March 30, 1943. S. B. WILLIAMS 2,314,961

TELEPHONE SYSTEM

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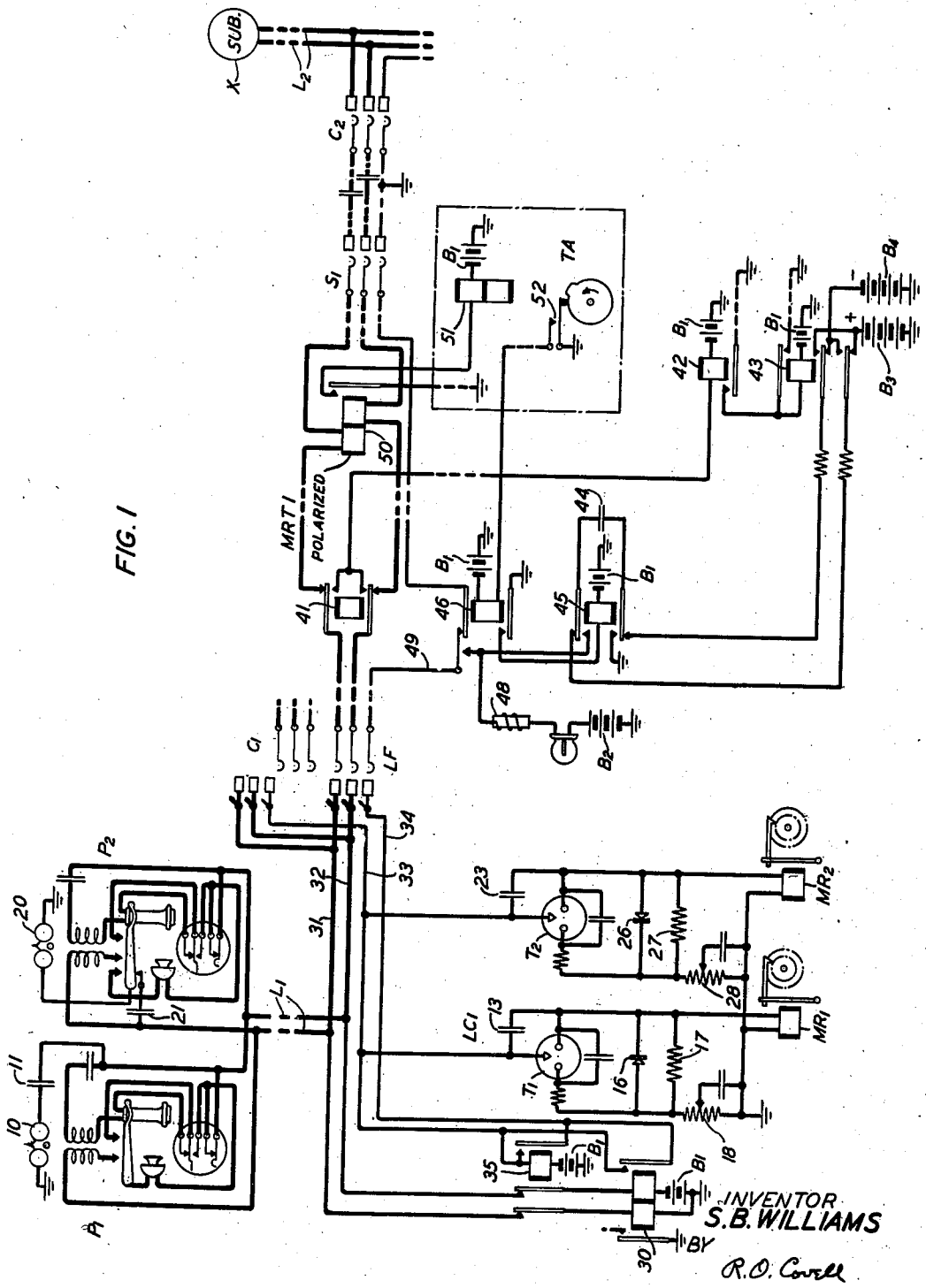


FIG. 1

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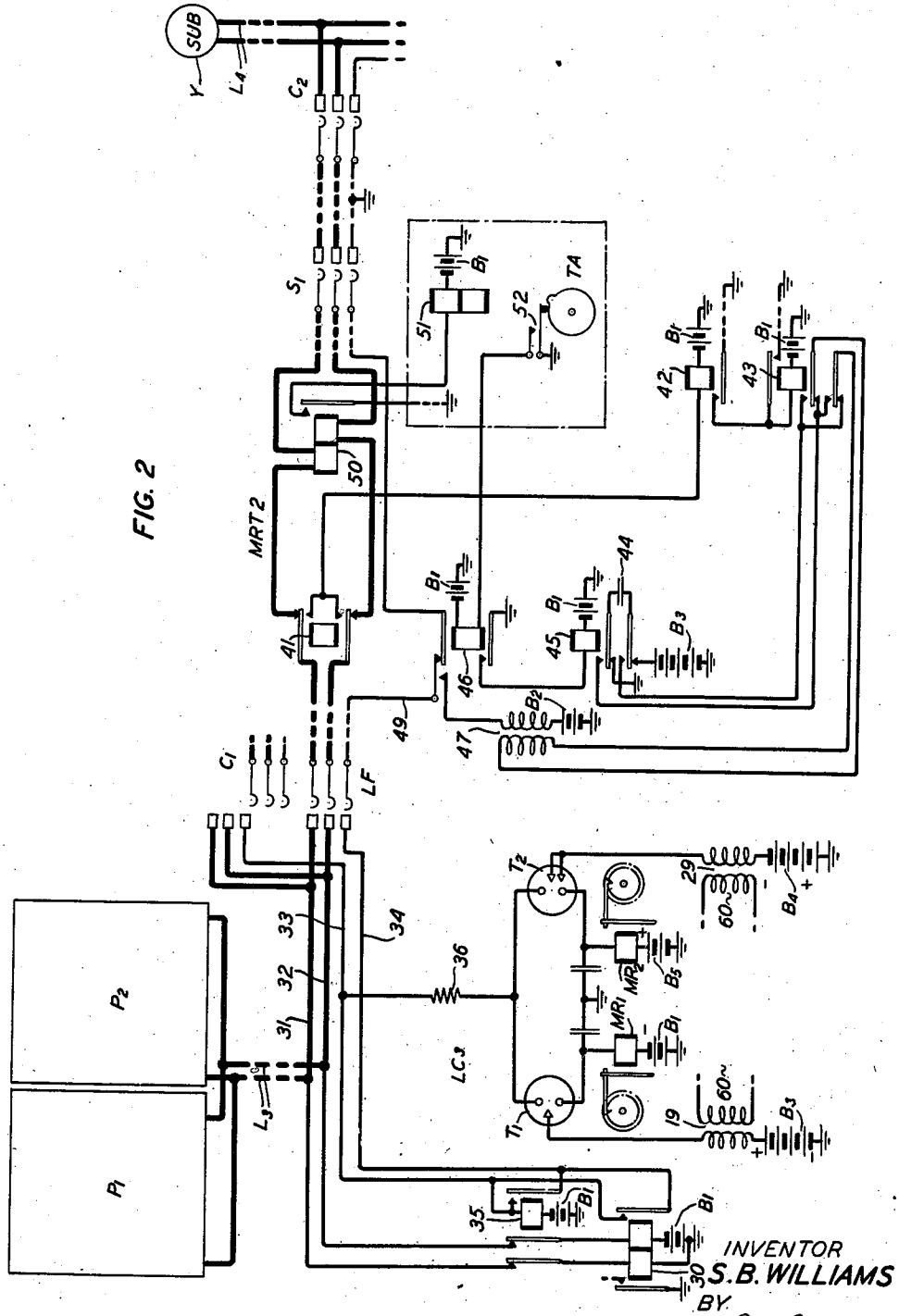


FIG. 2

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# UNITED STATES PATENT OFFICE

2,314,961

## TELEPHONE SYSTEM

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7 Claims. (Cl. 179—8.5)

This invention relates to telephone systems and particularly to systems comprising message-rate, party-line subscribers' stations.

It is the object of the invention to enable the automatic selective operation of the calling subscriber's message register on calls originating at party-line subscribers' stations, when the call is answered; and to enable the reoperation of the message register periodically during the time the talking connection is maintained.

According to this invention, means are provided for selectively operating either of the message registers of a two-party line, each of the registers being operatively connected through a three-element cold-cathode gas-filled tube to the conductor to which the winding of the line cut-off relay is connected. One of the tubes is polarized for breakdown in response to the impression of a sufficiently large voltage of one polarity on this conductor and the other tube is polarized for breakdown in response to the impression of a sufficiently large voltage of the opposite polarity, the message register being operated in either case by the connection of booster battery potential to the conductor, this potential being effective to maintain the operation of the cut-off relay. According to features of the invention, the gas-filled tubes may be polarized by the connection of oppositely poled rectifiers in parallel with the control elements of the tubes and the breakdown potential may be applied by the discharge of a condenser connected in series with the control elements of the tubes.

The invention and its various features will be further described by considering a telephone system in which the invention is embodied, one such system being shown in the drawings which form a part of this specification. The invention is not limited to the specific system or arrangement shown but is generally applicable to all party-line message-rate communication systems.

The drawings show schematically, in each of Figs. 1 and 2, a telephone system including a calling line and a called line, the calling line being a party line with two subscribers' stations P1 and P2 connected thereto, a line circuit LC1 or LC3, a line finder LF, selector S1, connectors C1 and C2 and a message rate trunk circuit MRT1 or MRT2 connecting the line finder LF to the first selector S1.

In Fig. 1, four batteries are shown, the usual central office battery B1, a booster battery B2 for operating the subscribers' message registers, and oppositely poled batteries B3 and B4 for use in effecting the connection of booster battery potential to the message register of a calling subscriber. In Fig. 2, five batteries are shown, the central office battery B1, booster battery B2, and batteries B3, B4 and B5 for controlling and effecting the operation of the registers MR1 and MR2.

The subscribers' stations P1 and P2 in Fig. 1 are of the type usually employed in common battery telephone systems and each includes a dial impulse sender for use in controlling the establishment of desired connections. The station P1 differs from the station P2 in that there is no connection of ground potential to the conductors of line L1 upon removal of the receiver at station P1 to originate a call; whereas removal of the receiver at station P2 connects both conductors of line L1 to ground through the ringer 20. This difference enables identification of the calling station on each call originated over line L1, as hereinafter explained. The stations P1 and P2 of line L3 in Fig. 2 are similar to the stations P1 and P2 of line L1.

The line-finder switch LF, selector switches S1 and connector switches C1 and C2 are of the well-known two-motion step-by-step type. Reference may be had to "Automatic Telephony," 2nd edition, by Smith and Campbell, pages 53 to 65, for a description of the structure of such switches and their operation when used as selectors and connectors. Reference may be had to the patent to R. L. Stokely No. 1,799,654 of April 7, 1931, for a description of the operation of a two-motion step-by-step line finder.

The line circuit LC1 comprises a line relay 30, a line cut-off relay 35, two three-element cold-cathode gas-filled tubes T1 and T2, oppositely poled by rectifiers 16 and 26 in parallel with their control elements, and two registers MR1 and MR2.

The line circuit LC3 is similar to the line circuit LC1 except that the control elements of tubes T1 and T2 are connected through registers MR1 and MR2 to oppositely poled batteries B1 and B5 for breakdown by the connection of oppositely poled breakdown potentials to conductor 34, the registers being operated in series with batteries B3 and B4 after breakdown of the associated tube. The tube T2 differs from tube T1 in that it is adapted for breakdown upon application of a negative potential to conductor 34. To this end the tube T2 may include a fourth element as shown in the drawings. Deenergization of tubes T1 and T2 is effected by 60 cycle alternating potential impressed through transformers 19 and 29.

The message rate trunk MRT1 includes party identifying means comprising a test control relay 41, a test relay 42, and a relay 43 for controlling the polarity of the breakdown potential applied through conductor 49 to the sleeve conductor of a connected line to effect selective operation of the calling subscriber's register. Relay 41 is operated, immediately after the first digit is dialed at the calling station in the manner described in Patent No. 1,823,688, granted to H. Hovland, September 15, 1931, to connect test relay 42 to the conductors of the calling line. In the case of a call originated at station P1, relay 42 does not operate; but in the case of a call originated at station P2, relay 42 is operated in series with the ringer 20, thereby closing a circuit for operating relay 43. Relay 43 then locks and remains operated until the connection is released at the calling station. The trunk circuit MRT2 is similar to the trunk circuit MRT1 except that the condenser 44 is charged by battery B3 and connected by relay 43 to impress through transformer 47 either a positive or a negative breakdown potential on conductor 49.

Assume first that a call is initiated at one of the stations of line L1 in Fig. 1. Operation of the line relay 30 upon origination of a call at either of stations P1 or P2 is effective as described in the above-mentioned patent to R. L. Stokely to start an idle line finder, the cut-off relay 35 being operated and the line relay 30 released as soon as the calling line is connected by the line finder to the associated message-rate trunk circuit MRT1 and first selector S1. The selector S1 is operatively controlled by the impulses created by the dialing of the first digit of a called subscriber's number to select a corresponding group of terminals and to select an unguarded set of terminals therein leading to a succeeding switch through which the desired connection may be established. Succeeding digits dialed by the calling subscriber effect the operation of intermediate selectors, if any, and a connector C2 to complete the connection with the called line. The connection is maintained under the control of the calling station by the connection of holding ground in the connector C2 to the sleeve terminal in the bank of selector S1, the selector S1, line finder LF1 and cut-off relay 35, all being held operated in usual manner by this ground. The connector C2 is arranged to ring the called station; and, when the call is answered, the connector reverses the current through the windings of polarized supervisory relay 50 to effect its operation. Relay 50 closes a circuit for operating the start magnet 51 of timing mechanism TA, which may be individual to trunk circuit MRT1 or common to a plurality of such trunk circuits. Reference may be had to the patent to R. L. Stokely No. 1,851,139 of March 29, 1932, for complete disclosure of a timing mechanism individual to a message-rate trunk circuit. As soon as the timing mechanism moves out of its normal position to begin the timing of an interval for which one operation of the message register of the calling stations is required, contact 52 closes a circuit for operating relay 46. Relay 46 closes a circuit for operating relay 45 and connects the meter operating booster battery B2 through retard coil 48, conductor 49, test brush of line finder LF, conductor 34 of line circuit LC1, front contact of relay 35, conductor 33, and through condensers 13 and 23 to one of the control elements of each of tubes T1 and T2. Relay 45 opens the charging circuit of condenser 44 and connects this condenser, in parallel with the meter operating battery B2, through conductors 34 and 33 of line circuit LC1 to the tubes T1 and T2. The retard coil 48 prevents the immediate discharge of condenser 44 through booster battery B2. If the call originated at station P1, relay 43 is not operated and condenser 44 is charged in series with batteries B3 and B4 in such a direction that discharge of the condenser when connected in series with conductors 49, 34 and 33 will effect breakdown of tube T1; but if the call originated at station P2, relay 43 is operated and condenser 44 is charged in series with batteries B3 and B4 in the opposite direction so that discharge of the condenser will effect breakdown tube of T2. Assuming first that the call is from station P1, the rectifier 26 permits the discharge of condenser 44 through condenser 23 and resistor 28, so that there is an insufficient drop in potential across resistor 27 and the control elements of tube T2 to effect breakdown of this tube; but rectifier 16 opposes the discharge of condenser 44 through condenser 13 and resistor 18 so that the voltage impressed across resistor 17 and the control elements of tube T1 is sufficient to effect the energization of tube T1. The booster battery B2 maintains the energization of tube T1 and the message register MR1 is operated in series with the anode element of tube T1. On a call from station P2, the condenser 44 is charged in the opposite direction, rectifier 16 permits the discharge of condenser 44 through condenser 13 and resistor 18 to prevent breakdown of tube T1; but rectifier 26 opposes the discharge of condenser 44 through condenser 13 and resistor 18 so that the voltage impressed across resistor 27 and the control elements of tube T2 is sufficient to effect the energization of tube T2. The booster battery B2 maintains the energization of tube T2 and the message register MR2 is operated in series with the anode of tube T2. In either case, the cut-off relay 35 is held operated in series with the booster battery B2. As soon as the timing mechanism 52 opens its contacts, relay 46 releases and booster battery B2 is disconnected from conductor 49, thereby deenergizing the tube T1 and register MR1 or deenergizing the tube T2 and register MR2; and ground is reconnected to conductor 49 to hold the cut-off relay 35 operated.

Each time that timing mechanism 52 again closes its contacts while the talking connection between the calling and called stations is maintained, the message register of the calling station is reoperated. If the called subscriber hangs up before the connection is released at the calling station, relay 50 is released and no further operation of relay 46 occurs. When the connection is released at the calling station, the holding ground potential is disconnected and all of the switches are restored to normal in usual manner.

Assume now that a call is initiated at one of the stations of line L3, that the calling station is identified in the manner above described on a call through trunk circuit MRT1, that connection with the called line L4 is completed, and that the call is answered at station Y. Condenser 44 is charged by battery B3; and, when relays 46 and 45 are operated due to the closure of contact 52 of the timing mechanism TA at the beginning of an interval for which one operation of the calling subscriber's register is required, condenser 44 is discharged through the left winding of transformer 47 to impress on conductor 49 a breakdown potential of desired polarity. If the call is

from station P1, relay 43 is not operated; and the potential thus impressed on conductor 49, thence through conductor 34 and resistor 36 to the control elements of tubes T1 and T2 is in a direction to effect breakdown of tube T1. If the call is from station P2, relay 43 is operated and condenser 44 is discharged through the left winding of transformer 47 in a direction to effect breakdown of tube T2. When tube T1 breaks down, register MR1 is operated in series with batteries B1 and B3. When tube T2 breaks down, register MR2 is operated in series with batteries B4 and B5. In either case, the cut-off relay 35 is held in series with booster battery B2. When relays 46 and 45 release due to the opening of contact 52, holding ground potential is reconnected to conductor 49; condenser 44 is again charged; and the energized one of tubes T1 and T2 is deenergized by the reduction of the potential across the anode and cathode of the energized tube due to the first opposing half cycle of 60 cycle alternating potential induced in the secondary winding of transformer 19 or transformer 29.

Although the arrangement shown contemplates a single operation of a calling subscriber's message register when a call is answered, the arrangement may be one in which the register is operated once or a plurality of times for each call or each unit period of a call.

What is claimed is:

1. In a telephone system, a line circuit comprising a control conductor, a line cut-off relay, means connecting said relay to said conductor, two message registers, two three-element gas-filled tubes connected in multiple to said conductor, and means comprising oppositely poled rectifier elements for polarizing said tubes so that one tube breaks down responsive to the application of a breakdown potential of one polarity to said conductor and the other tube breaks down responsive to the application of a breakdown potential of the opposite polarity to said conductor, each of said registers being connected in series with the anode-cathode elements of a different one of said tubes, means for connecting ground potential to said conductor to operate and hold said cut-off relay, and means for disconnecting said ground potential from said conductor, for momentarily applying a breakdown potential of the desired polarity to said conductor, and for applying a register operating potential to said conductor while said ground potential is disconnected, said register operating potential being of the polarity required for maintaining the energization of said cut-off relay and sufficient to maintain the energization of either of said tubes after breakdown and operate the register associated with the energized tube.

2. In a telephone system, a line circuit comprising a control conductor, two message registers, two three-element gas-filled tubes, one tube connecting one of the registers to said conductor and the other tube connecting the other of the registers to said conductor, and two rectifiers, one rectifier connected across the control elements of one of the tubes and poled to shunt these elements and prevent breakdown of the tube in response to the application of a breakdown potential of one polarity to said conductor, the other rectifier connected across the control elements of the other of the tubes and poled to shunt these elements and prevent breakdown of the tube in response to the application of a breakdown potential of the opposite polarity to said conductor, means for momentarily connecting a breakdown potential of either polarity to said conductor to selectively energize the one or the other of said tubes and for connecting a register operating potential to said conductor to maintain the energization of the tube and operate the associated message register.

3. In a telephone system according to claim 2, means for periodically repeating the application of said breakdown and register operating potentials to said conductor to reenergize the tube and reoperate the associated register.

4. In combination, a line circuit comprising a line cut-off relay, two message registers one for each of two subscribers' stations with which the line circuit is associated, two gas-filled tubes, one for each of said registers, and a control conductor, means for connecting ground potential to said conductor to operatively energize said relay, a contact of said relay connecting the control elements of said tubes to said conductor, means rendering one of said tubes subject to breakdown in response to the impression of a breakdown potential of one polarity to said conductor, means rendering the other of said tubes subject to breakdown in response to the impression of a breakdown potential of the other polarity to said conductor, means for impressing a breakdown potential of desired polarity on said conductor to selectively energize the one or the other of said tubes, means including the one tube when energized for operating one of said registers, means including the other tube when energized for operating the other of said registers, and means for holding said relay operated while either one of said registers is being operated.

5. In a telephone system, a line circuit comprising a control conductor, two message registers, two three-element gas-filled tubes, one tube connecting one of the registers to said conductor and the other tube connecting the other of the registers to said conductor, and two rectifiers, one rectifier connected across the control elements of one of the tubes and poled to shunt these elements and prevent breakdown of the tubes in response to the application of a breakdown potential of one polarity to said conductor, the other rectifier connected across the control elements of the other of the tubes and poled to shunt these elements and prevent breakdown of the tube in response to the application of a breakdown potential of the opposite polarity to said conductor, means comprising a condenser for momentarily applying a breakdown potential of either polarity to said conductor to selectively energize the one or the other of said tubes, and means rendered effective upon breakdown of either one of said tubes for operatively energizing the associated one of said registers.

6. In combination, a line circuit comprising a line cut-off relay, two message registers one for each of two subscribers' stations with which the line circuit is associated, two gas-filled tubes, one for each of said registers, and a control conductor, means for connecting ground potential to said conductor to operatively energize said relay, a contact of said relay connecting the control elements of said tubes to said conductor, means preventing breakdown of one of said tubes upon impression of a breakdown potential of one polarity to said conductor, means preventing breakdown of the other of said tubes upon impression of a breakdown potential of the other polarity of said conductor, means comprising a

condenser for momentarily impressing a breakdown potential of either polarity on said conductor to selectively energize the one or the other of said tubes, means including the one tube when energized for operating one of said registers, means including the other tube when energized for operating the other of said registers, and means for holding said relay operated while either one of said registers is being operated.

7. In a telephone system, subscribers' lines, a calling line, two stations connected to said line, means at said stations for distinguishing one of said stations from the other, a line circuit comprising a control conductor, a cut-off relay, means responsive to the initiation of a call at either of said stations for connecting said relay to said conductor, message registers one for each of said stations, a gas-filled tube controlling one of said registers, a gas-filled tube controlling the other of said registers, means comprising rectifiers selectively conditioning one of said tubes for breakdown upon impression of breakdown potential of one polarity on said conductor and the other of said tubes for breakdown upon impression of a breakdown potential of opposite polarity on said conductor, and means comprising contacts of said relay for connecting the control elements of said tubes to said conductor, a called line, means comprising a message-rate trunk circuit connecting said calling line to said called line, said trunk circuit comprising means for connecting ground potential to said conductor to operate said relay, means for determining which of said stations is the calling station, means responsive to the answer of the call for measuring off intervals of time while a talking connection is maintained between said lines, each such interval constituting a message unit for which one operation of the calling subscriber's message register is required and means effective at the beginning of a message unit interval for disconnecting ground potential from said conductor and connecting a breakdown potential of the polarity required for momentarily energizing the tube associated with the calling subscriber's register to said conductor, means including the energized one of said tubes for operating the associated register, and means connecting a booster battery potential to said conductor to hold said relay operated while said associated register is being operated.

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