

Aug. 8, 1944.

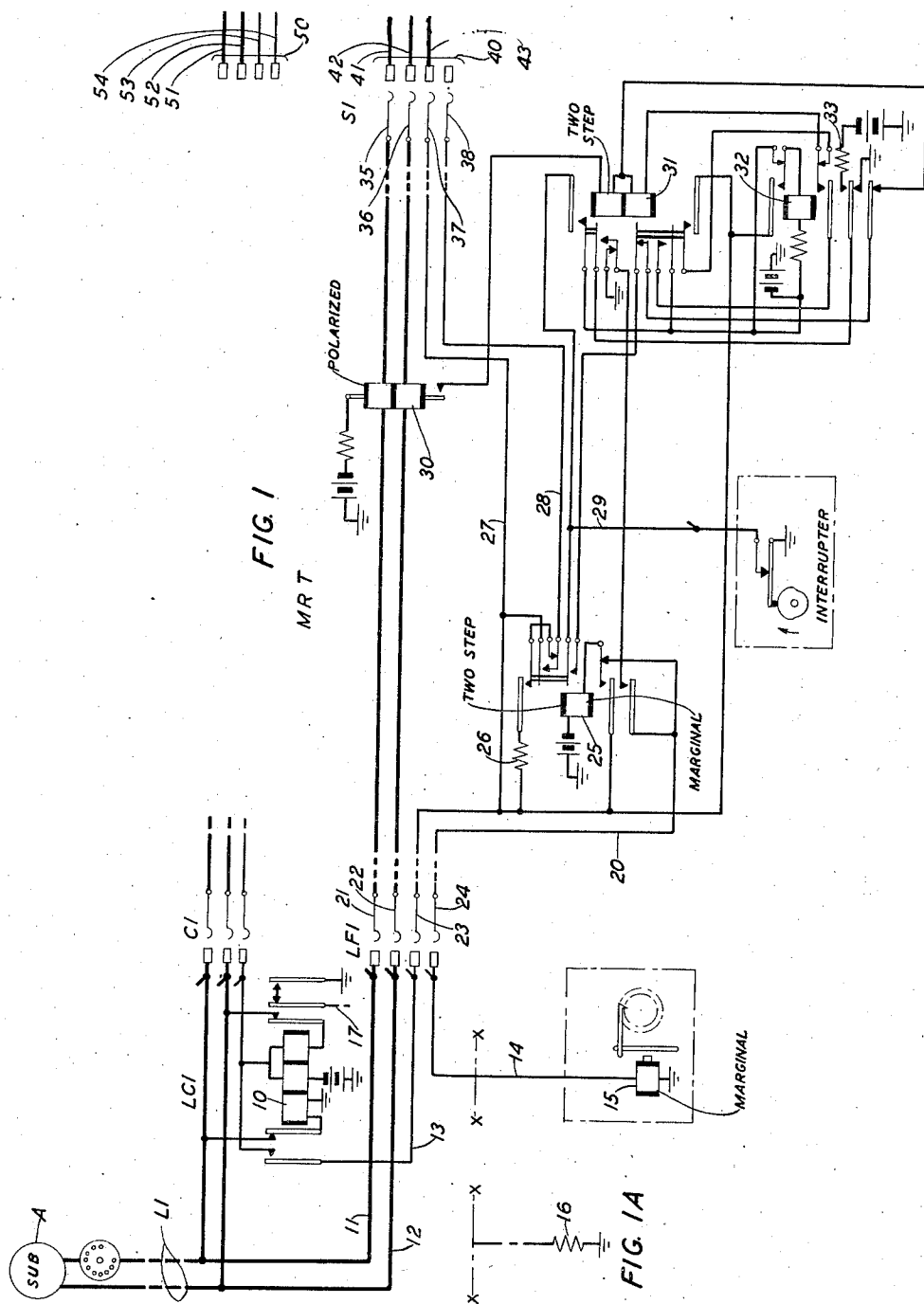
J. G. WALSH

2,355,251

TELEPHONE SYSTEM

Filed Dec. 15, 1942

3 Sheets-Sheet 1



INVENTOR
J. G. WALSH
BY

J. G. WALSH

BY

R. D. Covell

ATTORNEY

Aug. 8, 1944.

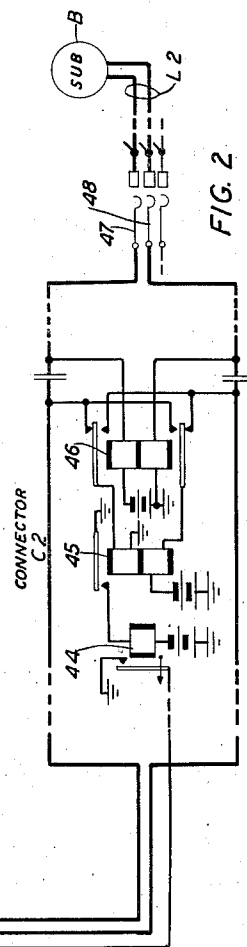
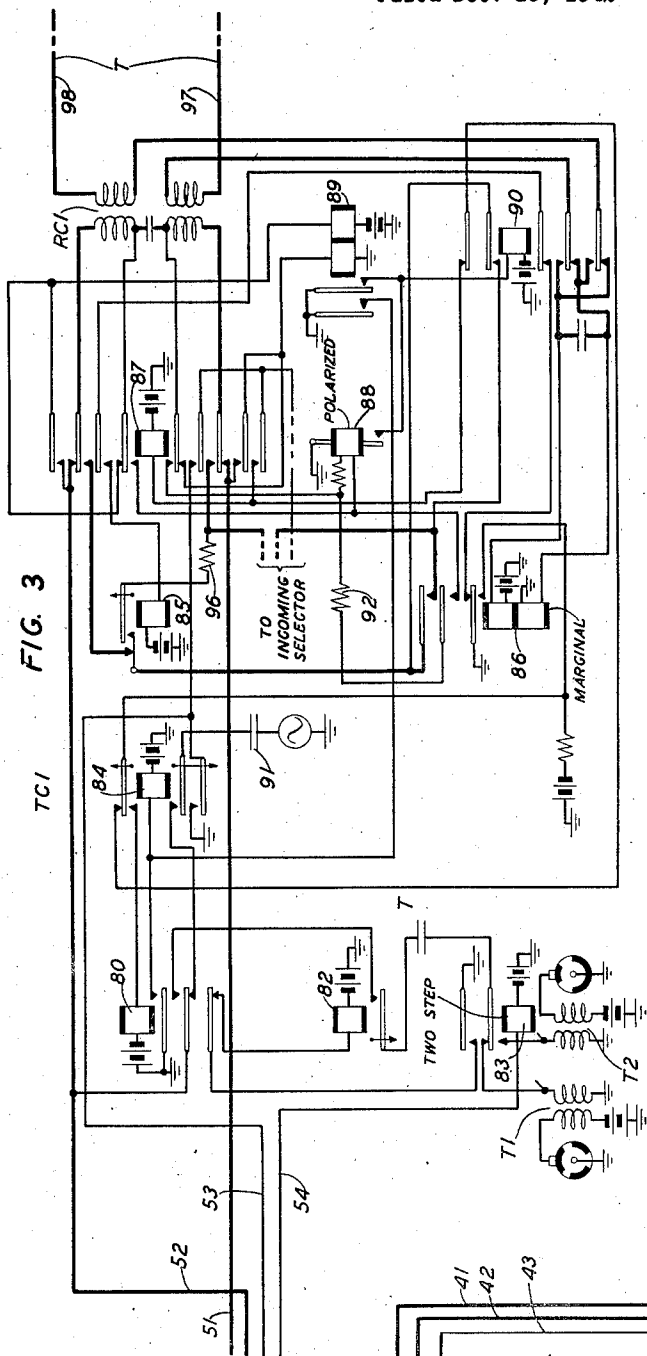
J. G. WALSH

2,355,251

TELEPHONE SYSTEM

Filed Dec. 15, 1942

3 Sheets-Sheet 2



INVENTOR
J. G. WALSH
BY
R. O. Cowell

ATTORNEY

Aug. 8, 1944.

J. G. WALSH

2,355,251

TELEPHONE SYSTEM

Filed Dec. 15, 1942

3 Sheets-Sheet 3

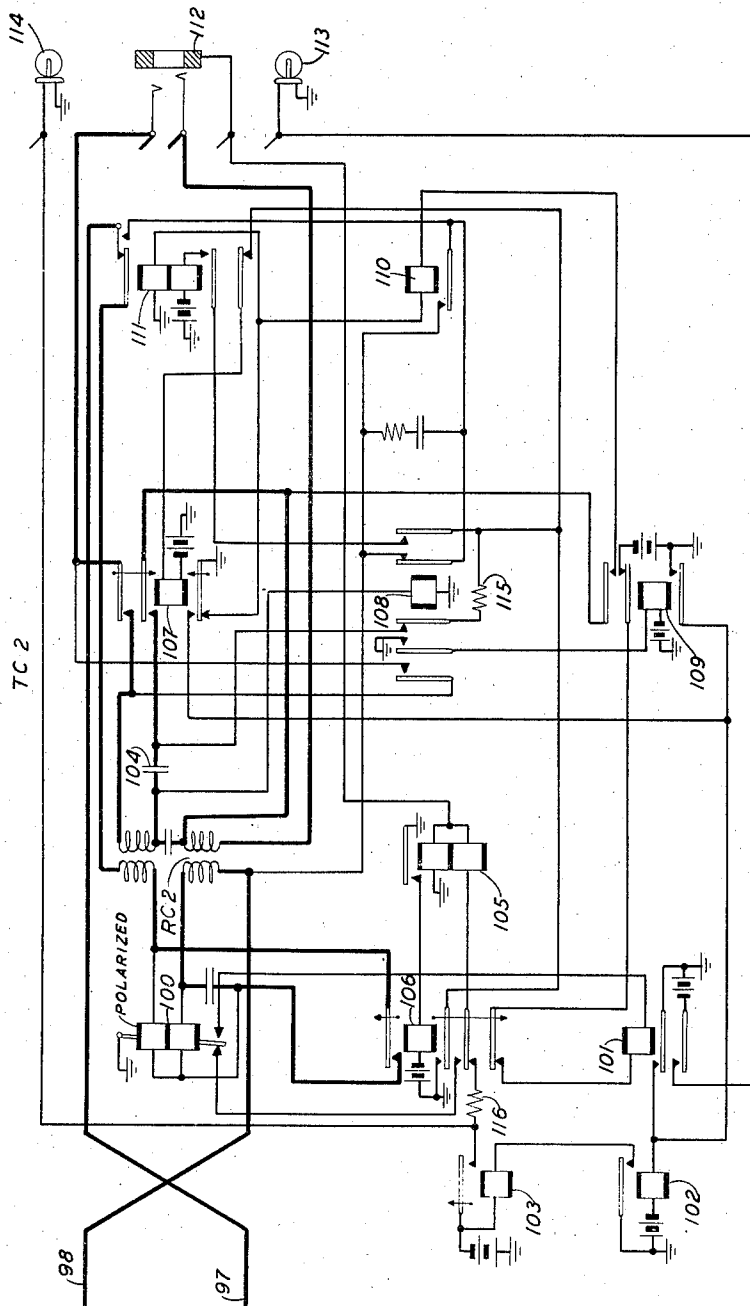


FIG. 4

INVENTOR
J. G. WALSH
BY

R. D. COVILL

ATTORNEY

UNITED STATES PATENT OFFICE

2,355,251

TELEPHONE SYSTEM

John G. Walsh, Newark, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application December 15, 1942, Serial No. 469,090

6 Claims. (Cl. 179-11)

This invention relates to telephone systems and particularly to systems arranged for a plurality of classes of service including message rate service.

Objects of the invention are an increase in the efficiency and a decrease in the cost of telephone systems arranged for a plurality of classes of service including message rate service.

It is known in automatic telephone systems to provide a trunk circuit individual to the first selector employed in establishing connections from calling message rate lines for controlling the operation of the calling subscriber's register. It is also known to provide means in automatic telephone systems effective to transmit a class-of-service indication to the answering operator on special service or intercepted calls. In some arrangements the lines of each class are grouped in the banks of line-finder switches, the transmission of the class-of-service indication being effected by actuation of normal post springs on the level or levels in which the lines of a particular class are terminated.

This invention is an automatic telephone system in which the line circuit of a subscriber's line includes an additional conductor for indicating the class of service to which the subscriber is entitled so as to allow connection of the line to any set of terminals in the banks of line-finder switches, and in which the operation of a message rate subscriber's meter is controlled over the line conductor which is used to give the class-of-service indication.

According to another feature of the invention, the line circuit of a message rate subscriber's line includes an additional conductor for controlling the operation of the subscriber's message register instead of effecting the operation of the register by the connection of a booster battery potential to the sleeve conductor used for operating the line cut-off relay thereby to obviate the necessity of providing a booster battery, the additional conductor being further utilized to give a class-of-service indication so as to allow connection of a message rate line to any set of terminals in the banks of the line-finder switches.

A system embodying the invention and its features is represented schematically in the drawings which form a part of this specification. The invention is not limited to the specific system shown in the drawings but is generally applicable to automatic telephone systems.

Referring to the drawings:

Fig. 1 shows a subscriber's station A and line L1, a line circuit LC1, a line finder LF1, a con-

ductor C1, a message rate trunk circuit MRT, and a first selector S1;

Fig. 2 shows a connector C2, a line L2 and a subscriber's station B;

Fig. 3 shows a trunk circuit TC1 connecting a set of terminals in the bank of the selector S1 of Fig. 1 to a trunk T; and

Fig. 4 shows a trunk circuit TC2 connecting the trunk T to a jack at an operator's position.

Each of the subscriber's stations A and B is of the usual type employed in common battery systems and includes a dial or other impulse sending device for controlling the operation of switches to establish desired connections. The line finders LF1, selectors S1 and connectors C1 and C2 are of the well-known two-motion step-by-step type. The line finder LF1, selector S1, and connectors C1 and C2 are each represented by a set of brushes and one or two sets of terminals. Reference may be had to pages 53 to 65, inclusive, of the second edition of "Automatic Telephony" by Smith and Campbell 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 T. L. Dimond No. 2,210,068, granted August 6, 1940, for a description of the operation of a two-motion step-by-step line-finder switch.

Assume now that a call is initiated at station A, the line relay 10 of line circuit LC1 being energized in series with the conductors of line L1 to actuate its outer front contacts, thereby connecting ground to conductor 17 to start an idle line finder and connecting the middle winding of relay 10, through conductor 13, to the test terminals of the line circuit LC1 in the banks of a group of line finders, including the finder LF1. Assuming the finder LF1 to be the finder which is operated, the middle winding of relay 10 is energized to fully operate relay 10 when the test brush 23 engages the terminal to which conductor 13 is connected and the line finder is stopped with its brushes 21, 22, 23 and 24 in engagement with the terminals to which conductors 11, 12, 13 and 14 of line circuit LC1 are connected. As soon as the cut-through relay (not shown) of line finder LF1 is operated, as described in the aforementioned patent to T. L. Dimond, the line L1 is connected through conductors 11 and 12, brushes 21 and 22, and the windings of supervisory relay 30 of message rate trunk circuit MRT to the line relay (not shown) of selector S1. Holding ground potential is thereupon connected to sleeve conductor 27 in usual manner to hold the line finder LF1 in operated position and to

maintain the operative energization of the middle winding of relay 10. The complete operation of relay 10 disconnects the conductors of line L1 from the outer windings of relay 10 and disconnects ground from start conductor 17. Relay 30 is polarized and the current through its windings is ineffective to cause its operation at this time. If the calling line is a message rate line, a register 15 is connected to the terminal engaged by brush 24; if the calling line is one of a second class of lines, ground is connected through a resistor 16 to the terminal engaged by brush 24 as shown in Fig. 1A; or if the calling line is one of a third class there is no connection to the terminal engaged by brush 24. If the calling line is a message rate line, the winding of class-of-service relay 25 is connected through conductor 20, brush 24 and conductor 14 in series with register 15; and relay 25 is thereby fully energized to actuate all of its contacts, but register 15 is marginal and does not operate at this time. If the calling line is one having a resistor 16 connected to the terminal engaged by brush 24, relay 25 is only partially energized; and, if the calling line is one of the third class, relay 25 remains normal. If relay 25 is operated completely, it locks through conductor 27 to holding ground potential in the selector S1, connects ground to conductor 20, and connects grounded conductor 27 directly to conductor 28; if relay 25 is operated only partially, grounded conductor 27 is connected to conductor 28 through resistor 26; and if relay 25 remains normal, there is no connection of ground potential to conductor 28.

When the calling line is connected to selector S1, dial tone is transmitted to the calling station A, in usual manner, to indicate that the subscriber may start dialing. When the calling subscriber dials the first digit, the brushes of selector S1 are stepped up to the level corresponding to the digit dialed and the brushes are thereupon advanced step by step to select an unguarded set of terminals in the selected level. Assuming this call to be one for another subscriber in the same dial office, the selected set of terminals 40 is connected through conductors 41, 42 and 43 to an intermediate selector (none shown) or directly to a connector C2, as shown in the drawings. Upon extension of the connection to a connector C2, the line relay 45 is operated in series with the calling line L1. Relay 45 closes a circuit for operating slow-to-release relay 44; relay 44 connects holding ground potential, through conductor 43, to the terminal engaged by brush 37 to hold the selector S1, to hold relay 25 if operated, to hold the line finder LF1, and to maintain the energization of the middle winding of relay 10. Relay 45 responds to the trains of impulses created by the dialing of the line selecting digits of the called subscriber's number, thereby effecting the operation of the connector to establish connection with the called line L2. The called line is tested and, if idle, the ringer at the called station B is operated. All of these operations are effected in usual and well-known manner. When the call is answered, relay 46 is operated thereby interchanging the connections between the windings of relay 45 and conductors 41 and 42 so as to reverse the direction of the current through the windings of supervisory relay 30 of trunk circuit MRT and thereby cause the operation of relay 30. If the calling line is a line other than a message rate line and relay 25 is not completely operated, the operation of relay

30 is without effect. But, if the calling line is a message rate line so that relay 25 is fully operated, a circuit for energizing the upper winding of relay 31 is closed when relay 30 operates or as soon thereafter as ground is next connected to conductor 29 by the interrupter which is common to all of the message rate trunk circuits. The interrupter intermittently connects ground to conductor 29, for instance for one-half a second out of every two and a half seconds. The energization of the upper winding of relay 31 effects the actuation of its outer lower front contact without actuating its other contacts. The lower winding of relay 31 is thereby connected to conductor 27 in series with the upper winding but, as long as ground is connected to conductor 29, the lower winding of relay 31 is short-circuited. As soon after relay 31 is partially operated as ground is disconnected from conductor 29, both windings of relay 31 are energized in series and the complete operation of this relay is thereby effected. At its outer upper front contact, relay 31 connects the winding of relay 32 to conductor 29; and, as soon as ground is next connected to conductor 29, relay 32 operates. Relay 32 locks directly to grounded conductor 27, disconnects ground from conductor 20, connects battery through resistance 33 to conductor 20 to operate the marginal register 15 of the calling line, disconnects the windings of relay 31 from conductor 27 and connects these windings to conductor 29. Relay 31 is thereby held operated until ground is next disconnected from conductor 29. When relay 31 releases, battery is disconnected from conductor 20 to release the register 15 and ground is reconnected to conductor 20. The connection between stations A and B is maintained until the telephone set is restored to normal at station A, whereupon relay 45 is released; and so also is relay 30, if operated. The release of relay 45 causes the release of relay 44. Relay 44 disconnects ground from conductor 43, thereby effecting the release of the selector S1, the release of relays 25 and 32, if operated, the release of line finder LF1 and the release of relay 10. If the telephone at station B is also restored to normal, the connector C2 returns to normal in usual manner.

Assume next that the subscriber at station A initiates a call to an operator, in which case the dialing of the digit 0 (or any other digit which is used as the code for calling an operator) causes the selector S1 to select a set of terminals 50 in the corresponding level of its bank, which set of terminals is connected to an idle trunk circuit TC1 associated with a trunk T leading to an operator's position. When the cut-through relay (not shown) of selector S1 operates, the connection from the calling line is extended through brushes 35, 36, 37 and 38 to trunk circuit TC1, thereby effecting the operation of line relay 89. The circuit for operating relay 89 is traced from battery through the right winding of relay 89, inner upper back contact of relay 87, upper left winding of repeating coil RC1, another back contact of relay 87, conductor 52, brush 36 of selector S1, lower winding of relay 30, brush 22 of line finder LF1, conductor 12 of line L1, through the telephone set at station A, conductor 11 of line L1, brush 21 of line finder LF1, upper winding of relay 30, brush 35 of selector S1, conductor 51, a back contact of relay 87, lower left winding of repeating coil RC1, inner lower back contact of relay 87, and the left

winding of relay 89 to ground. Relay 30 does not operate since the current through its windings is in the non-operate direction. Relay 89 closes circuits for operating relays 84 and 90. Relay 84 connects ground to conductor 53 to guard against seizure of trunk circuit TC1 by any other selector, to hold selector S1 and line finder LF1, to hold relay 25, if operated, and to hold relay 10 operated. Relay 84 also closes a connection between condenser 91 and conductor 52 for transmitting ringing tone to the calling subscriber to indicate that an operator is being signaled. Relay 90 interchanges the connections between the windings of relay 86 and conductors 97 and 98 of trunk T leading to an operator's position thereby effecting the operative energization of both windings of polarized relay 100 of trunk circuit TC2 at the distant end of trunk T. Although the windings of relays 86 and 100 are connected in a normally closed circuit over trunk T, the current is not strong enough to operate the marginal relay 86 and is in the non-operating direction with respect to relay 100. The operation of relay 100 closes a circuit for operating relay 101; relay 101 closes a circuit for operating relay 102; and relay 102 closes a circuit for operating relay 103. Relay 101 also closes a circuit for lighting answering lamp 113. Relay 103 closes a circuit for lighting busy lamp 114 and connects a busy potential, through resistor 116 and the lower winding of relay 105, to the sleeve of jack 112.

If the call is from a message rate line, relay 83 is fully operated due to the complete operation of relay 25 as hereinbefore described. If relay 25 is only partially operated, resistor 26 limits the current through conductors 28 and 54 to only partially operate relay 83; and, if relay 25 is not operated, relay 83 remains normal. With relay 83 completely operated, tone source T2 is connected to condenser T; and with relay 83 only partially operated, tone source T1 is connected to condenser T. With relay 83 either partially or fully operated, a circuit is closed for operating slow-to-release relay 82.

When an operator answers the call by inserting the plug of a cord in jack 112, a circuit is closed from battery in the operator's position circuit through the sleeve conductor of the answering cord and jack 112 and the upper winding of relay 105. Reference may be had to Patent No. 2,209,777 granted to R. E. King et al. July 30, 1940, for a disclosure of cord and position circuits arranged for cooperation with the trunk circuit TC2. Relay 105 operates, closing a circuit for operating relay 106. Relay 106 closes a circuit for operating relay 107; closes a short-circuit around the high resistance, upper winding of relay 100, thereby causing the operation of relay 86 of trunk circuit TC1; and opens the circuit through the winding of relay 101 to release this relay and extinguish lamp 113. Relay 107 closes a holding circuit for relay 102 and completes a talking connection between the right windings of repeating coil RC2 and the line conductors of jack 112.

The aforementioned operation of marginal relay 86, when the call is answered, closes a circuit for operating relay 80. Relay 80 disconnects condenser 91 from conductor 52, to end the transmission of ringing tone to the calling subscriber, and causes the release of relay 82.

While relay 82 is releasing, a class-of-service tone is transmitted through condenser T and front contact of relay 82 to conductor 52, thence

through repeating coils RC1 and RC2 to the answering operator to indicate the class of the calling subscriber. If relay 83 is operated completely, the tone is from source T2; if relay 83 is partially operated, the tone is from source T1; and if relay 83 is normal, no tone is transmitted.

The talking connection between the station A and operator includes repeating coils RC1 and RC2 and the connection is under the joint control of the calling subscriber and answering operator. When the telephone at station A is restored to normal, relay 89 releases thereby causing the release of relay 90 so as to restore the current over trunk T to its normal direction and thus effect the release of relay 100 of trunk circuit TC2. When relay 100 releases, it connects ground to the lower, low resistance winding of relay 105 thereby causing the lighting of a supervisory lamp in the operator's cord circuit as a disconnect signal. When the operator disconnects, relay 105 releases causing the successive release of relays 106 and 107. Relay 101 reoperates if relay 100 has not released. The release of relay 106 opens the short-circuit around the upper, high resistance winding of relay 100 thereby causing the release of relay 86 of trunk circuit TC1. The release of relay 86 causes the release of relay 80. When both the calling subscriber and answering operator have released the connection, relay 84 releases, thereby disconnecting ground potential from conductor 53 to effect the release of selector S1, line finder LF1 and relay 10.

What is claimed is:

1. In a telephone system, subscribers' lines including message rate lines, means including a trunk circuit interconnecting a calling message rate line and a called line, said trunk circuit comprising a class-of-service relay, a message register for said calling line, the connection between the calling line and trunk circuit comprising a conductor interconnecting said message register and said class-of-service relay thereby to operate said relay, said register being marginal to prevent its operation in series with said relay, and means including contacts of said relay for operating said register responsive to the answering of the call at the subscriber's station on the called line.

2. In a telephone system, subscribers' lines including message rate lines, a message register for each of said message rate lines, a trunk circuit, means responsive to the initiation of a call on one of said lines for connecting the calling line to said trunk circuit, an operator's position, means including subscriber controlled switching means for selectively connecting said trunk circuit with a called subscriber's line or with said operator's position, relay means in said trunk circuit, means comprising the message register of a calling message rate line connected to said trunk circuit for selectively operating said relay means to indicate that the calling line is a message rate line, means comprising means individual to a line, other than a message rate line, connected to said trunk circuit for selectively operating said relay means to indicate that the calling line is not a message rate line, and means including said relay means in said trunk circuit for effecting the operation of the message register of a calling message rate line connected to said trunk circuit in response to the answer of a call to one of said subscribers' lines.

3. In a telephone system, subscribers' lines in-

cluding message rate lines, a message register for each of said message rate lines, a trunk circuit, means responsive to the initiation of a call on one of said lines for connecting the calling line to said trunk circuit, an operator's position, means including subscriber controlled switching means for selectively connecting said trunk circuit with a called subscriber's line or with said operator's position, relay means in said trunk circuit, means comprising the message register of a calling message rate line connected to said trunk circuit for selectively operating said relay means to indicate that the calling line is a message rate line, means comprising means individual to a line, other than a message rate line, connected to said trunk circuit for selectively operating said relay means to indicate that the calling line is not a message rate line, means including said relay means in said trunk circuit for effecting the operation of the message register of a calling message rate line connected to said trunk circuit in response to the answer of a call to one of said subscribers' lines, and means selectively controlled by said relay means in said trunk circuit on a call to said operator's position for indicating to the answering operator the character of the calling line.

4. In a telephone system, subscribers' lines of different classes including message rate lines, a message register for each of said message rate lines, a trunk circuit, means responsive to the initiation of a call over one of said lines for connecting the calling line to said trunk circuit, class-of-service relay means in said trunk circuit, means including the message register of a message rate line connected to said trunk circuit for selectively operating said class-of-service means to indicate that the connected calling line is a message rate line, means including means individual to a line of another class connected to said trunk circuit for selectively operating said class-of-service means to indicate that the call is from a line of said other class, an operator's position, switching means controlled by the calling subscriber over the calling line and said trunk circuit in series for completing a connection with a called subscriber's line or with said operator's position as desired, means selectively operated under the control of said class-of-service relay means in said trunk circuit for giving to the answering operator on a call to said position an indication of the class of the connected calling line, and register operating means in said trunk circuit operatively responsive to the answer of a call though said trunk circuit to a called subscriber's station, the selective operation of said class-of-service relay means being effective to connect said register operating means to the register of a calling message rate line.

5. In a telephone system, subscribers' lines of a plurality of classes, the lines in one of said classes being message rate lines, a message register for each of said message rate lines, the winding of each of said registers having low electrical resistance, a resistor individual to each line in another of said classes, each of said resistors having a substantially higher resistance than each of said registers, a trunk circuit, means responsive to the initiation of a call over any one of said lines for connecting the calling line to said trunk circuit, said trunk circuit comprising a class-of-service relay and relay means for use in operating the message register of a connected calling mes-

sage rate line, said connecting means comprising talking conductors, a holding conductor and a control conductor, said control conductor connecting said class-of-service relay in series with the message register of a connected calling message rate line to fully operate said class-of-service relay in series with said register without operating said register, said control conductor connecting said class-of-service relay in series with the individual resistor of a connected calling line of said other class to partially operate said class-of-service relay, the partial operation of said class-of-service relay being ineffective and the complete operation of said class-of-service relay being effective to close a locking circuit, to disconnect the relay from said control conductor and to connect said control conductor to said relay means, and answering supervisory means in said trunk circuit for operating said relay means thereby to effect the closing of a circuit through said control conductor for operating the message register of a connected calling message rate line.

6. In a telephone system, subscribers' lines of a plurality of classes, the lines in one of said classes being message rate lines, a message register for each of said message rate lines, the winding of each of said registers having low electrical resistance, a resistor individual to each line in another of said classes, each of said resistors having a substantially higher resistance than each of said registers, a trunk circuit, means responsive to the initiation of a call over any one of said lines for connecting the calling line to said trunk circuit, said trunk circuit comprising a class-of-service relay and relay means for use in operating the message register of a connected calling message rate line, said connecting means comprising talking conductors, a holding conductor and a control conductor, said control conductor connecting said class-of-service relay in series with the message register of a connected calling message rate line to fully operate said class-of-service relay in series with said register without operating said register, said control conductor connecting said class-of-service relay in series with the individual resistor of a connected calling line of said other class to partially operate said class-of-service relay, the partial operation of said class-of-service relay being ineffective and the complete operation of said class-of-service relay being effective to close a locking circuit, to disconnect the relay from said control conductor and to connect said control conductor to said relay means, an operator's position, subscriber controlled switching means for establishing connections between calling lines and called lines and between calling lines and said operator's position, each of said connections including said trunk circuit, means selectively controlled by said class-of-service relay for indicating to the answering operator the class of the connected calling line on a call to said position, means including a supervisory relay in said trunk circuit for operating said relay means responsive to answer of a call to a called subscriber's line, the complete operation of said class-of-service relay and the operation of said relay means being effective to close a circuit through said control conductor for operating the message register of a connected calling message rate line.

JOHN G. WALSH.