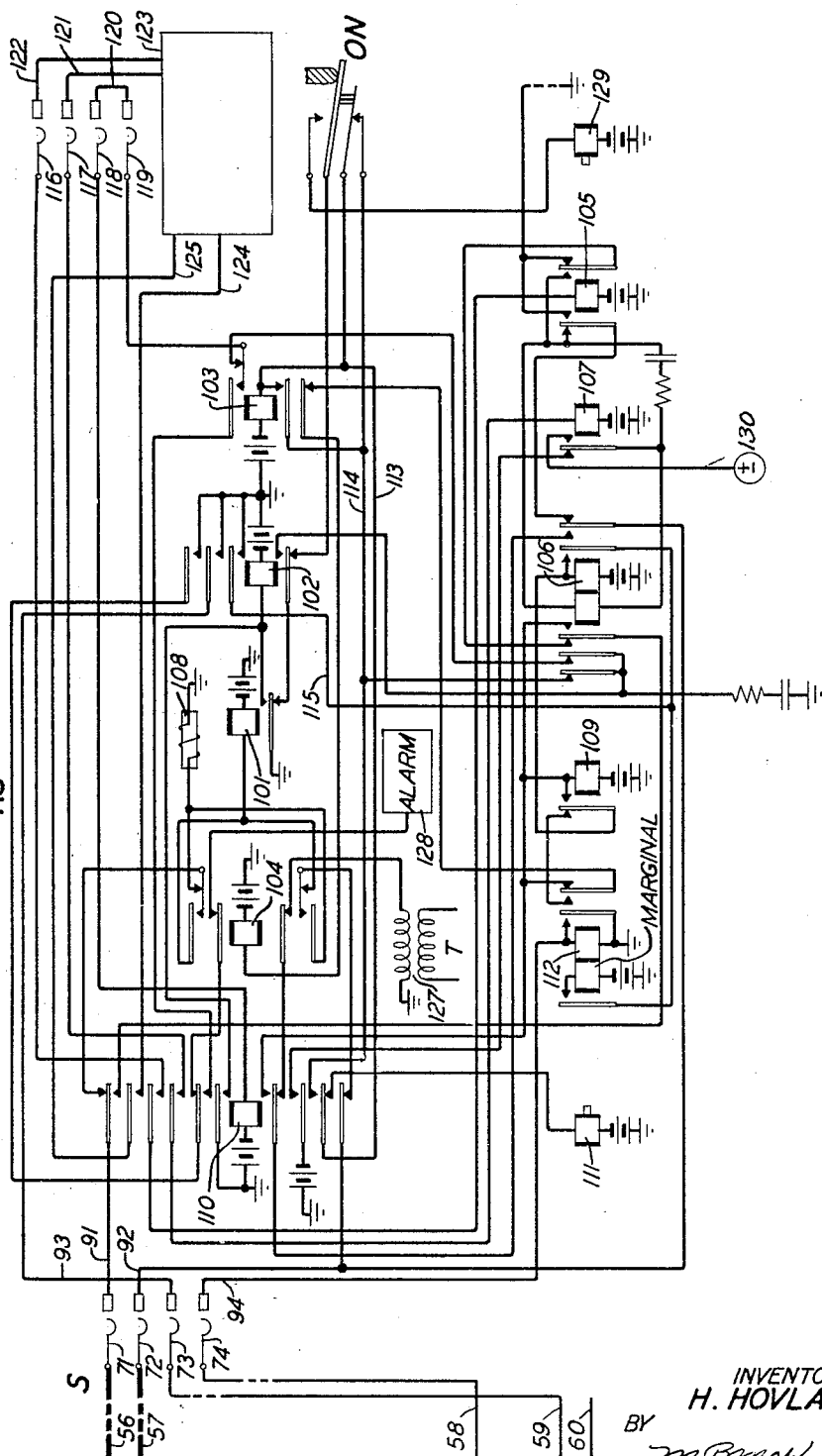
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FIG. 2

RS



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TELEPHONE EXCHANGE SYSTEM

Application filed January 27, 1931. Serial No. 511,511.

This invention relates to telephone exchange systems and more particularly to automatic systems arranged to give measured service to party-line subscribers.

The object of this invention is the provision of simple and efficient circuit arrangements for automatically controlling the operation of the service-meters of party-line subscribers.

Upon the origination of a call at one of the stations on a party line in an automatic measured-service system, the calling line is usually extended through a charging trunk which is arranged to automatically test the calling line to identify the calling station and to operate the corresponding service-meter if the call is answered. If the called station is on the same line as the calling station, the connection is extended to a reverting-call selector circuit which is arranged to automatically ring the called station as soon as the calling subscriber replaces the receiver upon the switchhook. On such a call the operation of the service-meter is controlled by an operator who supervises the call in order that no charge will be made if the calling subscriber again removes the receiver to release the connection prior to the answer of the called subscriber. Such a system is disclosed in Patent 1,695,828 issued December 18, 1928 to R. L. Stokely.

According to the present invention the reverting-call selector circuit is also arranged to receive an indication from the charging trunk as to which station is the calling station, to test the calling line as soon as the ringing is stopped by the removal of the receiver at one of the stations, and to initiate the operation of the calling subscriber's service-meter by reversing the current over the conductors of the charging trunk only in case the answering station is the called station.

The invention will be better understood by considering a telephone system in which the features of this invention are embodied. One such system is illustrated in the drawings and its operation will be described in detail insofar as such a description tends to explain the features of the invention.

Referring to the drawings,

Fig. 1 shows a subscriber's line 1 serving the stations A and B, a line finder LF, and a trunk circuit T arranged to determine which of the stations is the calling station and to control the operation of the corresponding message register.

Fig. 2 shows a first selector switch S which is permanently associated with the line finder LF and trunk T of Fig. 1, and a reverting-call selector RS which is used on calls between subscribers on the same line.

The invention is not limited in its use to the system illustrated in the drawings but may be applied in any automatic telephone system having message-rate party-line subscribers.

The subscribers' stations A and B, the line finder LF, the trunk circuit T, and the first selector switch S are similar to those shown and described in my Patent No. 1,823,688 dated Sept. 15, 1931, except that the trunk circuit has been modified by adding resistance 90 and by adding the outer left-hand contacts of relay 33; when thus modified the trunk circuit is able to indicate the identity of the calling station to the reverting-call selector which is used when one of the stations on a party line calls another station on the same line. The operation of the line finder, trunk, and first selector circuits will be omitted as far as possible from the following description, since reference may be had to the aforementioned patent for a detailed description of their operation. The reverting-call selector circuit RS is a modification of that shown and described in Patent 1,695,828 issued December 18, 1928 to R. L. Stokely. The ringing interrupter used with the reverting-call selector RS is represented schematically by the enclosure 123; reference may be had to the aforementioned patent of R. L. Stokely for a complete disclosure of the ringing interrupter.

It will now be assumed that a call is made from one of the stations of line 1 to the other station on the same line. The line 1 is thereupon extended through the brushes of line finder LF and trunk T to the first selector S. The calling subscriber then dials the code

number of the called station assigned for use on reverting calls, the impulses thus created being received by the line relay 30 of trunk T and repeated over conductors 56 and 57. The selector switch S is selectively operated in response to impulses corresponding to the first digit dialed to select a group of trunks all of which connect to reverting-call selectors. The selector S then automatically hunts for and seizes an idle trunk in this group, which we will assume to be connected to the selector RS. Immediately after receipt of the first train of impulses, the test relay 31 of trunk T is connected to both sides of the calling line to determine which of the stations is the calling station. If the call originated at station A, relay 31 operates thereby causing the operation of relay 33; if the call originated at station B, both of relays 31 and 33 remain normal. If relay 33 operates, it locks under the control of relays 34 and 37. The operations so far mentioned are described in detail in my aforementioned patent.

When the selector S extends the connection from line 1 through its brushes to the reverting selector RS, a circuit is closed for operating the line relay 101; this circuit is traced from battery through the winding of relay 101, the outer lower back contacts of relays 104 and 110, conductor 92, through brush 72 and conductor 57 of the selector S, right-hand winding of relay 55 in the trunk circuit T, outer lower back contact of relay 40, lower back contact of relay 32, retard coil 46, upper contact of relay 30, the outer upper back contact of relay 41, the left-hand winding of relay 55, conductor 56 and brush 71 of selector S, conductor 91, through the outer upper back contacts of relays 110 and 104, and through the winding of retard coil 108 to ground. Relay 101 closes an obvious circuit for operating relay 102. Relay 102 connects ground through its middle upper front contact over conductor 93, through brush 73 of selectors to conductor 59 to prevent the release of the selector S and line finder LF. Relay 102 also connects ground through its outer upper front contact and the inner upper back contacts of relays 110 and 104 to the alarm circuit 128; if neither of relays 104 and 110 operates within a predetermined length of time after relay 102 has operated, the alarm circuit functions to signal a maintenance man in the usual manner.

At the same time that the circuit for operating the line relay 101 is closed, another circuit may be traced from ground through the right-hand winding of marginal relay 112, over conductor 94, brush 74 and conductor 58 of selector S through the right-hand back contact of relay 34 in trunk T, conductor 49, through the winding of relay 40 to battery. If the call originated at station A, relay 33 is operated; in which case the connection from the winding of relay 112 of the revert-

ing-call selector RS is also extended from conductor 49 of trunk T through the outer left-hand front contact of relay 33 and resistance 90, to battery thereby causing the operation of relay 112 as well as relay 40. But, if the call originated at station B, relay 33 is normal so that the resistance 90 is not connected in parallel with the winding of relay 40; and in this case relay 40 operates but relay 112 does not operate. If operated, relay 112 locks through its left-hand winding and front contact over conductor 115 to ground at the inner upper front contact of relay 102; the left-hand contacts of relay 112 close before the right-hand winding is shunted by the inner right-hand front contact.

The next set of impulses, received by the line relay 30 of trunk T, is repeated over conductors 56 and 57 through brushes 71 and 72 of selector S, to the selector RS thereby causing relay 101 to be alternately released and reoperated in response to each impulse. Relay 102 is a slow-to-release relay and remains operated during the receipt of this train of impulses. The release of relay 101 in response to the first impulse closes a circuit for operating relay 103 and rotary magnet 111; this circuit may be traced from ground through the back contact of relay 101, the lower front contact of relay 102, the left outer back contact of relay 106, conductor 114, through the normally closed contact of the off-normal springs ON, conductor 113, through the winding of relay 103 to battery; and from conductor 113 through the next-to-the-outer lower armature and back contact of relay 110 through the winding of rotary magnet 111 to battery. The operation of magnet 111 advances the brushes 116, 117, 118 and 119 into contact with the first set of terminals in the associated bank. As soon as the switch is moved out of its normal position, the off-normal springs ON are operated so that the operating circuit through the windings of relay 103 and magnet 111 is now traced from conductor 114 to conductor 113 through the inner lower front contact of relay 103 instead of through the lower contact of the ON springs. When relay 101 reoperates at the end of the first impulse, magnet 111 releases; but relay 103 is a slow-to-release relay and it remains operated until all of the impulses in the train have been received. Each release and reoperation of relay 101 in response to impulses is thus effective to cause the operation and release of magnet 111, thereby advancing the brushes of switch RS to a corresponding set of terminals. The terminals in the banks of the reverting-call selectors are connected as shown in the aforementioned patent to R. L. Stokely, this arrangement being adapted for use with lines having not more than four parties.

No further operation takes place until the calling subscriber replaces the receiver upon

the receiver hook, at which time the release of the line relay 101 of the selector circuit RS closes a circuit for operating relay 110; this circuit may be traced from battery through the winding of relay 110, brush 118, conductor 120, brush 119, the upper back contact of relay 103, the middle left-hand back contact of relay 106, and through the lower front contact of relay 102 to ground at the back contact of relay 101. When relay 110 operates, relay 103 is reoperated in a circuit which may be traced from battery through its winding, conductor 113, the outer lower front contact of relay 110, conductor 114, the left outer back contact of relay 106, the lower front contact of relay 102, to ground at the back contact of relay 101. Relay 102 does not release when the calling subscriber hangs up since this relay is held operated in a circuit through the inner upper front contact of relay 110. Relay 110 also closes a circuit for starting the ringing interrupter 123, by connecting conductor 124 to conductor 125. Relays 105 and 107 of the reverting-call selector RS are now operated in response to impulses transmitted over conductors 121 and 122 from the interrupter circuit 123, so as to ring both the calling and called stations. The circuit for operating relay 105 may be traced from battery through its winding, a front contact of relay 110, through brush 116, over conductor 122 to the ringing interrupter 123. The circuit for operating relay 107 is traced from battery through its winding, a front contact of relay 110, brush 117, over conductor 121 to the ringing interrupter 123. With relay 107 operated and relay 105 normal, the ringing circuit is closed from the ringing source 130, through the front contact of relay 107, the left-hand winding of relay 106, the left-hand back contact of relay 105, the right-hand back contact of relay 106, over conductor 92, through brush 72 and conductor 57 of selector S, through the right-hand winding of relay 55 of trunk circuit T, the lower front contact of relay 40, the middle lower armature and back contact of relay 39, over conductor 27, through brush 12 of line finder LF, and over the ring conductor of line 1 to operate the ringer at station B. With relay 107 operated and relay 105 also operated, the ringing circuit is traced from the source of ringing current 130, through the front contact of relay 107, the left-hand winding of relay 106, the right-hand front contact of relay 105, the inner left-hand back contact of relay 106, the outer upper front contact of relay 110, over conductor 91, through brush 71 and conductor 56 of selector S, through the left-hand winding of relay 55 of trunk circuit T, the upper front contact of relay 40, the upper back contact of relay 39, over conductor 26, through brush 11 of line finder LF, over the tip conductor of line 1 to operate the ringer at station A.

The subscribers at stations A and B are thus alternately signaled under the control of the ringing interrupter 123 until the receiver is removed at the one or the other of these stations, at which time the current through the left-hand winding of relay 106 is increased sufficiently to cause the operation of this relay. Relay 106 locks through its right-hand winding and inner right-hand front contact, over conductor 115 to ground at relay 102. Relay 106 opens the ringing circuit and opens the locking circuit of relay 103 and closes a connection from battery through the winding of relay 109, the inner left-hand front contact of relay 106, the outer upper front contact of relay 110, conductor 91, through brush 71 and conductor 56 of selector S, through the left-hand winding of relay 55 of trunk circuit T, the upper front contact of relay 40, the upper back contact of relay 39, over conductor 26, through brush 11 of line finder LF, to the tip conductor of line 1; relay 106 also closes a connection from battery through the winding of relay 109, the inner lower front contact of relay 110, the outer right-hand front contact of relay 106, conductor 92, through brush 72 and conductor 57 of selector S, through the right-hand winding of relay 55 of trunk circuit T, the lower front contact of relay 40, the inner lower back contact of relay 39, through brush 12 of line finder LF, to the ring conductor of line 1. If the receiver has been removed at station A, relay 109 is operated by the identifying ground at 10; but if the receiver is removed at station B, relay 109 does not operate. Since relay 110 is locked under the control of relays 103 and 102 and since relay 103 is a slow-to-release relay, this circuit to ground at 10 is closed long enough for relay 109 to operate. When relay 103 releases, a circuit is closed for operating relay 104 if the call has been answered by the called station but is not closed if the call was answered by the calling station. If the call originated at station A and ringing is stopped by the answer of station B, relay 109 is normal and the circuit for operating relay 104 may be traced from battery through its winding, the lower back contact of relay 103, the outer right-hand front contact of relay 112, the back contact of relay 109, and through the inner right-hand front contact of relay 106, over conductor 115 to ground at relay 102. If the call originated at station B and ringing is stopped by the answer of station A, relay 109 is operated and the circuit for operating relay 104 may be traced through the back contact of relay 112 and the front contact of relay 109 instead of through the front contact of relay 112 and the back contact of relay 109. In case the receiver is removed by the calling subscriber to stop the ringing before the call is answered at the called station, relay 104 is not operated and the secondary

winding of transformer 127 is connected through the inner lower back contacts of relays 104 and 110, and through the outer right-hand front contact of relay 106 to conductor 92 so as to transmit a tone to the subscriber's line and thus prevent conversation between the calling and called stations in case the called subscriber answers the call after the ringing has been stopped by the calling subscriber.

The aforementioned operation of relay 106 is also effective to cause the release of relay 110; and with relay 110 released, relay 101 reoperates and remains operated until the receivers are replaced at both the calling and called stations. With relay 110 released relay 102 is held operated under the control of line relay 101. With relay 104 operated, the connections between conductors 91 and 92 and the windings of line relay 101 and retard coil 108 are reversed so that the current through the windings of the polarized supervisory relay 55 in the trunk circuit T is effective to cause the operation of relay 55; and the message register of the calling station is operated as described in my aforementioned patent.

Although the reverting-call selector RS is arranged for two-party service, it is suitable for use with four-party lines as far as ringing is concerned and can easily be modified, by anyone skilled in the art, so as to be capable of determining which of the stations on a four-party line is the answering station. A trunk circuit arranged for determining which of the stations on a four-party line is the calling station is disclosed in the patent to R. L. Stokely, No. 1,799,654 dated April 7, 1931; and the station identifying means provided in a four-party reverting-call selector might be similar to that provided in this trunk circuit.

What is claimed is:

1. In a telephone system, a line having a plurality of subscribers' stations permanently connected thereto, a reverting-call selector for use when the subscriber at one of said stations calls another of said stations, means including a trunk for extending said line to said selector, means associated with said trunk for testing said line to determine which of said stations is the calling station, means for indicating the result of said test to said selector, and means associated with said selector for determining the station at which the call is answered.

2. In a telephone system, a line, a plurality of subscribers' stations on said line, a reverting-call selector for use when the subscriber at one of said stations calls another of said stations, means including a trunk for extending said line to said selector, a supervisory relay associated with said trunk, means associated with said trunk for testing said line to determine which of said stations is the

calling station, means for indicating the result of said test to said selector, means associated with said selector for determining the station at which the call is answered, and means effective in consequence of the answer of said call by the called station for operating said supervisory relay.

3. In a telephone system, a line, a plurality of subscribers' stations on said line, a reverting-call selector for use when the subscriber at one of said stations calls another of said stations, means including a trunk for extending said line to said selector, a supervisory relay associated with said trunk, means associated with said trunk for testing said line to determine which of said stations is the calling station, means for indicating the result of said test to said selector, means associated with said selector for determining the station at which the receiver is removed to answer the call, and means effective in consequence of the answer of said call by the called station but ineffective in consequence of the removal of the receiver at the calling station for operating said supervisory relay.

4. In a telephone system, lines, subscribers' stations, a plurality of said stations being permanently connected to one of said lines, service-meters one for each of said stations, a reverting-call selector for use when the subscriber at one of the stations on said one of said lines calls another of the stations on said line, means including a trunk for extending said line to said selector, a supervisory relay in said trunk for initiating the operation of the calling station's service-meter in consequence of the answer of the called station, means associated with said trunk for testing said line to determine which of said stations is the calling station, means for indicating the result of said test to said selector, means associated with said selector for determining the station at which the receiver is removed to answer the call, and means effective in consequence of the answer of said call by the called station for operating said supervisory relay.

5. In a telephone system, a line, a plurality of subscribers' stations on said line, a reverting-call selector for use when the subscriber at one of said stations calls another of said stations, means including a trunk for extending said line to said selector, a service-meter for each of said stations, means associated with said trunk for testing said line to determine which of the stations is the calling station, means for indicating the result of said test to said selector, a supervisory relay, means rendered effective by the operation of said relay and associated with said trunk for operating the calling station's service-meter, means associated with said selector and rendered effective by replacing the receiver at the calling station for ringing over said line, means for stopping the ringing upon the

removal of the receiver at any of said stations, means associated with said selector for testing the line to determine the station at which the receiver is removed, and means for operating said relay if the station at which the receiver is removed is the called station.

6. In a telephone system, lines, subscribers' stations, a plurality of said stations being permanently connected to one of said lines, service-meters one for each of said stations, means including a trunk for extending said line upon the origination of a call at one of said stations, means associated with said trunk for determining which of said stations is the calling station, a supervisory relay in said trunk for initiating the operation of the calling station's register in consequence of the answer of the called station, a reverting-call selector for use on calls from one to another of the stations on said one of said lines, means associated with said selector for transmitting ringing current over said line, means for stopping the ringing in consequence of the removal of the receiver at one of the stations on said one of said lines, means associated with said selector for determining whether the station at which the receiver is removed is the same station as was found by said trunk to be the calling station, and means for operating said supervisory relay only in case the station at which the receiver is removed is the called station.

7. In a telephone system, party lines each having a plurality of subscribers' stations connected thereto, a service-meter individual to each of the stations on said lines, metering equipment for association with said lines, revertive-call equipment, means responsive to the origination of a call from one to another of the stations on one of said lines, for associating said metering and revertive-call equipment with the line of said calling station, means individual to said metering equipment for determining which of said stations on said calling line is the calling station, means for recording the result of said determination in said revertive-call equipment, means effective in response to replacing the receiver at the calling station for ringing the called and the calling stations, means actuated in consequence of the removal of the receiver at either of the called or calling stations for stopping the ringing, means individual to said revertive-call equipment for determining the station at which the receiver is removed, and means effective to initiate the operation of the calling station's service-meter if it is found that the receiver was removed at the called station but ineffective to initiate the operation of said meter if it is found that the receiver was removed at the calling station.

In witness whereof, I hereunto subscribe my name this 22 day of January, 1931.

HENRY HOVLAND.