July 30, 1940. J. DAVIDSON, JR 2,209,513

TELEPHONE SYSTEM

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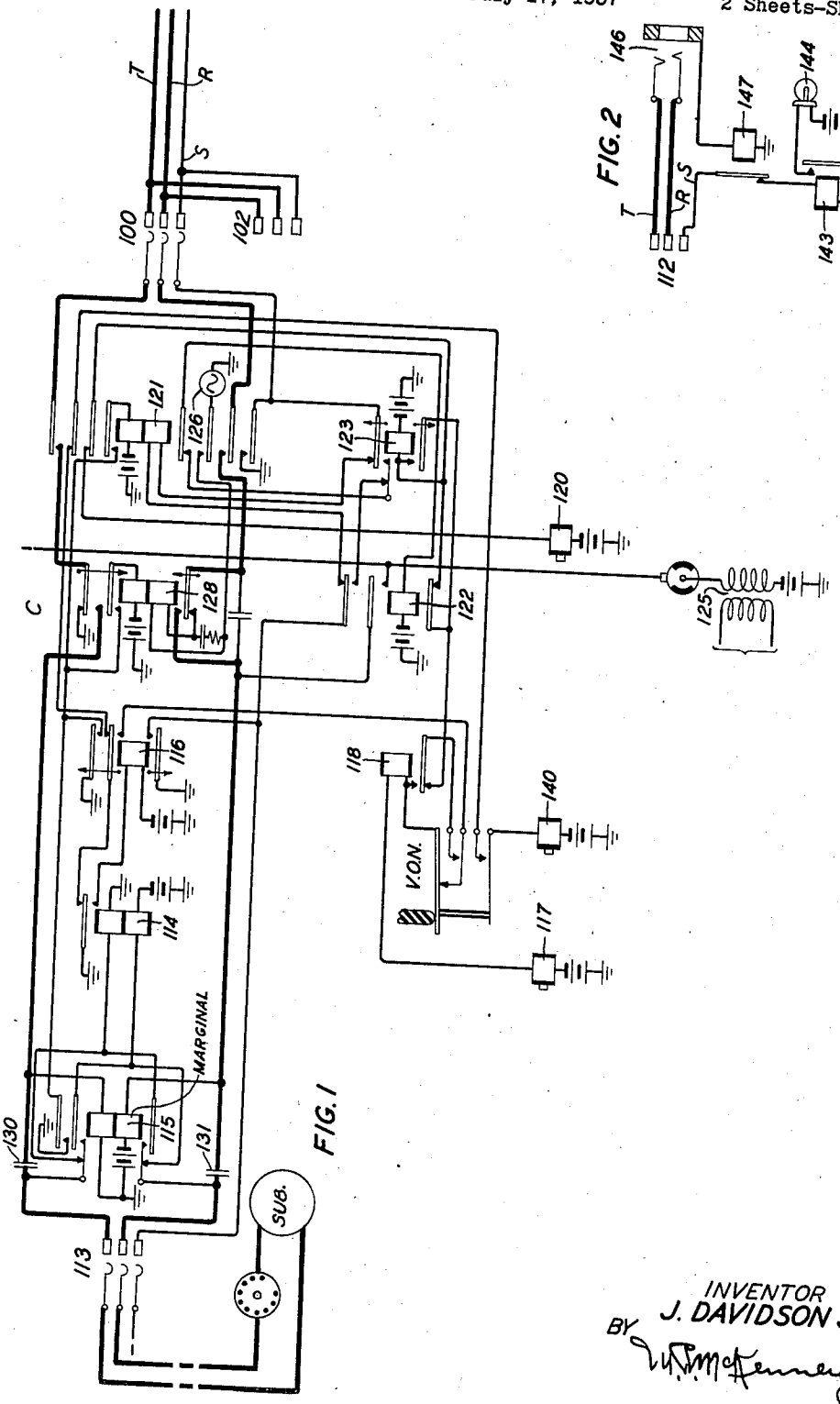

FIG. 1

FIG. 2

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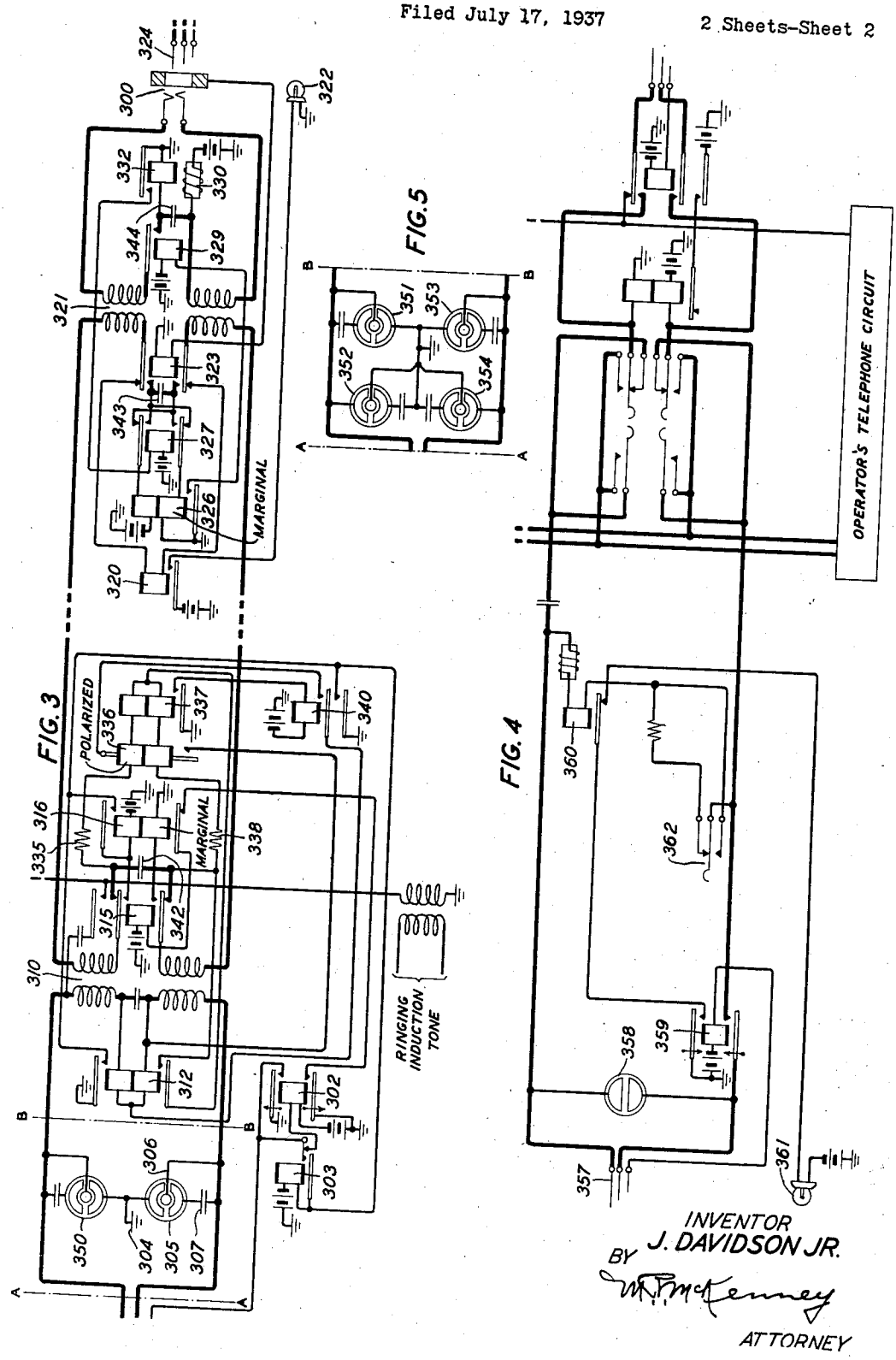

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TELEPHONE SYSTEM

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This invention relates to telephone systems and particularly to special service systems such as intercepting equipments in telephone systems.

An object of the invention is to provide an improved economically arranged ringing, signaling and tripping arrangement for intercepting equipments.

Heretofore systems have been provided in which, when subscribers' lines are changed or disconnected, calls for such lines over automatic telephone systems are extended to terminals connected to intercepting trunks leading to intercepting apparatus for supervision by operators. In such systems in case of an intercepting trunk circuit, for example, extending to a distant office, the ringing is usually tripped by the application of ground on the ring conductor as the ringing source is usually applied on this conductor. After the tripping relay has operated, the tripping ground connection on the ring conductor should not set up a false charge condition in the connector circuit which might occur should the operating battery connected through the winding of the usual supervisory relay be connected to the ring conductor. This is the usual practice as the operating battery in the preceding switches, such as selectors, is connected to the ring conductor. For operating reasons this is the preferred method. To avoid such false charge conditions the operating battery in the connectors are sometimes poled differently from the preceding switches. That is, with battery connected to the tip conductor and ground to the ring conductor.

It is a feature of this invention to provide a tripping arrangement for ringing in systems of this kind which includes cold cathode tubes. With this cathode tube arrangement the tripping relay in the automatic system is operated to trip the ringing as soon as the connection is established to the terminals of the intercepting trunk circuit. The cold cathode tube operates on the ringing voltage to establish a ground connection to the trunk conductors. As these tubes will not operate on the ordinary 48-volt operating battery, it cannot set up a false charge condition in the connector by operating the supervisory relay even though battery may be connected through the supervisory relay to the ring conductor of the line. This invention may be applied in systems of this kind in a number of different ways. For example, the tripping arrangement may be connected in the intercepting trunk to ground to a ring conductor as is the usual arrangement or to both the tip and ring conductors to trip ringing on either the tip or the ring conductor during the positive half of the ringing cycle depending on the conductor to which the ringing battery is connected. The system may also be arranged for tripping during both the positive and the negative halves of the ringing cycle by connecting two tubes alternately poled to the tip or ring conductors, or to both conductors. In some instances a tube may be arranged across the tip and ring conductors of a cord circuit for use by an intercepting operator to trip the ringing when she plugs into an intercepting trunk.

This invention has been illustrated in the accompanying drawings in which:

Fig. 1 shows a connector and associated terminals of an automatic step-by-step telephone system;

Fig. 2 shows a manual intercepting trunk terminating in the same office and selectable by the connector shown in Fig. 1;

Fig. 3 shows an intercepting trunk terminating in a distant office and selectable by the connector of Fig. 1;

Fig. 4 shows an intercepting operator's cord circuit in the same office; and

Fig. 5 shows a modified form of the applicant's invention as applied to an intercepting trunk circuit such as shown in Fig. 3.

Referring now to the drawings, terminals, accessible through a connector C shown in Fig. 1, and that have been disconnected from subscribers' lines, may be connected to intercepting trunks so that calls for these subscribers will be taken care of by operators. In Fig. 1 the terminals 100 and 102 that were normally connected to a two-party subscriber's line have been shown connected to an intercepting trunk, shown in Fig. 3. This trunk terminates in a distant office in a jack 300 in front of an operator's position who intercepts calls directed over this trunk. The terminals 112 that were also normally connected to a subscriber's line have been shown connected directly to a trunk terminating in a jack in the same office so that when calls are directed to these latter terminals the intercepting operator at this office may answer by using the intercepting cord circuit shown in Fig. 4.

If it is assumed that the last two digits of a called subscriber's number cause the connector C to have its brushes land on the terminals 100, the operations of the connector may be as follows: The connector may be seized by brushes 113 from a selector connecting with the terminals of this connector and this causes the operation of relay 114 from battery and ground through

the winding of this relay, terminals of relay 115 over the tip and ring conductors, then over the selector and other intermediate switches, if any, to the calling subscriber's loop. The operation of relay 114 closes an obvious circuit for the operation of relay 116 which is slow in releasing and remains operated during the succeeding dial pulses representing the tens digit. The first release of the pulsing relay 114, when the calling subscriber dialed this digit, closes a circuit for the vertical magnet 117 through the winding of this magnet and relay 118, vertical off-normal contacts and contacts of relays 116 and 114 to ground. This causes the connector to take one vertical step and operate the vertical off-normal contacts. Relay 118 is operated in this circuit and a circuit from now on will extend through contacts of relay 118 and the vertical off-normal contacts, and relay 118 is maintained operated during the succeeding impulses of this digit. At the end of the tens digit relay 118 releases and on the first release of relay 114 in response to a unit digit the rotary magnet 120 will operate over a circuit from battery through the winding of this magnet, contacts of relays 121, 122 and 118, the vertical off-normal contacts, contacts of relays 116 and 114 to ground. This circuit is also completed for relay 123, over contacts of relay 122, which operates and provides a locking circuit for itself independent of contacts of relay 122, and remains operated during the dialing of the unit digit. At the end of the unit digit, the brushes of the connector C land, as assumed, on terminals 100.

If the trunk shown in Fig. 3 is busy, there will be ground on the sleeve conductor and therefore a circuit will be completed immediately before the slow-release relay 123 releases for the operation of relay 122 from battery, through the winding of this relay, contacts of relays 121 and 123 to ground on the sleeve. Relay 122 in operating provides a locking circuit for itself when relay 123 releases through the make-before-break contacts of relay 123 and its own contacts to the ground at contacts of relay 116. Relay 122 in operating applies a busy tone from the source 125 over its upper inner armature and front contact to the ring conductor of the connection towards the calling subscriber's line.

If, however, the intercepting trunk is idle, a connection is established for the operation of relay 121 on the release of relay 123 from battery through the winding or relay 302, contacts of relay 303, the sleeve circuit, contacts of relay 123, lower winding of relay 121 to ground at relay 116. Relay 121 in operating closes a locking circuit for itself from battery through the upper winding and upper inner armature and front contact to ground at contacts of relay 116, and closes connections for the usual ringing of a called subscriber. In this case the ringing goes out towards the trunk in Fig. 3, from the source 126, contacts of relay 121, lower winding of the ringing trip relay 128, lower armature and back contact of this relay, contacts of relay 121, over the ring conductor of the intercepting trunk to ground at 304 through the cold cathode gas-filled tube 305 over lead 306. This tube may be so arranged that it will break down on the positive half of the ringing current as soon as it is applied. Any well-known type may be arranged as shown with a control connection over condenser 307 to ground at 304. The control gap in this connection has a comparatively low breakdown voltage which produces sufficient ionization of the tube to assist in the breakdown of the main gap established through the connection over the lead 306 to ground at 304. This breakdown connection over the main gap will then draw the peak current of the positive half of the ringing current. As soon as this occurs, tripping relay 128 will operate and close a locking circuit for itself from battery through its upper winding and its upper inner armature and front contact to ground at relay 116 and open the connection to the ringing source 126 for the ring conductor and thus discontinue the ringing. The breakdown voltage and the sustaining voltage of these gaps of the tube 305 are still sufficiently high to prevent a flow of the operating lower voltage direct current, applied on the ring conductor, from sustaining the ionization and cause current to flow through the tube after the tripping relay is operated. That is, the battery connection through the lower winding of supervisory relay 115 over the ring conductor is of a voltage below the sustaining voltage of the tube 305 and consequently no current will flow from this battery through the tube and this relay will therefore not be operated falsely. A false operation of this relay would in this case cause the call to be charged on the calling subscriber's meter or coin box, depending on the type of charging system employed.

On the operation of tripping relay 128 the connection for the tip and ring conductors of the connector is extended from battery and ground through the windings of relay 115, contacts of relays 128 and 121 over the tip and ring conductors, left-hand windings of the repeating coil 310, and the windings of relay 312. The resistance of the lower winding of relay 312 is sufficien to prevent the operation of relay 115 at this time. As stated, on the operation of relay 121, relay 302 was operated. This relay in operating closes a circuit for the operation of relay 315 from battery through the winding of this relay, contacts of relays 316 and 302 to ground. Relay 315 in operating closes a circuit for the operation of relay 320 located at the distant office in the intercepting trunk circuit. The circuit for relay 320 may be traced as follows: Battery and ground through the windings of relay 316, contacts of relay 315, right-hand windings of the repeating coil 310 over the tip and ring conductors and the left-hand windings of the repeating coil 321, contacts of relay 323 through the windings of relay 320. Relay 320 in operating closes an obvious circuit for the signal lamp 322 which indicates to the intercepting operator that a call is waiting on this trunk. Relay 316 is marginal and does not operate in this circuit.

When the operator now answers this call by inserting plug 324 into the jack 300, a circuit is completed over the sleeve in the usual manner for the operation of relay 323 from battery over the sleeve through the winding of relay 323 to ground. This relay in operating opens the circuit for relay 320 which now releases and extinguishes lamp 322. A circuit is also closed for the operation of relay 326 from ground and battery through the windings of this relay, contacts of relays 327 and 323 over the circuit traced through the windings of relay 316 to battery and ground. Battery and ground connections for these relays are such that both relays 326 and 316 will operate. Relay 326 closes an obvious circuit for the operation of relay 329 which closes the tip and ring connection through the right-hand windings of the repeating coil 321 towards

the operator's cord from battery through resistance 330 over the ring conductor and from ground through the winding of relay 332 over the tip conductor. Relay 316 in operating provides a locking circuit for itself to ground at relay 312. On the operation of relay 316, the circuit for relay 315 is opened and this relay in releasing closes a circuit from ground through the lower winding of relay 326, contacts of relays 327 and 323, the upper left-hand winding of repeating coil 321, the tip conductor, the upper right-hand winding of repeating coil 310, contacts of relay 315, resistance 335, upper windings of relays 336 and 337, contacts of relays 312 and 315, lower right-hand winding of repeating coil 310, the ring conductor, lower left-hand winding of repeating coil 321, contacts of relays 323 and 327, upper winding of relay 326 to battery. The polarity of this connection from battery and ground through the upper winding of relay 336 is such that this relay will not operate as it is polarized. Relay 337, however, operates and relay 340 also operates over an obvious circuit. Relay 340 provides ground to hold relay 316 operated independent of relay 312 to hold the connection under the control of the intercepting operator. Relay 340 also provides an obvious circuit for the operation of relay 303 which in turn opens the circuit for relay 302. Relay 302 opens the circuit for relay 315. The connection is now completed from the calling subscriber through the connection C and the intercepting trunk to the intercepting operator and conversation may proceed. Talking battery for the calling subscriber is applied through windings of relay 114 and the talking current is transmitted through the condensers 130 and 131. The signaling battery through the left-hand windings of repeating coil 310 is applied through the windings of relay 115. The conversation is repeated through repeating coils 310 and 321.

In case the intercepted call was extended by way of a calling operator's position and the intercepting operator decides to recall the calling operator, she will apply intermittent battery on the tip conductor to cause the intermittent operation of relay 332. This relay in turn closes an obvious circuit for the operation of relay 327 which reverses the current over the tip and ring conductors of the intercepting trunk to cause the operation of the polarized relay 336. This relay in turn closes a connection for short-circuiting the lower high resistance winding of relay 312 for the operation of marginal relay 115. The circuit for these relays may be traced from battery through the lower winding of relay 115 over the ring conductor, through contacts of relays 128 and 121, left-hand lower winding of repeating coil 310, contacts of relays 336 and 340, upper winding of relay 312, upper left-hand winding of repeating coil 310, tip conductor and contacts of relays 121, 128 through the upper winding of relay 115 to ground. On the operation of relay 115, the battery and ground connection through the windings of relay 114 is reversed over the tip and ring conductors to signal the calling operator by flashing impulses as is well known in the art.

If the calling party disconnects before the intercepting operator, relays 114 and 116 release. This latter relay in turn releases relays 128 and 121 and a circuit for the release magnet 140 is closed from battery through the winding of this magnet, vertical off-normal contacts, contacts of relays 121, 116 and 114 to ground and when the connector returns to normal the connection to the trunk is opened at terminals 100. This causes the release of relay 312. The release of relay 312 removes the short circuit around the lower windings of relays 336 and 337 and resistance 338 thus decreasing the current to relay 326 and causing it to release. This in turn releases relay 329 which gives a disconnect signal in the intercepting operator's cord. When the operator disconnects by removing plug 324 from jack 300, relay 323 is released, opening the talking circuit through the intercepting trunk. This in turn causes the release of relays 326, 329, 337, 340, 316 and 303.

If, on the other hand, the called subscriber's number had been that of the other party of the two parties originally connected to terminals 100 and 102 the brushes of the connector C would have landed on terminals 102. Under these conditions the ringing would be applied to the tip terminal of the connected intercepting trunk as the tip and ring terminals have been reversed as shown at 102. In this case the tube 350 will operate in the intercepting trunk to trip the ringing on the positive half of the ringing current in the same manner as tube 305 operated when the brushes of the connector C were connected to terminals 100.

Under other conditions it may be desirable to trip during the negative as well as the positive portion of the ringing cycle with the ringing current incoming over either the tip or ring conductor. In such cases the intercepting trunk would be changed to provide tubes in accordance with Fig. 5 connected between A—A and B—B so that no matter on which conductor the ringing current is received, it will be tripped immediately upon a positive or negative half of the ringing current. The wiring for the tubes would be as shown in Fig. 5, with the tube such as 351 connected in the same manner as tube 350 to respond on the positive half of ringing current applied on the tip conductor; with the tube 352 connected in the manner shown to the tip conductor to respond to the negative half of the ringing current applied on the tip conductor; with the tube 353 connected in the same manner as tube 305 to respond on the positive half of ringing current applied on the ring conductor, and with tube 354 connected in the manner shown to respond to the negative half of the ringing current applied to the ring conductor.

If the calling subscriber calls another disconnected subscriber in the same office, the brushes of this connector may land on terminals such as 112 to seize an intercepting trunk as shown in Fig. 2. In this case the relay 143 will operate over the sleeve to light lamp 144. When the intercepting operator sees this signal she inserts plug 357 of her intercepting cord circuit, Fig. 4, into jack 146. It should be noted that in this case when ringing is applied from the source 126, it will be tripped by tube 352, bridged across the tip and ring conductors. The tube will ionize and break down to cause the flow of ringing current on either the positive or negative half of ringing current. Inserting plug 357 in jack 136 causes relays 359 and 147 to operate. Relay 147 opens the circuit through the winding of relay 143 causing it to release and extinguish the line lamp 144. Relay 359 closes the ring conductor of the cord. Relay 360 is now operated from battery and ground from the connector. If the calling subscriber disconnects, relay 360 releases and the lamp 361 is lighted. The cord is also equipped with a flash-

ing key 362 which varies the resistance of the supervisory bridge across the tip and ring conductors of the cord to give a flashing signal back toward the connector.

What is claimed is:

1. In a telephone system, a calling line, an operator's position, a trunk terminating in said position, switching means for establishing a connection from said calling line over said trunk to said position and for transmitting ringing current over said trunk, and means controlled by the operator at said position and including a cold cathode tube for discontinuing said transmission of ringing current.

2. In a telephone system, a calling subscriber's line, a trunk line, switching means including a connector switch for establishing a connection from said calling subscriber's line to said trunk and for transmitting ringing current thereto, and means including cold cathode tubes in said trunk circuit and a relay in said connector responsive to the flow of ringing current for discontinuing the transmission of ringing current and for establishing a talking circuit over the trunk circuit from the subscriber's line.

3. In a telephone system, a calling subscriber's line, sets of tip, ring and sleeve terminals, switching means for establishing connections from a calling subscriber's line through said switching means to said terminal sets, means associated with said terminal sets and said switching means for transmitting ringing current over the tip terminals when certain terminal sets are connected with and over the ring terminals when certain other terminal sets are connected with, trunk circuits each connected in multiple to the terminals of two sets, and means associated with the switching means and associated with each trunk circuit and including cold cathode tubes for discontinuing the transmission of ringing current regardless of the set of terminals with which the switching means is connected.

4. In a telephone system, a calling line, a trunk line, means for establishing a connection between said lines, a source of ringing current, a relay, a gas-filled cold cathode tube, a circuit including said source and said relay, means for closing said circuit through said tube to ground when said connection is established to transmit ringing current from said source through said tube to operate said relay, and means responsive to the operation of said relay for discontinuing said transmission of ringing current.

5. In a telephone system, a calling circuit, a trunk line, a connector switch, means for establishing a connection from said calling circuit to said trunk line over said connector switch, a source of ringing current associated with said connector switch, a relay associated with said connector switch, a gas-filled cold cathode tube associated with said trunk line, a circuit extending from said source through said relay and through the elements of said tube to ground, means for closing said circuit operative when said connection is established to transmit ringing current from said source over said circuit to operate said relay, and means responsive to the operation of said relay for opening said circuit to discontinue the transmission of said ringing current.

6. In a telephone system, a calling circuit, a trunk line, a connector switch, means for establishing a connection from said calling circuit to said trunk line over said connector switch, a source of ringing current associated with said calling circuit, a relay associated with said calling circuit, a gas-filled cold cathode tube associated with said trunk line, a circuit extending from said source through said relay and through the elements of said tube to ground, means for closing said circuit operative when said connection is established to transmit ringing current from said source over said circuit to operate said relay, means responsive to the operation of said relay for opening said circuit to discontinue the transmission of said ringing current, and means responsive on the operation of said relay for locking it in operated position.

7. In a telephone system, a calling circuit, two sets of terminals each comprising a tip, a ring and a sleeve terminal, switching means for establishing connections from said calling circuit through said switching means to any one of said terminal sets, means associated with said switching means for transmitting ringing current over the tip terminal when one set of terminals are connected with and over the ring terminal when the other set of terminals are connected with, a trunk circuit connected in multiple to the terminals of said sets, cold cathode tubes associated with said trunk circuit, and circuit means operative through the elements of said tubes for discontinuing the transmission of ringing current regardless of the set of terminals with which the switching means is connected.

8. In a telephone system, a calling circuit, sets of terminals each comprising a tip, a ring and a sleeve terminal, switching means for establishing connections from said calling circuit through said switching means to any one of said terminal sets, means associated with said switching means for transmitting ringing current over the tip terminal when certain sets of terminals are connected and over the ring terminal when certain other sets of terminals are connected, trunk circuits each connected in multiple to the terminals of two sets, cold cathode tubes associated with each trunk circuit, and circuit means including the elements of a tube in a trunk circuit operative when a connection has been established from the switching means to said trunk circuit over a set of terminals for discontinuing the transmission of ringing current regardless of whether the ringing current is transmitted over a tip or a ring terminal.

9. In a telephone system a calling line, a trunk line, means for establishing a connection from said calling line to said trunk line, a source of ringing current, means for connecting said source to said trunk line, a space discharge tube, an operating circuit for said tube including the conductors of said trunk line and said source of ringing current, and means in said operating circuit responsive to the flow of ringing current over said operating circuit and through said tube for disconnecting said source from said trunk line.

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