

April 14, 1942.

I. H. HENRY ET AL

2,279,822

INTERCEPTING TRUNK

Filed Oct. 26, 1940

5 Sheets-Sheet 1

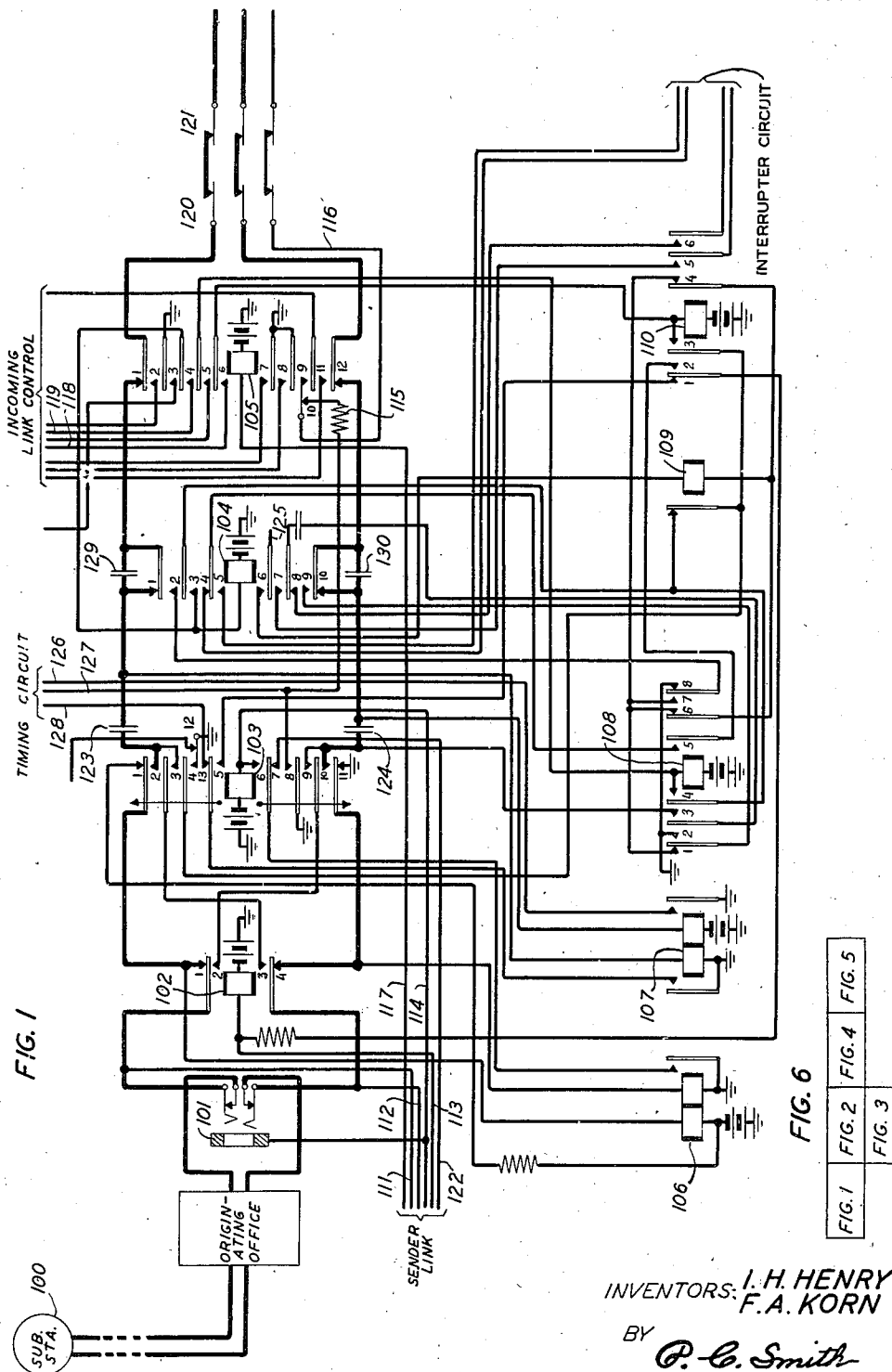


FIG. 6

FIG. 1	FIG. 2	FIG. 4	FIG. 5
	FIG. 3		

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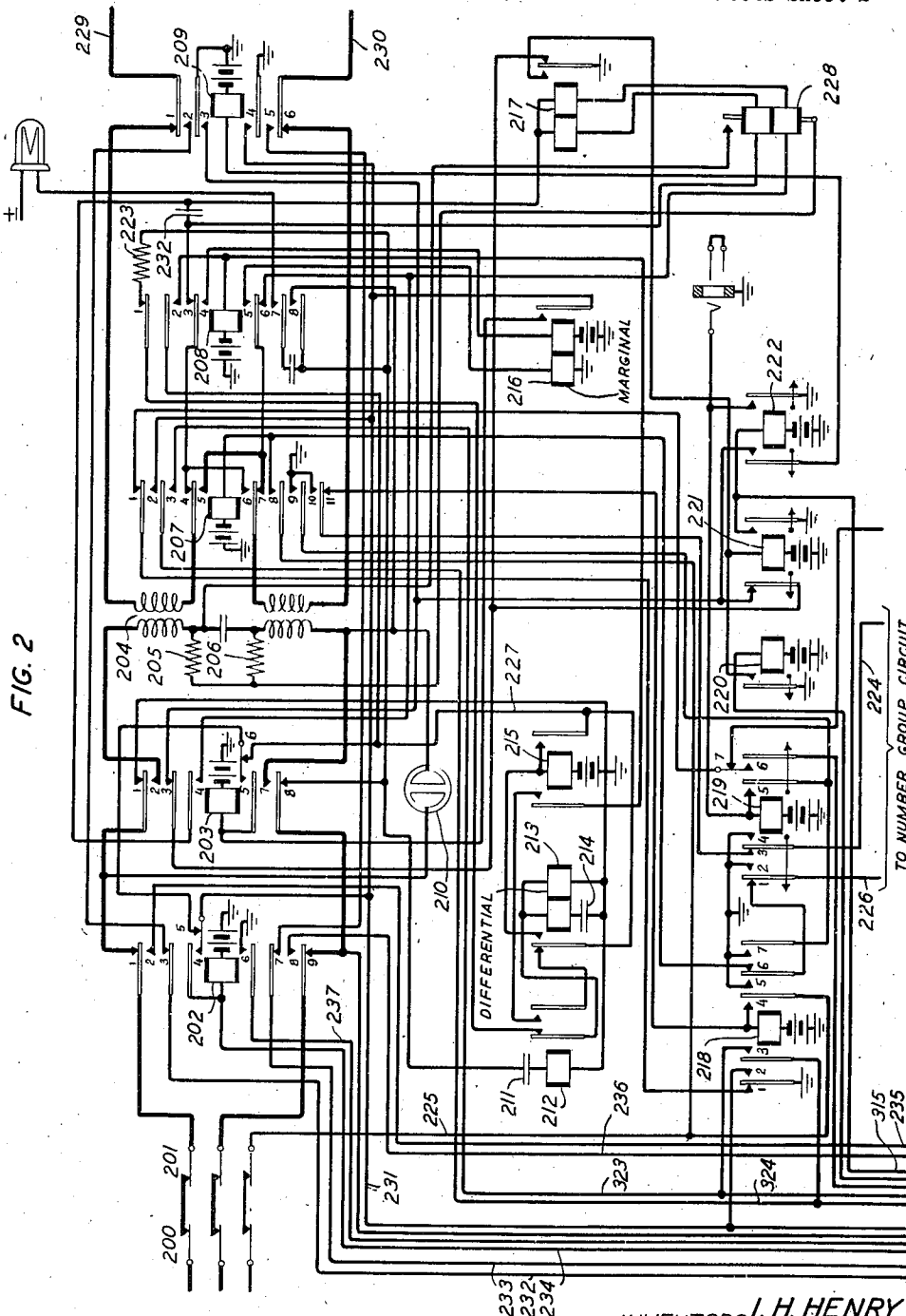
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5 Sheets-Sheet 2



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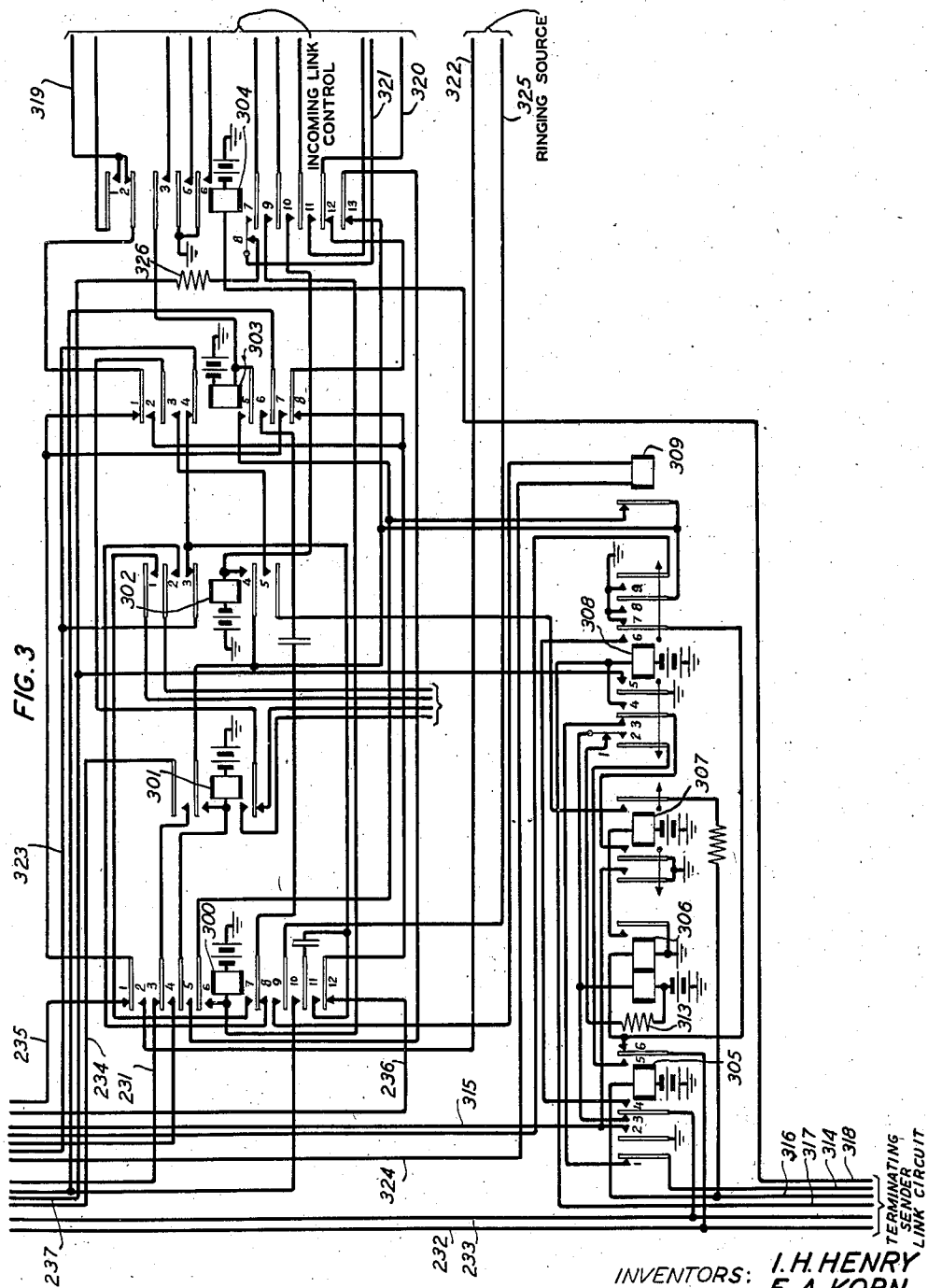
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5 Sheets-Sheet 3



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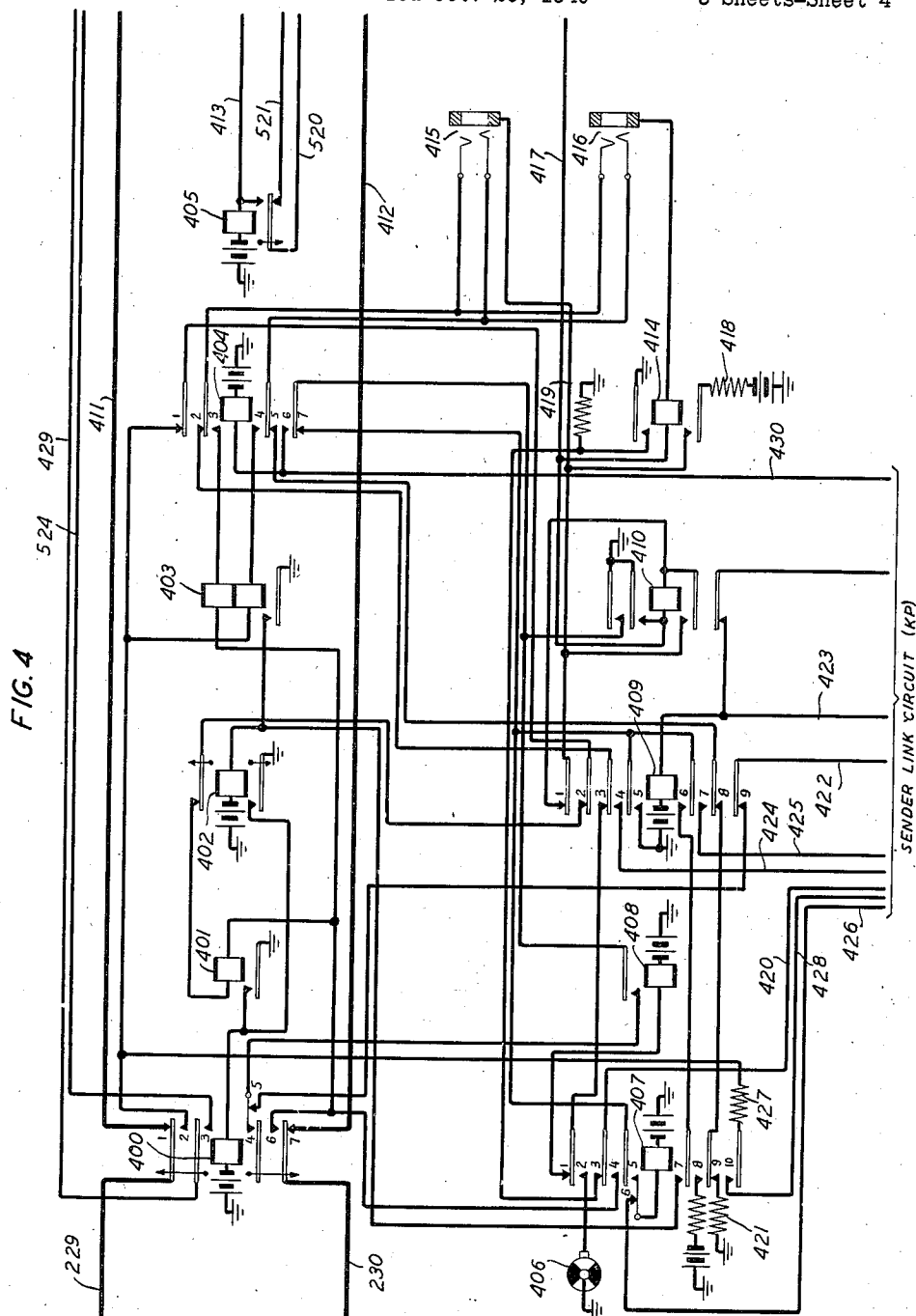
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5 Sheets-Sheet 4



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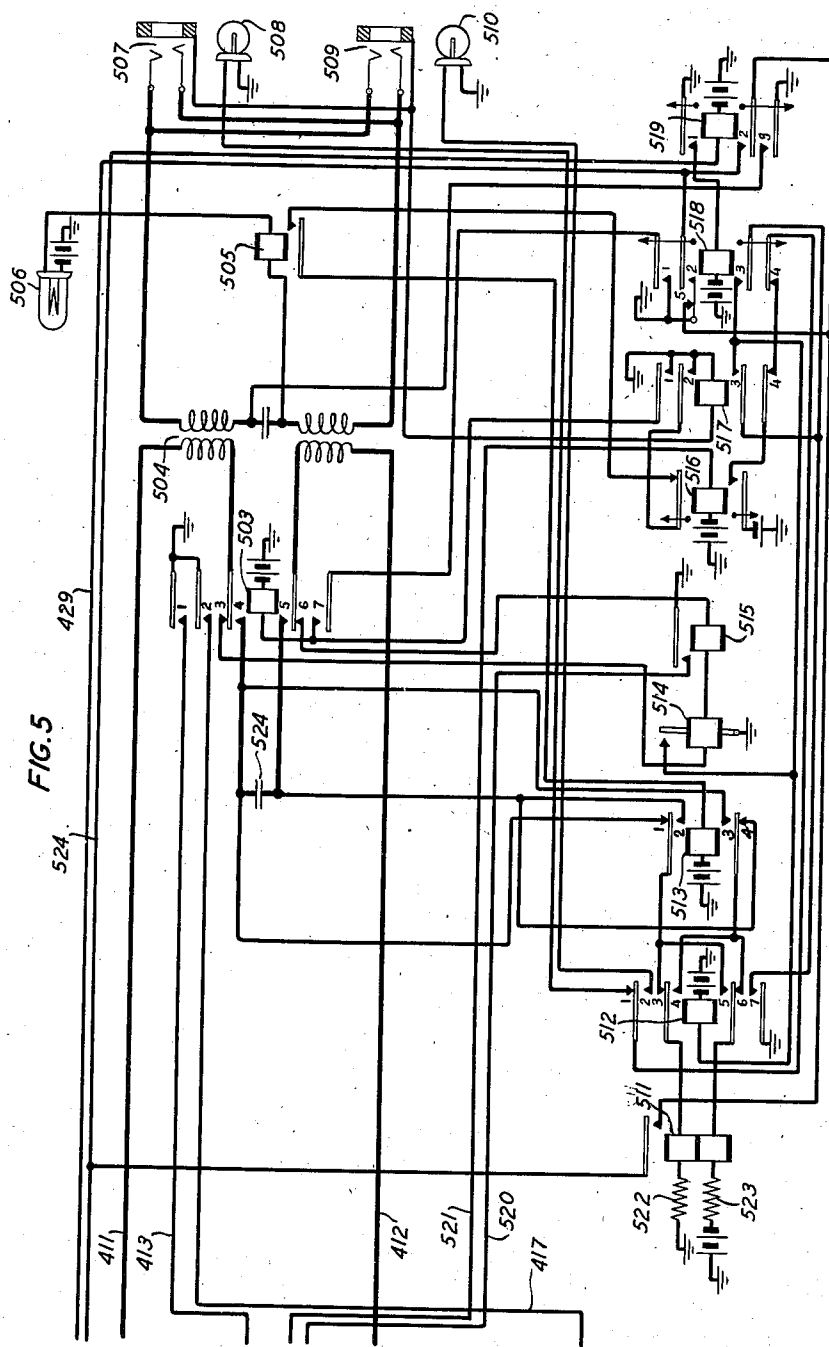
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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,279,822

INTERCEPTING TRUNK

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Application October 26, 1940, Serial No. 362,382

11 Claims. (Cl. 173—27)

This invention relates to telephone systems and has for its object to improve the functioning of the equipment used in intercepting calls which cannot be completed in the normal manner.

In the cross-bar system, when a number is not assigned for use, or for any other reason calls involving that number may not be completed, the corresponding terminals on the number group frame pass this information to the terminating marker which thereupon extends the connection to an intercepting trunk. Such trunks appear in jacks before an operator who can explain the reason for the non-completion of the call. In some cases, the intercepting positions are grouped at a centralized office and the trunk is equipped with means for tripping the ringing applied by the incoming junctor and lighting a lamp at the operator's position.

In previous intercepting trunks it has been possible for the operator to connect with the trunk before the ringing has been tripped and the talking circuit established so that the ringing current may enter the operator's telephone to her great discomfort. On the other hand, if she plugs in during a silent interval, her opening phrase may not be heard by the subscriber, requiring repetition and consequent delay.

In accordance with the present invention, special means is provided to ensure proper tripping of the ringing by connecting the tripping means to the trunk circuit only at the beginning of a complete ringing period at which time the operator is also signaled. To this end means is provided, responsive during the silent interval that intervenes between successive periods of ringing current, which must function in order that the subsequent application of the ringing current may establish the tripping circuit.

The intercepting trunk of the present invention may be selected either as a regular intercept trunk, when an unused number is dialed, or as a trouble intercept trunk, when the called line is out of service because of trouble. The trunk appears in two jacks at the operator's position and the lamps associated with the jacks are lighted selectively according to the manner in which the trunk was selected.

This trunk, together with the senders and other control equipment serves a plurality of offices and appears at the operator's position in a plurality of jacks over which the establishment of a connection with the desired line may be effected. These jacks are individual to the offices and the insertion of a plug in one of the jacks

transmits a signal to the sender to identify the office in which the wanted line is located.

The invention will be more clearly understood from a consideration of the following description in connection with the drawings in which:

Fig. 1 shows an incoming trunk circuit;

Fig. 2 shows the outgoing end of the intercepting trunk;

Fig. 3 shows a completing trunk associated with Fig. 2;

Figs. 4 and 5 show the incoming end of the intercepting trunk; and

Fig. 6 shows the arrangement of Figs. 1 to 5.

In general when a subscriber dials a number which does not represent an available called line, a relay is operated in the marker which controls the selection of a trunk leading to an intercepting operator's position. The incoming trunk to which the call was extended is then connected with the intercepting trunk over incoming and line switches as used in connecting with a called line. The manner in which the marker functions is disclosed in U. S. Patent No. 2,089,921, granted August 10, 1939, to W. W. Carpenter.

The intercepting trunk of Figs. 2 to 5 consists of three parts, viz., the outgoing trunk of Fig. 2 which is located in the same office as the incoming trunk of Fig. 1, the centralized incoming trunk of Figs. 4 and 5, located at the centralized office, and the completing trunk of Fig. 3, which is associated with and located at the same office as the outgoing trunk.

Assuming that the subscriber at substation 100 in attempting to make a call dials a number which has not been assigned, the number will be recorded at the originating office and the connection extended to an incoming trunk at the called office. Relay 103 will be operated in a circuit extending from battery through the left winding thereof, contact 1 of relay 102, tip contacts of jack 101, over a loop circuit closed in the sender at the originating office over the ring contacts of jack 101, contact 4 of relay 102, right winding of relay 106 to ground.

Relay 106, in operating, grounds conductor 122 over contact 7 of relay 103. This causes the terminating sender link to seize the trunk of Fig. 1 and to connect it with an idle terminating sender. When this connection has been completed, a pulsing circuit is established, connecting the sender of the originating office with the terminating sender over conductors 111 and 112. At the same time conductor 113 is grounded, operating relay 102 to remove the battery and ground supplied to the trunk through relay

106 and contacts of relay 103 for the purpose of improving the pulsating condition.

The sender registers the number transmitted from the calling office and, after transmitting a reverse battery release signal to the originating sender, releases relay 102 by connecting a low resistance battery to conductor 113. With relay 102 released, relay 106 reoperates following trunk closure in the originating office. At the same time that relay 102 is released, ground is connected to conductor 114, operating relay 103 which locks over its contact 6 under the control of relay 106. With relay 103 operated, ground is connected over its contact 8 through resistance 115, contact 10 of relay 105 to conductor 116 to mark the trunk busy.

This locking ground for relay 103 extends back over conductor 114 to the sender as a signal that the trunk has been closed, whereupon the sender summons a marker and transmits the number thereto. The marker then closes a circuit through the sender and link to conductor 117 operating relay 105. With relay 105 operated, the trunk and the incoming switches are connected to the marker through the incoming link control circuit.

Assuming that the number registered in the sender and transmitted to the marker is one which is not in use, the marker will operate switches 120, 121, 200 and 201 to connect the trunk of Fig. 1 with the intercepting trunk of Figs. 2 to 5. It will also ground conductors 118 and 119 operating relay 110 over contact 6 of relay 105 to indicate that no charge is to be made and relay 104 over contact 4 of relay 105 to prepare for ringing. Relay 110, when operated, locks over its third contact to ground over contact 4 of relay 103, while relay 104 locks over its third contact, back contact of relay 109 to ground at contact 4 of relay 103.

In handling intercepted traffic, the terminating marker is arranged to seize a trunk in any one of four different trunk groups depending on the type and condition of the line intercepted. Two groups of trunks are provided for local calls and two for toll calls, one of these groups handling calls intercepted because the number is vacant or for some similar reason and the other handling calls intercepted because the line is in trouble. When it is desired, the same trunks may be used for regular and trouble intercept, the operator receiving an indication, as will be pointed out hereinafter, of the nature of the call. Under the previously assumed condition, namely that an unused number was dialed, the marker tests the intercepting trunk over conductor 224. This conductor will be grounded over contact 4 of relay 219 if in use or made busy artificially, and over contact 3 of relay 219 and contact 10 of relay 207 if the trunk has been seized for use in connection with a trouble intercept call.

If this trunk is idle and is selected for use, the marker grounds conductor 224, completing a circuit over contact 3 of relay 219, contact 11 of relay 207 to the winding of relay 218 and battery. At its contact 6 relay 218 opens the circuit for relay 207 and at contact 5 connects ground over contact 1 of relay 219 to conductor 226 to mark the trunk busy as a trouble intercept trunk.

When the marker has completed its function, relay 105 is released reclosing ground to conductor 116 which extends over the sleeve conductors of switches 120, 121, 200 and 201 to conductor 225 providing a locking circuit for relay 218. The completion of this circuit is a signal to the mark-

er which now releases. With relay 105 released, a ringing circuit is established from the machine ringing source over conductor 125, contact 6 of relay 104, winding of relay 109, contacts 6 and 1, of relay 108, contact 9 of relay 104, contact 12 of relay 105, ring conductors of switches 120, 121, 200 and 201, contact 9 of relay 202, contact 8 of relay 203, condenser 211, winding of relay 212, contact 1 of relay 203, contact 1 of relay 202, tip contacts of switches 201, 200, 121 and 120, contact 1 of relay 105, contact 2 of relay 104, contact 8 of relay 108 to ground. A circuit exists in parallel with relay 212 which extends from contact 8 of relay 203, resistance 223, contact 1 of relay 208, back contact of relay 212, through the windings of relay 213 in parallel to contact 1 of relay 203. Ringing current is applied to these circuits at regular intervals by the ringing machine and a ringing tone is transmitted to the calling subscriber through condensers 129 and 130.

Relay 212 operates in response to the first application of sufficient duration and opens the circuit of relay 213 to prevent the operation of the latter relay. Relay 213 is prevented from operating in response to ringing current before relay 212 operates by its differential winding, the windings being oppositely energized by the ringing current.

After an interval, the ringing interrupter removes ringing current from conductor 125, substituting battery therefor. When this occurs, relay 212 falls back, reclosing the circuit of relay 213. The right winding of relay 213 is now effective, condenser 214 rendering the left winding opaque to direct current. Relay 213 closes a circuit from battery through the winding of relay 215, front contact of relay 213, conductor 227, contact 6 of relay 203, contact 5 of relay 202, conductor 231 to ground at contact 2 of relay 218. Relay 215 locks over its right contact to conductor 227 independent of relay 213.

At the end of the silent period relay 213 releases and immediately after, at the beginning of the ringing period, relay 212 reoperates. With relay 215 operated, a circuit is now closed from battery through the winding of relay 208, left contact of relay 215, front contact of relay 212, back contact of relay 213 to ground over conductor 227. Relay 208 locks over contact 2 of relay 208 to conductor 227. With relay 208 operated, the gas-filled tube 210 is connected across the trunk, the circuit extending from contact 1 of relay 202 to one cathode of the tube and from the other cathode of the tube over contact 8 of relay 208, contact 8 of relay 203 and contact 9 of relay 202.

This arrangement insures the application of the tripping tube 210 to the trunk at the start of a ringing period. If the trunk is closed through during the silent period, relay 213 may operate immediately, but unless it is held operated long enough for relay 215 to operate and lock, this operation is ineffective, relay 213 releases and is reoperated at the next silent period. With tube 210 connected to the trunk at the beginning of a ringing period, the operation of relay 109 in the incoming trunk and the establishment of the talking circuit is assured before the operator connects her telephone with the jack at the centralized office as will be described hereinafter.

With tube 210 across the trunk, ringing current breaks down the tube which then presents sufficiently low resistance to operate relay 109. Relay 109 opens the locking circuit of relay 104

which cuts off the ringing current and extends the tip conductor of the trunk over contact 1 of relay 105, contact 1 of relay 104, to ground through the left winding of relay 107 and extends the ring conductor of the trunk over contact 12 of relay 105, contact 10 of relay 104 to battery through the right winding of relay 107.

The operation of relay 208 also transmits a signal to the intercepting operator by closing a circuit from battery through the right winding of relay 216, contact 4 of relay 208, contact 4 of relay 207, upper right winding of repeating coil 204, contact 1 of relay 209, conductor 229 of the interoffice trunk, contact 1 of relay 400, conductor 411, upper left winding of repeating coil 504, contact 3 of relay 503, windings of relays 514 and 515, contact 6 of relay 503, lower left winding of repeating coil 504, conductor 412, contact 7 of relay 400, conductor 230, contact 6 of relay 209, lower right winding of repeating coil 204, contact 7 of relay 207, contact 5 of relay 208, left winding of relay 216 to ground.

Relay 515 operates in this circuit, but the current flow is in the wrong direction to operate polarized relay 514 and of insufficient strength to operate marginal relay 216. Relay 515 closes a circuit from ground over its contact, conductor 520, back contact of relay 405, conductor 521, winding of relay 516 and battery. Relay 516 closes a circuit from battery over its front contact, contact 4 of relays 517 and 518, contact 1 of relay 512 through lamp 508 to ground.

The trunk terminates in two jacks 507 and 509, with which are associated lamps 508 and 510. When the trunk is used for a regular intercepting call, lamp 508 is lighted as above described and the operator responds by inserting the plug of a cord circuit at her position into jack 507. Jack 509, and lamp 510 are used when the trunk is used for a trouble intercept call, as will appear hereinafter.

Battery on the sleeve of the cord completes a circuit over the sleeve of jack 507, winding of relay 517 and ground. Relay 517 opens the circuit of lamp 508 extinguishing the lamp. At contact 1, it connects ground to the winding of relay 503. Relay 503 operates, disconnecting relays 514 and 515 from the circuit of relay 216 and connects the upper left winding of coil 504 over contact 4 of relay 503, contact 1 of relay 513, contact 3 of relay 512 through the upper winding of relay 511, and resistance 522 to ground. Relay 503 also connects the lower left winding of repeating coil 504 over contact 5 of relay 503, contact 4 of relay 513, contact 6 of relay 512, through the lower winding of relay 511 and resistance 523 to battery. Condenser 524 is also connected between the left windings of coil 504 over contacts 4 and 5 of relay 503. In addition, relay 503 closes a circuit from battery through the winding of relay 405, conductor 413, contact 1 of relay 503 to ground. The disconnection of relay 515 causes that relay to release, in turn, releasing relay 516.

With relay 503 operated, ground through the upper winding of relay 511 is connected to battery through the right winding of relay 216 over the circuit previously traced and battery through the lower winding of relay 511 is connected to ground through the left winding of relay 216. Relay 216 operates in these circuits but relay 511 does not.

The operation of relay 216 closes a circuit from battery through the winding of relay 203, contact of relay 216, to ground over conductor 231.

Relay 203 locks over its contact 5 and contact 5 of relay 202 to ground over conductor 231. At contact 6, relay 203 disconnects ground from conductor 227, thereby releasing relays 208 and 215.

With relay 208 released the tip conductor 229 of the interoffice trunk is extended over contact 1 of relay 209, upper right winding of repeating coil 204, contact 4 of relay 207, contact 3 of relay 208, upper winding of polarized relay 228, left winding of relay 217, contact 4 of relay 203, contact 6 of relay 208, contact 7 of relay 207, lower right winding of coil 204, contact 6 of relay 209, to the ring conductor 230 of the interoffice trunk. This circuit extends at the other end of the trunk through the windings of relay 511 as previously traced. Relay 217 operates in this circuit but the direction of current is not such as to operate polarized relay 228. Relay 217 closes an obvious circuit for relay 221 which in turn operates relay 222. Relay 222 operates relay 219 which locks under the control of relay 218.

Relay 511 also operates in the circuit of relay 217 and closes a circuit from battery through the winding of relay 519, conductor 524, contacts of relay 511, contact 5 of relay 518, to ground. Relay 519 closes an obvious circuit for relay 518. With relay 518 operated, a locking circuit is closed for relay 519 under the control of relay 511 extending from the contact of relay 511 over contact 2 of relay 519 to ground over contact 2 of relay 518. Contacts 5 and 2 of relay 518 overlap in operation so that relay 519 is held operated. Relay 519 connects ground to the tip of jack 507 to indicate to the operator that the talking circuit is ready.

This talking circuit which now exists between the calling subscriber and the intercepting operator is made up of a plurality of sections. One section, not shown, includes the calling line and a part of the equipment at the originating office from which the subscriber receives talking battery. The first section shown in detail extends from battery through the left winding of relay 106, contact 1 of relay 102, tip contacts of jack 101, over a dry bridge in the originating office, ring contacts of jack 101, contact 4 of relay 102 to ground through the right winding of relay 106. This section is linked to the next section by means of condensers 123 and 124 to which it is connected over contacts 2 and 10 of relay 103. The next section may be traced from battery through the right winding of relay 107, contact 10 of relay 104, contact 12 of relay 105, ring contacts of switches 120, 121, 200 and 201, contact 9 of relay 202, contact 7 of relay 203, lower left winding of repeating coil 204, resistances 206 and 205, upper left winding of repeating coil 204, contact 2 of relay 203, contact 1 of relay 202, tip contacts of switches 201, 202, 121 and 120, contact 1 of relays 105 and 104 to ground through the left winding of relay 107.

The third section is linked to the second section through repeating coil 204 and may be traced from battery, through resistance 523, lower winding of relay 511, contact 6 of relay 512, contact 4 of relay 513, contact 5 of relay 503, lower left winding of repeating coil 504, conductor 412, contact 7 of relay 400, conductor 230, contact 6 of relay 209, lower right winding of repeating coil 204, contact 7 of relay 207, contact 6 of relay 208, contact 4 of relay 203, left winding of relay 217, upper winding of relay 228, contact 3 of relay 208, contact 4 of relay

207, upper right winding of repeating coil 204, contact 1 of relay 209, conductor 229, contact 1 of relay 400, conductor 411, upper left winding of repeating coil 504, contact 4 of relay 503, contact 1 of relay 513, contact 3 of relay 512, upper winding of relay 511, resistance 522 to ground. The final section of the talking circuit which links with that just traced through coil 504 extends from battery through resistance lamp 506, winding of relay 505, lower right winding of repeating coil 504, ring of jack 507, over a bridge in the operator's cord to the tip of jack 507, upper right winding of coil 504, to ground at contact 3 of relay 519. Relays 106, 107, 217 and 511 are operated in this talking circuit.

The intercepting operator now converses with the calling subscriber. If the call cannot be completed she so informs the subscriber and withdraws her cord from jack 507, releasing relay 517 and opening the operating circuit of relay 503.

The subscriber hangs up his receiver, releasing the equipment at the originating office, thereby opening the circuit of relay 106 in turn releasing relay 103. With relay 107 held operated over the trunk, ground is connected over the right contact of relay 107 to conductor 126 and through the timing circuit to conductor 127 which extends through resistance 115 and contact 10 of relay 105 to conductor 116 and the sleeve contacts of the switches, holding the connection. When relay 103 releases it connects ground from the left contact of relay 107 over contact 13 of relay 103 to conductor 128 leading to the timing circuit. After an interval the timing circuit responds to ground on conductor 128 by disconnecting conductors 126 and 127, thereby releasing switches 120, 121, 200 and 201.

The opening of the switch contacts releases relay 218, in turn releasing relay 203. The opening of contact 4 of relay 203 includes the right winding of relay 217 and the lower winding of relay 228 in the circuit of relay 511 causing that relay to release, in turn releasing relays 519, 518 and 503. The release of relay 503 disconnects battery and ground from conductors 411 and 412, thereby releasing relay 217 which in turn releases relays 221 and 222 and the trunk is restored to normal.

Call completed

If, after talking with the calling subscriber, it is possible and desirable for the operator to complete the connection, she does so by inserting the plug of a cord at her position into one of the jacks of Fig. 4.

The arrangement of Fig. 4 is for use where the intercepting trunks and the control equipment serve a plurality of offices. Jack 415 is used in completing calls in one office and jack 416 in completing calls in a second office. The insertion of a plug in jack 415 completes a circuit from battery on the sleeve of the cord, sleeve of jack 415, contact 1 of relay 409, winding of relay 410, conductor 417 to ground at contact 2 of relay 503. Relay 410 locks to ground at its inner upper contact and to battery over its lower front contact and the sleeve of jack 415. For calls to the second office, the insertion of the plug in jack 416 closes a circuit from battery on the sleeve of the cord, sleeve of jack 416, winding of relay 414 to ground over conductor 417. With relay 414 operated, battery through resistance 418 is connected over the lower contact of relay 414 and contact 1 of relay 409 to the winding of

relay 410 so that both relays 410 and 414 are operated for calls to the latter office. With relay 414 normal, ground through 1000-ohm resistance 419 is connected over contact 3 of relay 407 to conductor 420 to indicate that the call is to be completed in the first office. With relay 414 operated, direct ground is connected in shunt of resistance 419 as an indication that the connection is to be completed in the second office.

Assuming that the plug has been inserted in jack 415, when the plug is seated a circuit is closed from battery through the winding of relay 408, contact 1 of relay 407, contact 3 of relay 409, contact 2 of relay 404, tip of jack 415, over a loop in the cord circuit back to the ring of jack 415, contact 5 of relay 404, contact 8 of relay 409, contact 9 of relay 407, resistance 421 and ground. Relay 408 operates in this circuit, closing a circuit from ground at the upper contact of relay 410, contact of relay 408, contact 5 of relay 400, contact 9 of relay 409, conductor 422 to battery. The grounding of conductor 422 causes a key pulsing sender to be connected with the trunk. When the sender is attached and ready, ground is connected to conductor 423, operating relay 409. Relay 409 disconnects ground from start lead 422, and opens the circuit of relay 408 causing that relay to release. With relay 409 operated, the tip and ring of jack 415 are connected over contacts 2 and 5 of relay 404 and contacts 4 and 7 of relay 409 to conductors 424 and 425 leading to the sender.

When conductors 424 and 425 are closed through from the sender to the position key-set associated with the plug in jack 415, the operator is given a signal and she proceeds to set up the proper number on her key-set, thereby recording the number in the sender.

When the number has been set up in the sender, ground is connected to conductor 426, operating relay 407 which locks over its contact 5 to ground over contact 5 of relay 409. With relay 407 operated the office identifying ground is removed from conductor 420. A circuit is closed from battery through the winding of relay 402, contact 7 of relay 407, contacts 6 and 5 of relay 409 to ground, operating relay 402 which closes an obvious circuit for relay 400. Relay 400 in operating disconnects conductors 229 and 230 from conductors 410 and 412, disconnecting the talking circuit from the jack 507.

With relays 400 and 407 operated the tip conductor 229 is extended over contact 2 of relay 400, through resistance 427, contact 10 of relay 407 to conductor 428 leading to the sender, while the ring conductor 230 is extended over contact 6 of relay 400, contact 4 of relay 407 to conductor 420. Conductors 420 and 428 extend to pulsing equipment in the key-pulsing sender.

The opening of the talking circuit at contacts 1 and 7 of relay 400 releases relay 511 which opens the circuit of relay 519, but a substitute holding circuit is closed by relay 400 which may be traced from battery through the winding of relay 519, conductor 524, contact 3 of relay 400, conductor 429, to ground over contact 2 of relay 518, thereby maintaining the lamp 508 dark.

The operation of relay 400 also opens the circuit of relay 217 causing that relay to release, in turn releasing relays 221 and 222. These relays each release slowly so that a circuit is closed after relay 221 releases and before relay 222 releases from ground at the back contact of relay 217, back contact of relay 221, left contact of relay 222 to the winding of relay 209 and battery.

Relay 209 connects conductor 229 over contact 2 of relay 209, contact 3 of relay 202, conductor 232, contact 6 of relay 305 to ground through the right winding of relay 306 and in shunt of the winding of relay 306 to ground at contact 7 of relay 308. Conductor 230 is connected over contact 5 of relay 209, contact 7 of relay 202, conductor 233, contact 3 of relay 305 to battery through the left winding of relay 306 and in parallel with the winding of relay 306 over contact 1 of relay 308 and through resistance 313.

Relay 306 operates through its left winding and closes an obvious circuit for relay 307. At its inner left contact relay 307 connects ground over contact 3 of relay 308 and contact 1 of relay 305 to conductor 314, thereby causing the terminating sender link circuit to connect a terminating sender with this trunk. At its outer left contact, relay 307 connects ground over conductor 315 to the winding of relay 222 preventing its release and thereby holding relay 219 operated to hold the trunk.

When the sender is ready for use, battery and ground are connected to conductors 233 and 232 by the sender in parallel with that supplied by relay 306. Ground is also connected to conductor 316, operating relay 305. Relay 305 opens the link start circuit at contact 1, connects ground over contact 2 to conductor 315 to hold the trunk circuit and disconnects relay 306 from conductors 232 and 233, thereby releasing relays 306 and 307.

The terminating sender proceeds to register the number transmitted to it by the key pulsing sender and when all the digits have been recorded transmits a signal to the key pulsing sender, discharges the trunk conductors and then connects low resistance battery to conductor 316 in place of ground, thereby releasing relay 305.

With relay 305 released, relay 306 is again connected to conductors 232 and 233 so that relay 306 reoperates, in turn operating relay 307.

At the same time that relay 305 is released, ground is connected to conductor 317, operating relay 308 which locks under the control of relay 307. This locking circuit is a signal to the sender which now seizes a marker after which the marker extends ground to conductor 318, operating relay 304. Relay 304 operates and connects the outgoing tip, ring and sleeve conductors 319, 320 and 321 to the marker for test and connects the ringing control conductors to relays 300, 302 and 303 to determine the ringing to be used, these relays functioning in a manner similar to relays 104, 110 and 108 of the incoming junctor. Assuming that relay 300 is operated alone to ring an individual line, it locks over the back contact of relay 309 to ground at contact 8 of relay 308.

When the marker has selected the wanted line and operated the switches connecting the trunk of Fig. 3 to that line, relay 304 is released and a ringing circuit is closed from ringing ground on conductor 322, contact 2 of relay 300, contact 1 of relay 303, contact 2 of relay 304, conductor 319, over the switches and the called line back to conductor 320, contact 12 of relay 304, contact 8 of relay 303, contact 11 of relay 300, contact 3 of relay 302 in parallel with contact 4 of relay 303, conductor 323, contact 3 of relay 218, conductor 324, winding of relay 309, contact 9 of relay 300 to the ringing machine over conductor 325.

With relay 304 released, the outgoing switches are held by ground connected to conductor 321 over contact 8 of relay 304, resistance 326, conductor 237 and contact 5 of relay 308. In addition,

with relay 304 released and relay 300 operated a circuit is closed from battery through the winding of relay 301, contact 5 of relay 300, contact 13 of relay 304 to ground at contact 8 of relay 308. Relay 301 locks over its inner upper contact to ground over contact 8 of relay 308, independent of relay 300.

When the key pulsing sender receives a signal from the terminating sender that the designation has been received, the former sender extends ground to conductor 430 operating relay 404 which locks over contact 6 to ground at the outer upper contact of relay 410. Relay 404 disconnects the tip and ring of jack 415 from the key pulsing sender and connects them through the windings of relay 403 and contacts 6 and 2 of relay 400 to conductors 230 and 229. With relay 209 operated, conductor 230 extends over contact 5 of relay 209, contact 7 of relay 202, conductor 233, contact 3 of relay 305 to battery through the left winding of relay 306, while conductor 229 extends over contact 2 of relay 209, contact 3 of relay 202, conductor 232, contact 6 of relay 305, to ground through the right winding of relay 306. Relay 403 operates in this circuit and closes a holding circuit for relay 402. After an interval, the key pulsing sender releases in turn releasing relay 409 which unlocks relay 407 and permits that relay to release. Relay 403 is held operated to transmit to the operator supervisory signals from the outgoing connection.

When the called subscriber answers, relay 309 operates, opening the locking circuit of relay 300 and permitting that relay to release. A circuit is now closed from battery through the winding of relay 202, conductor 234, outer upper contact of relay 301, contact 3 of relay 300, to grounded conductor 231. Relay 202 locks over contact 4 to grounded conductor 231. With relay 202 operated, the tip contact of switch 201 is connected over contact 2 of relay 202, conductor 235, contact 1 of relays 300 and 303, contact 2 of relay 304 to conductor 319, and the ring contact of switch 201 is connected over contact 8 of relay 202, conductor 236, contact 12 of relay 300, contact 8 of relay 303 and contact 12 of relay 304 to conductor 320. A talking circuit is thereby established connecting the calling and called subscriber over two sets of incoming and line switches at the terminating office.

The operation of relay 202 disconnects relay 306 from the key-pulsing sender, releasing relay 306 and in turn relays 307 and 308. With relay 308 released ground is disconnected from conductor 321 at contact 5 of relay 308, but the outgoing switches are held operated by ground over contact 6 of relay 202, conductor 237, resistance 326, contact 8 of relay 304 and conductor 321. Relay 308 in releasing opens the locking circuit for relay 301 causing that relay to release. Throughout conversation no relays are operated in the completing portion of the outgoing trunk which is shown in Fig. 3. Relay 107 is held operated under the control of the called subscriber.

The operation of relay 202 as above described, opens the circuit of relay 403 and that relay releases, in turn releasing relays 402 and 409. The release of relay 409 gives a release signal at jack 415.

The release of relay 307 also releases relay 220, in turn releasing relays 221, 222 and 209. With relays 209 and 409 released, relay 511 is reconnected to relays 228 and 217. However, the

operation of relay 202 opened the locking circuit of relay 203 so that both windings of relays 217 and 228 are included in the circuit of relay 511 and that relay cannot operate. Relay 400 in releasing also opens the holding circuit for relay 519, which in turn releases. With relay 519 released, ground is disconnected from the tip of the jack 507 and the associated cord, thereby lighting the lamp associated with that cord as a signal that the called subscriber has answered. Relay 519 also releases relay 518.

The operator may now withdraw the plug from jack 415, releasing relay 410. Relay 410 in turn releases relay 404. When the operator withdraws the plug from jack 508, relay 517 is released in turn releasing relay 503. The release of relay 503 disconnects relay 511 from relays 217 and 228. Relay 503 also releases relay 405 which is made slow to release to prevent the operation of relay 516 should relay 515 operate momentarily following the release of relay 503. With relay 405 released the trunk at the centralized office is restored to normal.

Trouble intercept

If the number called had been taken out of service because of trouble, the marker would have seized the intercepting trunk by grounding conductor 226, thereby closing a circuit over contact 1 of relay 219, contact 6 of relay 218, winding of relay 207 and battery. Relay 207 locks to conductor 225 when the connection is established through switches 120, 121, 200 and 201. In general, it functions in the same manner as relay 218 but it reverses the connection of battery and ground through the windings of relay 216 to conductors 229 and 230. At the centralized office, this reversal causes polarized relay 514 to operate as well as relay 515. Relay 514 in operating closes an obvious circuit for relay 512 which locks over contact 3 of relay 517 and contact 3 of relay 518 in parallel to ground at contact 7 of relay 512. Relay 512 reverses the connection of battery and ground through the windings of relay 511 to conductors 411 and 412 and therefore to conductors 229 and 230 to compensate for the reversal introduced by relay 207, so that polarized relay 228 is normally not operated. Relay 512 also transfers the lamp circuit closed by relay 516 from lamp 508 to lamp 510 to indicate to the operator that the call has been intercepted because of trouble. Since jacks 507 and 509 are connected in parallel, the result of the insertion of the plug in jack 509 associated with lamp 510 is the same as previously described.

This intercepting trunk may also be seized over an incoming trunk from an operator's position and in that case it may be desirable for the intercepting operator to signal the operator at the originating office. In that case, the operation of the flashing key by the intercepting operator connects ground to the ring of jack 507, operating relay 505 in series with resistance lamp 506 and battery. Relay 505 closes a circuit from battery through the winding of relay 513, front contact of relay 505, back contact of relay 516, to ground at contact 2 of relay 517. Relay 513 reverses the connection of battery and ground to conductors 411 and 412 through the windings of relay 511. Polarized relay 228 operates in response to this reversed current and closes a circuit from the lower left winding of repeating coil 204, through resistance 206, over the front contact of relay 228 to the

upper left winding of coil 204 in shunt of resistance 205, thereby decreasing the resistance in the circuit of a relay in the incoming trunk to signal the originating operator.

What is claimed is:

1. In a telephone system, an operator's position, a trunk terminating at said position, a signal associated with said trunk, means for establishing a connection over said trunk to said position, means responsive to the establishment of said connection for transmitting ringing current over said trunk in spaced periods and means responsive to the first complete period of ringing current to simultaneously discontinue the transmission of said ringing current and to operate said signal.

2. In a telephone system, an operator's position, a trunk terminating at said position, a signal associated with said trunk, means for establishing a connection over said trunk to said position, means responsive to the establishment of said connection for transmitting ringing current over said trunk in spaced periods, means comprising a cold cathode tube responsive to the first complete period of ringing current to discontinue the transmission of said ringing current and means simultaneously effective to operate said signal.

3. In a telephone system, a first trunk, a second trunk, means for connecting said trunks together, a ringing machine associated with said first trunk, means in said ringing machine for connecting ringing current and direct current to one conductor of said trunk for alternate periods, a relay in series with said conductor, and means in said second trunk for operating said relay comprising a gas-filled tube and means for connecting said tube to said conductor at the beginning of a ringing period.

4. In a telephone system, a first trunk, a second trunk, means for connecting said trunks together, a ringing machine associated with said first trunk, means in said ringing machine for connecting ringing current and direct current to one conductor of said trunk for alternate periods, a relay in series with said conductor, and means in said second trunk for operating said relay comprising a gas-filled tube, means responsive to said ringing current, means responsive to said direct current and means effective when said ringing current responsive means operates after said direct current responsive means to connect said gas-filled tube to said conductor.

5. In a telephone system, a first trunk, a second trunk, means for connecting said trunks together, a ringing machine associated with said first trunk, means in said ringing machine for connecting ringing current and direct current to one conductor of said trunk for alternate periods, a relay in series with said conductor, and means in said second trunk for operating said relay comprising a gas-filled tube, a relay responsive to said ringing current and a relay responsive to said direct current connected in parallel, and means responsive to the operation of said ringing current relay subsequent to the operation of said direct current relay to connect said gas-filled tube to said conductor.

6. In a telephone system, a first trunk, a second trunk, means for connecting said trunks together, a ringing machine associated with said first trunk, means in said ringing machine for connecting ringing current and direct current to one conductor of said trunk for alternate pe-

riods, a relay in series with said conductor, and means in said second trunk for operating said relay comprising a gas-filled tube, a relay responsive to said ringing current and a relay responsive to said direct current connected in parallel, means responsive to the operation of said ringing current relay subsequent to the operation of said direct current relay to connect said gas-filled tube to said conductor, and means for rendering said direct current relay unresponsive to said ringing current.

7. In a telephone system, a first trunk, a second trunk, a signal associated with said second trunk, means for connecting said trunks together, a ringing machine associated with said first trunk, means in said ringing machine for connecting ringing current and direct current to one conductor of said trunk for alternate periods, a relay in series with said conductor, and means in said second trunk for operating said relay comprising a gas-filled tube, a relay responsive to said ringing current and a relay responsive to said direct current connected in parallel, means responsive to the operation of said ringing current relay subsequent to the operation of said direct current relay to connect said gas-filled tube to said conductor, and means under the control of said responsive means to operate said signal.

8. In a telephone system, an intercepting trunk appearing in a plurality of jacks at an operator's position, lamps associated with said jacks, means for seizing said trunk as a regular intercepting trunk, means for seizing said trunk as a trouble intercepting trunk, and means to light the lamps at different jacks in accordance with said seizing means.

9. In a telephone system, an intercepting

trunk serving a plurality of offices, an operator's position, answering jacks and completing jacks connected with said trunk at said operator's position, means for establishing a connection over said trunk through one of said answering jacks, means effective while said connection with said answering jack is maintained to seize said trunk over one of said completing jacks to establish a connection with a line in one of said offices over a portion of said intercepting trunk circuit and means operated in accordance with the completing jack used for determining the office in which said line is located.

10. In a telephone system, an operator's position, a trunk terminating at said position, a signal associated with said trunk, means for establishing a connection over said trunk to said position, means responsive to the establishment of said connection for transmitting ringing current over said trunk in spaced periods, means effective to discontinue the transmission of said ringing current and to operate said signal, and means to render said last-mentioned means responsive only to a complete ringing period.

11. In a telephone system, an operator's position, a trunk terminating at said position, a signal associated with said trunk, means for establishing a connection over said trunk to said position, means responsive to the establishment of said connection for transmitting ringing current over said trunk in spaced periods, means effective to discontinue the transmission of said ringing current and to operate said signal, and means to render said last-mentioned means unresponsive to an incomplete ringing period.

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