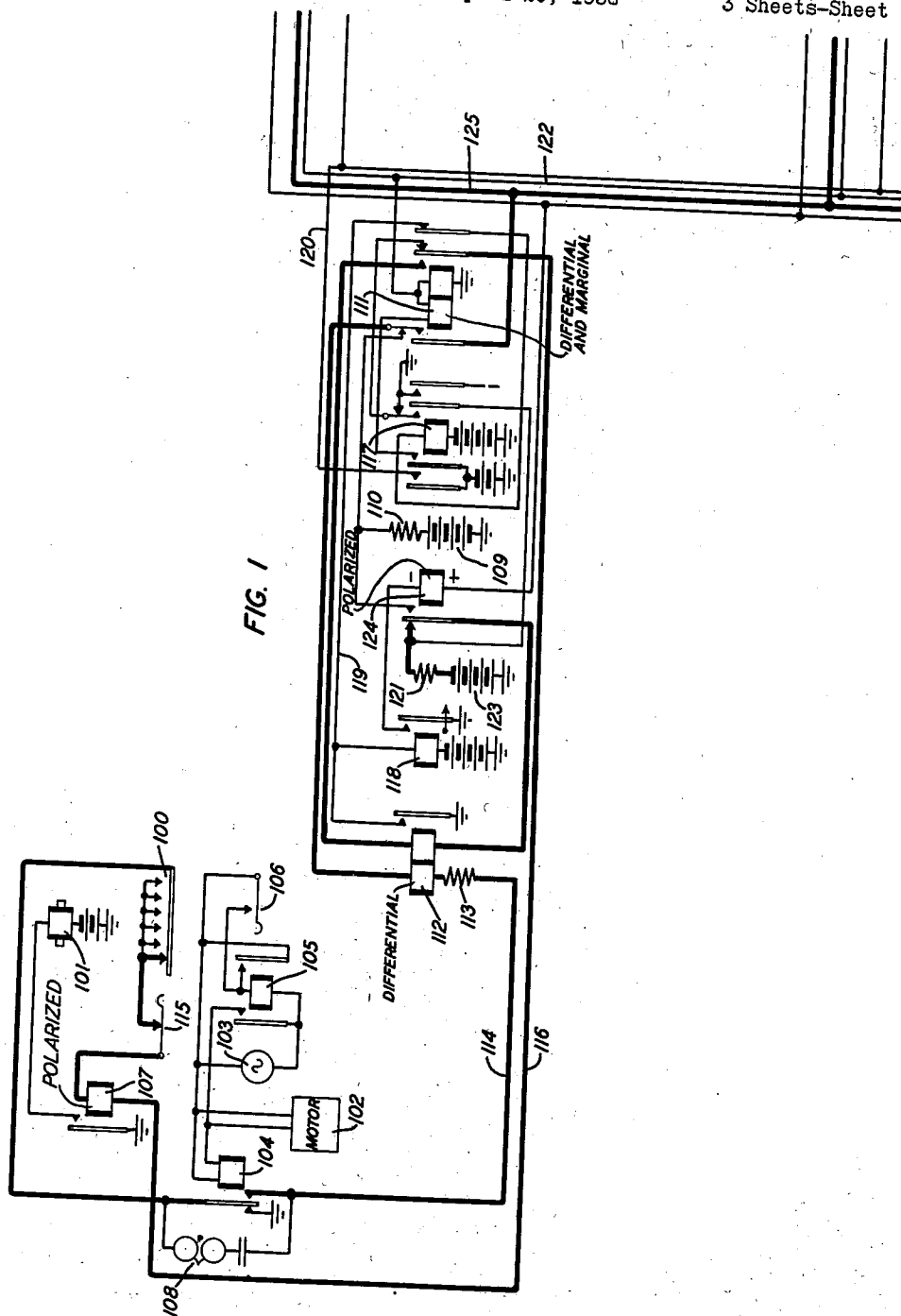


March 9, 1937.

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COMMUNICATION SYSTEM
Filed April 25, 1936

2,073,468

3 Sheets-Sheet 1



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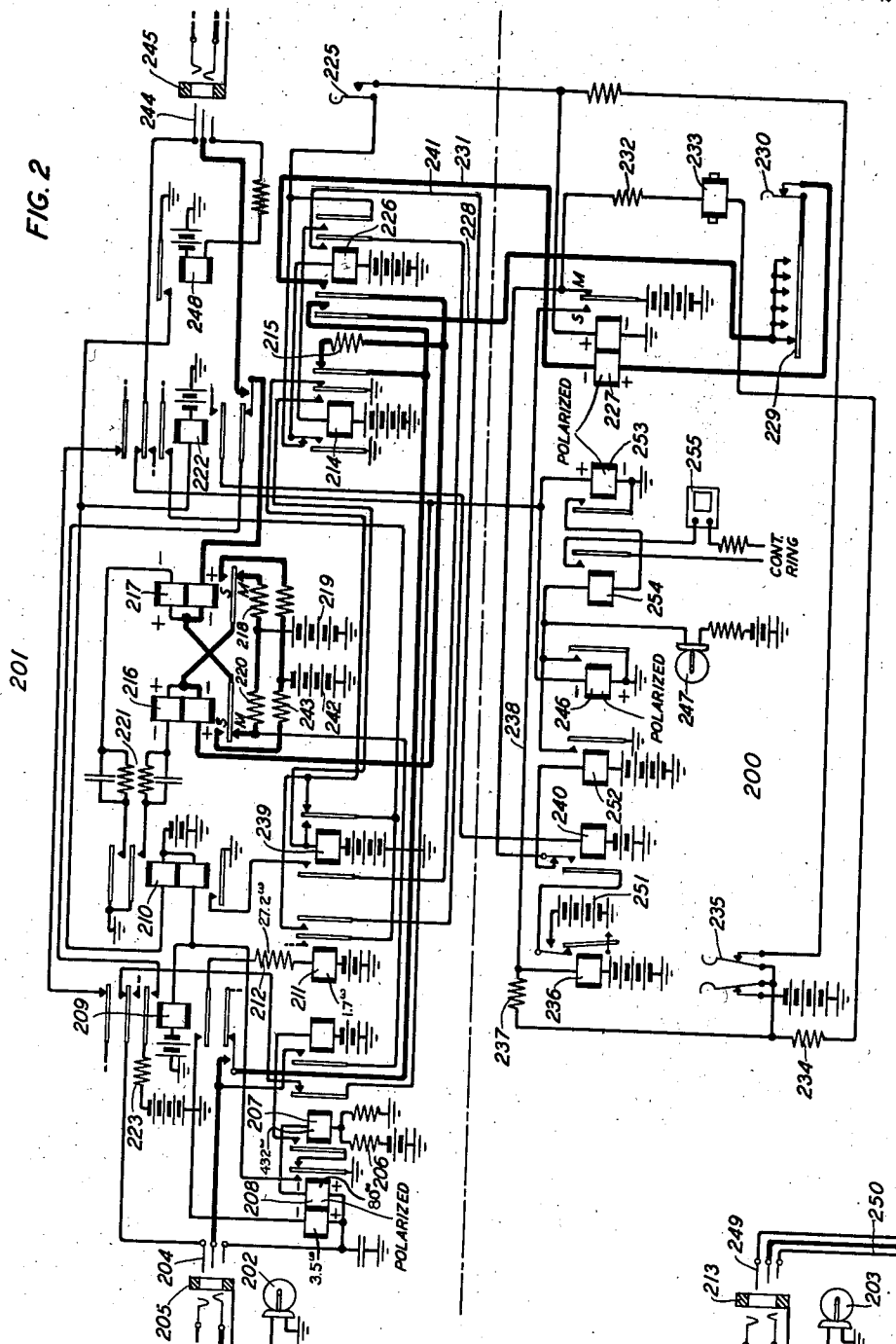
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COMMUNICATION SYSTEM

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3 Sheets-Sheet 2

FIG. 2



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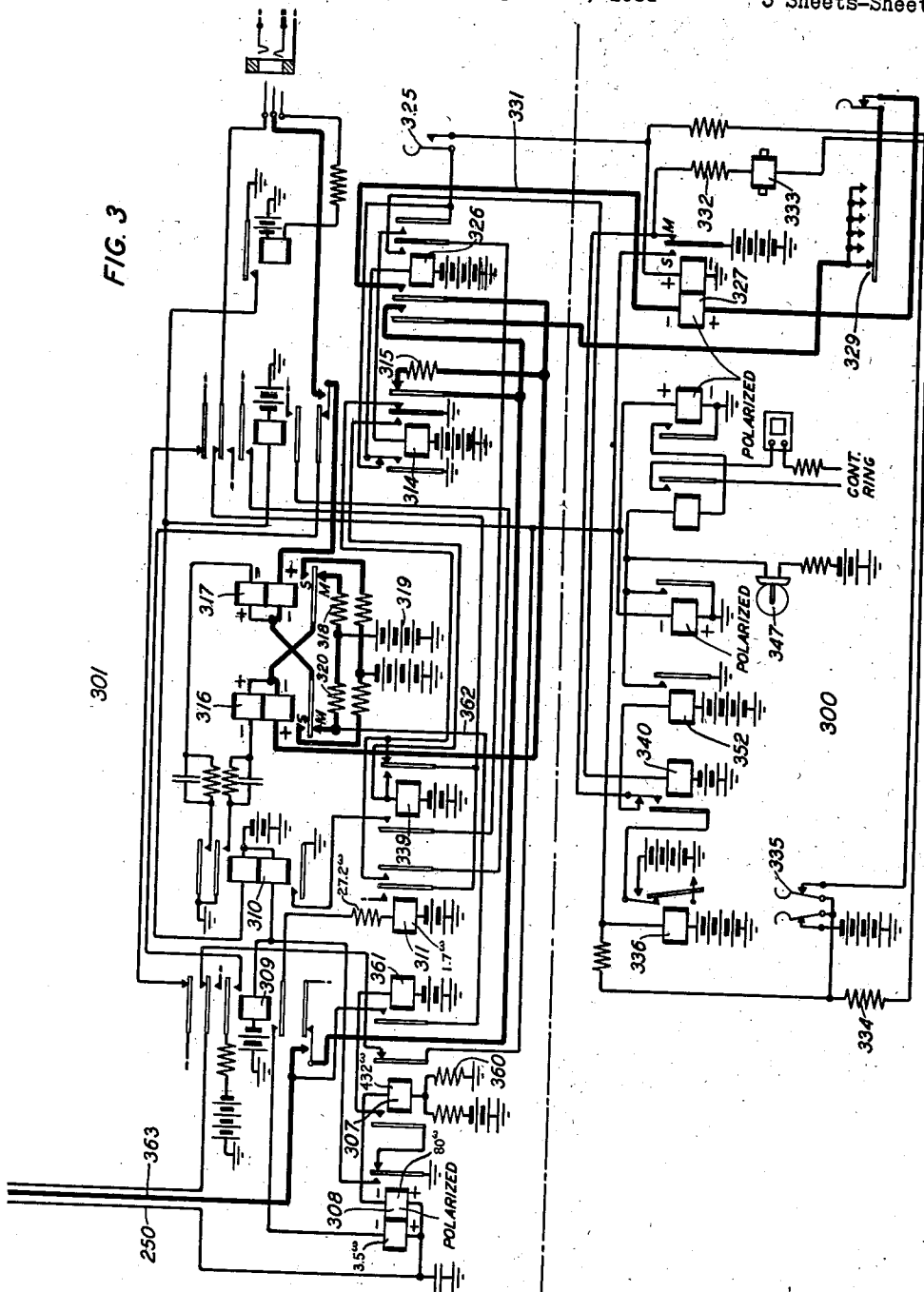
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COMMUNICATION SYSTEM

Filed April 25, 1936

3 Sheets-Sheet 3

FIG. 3



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2,073,468

COMMUNICATION SYSTEM

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Application April 25, 1936, Serial No. 76,335

10 Claims. (Cl. 178—75)

This invention relates to communication systems and particularly to telegraph exchange systems in which operators serve to establish connections between subscriber's lines.

The objects of this invention are to facilitate the work of the operators in answering and completing calls; to safeguard against the transmission of false communications; and otherwise to secure improvements in systems of this character.

A feature of the invention is a system in which the subscribers' lines appear in multiple answering jacks at a plurality of operators' positions and which is so arranged that the first cord inserted by an answering operator in the jack of a calling line causes the completion of a transmission circuit between the line and the operator's position transmitter and typewriter, whereas, if a second cord is subsequently inserted by a second operator in another jack of the same line, the transmission circuit between the line and the second operator's position is held ineffective, and the act of inserting the second cord automatically disables the transmission circuit to the first position to prevent any further communication with the subscriber, and a signal lamp is lighted at the position of the second operator to advise her that another operator has previously answered and that she should withdraw.

Another feature of the invention is a circuit arrangement such that the prolonged release of the signal receiving relays at both the first and second operators' positions, caused by the disabled transmission circuits resulting from the insertion of the second cord, does not cause the typewriters at these positions to run in an idling or open movement. And the operation of the keyboard of the teletypewriter in this condition will not cause printing to take place. To prevent such idle operation of the typewriters, the circuits are arranged to maintain the receiving magnets in an energized condition the same as when the positions are normal. The virtually locked condition of the first operator's typewriter informs her that another operator has subsequently answered the same line and that she should postpone her communication with the subscriber until the second operator withdraws.

When the second operator to answer a line observes her busy signal lamp and finds her typewriter locked against operation, she recognizes that another operator has preceded her, and she removes her cord circuit from the line. This restores the transmission circuit between the line

and the first operator's position and unlocks the first operator's typewriter so that she may proceed to communicate with the subscriber.

These and other features of the invention will be described more fully in detail in the following specification and will also be set forth in the appended claims.

The specification should be considered in connection with the accompanying drawings, in which:

Fig. 1 discloses a telegraph subscriber's line, illustrating the equipment at the subscriber's station and also the line circuit at the central office;

Fig. 2 illustrates an operator's position at the central office, showing in the upper portion thereof one of the operator's cord circuits and in the lower portion thereof the common position equipment; and

Fig. 3 shows a second operator's position in the central office, illustrating one of the cord circuits and the common position equipment.

Each of the telegraph subscriber's stations, such as the one disclosed in Fig. 1, is equipped with a keyboard transmitter for transmitting requests to the central office operators and for sending messages to other subscribers. Also the substation is provided with a teletypewriter for printing communications received over the line from central office operators and from other telegraph subscribers. Since these devices are well known in the art, they are not disclosed in detail herein, it being sufficient to illustrate them in diagrammatic manner. The subscriber's substation is further equipped with a driving motor, a source of power, controlling relays, a start key, and a ringer.

At the central office the subscribers' lines appear in jacks at the operators' positions. These lines may be multiplied to jacks in a plurality of operated positions for use both in answering and completing calls, or they appear in multiple jacks at answering operators' positions and also in multiple jacks at other operators' positions where calls to the lines are completed. The subscriber's line disclosed in the drawings is illustrated as appearing in the multiple answering jacks at the two operators' positions shown in Figs. 2 and 3. This line may have further appearances in the answering jacks at other operators' positions and may also appear in the multiple jacks at positions where calls to this line are completed.

The operators' cord circuits are provided with answering and calling plugs, with telegraph repeaters for repeating the telegraph signals, and

with necessary relays and other equipment for controlling the various operations involved in the establishment of connections and in giving the necessary supervision. The cord circuits illustrated in the drawings disclose only as much of this equipment as is necessary to an understanding of the present invention, all parts not particularly essential in such an understanding being omitted for the sake of brevity. For example, the supervisory lamps and circuits, the operators' ring keys, and some of the equipment associated with the calling end of the cord circuits have been omitted. Each of the operators' positions is equipped with a telegraph keyboard transmitter and a teletypewriter in order that the operator may communicate with the subscribers and with other operators in the system. The operator's position is also equipped with signal devices to enable her to determine the condition of subscribers' lines.

While only one subscriber's line has been illustrated, it will be understood that the central office operators may complete connections with their cord circuits between local subscribers' lines, or they may extend a calling subscriber's line over a trunk or toll line to a distant office, or they may complete calls incoming over trunks or toll lines from distant offices to local called subscribers.

For a better understanding of a telegraph exchange system in which the operators in the central offices complete both local and interoffice telegraph connections reference is made to the copending application of Locke and Kinhead, Serial No. 459,684, filed June 7, 1930, which discloses operators' positions of the type to which the present invention is particularly applicable, and which contains a detailed disclosure and description of the different operations involved in the establishment of telegraph connections.

Since the subscribers' lines in the present system appear in a plurality of operators' positions, it is possible that two or more operators, seeing the line lamps burning, will attempt to answer the calling line at about the same time. And the cord circuits and position circuits are so arranged that any operator, who first answers a subscriber's line, will succeed in establishing a transmission circuit from the line through to her position equipment, which will enable her to communicate with the subscriber. Should, however, another operator, attempting to answer the same line, subsequently plug one of her cord circuits into a jack of the line, this act on the part of the second operator disables the transmission circuit previously established between the subscriber and the first operator, prevents the establishment of a similar transmission circuit between the subscriber's line and the second operator, and causes a busy signal lamp to light at the position of the second operator, notifying her that another operator has already answered the call and that she should withdraw from the line. Moreover, the act of the second operator in attempting to answer the subscriber's line causes the energization of the magnets of the typewriters at both positions to prevent these machines from operating. The disabling of the typewriter at the first operator's position acts as a signal to her that another operator has entered the connection and that she should wait until the second operator withdraws. The signal lamp at the second operator's position is a signal to her that another operator has already answered the call and she should withdraw her cord cir-

cuit from the jack of the subscriber's line. As soon as she does remove her cord circuit, the transmission circuit between the first operator and the subscriber's line is again rendered effective, and the operator's printer is unlocked, and communication between the operator and the subscriber may now proceed.

A better understanding of the invention may be had from a detailed description of the operation of the system. For this purpose assume that the subscriber at the substation shown in Fig. 1 wishes to make a call. To initiate a call, he closes the start key 106. Key 106 completes a circuit from the source of current 103 for operating the relay 105. Relay 105 locks through its right-hand contact independently of the key 106. Relay 105 closes an obvious circuit for starting the motor 102 and also closes a circuit for the relay 104. Relay 104 at its back contact disconnects ground from the line and at its front contact closes the line loop. A circuit may now be traced from the positive pole of telegraph battery 109, resistance 110, left normal contact of relay 111, left winding of line relay 112, resistance 113, conductor 114, front contact of relay 104, contacts of the subscriber's keyboard transmitter 100, key 115, signal receiving relay 107, conductor 116, inner right back contact of relay 111 to ground through the contacts of relay 117. The battery 109 is a 48-volt battery. This is called the telegraph battery and is illustrated throughout the drawings by the convention using four units. This four-unit convention is employed to distinguish from the signaling battery which is a 24-volt battery and which is illustrated in the drawings as having two units. The line relay 112 operates in the circuit above traced and closes an obvious circuit for the slow-release relay 118. Relay 112 also closes a circuit from its grounded contact, over conductor 119, outer right back contact of relay 111 through the winding of relay 117 to the negative pole of the telegraph battery. Relay 118 operates but without effect at this time. Relay 117 in operating closes a circuit from the signaling battery, through the inner left contact of said relay, through the windings of relay 111 in series to ground. The windings of relay 111 are differential, and current flowing through them in the circuit traced does not cause the relay to operate. Relay 117 also closes a circuit from the signaling battery through the outer left contact of said relay, conductor 120 and thence in multiple through the lamps 202, 203, etc., associated with the multiple answering jacks at the several operators' positions. These lamps light as a calling signal to the operators. Relay 117 at its inner right contacts removes ground from the line conductor 116 and substitutes therefor the negative pole of telegraph battery. The line circuit may now be traced from the positive pole of the telegraph battery 109, resistance 110, normal contacts of relay 111, through the left-hand winding of line relay 112, thence over the subscriber's loop and returning over conductor 113 through the inner right back contact of relay 111, right front contact of relay 117, resistance 121 to the negative pole of the telegraph battery. This increases the current flowing over the subscriber's line.

Assume that the operator at position 200, being idle at the time, observes lamp 202 burning and answers the call with her cord circuit 201. To do this, she inserts the answering plug 204 in the multiple jack 205 of the calling line. A circuit is now closed from the negative pole of signaling

battery, potentiometer resistance 206, winding of relay 207, right winding of polarized relay 208, through the sleeve of the plug and the multiple jack, through the right winding of relay 111 to ground. The current flowing in the polarized relay 208 is in the proper direction to operate this relay. Relay 207 also operates in this circuit. Relay 208 closes obvious operating circuits for relays 209 and 210. Relay 209 closes a circuit from signaling battery through the winding of relay 211, resistance 212, contact of relay 209, left winding of relay 208, thence as traced through the right winding of relay 111 to ground. The combined resistance of the series-parallel circuit through the right winding of relay 111 is such that sufficient current flows through this winding to cause the relay to operate. The resistance of the circuit through the relay 211, resistance 212, and the left-hand winding of the polarized relay 208, being comparatively low, causes an increase in the potential on the sleeves of the multiple jacks 205, 213, etc., these sleeves being multiplied together by the conductor 122. Since the sleeves are now negative with respect to ground the current in the right-hand winding of relay 208 reverses, but the current in the left-hand winding is greater and is in the direction necessary to hold relay 208 operated. Relay 111 in operating opens the circuit of relay 117, which releases and extinguishes the lighted lamps 202, 203, etc. Relay 117 also opens the left-hand winding of relay 111, and the latter relay now remains energized over the circuit closed from battery in the cord. Relay 111 opens the previously traced circuit for supplying telegraph battery to the subscriber's loop and replaced this circuit with a new one, which extends to telegraph battery in the operator's cord. The new circuit may be traced from negative pole of telegraph battery 123 in the line circuit, resistance 121, back contact of relay 124, right winding of line relay 112, inner right front contact of relay 111, thence over line conductor 116, through the substation loop and returning over conductor 114, resistance 113, left winding of relay 112, left front contact of relay 111, conductor 125, over the ring contacts of the jack 205 and the plug 204 through the lower front contact of relay 209, outer right contact of relay 214, resistance 215, lower winding of the polarized repeating relay 216, marking contact of repeating relay 217, resistance 218 to the positive pole of telegraph battery 219. Since current flows through both windings of the line relay 112, this relay releases because of its differential character. Relay 112 in releasing causes the release of relay 118.

Before proceeding further with the extension of the transmission circuit to the operator's position, an explanation will be given of the operation of the cord circuit repeater, including the polarized repeating relays 216 and 217. The upper windings of these relays are biasing windings, and, when current flows through these biasing windings in a given direction, the relays tend to operate their armatures to the front or space contacts. The lower windings are the line windings, and, when current flows through these windings in a given direction, the effect of the biasing windings is overcome, and the relays maintain their armatures on the lower or marking contacts. When the line winding is opened or rendered currentless by opposing batteries, the relay operates its armature to the space contact, unless at the same time the current through the biasing winding is reversed to maintain the armature on the marking

contact. When the transmission is coming from the calling line and is proceeding toward the operator or toward a distant called line, the repeating relay 217 maintains its armature constantly on its marking contact, and the relay 216 follows the signals and operates its armature from the marking to the spacing contacts to open the transmission line toward the outgoing line.

At the time the relay 210 operated a circuit was closed from the positive pole of telegraph battery 219 through resistance 218, marking contact of relay 217, biasing winding of relay 216 through the artificial line 221 to ground at the contact of relay 210. Similarly a circuit is closed from positive pole of battery 219, resistance 220, marking contact of relay 216, biasing winding of relay 217 and the artificial line 221 to ground. The current flowing in these biasing windings is in the direction which tends to cause the armatures to move to the spacing contacts. Relay 217 at this time also has a circuit traceable from positive telegraph battery, resistance 220, marking contact of relay 216, lower or line winding of relay 217, normal contact of relay 222, inner upper contact of relay 209, resistance 223, to the negative pole of telegraph battery. The current flowing through this circuit is in the proper direction to cause the line winding of relay 217 to oppose the biasing winding, thereby holding the armature on the marking contact. Also the current in the circuit previously traced is in the direction to cause the line winding of relay 216 to overcome its biasing winding, thereby maintaining the armature on the marking contact.

The operator, having inserted her cord circuit in the answering jack of the calling line, now operates the typing key 225 individual to the cord to prepare her position equipment for communication with the calling subscriber. The closure of key 225 completes a circuit from positive telegraph battery through the winding of relay 226, normal contacts of relay 214, key 225, through the right winding of polarized signal receiving relay 227 to ground. The current flowing in this circuit is in the direction such that relay 227 tends to move its armature from the marking contact to the spacing contact. Relay 226 operates in the circuit traced and extends the grounded conductor leading from the right winding of relay 227 to the contacts of key 225 through the outer right contacts of relay 226 and the winding of relay 214 to positive telegraph battery. Relay 214 operates and closes a holding circuit for relay 226 at the same time opening the original operating circuit of relay 226. Relay 214 also closes an obvious circuit for the energization of relay 239. The operation of relays 214 and 226 results in the extension of the telegraph transmission circuit into the operator's position. This circuit may now be traced from the negative pole of the telegraph battery 123 in the line circuit, thence over the subscriber's line loop and returning as above explained over the ring conductor 114, thence to the ring of the jack and plug, through the closed contacts of relay 209, outer left closed contacts of relay 226, conductor 228, through the operator's transmitter 229, key 230, through the left winding of polarized receiving relay 227, conductor 231, inner left front contact of relay 226, through the line winding of relay 216, marking contact of relay 217, resistance 218 to the positive pole telegraph battery. The current flowing in this circuit through the line winding of relay 216 is in the same direction as before, with the result that the relay maintains its armature on

the marking contact. The current flowing in this circuit through the line winding of relay 227 is also in the proper direction to oppose the effect of the biasing winding, maintaining the armature on its marking contact.

Considering the operator's position for the moment, while the armature of the signal relay 227 is on its marking contact, a circuit may be traced from positive telegraph battery through said armature and its marking contact, resistance 232, through the printer magnet 233, resistance 234 through the contacts of the closed key 235 to the negative pole of telegraph battery. The purpose of this closed circuit is to maintain the magnet 233 energized to prevent the operator's typewriter from running in an open or idling condition while no signals are being received by the relay 227. Furthermore the relay 236 at the operator's position remains in an energized condition so long as the armature of the relay 227 does not rest on its space contact for any appreciable length of time. The energizing circuit of relay 236 extends from the positive pole of telegraph battery through the winding of said relay, resistance 237 through the contacts of key 235 to the negative pole of battery. Each time the armature of relay 227 moves to its space contact while signals are being received a circuit is closed from the positive pole of telegraph battery through said space contact, conductor 238 to the upper terminal of relay 236. This path constitutes a direct short circuit on the winding of relay 236. The relay, however, maintains its armature energized during the brief periods that the signal receiving relay 227 holds its armature on its space contact in the normal course of signaling. However, as will be explained later, should the relay 227 move its armature to the space contact for an extended interval, the relay 236 then releases its armature. With the relays 226 and 239 operated, a circuit is also closed for operating the relay 240 in the operator's position. This circuit may be traced from battery through the winding of relay 240, conductor 241, inner right contact of relay 226, left contact of relay 239 to ground at the bottom contact of relay 210. Relay 240 operates but does not perform any function at this time.

The operator having answered the subscriber's call, by inserting the plug of her cord circuit in the subscriber's line and operating her typing key 225, and the relays 209, 214 and 226 having been energized as above explained, and the transmission circuit having been completed from the subscriber's line through the cord circuit to the operator's keyboard transmitter and signal receiving relay, the equipment is now in condition for communication between the operator and the subscriber. The operator challenges the subscriber by manipulating the keyboard transmitter 229 to send telegraph code impulses over the transmission circuit to operate the polarized signal receiving relay 107, which in turn operates the printing magnet 101 at the substation. Each time the transmitting contacts are opened at the operator's position, the line windings of polarized relays 227 and 216 are deenergized and these relays shift their armatures to the space contacts. The magnet 233 follows the operation of the armature of relay 227, and the characters set up by the operator on her keyboard are printed on her typewriter. The magnet 101 follows the operations of relay 107, and these characters are also printed on the typewriter at the subscriber's station. On each opening of the transmission circuit through the line winding of relay 216 the

armature of relay 216 moves to its spacing contact, opening the circuit through the line winding of relay 217. When the armature of relay 216 reaches the spacing contact, a circuit is closed from negative pole of telegraph battery 242, resistance 243, spacing contact of relay 216, through the biasing winding of relay 217 to ground. Current in this circuit flows through the biasing winding of relay 217 in the direction to maintain the armature of the relay on the marking contact. The repeated operation of relay 216 in response to the code signals is without effect.

After the operator has challenged the subscriber, the subscriber manipulates his keyboard transmitter 100 and sends his order to the central office operator where it is printed on her typewriter. In response to the subscriber's order the operator inserts the calling plug 244 of the cord circuit 201 in the jack 245 of the outgoing circuit. The outgoing circuit may be another subscriber's line or a trunk or toll line. Before inserting the plug 244 in the jack 245 the operator tests the jack by touching the tip of the plug to the sleeve of the jack to determine whether the circuit is busy or idle. If the circuit is busy a negative potential exists thereon. In case the outgoing circuit is a subscriber's line, the negative potential is supplied through the contacts of a relay such as relay 117 and the left winding of a relay such as relay 111 if the subscriber of the line has just initiated a call and the operator has not yet answered it. In case the line is one that is made busy by reason of a cord circuit having been inserted in the jack 245, the negative potential on the sleeve of the jack is then maintained by reason of a circuit from the negative pole of battery in the cord circuit through the winding of a relay 211, resistance 212, thence as previously traced to the sleeve of the jack. Because of the busy negative potential on the sleeve of the jack 245 a current will flow through the tip of the plug 244, when the operator touches the jack to test it, middle upper back contact of relay 222, through the winding of relay 246 to ground. Current flowing in this circuit is in the proper direction to operate the polarized relay 246. Relay 246 closes a circuit for the busy signal lamp 247. The lamp lights to notify the operator that the circuit tested is busy. If, however, the outgoing circuit is idle, the operator inserts the plug 244 into the jack 245 thereof and applies ringing current to the called line to signal the called subscriber or the called operator. The insertion of the plug in the jack causes the operation of the sleeve relay 248. This relay closes an obvious circuit for relay 222. Relay 222 extends the transmission circuit through the line winding of the repeating relay 217 over the ring of the plug 244 thence to the ring of the called line. After obtaining the called party, the operator releases the cord circuit from her position by opening the typing key 225. The opening of this key releases relay 214 which restores the transmission circuit previously traced from the calling line through the resistance 215 to the line winding of relay 216. Relay 214 releases relay 226 and relay 239. Relay 226 disconnects the operator's position from the transmission circuit and relays 226 and 239 open the circuit of relay 240.

At the end of the communication between the calling and called subscribers the operator is given the usual supervision, and she then proceeds to release the connection by removing the plugs of the cord circuit 201 from the respective

jacks, allowing all associated equipment to restore to its normal condition.

Assume next that the operators at both positions 200 and 300 observe the calling condition of the subscriber's line and that both attempt to answer the call. Assume also that the operator at position 200 is the first of the two operators to insert the answering plug of one of her cord circuits in the jack 205 of the subscriber's line. As has already been described in detail, the insertion of the plug 204 of the cord 201 in the jack of the calling line causes the operation of relays 208, 207, 209 and 210 in the cord circuit 201. Also the act of inserting the plug 204 in the jack 205 causes an increase in the potential on the sleeve of jacks 205 and 213 and on other multiple jacks associated with this line. When, therefore, an instant later, the operator at position 300 inserts the plug 249 of her cord circuit 301 in the jack 213, the increased potential on the sleeve of jack 213 is sufficient to cause current to flow from the jack over the sleeve conductor 250 of the cord, through the right-hand winding of relay 308, winding of relay 307, through the potentiometer resistance 360 to ground. It will be noted that the current flowing through the right-hand winding of relay 308 is in a direction opposite to the flow of current through the right winding of relay 208 when the first cord was inserted. This direction is such that the polarized relay 308 of the second cord does not attract its armature. Consequently relays 309 and 310 do not operate, and the low resistance relay 311 is not connected in series with the left winding of relay 308. Relay 307, however, operates and, in so doing, closes a circuit from ground through the back contact of relay 308, left contact of relay 307, winding of relay 361 to battery. Relay 361 in operating closes a path from positive telegraph battery 319 in the cord 301, through the plug 249 and jack 213 to the transmission circuit of the subscriber's line. This path, which acts as a shunt on the transmission circuit in the first operator's cord 201, may be traced from the positive pole of telegraph battery 319, resistance 320, conductor 362, contact of relay 361, conductor 363, thence through the ring of the plug 249 and jack 213, conductor 125, left front contact of relay 111, which was operated when the first cord was inserted, thence through the left winding of relay 112, over the line circuit and returning to the negative pole of telegraph battery 123, as hereinbefore traced. The resistance 320 in this path is sufficiently low to reduce the current flowing through the line winding of the signal relay 227 of the first operator's position to the point where this relay moves its armature to the space contact under the influence of the biasing winding. After the armature of relay 227 has rested on the space contact for an interval, the slow relay 236 releases, being short-circuited by the armature of relay 227, and closes its contacts. A circuit is now completed from the positive pole of telegraph battery 251, contacts of relay 236, closed contacts of the energized relay 240, resistance 232, magnet 233, resistance 234, through the contacts of key 235 to the negative pole of telegraph battery. This circuit maintains the magnet 233 energized while the armature of relay 227 is resting on its space contact. Thus the transmission circuit extending to the first operator's position is disabled, and the manipulation of the operator's keyboard transmitter is ineffective to transmit telegraph signals to the subscriber's sub-station because of the low resistance

shunt that is being maintained through the resistance 320 in the second cord circuit 301. Similarly, the manipulation of the transmitter at the subscriber's station is without effect to cause the operation of the signal receiving relay 227. Furthermore, the magnet 233 is held energized in the circuit above traced, and the typewriter at the first operator's position is prevented from running in an idle or open condition. The operator at position 200, noting that her typewriter does not follow the manipulation of her keyboard, realizes that another operator has inserted a cord in a jack of the same line and that she should wait until such other operator has withdrawn.

The operator at position 300 having inserted her answering cord as above described closes her typing key 325, and relays 326, 314 and 339 operate as explained in connection with the first cord circuit, and a circuit is closed through the right-hand winding of the signal relay 327. Since, however, the relay 309 of the second cord does not operate, the transmission circuit from the ring conductor 125 of the subscriber's line is not extended into the operator's position and through the left-hand winding of the signal receiving relay 327, nor is the transmission circuit completed to the repeating relays 316 and 317 in cord 301. Accordingly, the relay 327 is controlled by its biasing winding and moves its armature over to the space contact, and the operator's keyboard transmitter 329 is ineffective to send code impulses. Also it will be noted that the relay 340 in the second operator's position is not energized for the reason that its circuit is not closed at the lower contact of relay 310. After the armature of relay 327 has rested on its space contact for an interval, the normally-energized slow-release relay 336, being short-circuited by the armature of relay 327, releases and closes its contacts. The release of relay 336 at this time is without effect. As soon as the armature of relay 327 leaves its marking contact, the normally-closed holding circuit for the magnet 333 is opened, but this magnet is now held in a circuit from the positive pole of telegraph battery, through the winding of relay 352, normal contacts of relay 340, resistance 332, magnet 333, resistance 334, key 335 to the negative pole of telegraph battery. Thus the magnet 333 is held energized to prevent the operator's typewriter from running in an idle or open condition. Relay 352 operates in the circuit traced and closes an obvious circuit for the busy signal lamp 347. The operator at position 300, noting the lamp 347 burning, realizes that another operator has preceded her in answering the calling subscriber. The second operator thereupon withdraws her plug 249 from the jack of the calling line, permitting the equipment in the cord circuit 301 and at the position 300 to restore to normal. As soon as the second cord 301 is removed from the jack of the subscriber's line, the shunt on the transmission circuit is opened, and full telegraph current now flows over the transmission circuit between the subscriber's line and the equipment of the operator at position 200. Thereupon the relay 227 moves its armature back to the marking contact, and relay 236 again operates. Relay 236 opens the locking circuit of the magnet 233. This magnet is now held under the control of the marking contact of the relay 227. The operator at position 200 now proceeds to communicate with the calling subscriber, and the connection is established as previously described.

Whenever a subscriber's line is out of order, a special plug (not shown) is inserted in one of

the jacks 205 for the purpose of placing a positive battery potential on the sleeve of the jack. If, while the line is in this condition, an operator tests a sleeve of one of the multiple jacks, a circuit is closed, and current flows from the positive source of potential over the tip conductor of the plug 204, contacts of relays 209 and 207, thence through the winding of relay 253 to ground. Relay 253 is polarized in such a direction that current flowing in this circuit causes the relay to attract its armature. Relay 253 in operating closes an obvious path from ground through the winding of relay 254 and the signal lamp 247 to battery. The lamp lights, telling the operator that the line is busy, and the relay 247 closes a circuit to the buzzer 255 to inform the operator as to the reason why the line is not available.

What is claimed is:

1. The combination in a communication system having operators' positions, of a subscriber's line appearing in multiple jacks at said positions, cord circuits at said positions, operators' sets, one at each position for communication between the operator and the subscriber, means responsive to the insertion of a cord by any particular one of said operators in a jack of said line for completing a communication circuit between said line and the operator's set, and means responsive to the insertion of a second cord by another operator in a jack of said line for closing a shunt around the first-mentioned operator's set to render it ineffective for communication.

2. The combination in a communication system having operators' positions, of a subscriber's line appearing in multiple jacks at said positions, cord circuits at said positions, operators' sets, one at each position for communication between the operator and the subscriber, means responsive to the insertion of a cord by any one of the operators in a jack of said line for completing a communication circuit between said line and the operator's set, means responsive to the subsequent insertion of another cord by a second operator for disabling the communication circuit to said first-mentioned operator's set, and means for notifying the second operator that another operator has already answered the line.

3. The combination in a communication system having two operators' positions, of a subscriber's line appearing in terminals at both positions, cord circuits at said positions, operators' sets for communication between the operators and the subscriber, means responsive to the insertion of a cord circuit by one of said operators in a terminal of said line for completing a communication circuit to the operator's set, means responsive to the subsequent insertion of a cord by the second operator for closing a shunt around the first operator's set to render said communication circuit ineffective, and means responsive to the closing of said shunt for locking the first operator's set against operation.

4. The combination in a communication system having two operators' positions, of a subscriber's line appearing in jacks at both positions, each of said positions having a cord circuit thereat for making connections with said line, operators' sets for communicating with the subscriber, means in each of said cord circuits effective when the cord is the first one to be inserted in a jack of the subscriber's line for establishing a communication circuit between the line and the corresponding operator's set, means in each of said cord circuits effective when the cord is a subsequent one to be inserted in a jack

of the subscriber's line for disabling the communication circuit between the line and the set of the operator first to insert her cord, and means for signaling the operator who makes connection with the line subsequent to the other operator.

5. The combination in a communication system having two operators' positions and a line appearing in both positions, of operators' cord circuits at said positions for making connections with said line, operators' sets for communication with said line, means in each of said cord circuits effective when the cord is the first one to be connected to the line for establishing a communication circuit between the line and the corresponding operator's set, and means in each of said cords effective when the operator connects the cord to said line subsequent to the connection of a first cord by the other operator for closing a low resistance path from the subsequent cord to said line to shunt the set of the operator who previously made connection to the line with said first cord.

6. In a communication system having operators' positions, a line appearing in jacks in all of said positions, cord circuits at said positions for making connections with said line, operators' sets for communication with said line, signal lamps, one at each of said positions for use by the operators in testing said line to determine whether it is busy or idle, means responsive to the insertion of a cord by any particular one of said operators in a jack of said line for completing a communication circuit between said line and the operator's set, means responsive to the subsequent insertion of another cord by a second operator for disabling the communication circuit to said first-mentioned operator's set, and means effective in response to the subsequent insertion of a cord circuit by one of said operators for lighting the signal lamp at her position to apprise her that another operator has preceded her in answering the call.

7. A communication system having two operators' positions and a subscriber's line appearing in both positions, cord circuits at said positions for making connections with the line, means at each of said positions for sending communications to the line, typewriters, one at each of said positions for receiving communications from said line, means responsive to the insertion of a cord at either of said positions in the subscriber's line for establishing a communication circuit between such position and the line, and means effective when one of the operators inserts a cord circuit in the line subsequent to the other operator for causing the typewriter of the first operator to make connection with the line to be locked against operation.

8. In a communication system having operators' positions and a subscriber's line appearing in all of said positions, cord circuits at said positions for making connections with said line, typewriters, one at each of said positions for receiving communications from said line, means for operating said typewriters, means responsive to the insertion of a cord circuit at any one of said positions in said line for establishing a communication circuit between the line and such position, and means effective in response to the subsequent insertion of a cord circuit in the line at a second position for locking the typewriters at both the first and second positions.

9. The combination in a communication system having operators' positions and a line ap-

appearing in jacks at all of said positions of cord circuits at said positions for making connections with said line, communication sets, one for each of said positions for communication with said
5 line, busy signal lamps, one at each of said positions, means responsive to the insertion of a cord circuit at any particular one of said positions in a jack of said line for establishing a communication circuit between the line and such
10 position, and means responsive to the subsequent insertion of a cord at a second operator's position in a jack of said line for disabling the communication circuit between the line and the first-mentioned operator's position and for
15 lighting the busy signal lamp at said second operator's position.

10. The combination in a telegraph system having operators' positions, of a subscriber's line appearing in jacks at said positions, transmitting and receiving mechanisms at said positions

for communication between the subscriber and an answering operator, cord circuits at said positions, each having means therein for closing a transmission circuit from said line to the corresponding operator's position when the cord is
5 the first one to be inserted in a jack of said line and for detecting the presence of a previously inserted cord to withhold the closure of said transmission circuit, means responsive to the subsequent insertion by a second operator
10 of one of her cords for disabling the transmission circuit closed to a first operator's position by the insertion thereof of a previous cord, and further means responsive to subsequent insertion
15 of the cord at said second position for locking the receiving mechanisms at both said positions and for notifying the second operator to withdraw.

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