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W. WHITNEY

TELEPHONE SYSTEM

Filed Oct. 19, 1926

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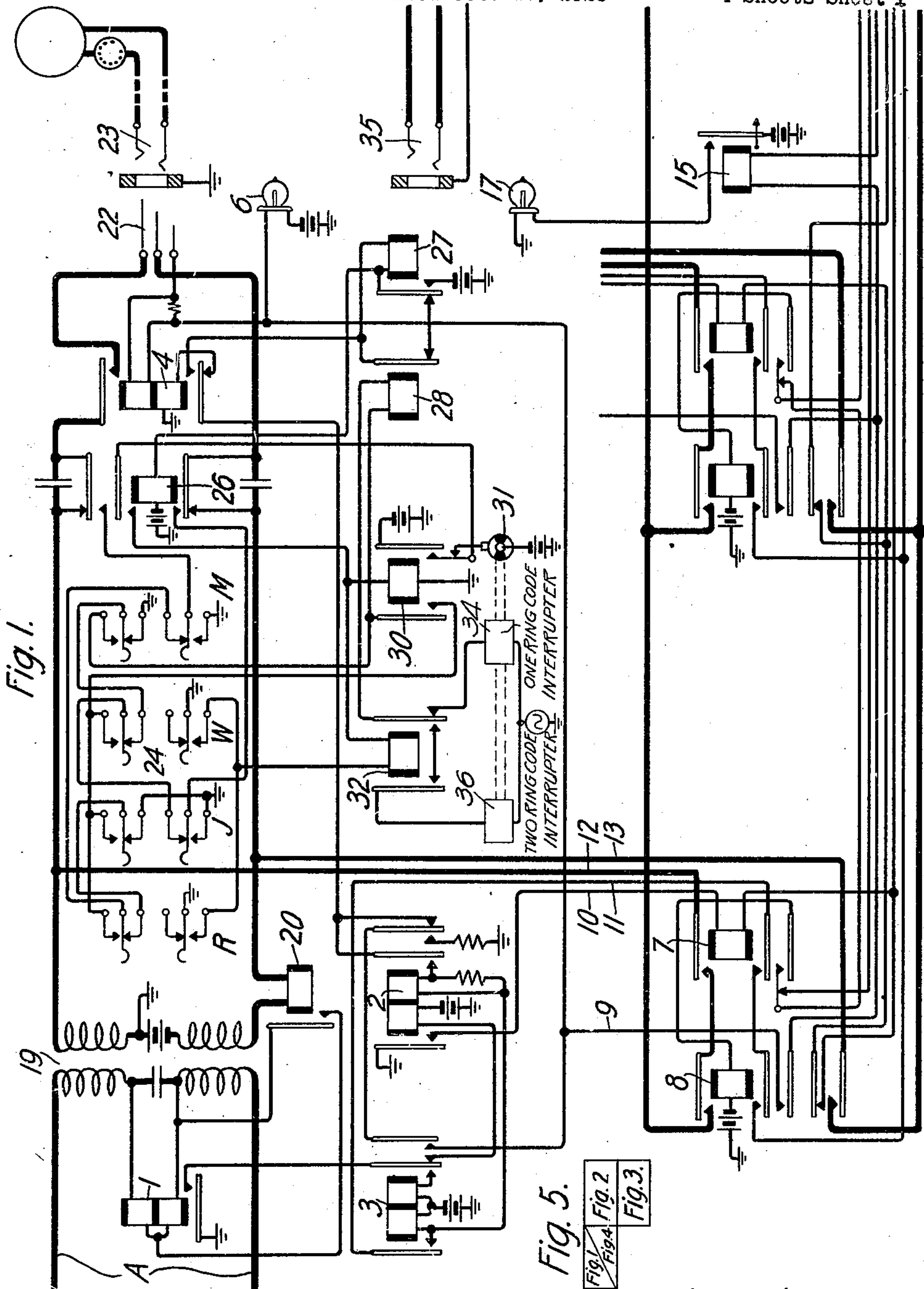


Fig. 1.

Fig. 2
Fig. 3
Fig. 4

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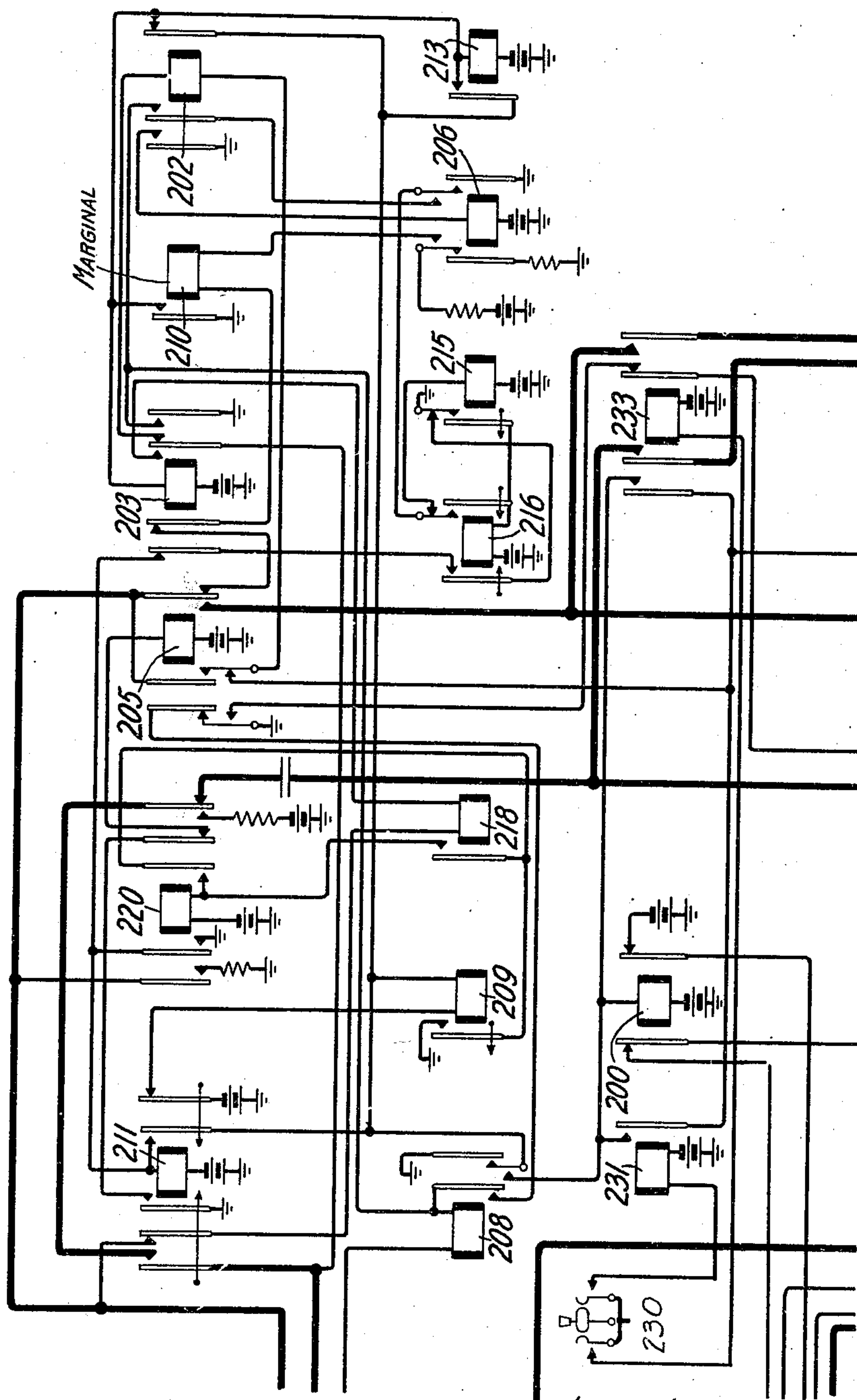
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Fig. 2.



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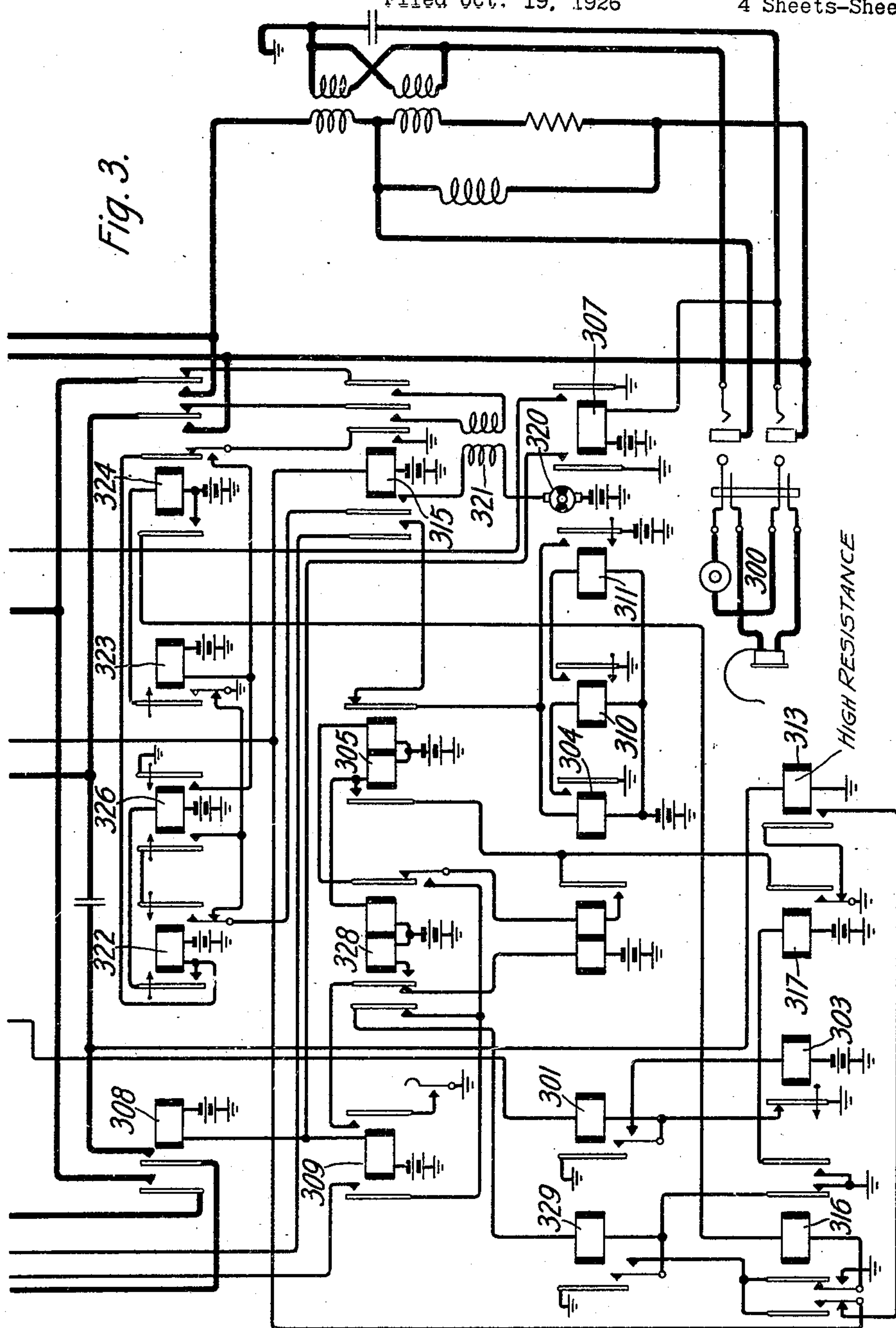
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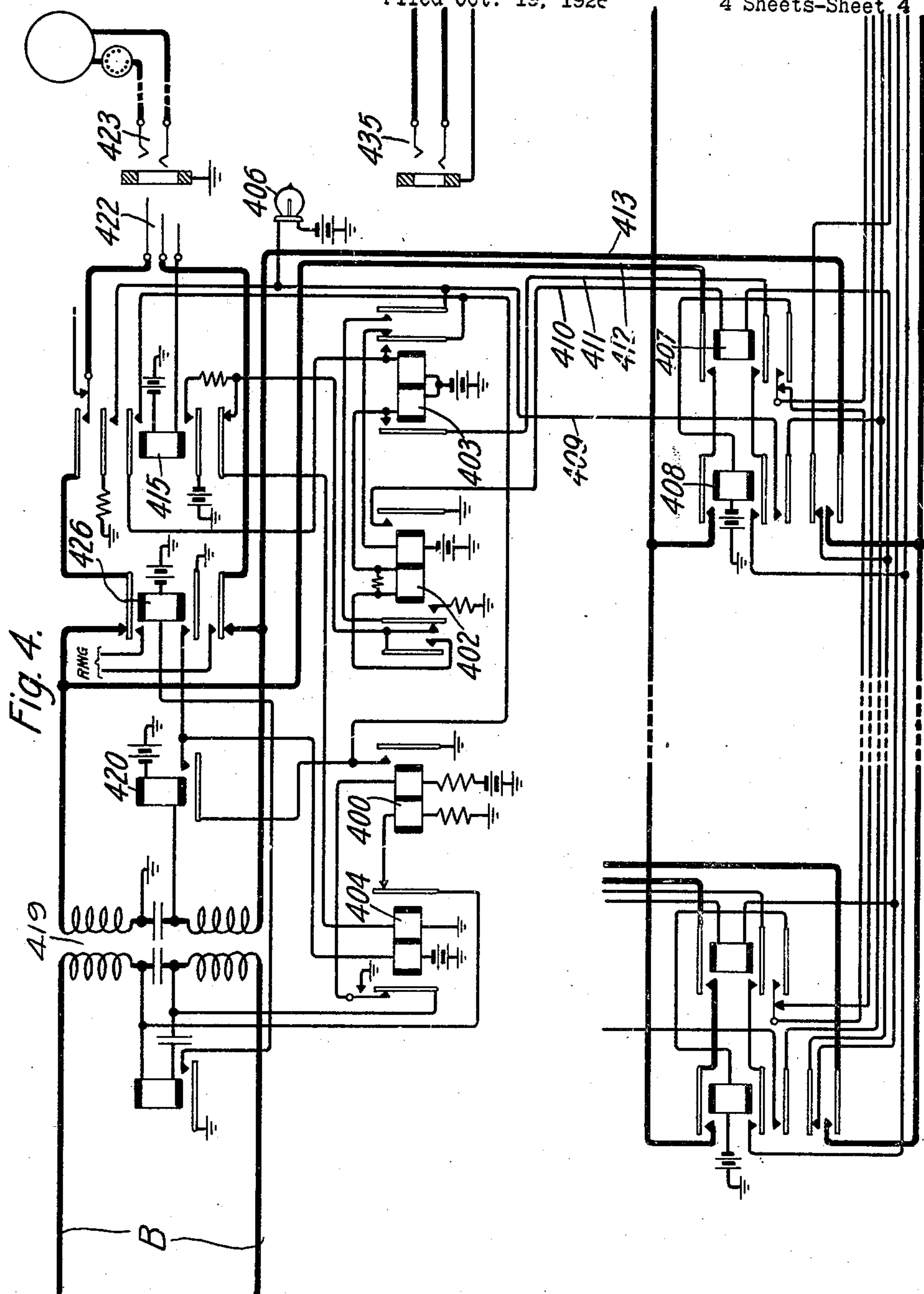
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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed October 19, 1926. Serial No. 142,557.

This invention relates to telephone systems and more particularly to improvements in emergency listening circuits to be used in common with different types of connections between manual exchanges.

According to this invention an emergency listening circuit is arranged to be interchangeably used in the establishing of connections involving such trunks as AB trunks, tandem completing trunks, or toll switching trunks or other connecting trunks having similar characteristics which are operated on the so-called straightforward basis. In trunks of these various types different circuit conditions are encountered and this circuit is designed to prevent interference and false signaling when it becomes necessary to employ an emergency listening circuit.

When the emergency listening circuit, according to another aspect of the invention, is used in connection with an AB or tandem completing trunk connection, when the automatic listening arrangement is not functioning properly, the application of a signal over the trunk is prevented. Accordingly means is provided in this emergency listening circuit whereby, when it is connected to an established trunk connection of either of these two types the supervisory relay in the trunk circuit is operated only for a comparatively short period, which is insufficient to cause any current changes to take place at the distant end of the trunk. The ringing trip relay in the trunk will also be actuated but the trunk will otherwise be maintained in an undisturbed condition as long as it is connected to the emergency listening circuit.

In the case of the use of the emergency listening circuit with a toll switching trunk connection, the problem is to prevent the machine ringing in the toll line connected to the toll switching trunk from starting to transmit ringing current over the toll switching trunk. Means is therefore also provided in this emergency listening circuit whereby the supervisory relay in the toll switching trunk is operated and maintained operated as long as the connection to the emergency listening circuit remains. The operation of the sleeve relay in the toll switching trunk, which ordinarily starts the

machine ringing, is thereby prevented from having such an effect.

This invention has been illustrated in the accompanying drawings in which Fig. 1 shows the incoming end of an AB or tandem completing trunk for straightforward trunk connections and a portion of a common sequence circuit having part of a listening circuit for automatically connecting the trunk operator's telephone set to the incoming end of the trunk, of a group of trunks, over which a connection is to be established; while Figs. 2 and 3 show a toll operator's telephone set, the remainder of the listening circuit arrangement for supervising the connection and associating the toll operator's telephone set through the sequence circuit to the engaged trunk and also an emergency listening circuit associated therewith designed in accordance with this invention. Fig. 4 illustrates the incoming end of a toll switching trunk of the straightforward type and a portion of a sequence circuit identical with that shown in Fig. 1. This circuit may be used in connection with the automatic listening circuit and the emergency listening circuit shown in Figs. 2 and 3 and connected thereto in the same manner as the circuit shown in Fig. 1 is connected with these circuits. Fig. 5 shows the manner of arranging the Figs. 1 to 4 for reading of the circuits.

In the following detailed description of the invention it will be assumed that the emergency listening circuit shown in Figs. 2 and 3 will be required in clearing calls incoming over the different types of trunks shown in Figs. 1 and 4. It is well-known in the art how trunks of these types may be used for completing connections from an A board, from a tandem office, or from a toll line over a toll switching trunk without the use of call wire circuits. It will therefore only be necessary to describe as much of the operations of these trunk connections as will be required to fully understand the conditions that an emergency listening circuit, designed in accordance with this invention encounters when it becomes necessary to employ it in connections of these types of trunks.

In the AB trunk A shown in Fig. 1, or in a similar trunk such as a tandem complet-

ing trunk, it may be assumed that relay 1 is actuated to signal a trunk operator at whose board the incoming end of this trunk terminates. When this relay operates a circuit is closed for the operation of relay 2 through the left-hand winding of this relay and the inner right-hand armature of relay 3. The operation of relay 2 closes a circuit for the operation of relay 3 as follows: Battery, left-hand winding of relay 3, right-hand winding and inner right-hand armature and front contact of relay 2, lower armature and back contact and lower winding of relay 4 to ground. Relay 3 in operating closes a locking circuit for itself through its right-hand armature and front contact under control of relay 1, while the original energizing circuit for relay 2 is opened. This relay is, however, now maintained locked through its right-hand winding over the above mentioned circuit through the lower winding of relay 4.

The operation of relays 2 and 3 causes the guard and disconnect lamp 6 to be lighted over a circuit as follows: Battery, lamp 6, outer right-hand armature and front contact of relay 3, outer right-hand armature and front contact of relay 2 through a resistance to ground. The automatic listening circuit comprising the sequence circuit shown in the lower part of Fig. 1 and the central circuit in Figs. 2 and 3 function to connect the operator's telephone set 300 to trunks such as A in a predetermined sequence. When therefore relay 2 is operated a circuit is closed for the operation of relay 7, of the group of relays 7 and 8 in the sequence circuit that are individual to trunk A. This circuit may be traced as follows: Battery, right-hand armature and back contact of relay 200, winding of relay 7, left-hand armature and front contact of relay 2 to ground. The operation of relay 7 closes a circuit for the operation of relays 8 and 301 as follows: Battery, relay 8, lower outer armature and front contact of relay 7, left-hand armature and back contact of relay 200, winding of relay 301, armature and back contact of relay 303 to ground. Relay 301 in operating closes an obvious circuit for the operation of relay 303 which opens the original energizing circuit of relay 301 and extends this circuit to ground through the left-hand armature and front contact of relay 301. The operation of relays 7 and 8 in the sequence circuit prevents, as is well known in the art, any other relays corresponding to 7 and 8, individual to other trunks, from operating when attempts are made to establish such connections. The operation of relays 7 and 8 extends the individual leads 9, 10, 11, 12 and 13 to the control circuit shown in Fig. 3.

The extension of lead 13 causes certain relays in the control circuit to operate to connect a tone to the trunk A and closes a cir-

cuit for the flashing of the guard and disconnect lamp 6 in a manner as will hereinafter become apparent. The extension of lead 9 closes a circuit for the operation of relay 15 over a circuit as follows: Battery, winding of relay 304, right-hand armature and back contact of relay 305, armature and front contact of relay 315, winding of relay 15, second lower armature and front contact of relay 8, outer right-hand armature and front contact of relay 3, outer right-hand front contact of relay 2 to ground. It will be noted that if the operator's telephone set 300 is connected through the plugs and jacks shown in Fig. 3 to the control circuit, relay 307 will be operated and if this relay is operated, the circuits for actuating and maintaining relays 308 and 309 are closed and as will be hereinafter described, relay 315 will also be operated so that the above mentioned circuit for relay 15 is therefore closed at this time. The operation of relay 15 lights the pilot lamp 17 which is associated with the group of trunks served by the sequence circuit shown in Fig. 1. This pilot lamp lights only when a trunk in this group is connected to the control circuit.

The circuit for lighting of lamp 6 is extended as shown through the winding of relay 304 to battery but the resistance of the winding of relay 304 is such that the lamp 6 will remain lighted. Relay 304, however, operates and closes an obvious circuit for the operation of slow-to-operate relay 310. Relay 310 in operating closes an obvious circuit for the operation of slow-to-operate relay 311. Relay 311 in operating extends the circuit previously traced through the winding of relay 304 directly to battery at the armature and front contact of this relay, thus permitting relay 304 to release. Direct battery is therefore connected to shunt the guard and disconnect lamp 6 extinguishing it by the low resistance winding of relay 15. On the release of relay 304 relays 310 and 311 release in succession to cause relay 304 to again be actuated and cause relay 306 to be again lighted. This process of connecting and disconnecting direct battery to the lamp circuit causes it to be periodically flashed to indicate to the toll operator that her telephone set is connected to the trunk A.

The connection of the operator's telephone set and the sending of the tone signal to the operator at the distant end of trunk A will now be described. The extension of lead 13 by the sequence circuit, as previously mentioned, causes the operation of relay 313 over a circuit as follows: Battery, lower right-hand winding of repeating coil 19 of trunk A, winding of supervisory relay 20, lower outer armature and front contact of relay 8, inner left-hand armature and front contact of relay 308, winding of relay 313 to ground. Relay 313 is of high resist-

ance so that relay 20 does not operate in the above circuit. The operation of relay 313 closes a circuit for the operation of relay 315 as follows: Battery, winding of relay 315, outer left-hand make-before-break contacts of relay 316, armature and front contact of relay 313, make-before-break contact of relay 317 to ground. The operation of relay 315 closes a circuit for the operation of the tone circuit equipment as follows: Battery, interrupter 320, left-hand winding of the tone transmitting coil 321, inner left-hand armature and contact of relay 315, make-before-break contacts of relay 322, make-before-break contact of relay 323 to ground. The secondary of the coil 321 is connected through the operation of relay 315 to trunk A through contacts of relays 324 and 308 and the leads 12 and 13. This causes a tone to be transmitted from this equipment to the operator at the distant end of trunk A. Relay 315 in operating also closes an obvious circuit for the operation of the slow-to-operate relay 322. This relay in operating opens the original circuit for the tone equipment through the primary of coil 321, thus removing the tone from the trunk. However, on the operation of this relay an obvious circuit is closed for relay 326 which is also slow-to-operate. This relay in operating closes through its left-hand armature and front contact a substitute circuit for the primary coil 321 from the ground at the make-before-break contacts of relay 323. A second application of tone is now therefore made to trunk A. Relay 326 in turn closes an obvious circuit for the operation of the slow-to-operate relay 323. Relay 323 in operating closes an obvious circuit for the operation of relay 324 and opens the second mentioned circuit through the primary of coil 321, thus discontinuing the second application of tone from the trunk A. The operation of relay 324 opens the original energizing circuit for relay 322 so that this relay and relay 326 are now released. Relay 323, however, is maintained operated through a circuit passing through the make-before-break contacts of relay 324 and inner right-hand armature and front contact of relay 315 so that no further application of tone can be transmitted to the trunk A as long as relay 315 remains operated. It will be noted that the operation of relay 324 opens the circuit through the secondary winding of coil 321 and connects the tip and ring leads to the telephone circuit 300 which is now therefore connected to the trunk A. The tone is transmitted over the trunk to the operator at the distant end of trunk A to indicate, as stated, that the toll operator is ready to receive the number of the called subscriber.

After receiving this information the toll operator will operate the proper party line

ringing key of the equipment shown at 24 and then insert plug 22 into jack 23 of the wanted subscriber's line in the manner well-known in the art. The insertion of plug 22 into jack 23 causes the operation of relay 4 through to the sleeve circuit. This relay closes the tip conductor of the trunk to the ringing equipment 24 by the operation of its upper armature. A circuit is also closed by the operation of this relay for relays 26 and 329 as follows: battery, winding of relay 26, armature and back contact of relay 27, armature and back contact of relay 28, lower armature and front contact of relay 4, inner right-hand armature and front contact and right-hand winding of relay 2, left-hand armature and front contact of relay 3, through lead 11, inner lower armatures and front contacts of relays 7 and 8, left-hand armature and front contact of relay 309, outer left-hand armature and back contact of relay 328, winding of relay 329, inner left-hand armature of relay 316 to ground. Relay 26 connects the tip and ring of trunk A directly to the party line ringing equipment 24 at its upper outer front contact and lower armature and front contact. Relay 329 in operating closes a circuit to ground through its armature and inner front contact independent of the original circuit to ground at the inner right-hand armature and back contact of relay 316. The connection through the sleeve circuit over plug 22 and jack 23 to ground causes the guard and disconnect lamp 6 to be extinguished. The operation of relay 4 opens the holding circuit for relay 2, and this relay in releasing opens the operating circuit for relay 7. The sequence circuit and control circuit relays are thereby released and the operator's telephone set removed from trunk A. On the operation of relay 26 a circuit is closed for the operation of relay 30 on the usual pick-up battery through the interrupter 31 and this relay in operating closes a locking circuit for itself through its left-hand armature and front contact. The operation of relay 30 connects ringing current from relay 32 through the ringing trip relay 28 to the trunk ringing keys in a manner well-known in the art. The particular type of ringing circuit shown here is known as four-party semi-selective, wherein ringing current is applied to either the tip or the ring conductor and the two stations on the conductor selected are run in a code of either one or two rings. Such a system is shown on Patent 1,609,395, granted to R. S. Bailey December 7, 1925. The function of relay 30 is to delay the application of ringing current to the wanted subscriber's line so as to insure against ringing the wrong party when the plug 22 is inserted into jack 23. As the method of ringing the proper party is well-known in the art no further description will

be made of the functioning of party line equipment 24, or the operations in the trunk circuit when the party answers the call.

If trouble should develop in the automatic listening circuit equipment, the emergency listening circuit is employed to send the required tone trunk signal to the operator at the distant end of the trunk A and to connect the toll operator's telephone set to the disabled trunk. The first operation in this case will be to insert plug 22 into jack 35 of the emergency listening circuit shown in Fig. 2 which, as indicated, is associated with the control circuit shown in Fig. 3. The first effect of this connection will be the operation of relay 202 and the supervisory relay 20 over a circuit as follows: Battery, lower right-hand winding of repeating coil 19, winding of supervisory relay 20, lower armature and back contact of relay 26, ring terminals of plug 22 and jack 35; left-hand inner armature and back contact of relay 203, winding of relay 202, inner left-hand make-before-break contacts of relay 205, right-hand armature and front contact of relay 307 to ground. The operation of relay 202 causes the operation of relay 206 over an obvious circuit and the operation of relay 206 closes a circuit for the lighting of lamp 6 and the operation of the sleeve relays 4 and 208 over a circuit as follows: Battery, lamp 6, upper winding of relay 4, sleeve terminals of plug 22 and jack 35, winding of relay 208, inner left-hand armature and front contact of relay 202, right-hand armature and front contacts of relay 206 to ground. The operation of relay 208 closes an obvious circuit for relay 200 which relay in operating opens the connections from the sequence circuit to the control circuit so as to prevent the operation of the control circuit in the usual manner. Relay 208 provides a locking circuit for itself and for the relay 4 through its inner right-hand armature and front contact to ground at the outer left-hand armature and back contact of relay 205. Relay 208 also closes an obvious circuit for the operation of relay 209, the purpose of which will be described hereinafter. The operation of the sleeve relay 4 in the trunk circuit causes the relay 2 to be released and the release of this relay shunts the lamp 6 so that this lamp is now extinguished. That is, a circuit is closed for the operation of relay 26 as follows: Battery, winding of relay 26, armature and back contact of relay 27, armature and back contact of relay 28, lower armature and front contact of relay 4, outer right-hand armature and back contact of relay 2, outer right-hand armature and front contact of relay 3, upper winding of relay 4, winding of relay 208 to ground at the outer left-hand armature and back contact of relay 205. The operation of relay 26 connects the ringing

trip relay 28 to the ring conductor through a key, as will be more fully explained later, and opens the circuit for the supervisory relay 20 and relay 202 in releasing releases relay 206.

It should be noted that the operation of the above mentioned relays takes a comparatively short time so that the momentary operation of relay 20 will not have any effect on the circuits at the opposite end of trunk A, in other words, if relay 20 is operated under ordinary circumstances when the wanted subscriber answers, the effect would be to charge a toll connection to the calling subscriber. In this case, however, the momentary operation of the supervisory relay will have no such effect as it is of a very short duration.

As is well known in the art of party line ringing, one of the party line keys in equipment 24 is always operated. The effect in this circuit from such operations will be as follows: For example, if key M is operated a connection to ground will be made to the tip conductor of trunk A and the generator or silent battery connection will be made to the ring conductor of trunk A. In this case therefore the ground connection to the tip conductor will cause the operation of relay 210 over a circuit as follows: Battery, through a resistance through the left-hand armature and front contacts of relay 206, winding of relay 210, inner left-hand armature and back contact of relay 203, right-hand armature and back contact of relay 205, tip terminals of jack 35 and plug 22, upper armature and front contact of relay 4, upper outer armature and front contact of relay 26, lower made contacts of key M to ground. No effect will be produced by the generator or a silent interval battery on the ring conductor in this case as the ring conductor will be opened at the inner upper armature of relay 203 as hereinafter described. The operation of relay 210 closes obvious circuits for the operation of relays 203 and 213 and these relays are held operated by the ground connection at the front contacts and the outer right-hand armature of relay 208 through the armature and front contact of relay 213. It will be noted that on the operation of relay 206 a circuit is closed for relay 215. On the operation of relay 215 an obvious circuit is closed for the operation of relay 216. Relay 216, in operating, opens the energizing circuit for relay 215 and a circuit will therefore be completed from ground, through the make-before-break contacts of relay 215 and the left-hand armature and front contact of relay 216, but due to the fact that relay 215 is slow to release and relay 216 is slow to operate, this connection cannot therefore have any effect before it is again opened at the operation of relay 203 and as relay 206

will be released on the release of relay 202 relay 216 will be presently released. The release of relay 206 will of course also cause the release of relay 210, while relays 203 and 213 are held operated as previously described. The release of relay 206, however, does not affect the operation of relay 208 as it is now held operated through the ground supplied at the outer right-hand armature and front contact of relay 203, in addition to the locking circuit through the outer left armature and back contact of relay 205, which however, will be presently removed.

The operation of relay 203 also closes a circuit for the bridging of relay 218 across the tip and ring conductors of the trunk as follows: From ground at the lower made contacts of key M through the middle left hand armature and back contact of relay 211, winding of relay 218, inner right-hand armature and front contact of relay 203, ring terminals of jack 35 and plug 22, lower armature and front contact of relay 26, lower normal contacts of key J and upper normal contacts of key W, upper made contacts of key M, winding of tripping relay 28, through the right-hand armature and back contact of relay 32 to the source of ringing current 34. The circuit completed over the path just traced causes the operation of relay 218 and this relay, in operating, closes a circuit for the operation of relay 220 as follows: Battery, winding of relay 220, armature and front contact of relay 218, armature and front contact of relay 209 to ground. It will be remembered that the relay 209 was operated on the operation of relay 208. Relay 220, in operating, provides a locking circuit for itself through its inner right-hand armature and front contact of relay 209 independent of the original energizing circuit for this relay through the armature and front contact of relay 218.

The operation of relay 220 closes an obvious energizing circuit for relay 211, which in operating, closes an obvious locking circuit for itself through the outer right-hand armature and front contact of relay 208. On the operation of relay 211, the energizing circuit for relay 209 is opened at the outer right-hand armature and back contact of this relay and relay 209 is released, but as this relay is slow to release it will maintain relay 220 operated for a short period after relay 211 is operated so that a momentary circuit will be completed for the operation of the tripping relay 28 as follows: Battery, through the outer right-hand armature and front contact of relay 220, outer left-hand armature and front contact of relay 211, ring terminals of jack 35 and plug 22, lower armature and front contact of relay 26, lower normal contacts of key J, upper normal contacts of key W, upper made

contacts of key M, winding of tripping relay 28, right-hand armature and back contact of relay 32 to ringing source 34. This connection directly to battery at the outer right-hand armature and front contact of relay 220 is such that the tripping relay 28 will be actuated as is well known in the art. The operation of relay 28 opens the short circuit for the winding of relay 27 through the armatures and back contacts of relays 28 and 27 and relay 27 will now therefore operate in series with relay 26. The operation of relay 27, in turn establishes a short circuiting connection to battery for relay 26, which is thereby released.

The release of relay 26 opens the circuit for relay 28 which is now released, whereas relay 27 remains operated. By this time relay 211 is operated to open the original energizing circuit for relay 28, and as relays 209, 218 and 220 have released the supervisory relay 20 cannot be again operated as long as the connection to the emergency listening circuit is maintained.

The release of the relay 220 and the maintenance of relay 211 operated causes a circuit to be completed for the operation of relay 205 as follows: Battery winding of relay 205, middle right-hand armature and back contact of relay 220, inner left-hand armature and front contact of relay 211 to ground. Relay 205, in operating, completes the tip conductor connection at its right-hand armature and front contact to the control circuit shown in Fig. 3 and the fact that relay 211 is operated and relay 220 is released causes the connection from the ring conductor to be also completed to the control circuit. The operation of relay 205 also provides a ground connection at its outer make-before-break contacts through the inner left-hand armature and back contact of relay 223 for the operation of relay 315 in the control circuit. The operation of relay 315 causes, as hereinbefore described, the control circuit to function to apply tone to the trunk A and thereafter to connect the operator's telephone set 300 to the trunk A.

The toll operator will now receive the desired information from the operator at the distant end of the trunk A and when this information is received, she will remove the plug 22 from jack 35 of the emergency listening circuit and insert this plug into the jack of the desired subscriber's line. The removal of plug 22 from jack 35 causes the release of the operated relays in the emergency listening circuit as follows, that is, relay 208 is first released and this relay, in turn, releases relay 213, 203, 211, 205 and 200.

If key W is operated in place of key M, battery or silent interval battery is applied to ring conductor from the source 36 and ground on the tip conductor. In this case

the operation of the circuit would be the same as hereinbefore described. On the other hand, if either key J or key R is operated ground will be connected to the ring conductor and battery and silent interval battery of this character connected to the tip conductor. In this case relay 202 will release and relays 203 and 213 be operated through the right hand armature and back contact of relay 202 from ground at relay 208 and from thereon the operations of the circuit will be the same as in the previous two cases.

Referring now to the operation of the emergency listening circuit when used in connection with a toll switching trunk such as is shown in Fig. 4. It should be mentioned in this connection that the functions for automatically transmitting, through the control circuit shown in Figs. 2 and 3, a tone signal to the operator at the distant end of a toll switching trunk B and for subsequently connecting the operator's telephone, in this case a toll switching operator, are practically identical with the operations previously described in connection with the A, B or tandem completing trunk A. It is therefore, only necessary to briefly outline the functions relating to the seizing of the trunk B.

Assuming then that relay 400 is operated when the toll switching trunk B is taken for use, a circuit will be completed for the operation of relay 402 as follows: Right-hand winding of relay 402, inner right-hand armature and back contact of relay 403, armature and front contact of relay 400 to ground. The operation of this relay closes a circuit for the operation of relays 403 and 404 as follows: Battery, left-hand winding of relay 403, left-hand winding of relay 402, outer left-hand armature and front contact of relay 402, lower outer armature and back contact of relay 415, right-hand winding of relay 404 to ground. Relay 404 in operating closes an obvious holding circuit for relay 400 and opens the connections from battery and ground to the trunk B through the windings of relay 400. As is well known the removal of the battery and ground from the trunk has no effect at this time at the distant end of the trunk.

Relay 403 in operating closes a locking circuit for itself under control of relay 400 and completes an obvious circuit for the lighting of lamp 406. This relay also completes the connections for conductors 409, 410 and 411 to the sequence circuit in the same manner as the connections for conductors 9, 10 and 11 were completed to the sequence circuit from trunk A in Fig. 1. The automatic connection of the toll switching operator's telephone set and the transmission of the tone signal to the distant end of the trunk B is accomplished in the same

manner as in the case of trunk A hereinbefore described.

If trouble should develop in the automatic listening circuit equipment the emergency listening circuit will be employed to send the required tone signal to the operator at the distant end of trunk B and to connect the toll switching operator's telephone set to this trunk. The first operation in this case will be to insert plug 422 into jack 435 that may be considered as the equivalent of jack 35. The effect of this connection will be the operation of relay 202 and the supervisory relay 420 over a circuit as follows: Battery, winding of relay 420, lower right-hand winding of repeating coil 419, lower outer armature and back contact of relay 426, ring terminals of plug 422 and jack 435, inner right-hand armature and back contact of relay 203, winding of relay 202, inner left-hand make-before-break contacts of relay 205, right-hand armature and front contact of relay 307 to ground. The operation of relay 202 causes the operation of relay 206 over an obvious circuit. The operation of relay 206 closes a circuit for the lighting of lamp 406 and the operation of sleeve relays 415 and 208 over a circuit as follows: Battery, winding of relay 415, sleeve terminals of plug 422 and jack 435, winding of relay 208, inner left-hand armature and front contact of relay 202, right-hand armature and front contacts of relay 206 to ground. The operation of relay 208 closes an obvious circuit for relay 200 which relay in operating opens the connections from the sequence circuit to the control circuit so as to prevent the operation of the automatic listening circuit in the usual manner. Relay 208 provides a locking circuit for itself and for relay 415 through its inner right-hand armature and front contact to ground at the outer left-hand armature and back contact of relay 205. Relay 208 also closes an obvious circuit for the operation of relay 209. This relay serves no useful purpose in this type of connection.

The operation of relay 206 also completes a circuit from battery and ground through resistances and the left-hand armature and front contacts of relay 206 through the winding of relay 210, the inner left-hand armature and back contact of relay 203, right-hand armature and back contact of relay 205, through the tip conductor on the trunk B and the upper right-hand winding of repeating coil 419 to ground over the upper outer armature and front contact of relay 415 and upper armature and back contact of relay 426 but due to the marginal characteristics of relay 210 it does not operate in this circuit. It should be noted that this relay did operate under certain conditions when the emergency circuit was connected to an AB or tandem completing trunk, and the fact that this relay does not operate in this

circuit connection distinguishes the operations as follows from the operations when the AB or tandem completing trunks are connected to the emergency listening circuit.

5 The operating of relay 206 also completes an obvious circuit for the operation of relay 215 which in operation closes an obvious circuit for the operation of relay 216. On the
10 operation of relay 216 the original energizing circuit for relay 215 is opened and this relay is now released. Relay 216 is slow-to-operate and relay 215 is slow-to-release, hence the circuit from the ground at the make-before-break contacts of relay 215
15 through the left-hand armature and front contact of relay 216 is delayed for a short period although this is of no importance in this case. That is, this delay in completing the above circuit through the armatures and
20 contacts of relays 215 and 216 is not required when the emergency listening circuits are connected to a toll switching trunk, but as previously stated, it was necessary to introduce this delay when the emergency listening circuit was connected to an AB or tan-
25 dem completing trunk in order to prevent any effects in the circuits from this connection. In this case however, this circuit is completed for the operation of relay 211 over
30 a circuit as follows: Battery, winding of relay 211, outer left-hand armature and back contact of relay 203, left-hand armature and front contact of relay 216 and make-before-break contact of relay 215 to ground. The
35 operation of relay 211 closes the ring conductor through to outer right-hand armature of relay 220. This relay also in operating opens at its middle left-hand armature and back contact the circuit for relay 218 which
40 is not used in this case but was employed in the previous case to cause the tripping of the ringing equipment. Relay 211 in operating closes an obvious locking circuit for itself under control of relay 208 and opens
45 the circuit for relay 209 which is now released. Another circuit completed by the operation of relay 211 is one for the operation of relay 205 as follows: Battery, wind-
50 ing of relay 205, middle right-hand armature and back contact of relay 220, inner left-hand armature and front contact of relay 211 to ground.

Relay 205 in operating disconnects the relay 210 from the tip side of the connection
55 and bridges relay 202 across the tip and ring conductors as follows: The tip conductor of the emergency listening circuit, inner left-hand armature and front contact of relay 205, winding of relay 202, inner left-hand
60 armature and back contact of relay 203 to the ring conductor. It should be remembered that the supervisory relay 420 was operated on the insertion of plug 422 into jack 435 through the inner left-hand make-
65 before-break contacts of relay 205. The cir-

cuit for this relay will now, due to the operation of relay 205, extend through the winding of relay 202, the inner left-hand armature and front contact of relay 205, the tip
70 conductors of the emergency listening circuit and the toll switching trunk through the upper right-hand winding of repeating coil 419 to ground so that the supervisory relay will, even though the above
75 mentioned changes have taken place in the emergency listening circuit, be maintained operated as long as this circuit connection remains. This is in order to prevent any effects from the connection of the emergency
80 listening circuit to the toll switching trunk from being transmitted to the distant end of trunk B which would ordinarily be produced on the operation of the sleeve relay 415. It will be observed that on the operation of relay 415 the original energizing cir-
85 cuit for relay 404 is opened at the lower outer armature and back contact of this relay so that under ordinary circumstances when plug 422 is inserted in the jack of the wanted subscriber's line the operation of
90 this relay 415 and the release of relay 404 would connect battery and ground across the tip and ring conductors of trunk B which would, as is well known in the art, have the effect of notifying the operator at the dis-
95 tant end of the trunk that a connection has been extended to the wanted subscriber and that he may be rung. In this case therefore this effect is not transmitted as relay 404 is maintained operated due to the operation of
100 the supervisory relay 420. The circuit for maintaining relay 404 operated may be traced as follows: Battery, left-hand winding of relay 404, armature and front contact of supervisory relay 420, armature and front
105 contact of relay 400 to ground.

The operation of relay 205 also completes a circuit from ground at its left-hand outer make-before-break contacts through the in-
110 ner right-hand armature and front contact of relay 233 for the operation of relay 315 in the control circuit. The operation of this relay starts the control circuit to function to transmit the tone signals to the distant end of the trunk B and connect the opera-
115 tor's telephone set 300 to the trunk in a manner as hereinbefore described except that the connection extends through jack 435.

When the toll switching operator receives the number of the wanted subscriber from
120 the operator at the distant end of trunk B she will remove plug 422 from jack 435 and insert the plug into jack 423 of the wanted subscriber's line and the connection will then be completed as in the ordinary way. The
125 removal of the plug from jack 435 causes the release in the emergency listening circuit of the relays that were operated, namely: Relays 202, 208, 200, 206, 216, 211 and
130 205.

Another means is provided in this circuit arrangement for suspending automatic listening for the trunks. This means is the key 230. If the relays for transmitting the tone to the distant end of the connected trunk are functioning properly the key 230 is operated to the right. This closes an obvious circuit for the operation of relay 231. Relay 231 in operating closes a circuit for the operation of relay 200 as follows: Battery, winding of relay 200, armature and front contact of relay 231, right-hand armature and front contact of relay 307 to ground. The operation of relay 200 functions as hereinbefore stated to open the connection from the sequence circuit to a control circuit to make the automatic listening equipment inoperative.

If the relays for transmitting the tone are not functioning properly or are to be tested the key 230 is operated to the left. This operation of key 230 closes an obvious circuit for relay 233. Relay 233 in operating performs the same function as relay 231, that is, it closes a circuit for the operation of relay 200 and in addition bridges the talking leads across the two outer right-hand armatures of the last tone relay 324, thus providing a means for connecting the operator to the trunk while the tone signal equipment is being tested. The lead from the left-hand outer make-before-break contacts and relay 205 for the starting of the tone signal equipment at the operation of this relay in case the emergency listening circuit is inadvertently used is opened by the operation of relay 223.

It should be understood that the invention is not limited in its use to trunks of these particular types but may be applied in any other suitable manner to other trunks of similar characteristics in regard to the prevention of disturbances in trunk connections during the use of an emergency listening circuit.

What is claimed is:

1. In a telephone system, subscribers' lines, trunks of different character arranged to transmit a signal during the connection of a subscriber's line thereto, and a listening circuit including a marginally responsive device for differentiating between said different character trunks, means coacting with said device when the listening circuit is connected to a trunk of a certain character to prevent the transmission of a signal by said trunk, and means coacting with said device when the listening circuit is connected to a trunk of a different character to prevent the transmission of a signal by said second mentioned trunk.

2. In a telephone system, subscribers' lines, trunks of different character, each includ-

ing a supervisory relay arranged to be operated to transmit a signal when the subscriber on the line connected to the trunk answers a call, and a listening circuit arranged when connected to a trunk of one character to actuate the corresponding supervisory relay as long as the listening circuit is connected to the trunk to prevent the transmission of a signal, and arranged when connected to a trunk of another character to actuate the corresponding supervisory relay for a short period only during the connection of the listening circuit to the trunk, said period of actuation being insufficient to cause a signal to be transmitted thereby.

3. In a telephone system, subscribers' lines, trunks of different character arranged to transmit a signal during the connection of a subscriber's line thereto, an automatic listening circuit including an operator's telephone set arranged to be connected to a trunk in response to the seizure of said trunk, means for independently connecting said operator's telephone set to a trunk for disabling the automatic listening circuit and for preventing the transmission of a signal by said trunk, regardless of its character in response to the association of said means with said trunk.

4. In a telephone system, trunks of different character, subscribers' lines, an automatic listening circuit including an operator's telephone set and a tone producing equipment, means responsive to the seizure of a trunk for actuating said automatic listening circuit to transmit a tone signal over said trunk and connect the operator's telephone set to said trunk, means for connecting a trunk to a subscriber's line, a source of ringing current, means responsive during the connection of a subscriber's line to a trunk for rendering said source effective, an emergency listening circuit associated with said automatic listening circuit, means for connecting said emergency listening circuit to a trunk, means responsive to such a connection for preventing the normal functions of the automatic listening circuit and actuating it to transmit a tone signal through the emergency listening circuit to the connected trunk, means to connect the operator's telephone set through the emergency listening circuit to the connected trunk, and means in said emergency listening circuit for preventing the transmission of a ringing signal, over the trunk when the emergency listening circuit is connected thereto, regardless of the character of the connected trunk.

In witness whereof, I hereunto subscribe my name this 18th day of October, A. D. 1926.

WILEY WHITNEY.