

Nov. 26, 1940.

W. V. K. LARGE

2,222,672

COMMUNICATION SWITCHING SYSTEM

Filed March 2, 1938

4 Sheets-Sheet 1

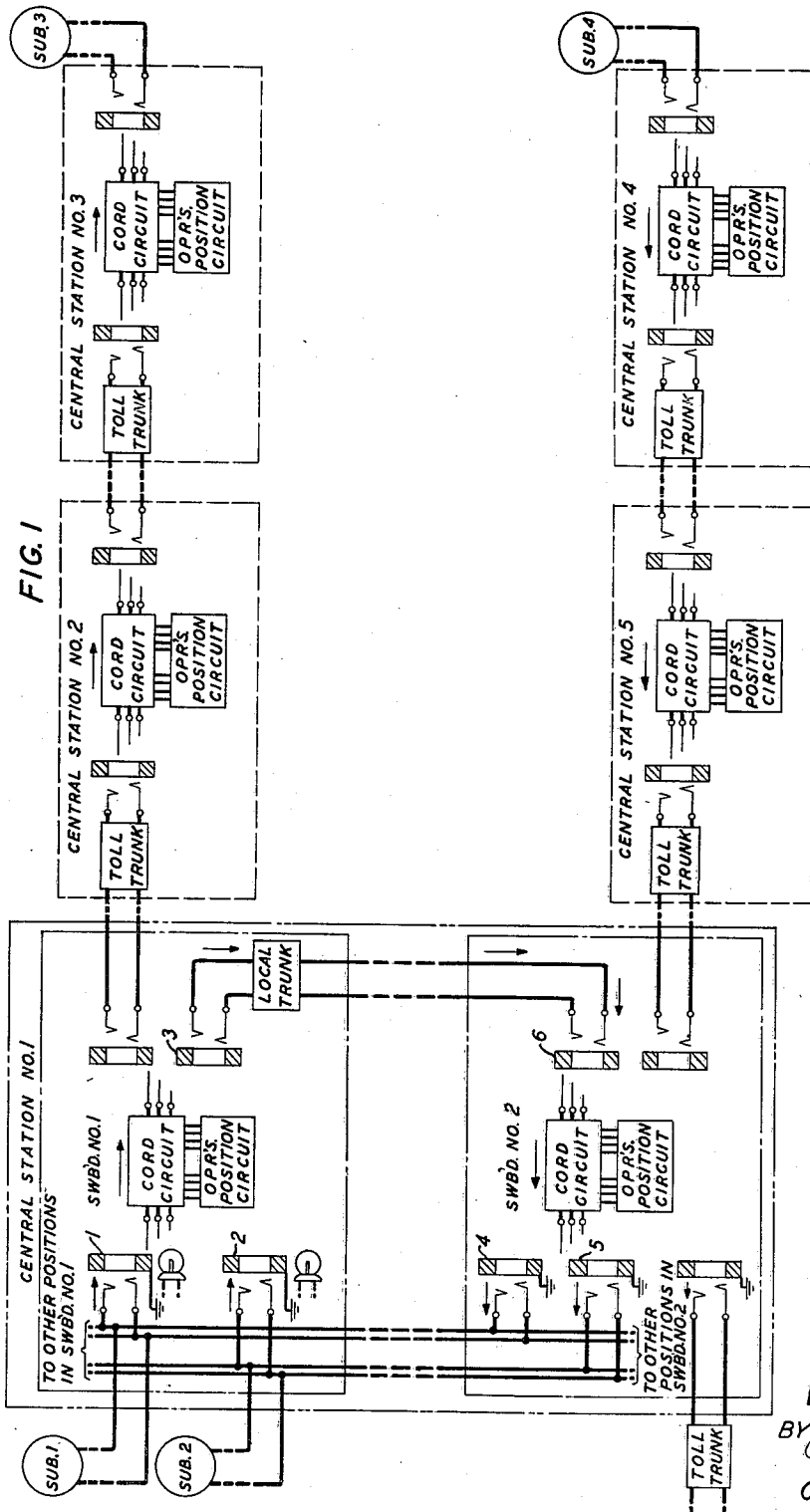
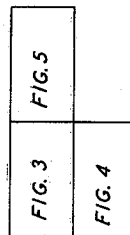


FIG. 2



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4 Sheets-Sheet 2

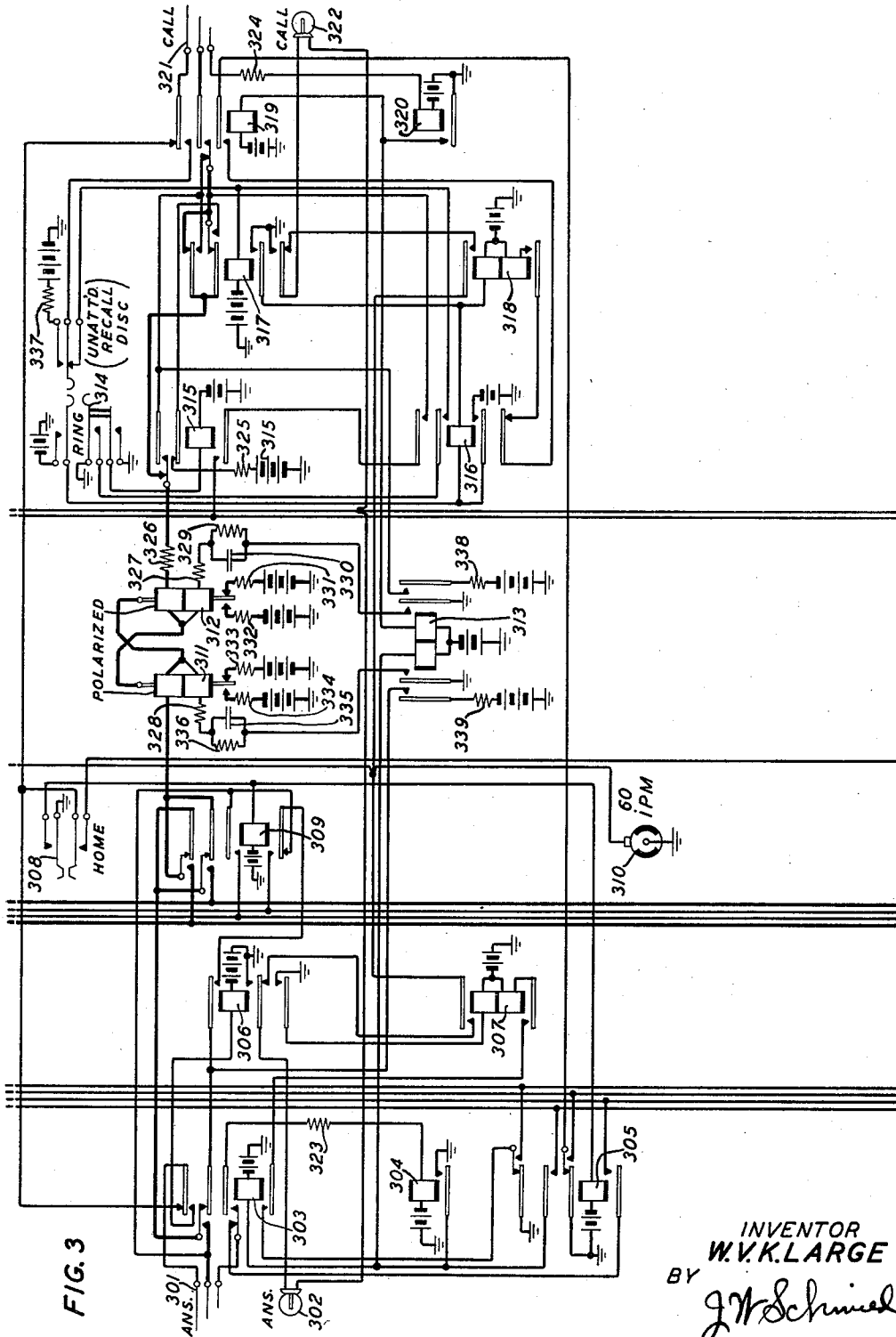


FIG. 3

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COMMUNICATION SWITCHING SYSTEM

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4 Sheets-Sheet 3

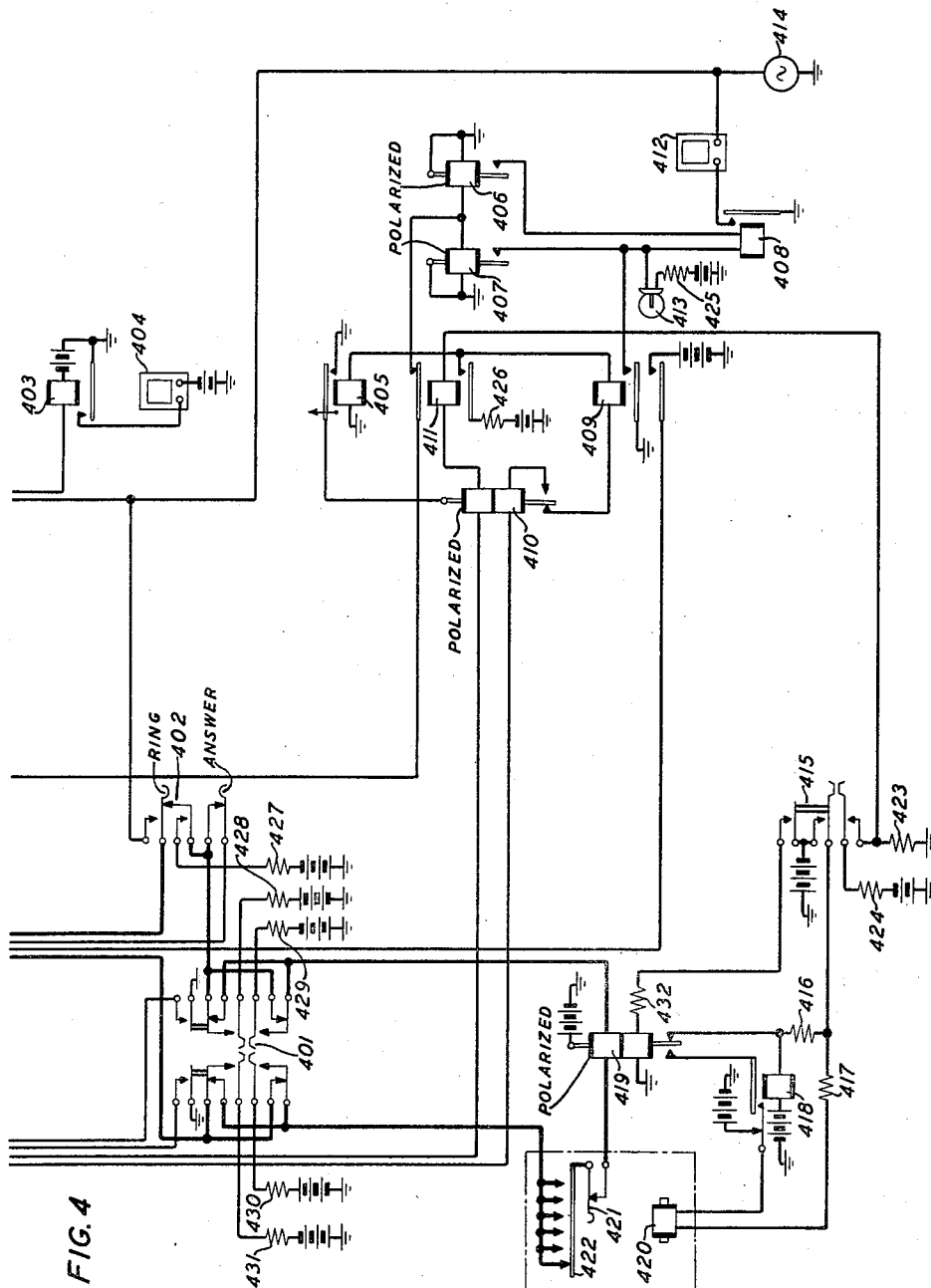


FIG. 4

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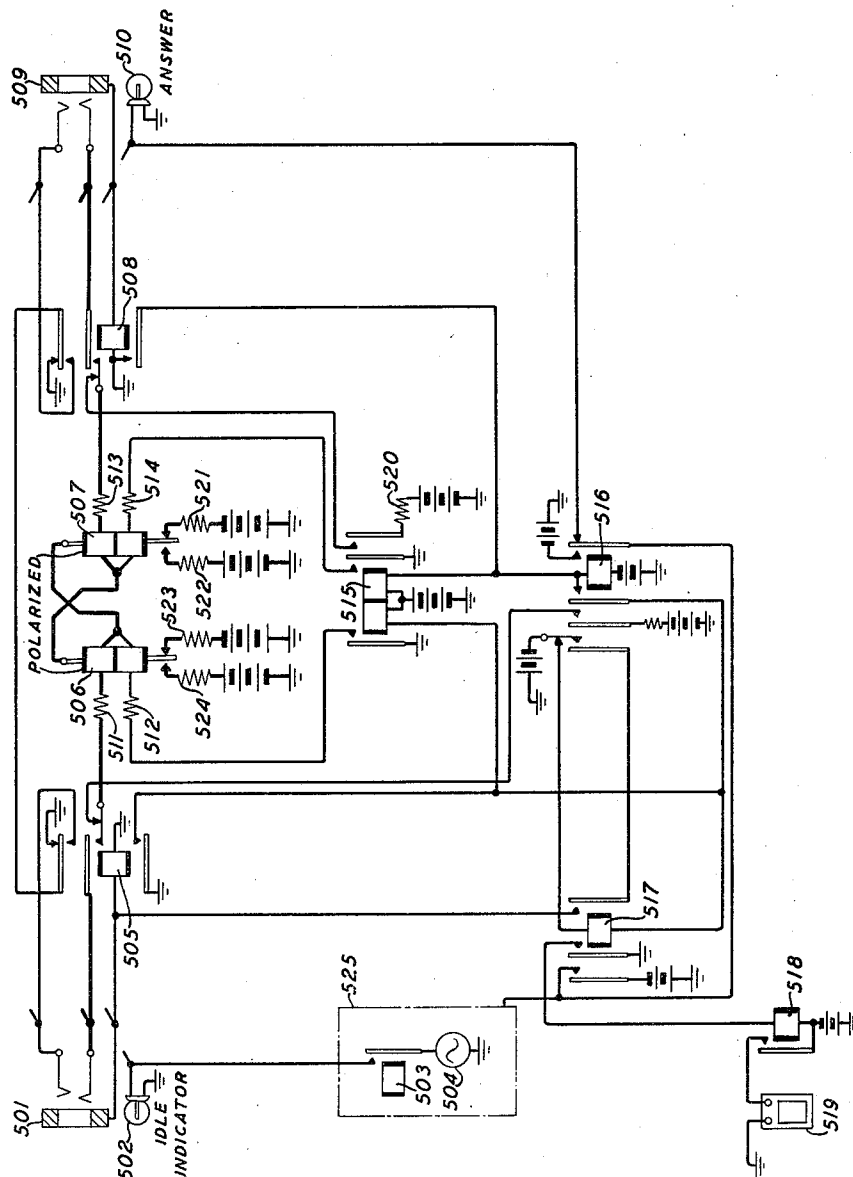
2,222,672

COMMUNICATION SWITCHING SYSTEM

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4 Sheets-Sheet 4

FIG. 5.



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2,222,672

COMMUNICATION SWITCHING SYSTEM

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Application March 2, 1938, Serial No. 193,477

14 Claims. (Cl. 178—2)

This invention relates to improvements in manual communication switching systems and particularly in telephone, telegraph and teletypewriter manual switching systems.

5 More particularly it relates to improvements in switching arrangements in switchboards for handling combined local and long distance traffic and to improvements in certain of the circuits used in performing these functions, namely, the
10 cord circuit, the operator's position circuit and the completing trunk circuit.

An object of this invention is to provide improved switching arrangements in communication switchboards for handling combined local and
15 long distance traffic.

A feature of this invention is that the switchboards are arranged so that local and long distance traffic originate in one switchboard which extends the long distance traffic directly to a long
20 distance trunk. The local traffic, instead of being completed in the originating board is trunked to a second board, which completes all incoming traffic both local and long distance. This feature is shown herein as applied to a manual teletypewriter switching system, but it is applicable to all
25 known manual switching communication systems.

A further feature of this switchboard is a reduction in the number of apparatus units required per operator's position, to provide what is known
30 as the operator lockout feature. This feature prevents more than one operator from answering an incoming call at any one time. The apparatus required per position has been materially reduced, by the design of a position circuit, which provides the feature for each cord to which it is connected. The apparatus is furnished once per
35 position instead of being included in each cord. This modification, to make possible furnishing the operator lockout device but once per position, instead of for every cord at a manual
40 switchboard, is shown herein as applied to a teletypewriter switching system, but it is applicable to all manual communication switching systems.

45 A further feature of this invention is that in the cord circuit, which includes a telegraph repeater, one relay only per cord is used to split and terminate the calling and answering ends of the cord.

50 A further feature of this invention is that it provides a four-wire trunk including a repeater for intra-office interboard use.

55 These and other features will become apparent from a consideration of the following description and the appended claims.

In the accompanying drawings, Fig. 1 is a schematic diagram disclosing the new arrangement of this invention for handling combined local and long distance traffic;

Fig. 2 is a block diagram showing the inter- 5 relation of Figs. 3, 4 and 5 herein;

Fig. 3 is the cord circuit used for extending subscribers' line circuits either to a long distance trunk to a distant office or for extending subscribers' line circuits through a completing
10 trunk, per Fig. 5, to another switchboard in the same office, which handles all incoming calls both local and long distance, where they are further extended to a local subscriber's line. In Fig. 3 relay 317 performs the function of split-
15 ting the cord and terminating the repeater in the cord associated with the answering end of the cord, and at the same time terminating the trunk repeater to which the calling end of the cord is connected;

Fig. 4 is the operator's position circuit. This circuit is individual to each position and common to each cord per Fig. 3 at each position. The operator lockout relays, which prevent more than one operator from being connected to a
20 subscriber's line at any one time by barring all operators when more than one is connected to a subscriber's line are relay 409, relay 410 and relay 411; and

Fig. 5 is a four-wire repeater circuit used for
30 interboard connection within the office. It functions only on local calls to connect a subscriber's line from the board in which all calls originate, to the board in which all calls are completed. It includes a repeater, namely, relays 506, 507 and their associated connections.

Refer now to Fig. 1 which shows the new manner of handling incoming and outgoing traffic according to this invention. Fig. 1 provides an arrangement for handling all outgoing traffic, both local and long distance in one switch-
40 board, and all incoming traffic both local and long distance and all through long distance traffic in a second switchboard. To do this, the answering jacks and line signals associated with the subscribers' lines appear in one switchboard,
45 the outgoing board only, and the calling jacks, by means of which calls are completed to subscribers in the local area served by the central station, and which are a multiple of the answering
50 jacks, are segregated in a second switchboard in the same office. This second switchboard handles all incoming traffic to the local area, both local and long distance. It is used, also, as a through board to extend toll calls. The
55

outgoing long distance calls are extended directly from the originating switchboard over long distance trunks to a distant office, where they may be completed to subscribers in the local area served by the distant office, or further extended to a more distant office. The outward switchboard in the first central office in this arrangement, handles outgoing long distance calls directly, without the use of an intervening toll board.

Although in telephone practice it is old to provide a separate outgoing and incoming switchboard, separate toll boards are provided for use in conjunction with these boards, when the traffic is so divided, for handling toll traffic and such traffic is not handled directly by the incoming and outgoing boards.

In Fig. 1, a calling subscriber is represented by the circle marked Sub. 1. This may be any of the subscribers served by central station 1. Sub. 1 line has connected to it an answering jack with which is associated a signal, usually a lamp, in switchboard 1. The answering jack and lamp have multiple appearance before various operators in switchboard 1. Subscriber 1 has, in addition, connected to his line in switchboard 2, multiple jacks, whereby a call for his line may be completed. All of the subscribers' lines in the local area served by central station 1 are similarly arranged. Let us assume that Sub. 1 wishes to call Sub. 2. In response to his signal at switchboard 1, the operator at one of the positions where Sub. 1 signal appears, will insert a cord into the associated jack. An operator's position circuit is connected to this cord. The subscriber passes a number for Sub. 2, connected to the same central station. The operator will not complete the call in switchboard 1, but will extend the call to switchboard 2, by means of the local completing trunk. The operator at switchboard 2 will connect a cord and her position circuit to the trunk. The necessary information for completing the call will be passed to the operator at switchboard 2, who will thereupon complete the call to one of the called subscribers' multiple completing jacks.

If instead of calling a subscriber connected to central station 1, the subscriber calls another subscriber, Sub. 3, in a distant area, the operator at switchboard 1 will extend the call to a second central station in the distant area, directly over a long distance trunk, if it can be reached directly, or through a second central station to a more distant central station, by means of a number of long distance trunks and central stations in tandem. The latter condition is represented by the chain connection through central stations 2 and 3 in the upper portion of Fig. 1.

In the lower portion of Fig. 1 a diagram of connections for a call is shown, originated by Sub. 4 in a distant area. This call is extended through central stations 4 and 5 to switchboard 2 in central station 1. Here the call may be completed to the multiple completing jack of any subscriber connected to central station 1 or it may be extended, if the call is for a more distant subscriber, to a distant office over another long distance trunk.

One of the advantages of this mode of handling traffic lies in the facility with which calls may be handled, by relieving the operator at switchboard 2 of the duties of an operator at an originating switchboard, such as timing the calls, etc. Another is the obvious advantage of eliminating the separate toll switchboards.

This traffic arrangement does not involve new subscribers' line circuits. The subscriber's loop and line circuit shown in Figs. 1 and 2 of C. C. Lane Patent 1,965,383, July 3, 1934, will function with this invention and this patent is hereby made part of the present application as if fully included herein. When Fig. 2 of Patent 1,965,383 is used multiple jack appearances are provided as indicated in Fig. 1 herein. The line circuits used may, in addition to that shown in Patent 1,965,383, be any of a number, well known in the art. Neither is it limited to line circuits in which either the answering jacks or calling jacks have multiple appearances in their respective boards. It may be used where there is a single answering jack connected to the line appearing in switchboard 1, and a single calling jack connected to the line in switchboard 2, but, in the preferred embodiment, there are multiple answering jacks in switchboard 1 and multiple calling jacks in switchboard 2. Further, this traffic arrangement is not limited as to the other circuits involved, but may be operated with various cord and trunk circuits well known in the art. As applied in the preferred embodiment, use is made of well-known line circuits, long distance trunk circuits and the cord and position circuits at switchboard 2. In order to facilitate switching operations, however, various novel features have been introduced into the cord and operator's position circuit at switchboard 1 and a novel completing trunk is provided to interconnect switchboards 1 and 2. The general relationship of these circuits is indicated by the diagram of Fig. 1 in which the cord circuit and position circuit of switchboard 1 are shown as well as the local completing trunk connecting the boards. It is further illustrated in the block diagram of Fig. 2 and in the following detailed description read with reference to Figs. 3, 4 and 5.

The subscriber's line circuit, with which the cord circuit per Fig. 3 functions is provided with multiple line signals and answering jacks which are located at a number of positions in the originating switchboard, so that a calling subscriber's line may be answered at a number of positions. The associated line signal at each position, usually a lamp, indicates that a particular line is calling. In response to this signal any of the operators, at the positions where the line signals appear, may answer the call by first operating typing key 308 of any idle cord, all of which are identical with Fig. 3, at said position, and thereafter inserting the answering plug 301 of the same cord into the line jack associated with the signal. Key 415 in Fig. 4 is operated whenever the operator's position is occupied.

The operation of the cord typing key 308 cuts the operator's position circuit per Fig. 4, of which there is but one per position, into the circuit, to associate it with the cord whose typing key has been operated. The operation of key 308 also operates relays 309 and 305 in parallel, over a circuit from ground, through the upper armature and front contact of key 308, through the windings of relays 309 and 305 in parallel, to battery. The operation of relay 305 extends the sleeve circuit of the connecting line circuit, not shown, through the sleeve of plug 301, through the upper inner front and break contact of relay 303, the lower armature and front contact of relay 305, into Fig. 4, through the upper winding of polarized relay 410, relay 411 winding, to a mid-point of the potentiometer formed by battery through resistance 424, lower armature and front contact of key 415,

resistance 423 to ground. If the cord circuit which we are considering is the first cord circuit to answer the call, a condition on the sleeve of the connecting line circuit will operate relay 410 armature to its right-hand contact and will also operate relay 411. Relay 411 operated will furnish battery through its lower armature and front contact, through relay 405 winding, to ground, operating relay 405. Relay 405 will furnish ground, through its single front contact and armature, relay 410 armature and right-hand contact, through the lower winding of relay 410 into Fig. 3, through the upper middle front contact and armature of relay 335, through the windings of relays 303 and 313 in parallel, to battery, operating relays 303 and 313. After the operation of relay 405, relay 410 will lock momentarily over the holding path through its lower winding, heretofore traced, to insure a proper sequence of operation. The operation of relay 313 in Fig. 3 will close a circuit from ground, through the left-hand inner armature and front contact of relay 313, through resistances 336 and 328, through the lower winding of relay 311, through the armature and right-hand contact of relay 312, resistance 331, to positive battery. The operation of relay 313 will also close a circuit, from ground, through the right-hand inner armature and front contact of relay 313, through resistances 329 and 327, lower winding of relay 312, through relay 311 armature and right-hand contact, resistance 333 to positive battery. The operation of relay 303 in Fig. 3 will extend the transmission conductor of the line circuit, through the position circuit of Fig. 4 back to the repeater in Fig. 3. This circuit may be traced, from the ring of plug 301, through the upper middle front and back contacts of relay 303, through the back and front contacts associated with the upper middle armature of relay 309, into Fig. 4, through the upper armature and break contact of key 402, key 402 being unoperated, through the right-hand upper and lower break contacts of key 401, key 401 being unoperated, the upper winding of relay 419, through break key 421, the sending contacts 422, the left-hand lower and upper break contacts of key 401, back into Fig. 3, through the front and back contacts associated with the upper outer armature of relay 309, through the upper winding of relay 311, the armature and right-hand contact of relay 312, resistance 331 to positive battery. The other side of the repeater is closed, from positive battery, through resistance 333, right-hand contact and armature of relay 311, upper winding of relay 312, resistance 326, break contacts associated with the upper outer armature of relay 315, upper outer and inner armatures and back contacts of relay 317 in parallel, break contacts of the make-before-break combination associated with the upper middle armature of relay 319, right-hand outer make contact and armature of relay 313, resistance 333 to positive battery. The operation of relay 303 will also open the path from plug 301 sleeve, heretofore traced, the break contacts of the make-before-break combination associated with the upper inner armature of relay 303, through the lower armature and front contact of relay 305, upper winding of relay 410 and relay 411 winding. The operation of relay 303, further, transfers the sleeve connection of plug 301, through the upper inner front contact and armature of relay 303, resistance 323, through the winding of relay 304 to battery, operating relay 304. The operation of relay 304 furnishes ground, through its single

front contact and armature, to hold relays 303 and 313 operated, under control of the plug 301. The operation of relay 303, also transfers the tip of plug 301, from the busy test lead to the busy test relays, 406 and 407 in the position circuit, Fig. 4, to the winding of relay 306 in the cord circuit.

If an operator at another position has inserted a cord into a multiple jack associated with the same line, so that the cord which we are considering is a second or subsequent cord to answer the call, the condition on the sleeve of the associated jack will be changed, in a manner well known in the art, due to the connection of the interfering cord or cords. Under these circumstances, relay 410 will not operate to its right-hand contact. Relay 411 will, however, operate in turn operating relay 405. When relay 405 operates, a circuit will be closed from ground through relay 405 front contact and armature, relay 410 armature and left-hand contact, relay 409 winding, lower front contact and armature of relay 411, resistance 426, to battery, operating relay 409. When relay 409 operates, positive battery is connected through relay 409 lower outer front contact and armature, through the upper inner front contact and armature of relay 309, to the transmitting conductor of the cord at the ring of plug 301. The circuit will be extended from the ring of plug 301 of the second and subsequently connected cords, if any, through the ring circuit of the multiple jacks, into the ring of plug 301 of the first cord, over the communication circuit, through the cord and position circuit of the first cord, to meet positive battery through resistance 331. This deenergizes the line and releases relay 419. When the line is deenergized it is impossible to transmit by operating key contacts 422 and receiving relay 419 is maintained permanently on its right-hand or spacing contact. The operator at the first position will be unable to communicate, because her keyboard is locked, even though her communication circuit is otherwise complete. As the 303 relays of the second and subsequent cords do not operate, the transmission circuits for these cords and the associated position circuits are open, and the operators at these positions cannot communicate with the subscriber.

When relay 409 operates in the second and subsequently connected cords, if any, a circuit is closed from ground, through the lower inner armature and front contact of relay 407, through lamp 413 and resistance 425 to battery. This is a signal for these cords to be disconnected. Disconnection removes positive battery on the ring or transmitting conductor of the first cord, unlocking the associated position keyboard and the calling subscriber and operator at said position may communicate. It is to be observed that the relays which perform the lockout function, namely, relays 405, 409, 410 and 411, are located in the position circuit, Fig. 4 and are therefore required only once per position since Fig. 4 is common to all cords at a particular position, being associated with a particular cord only while the typing key 303 of that cord is operated. After the called number has been passed to the operator and the operator has extended the call to the succeeding switchboard and the subscribers are in communication, the operator disconnects her position circuit from the particular cord and the position circuit is available for connection to another cord.

The operation of the receiving relay 419 and

its associated apparatus will now be described in detail. It has been explained that key 415 in the position circuit per Fig. 4 is operated whenever the position is occupied. When key 415 is operated, negative battery is furnished through its upper armature and front contact, resistance 432, lower winding, which is the biasing winding, of polar relay 419 to ground. When current flows through both windings of relay 419, the relay armature is operated to engage its left-hand contact. When the path through the upper winding of relay 419 is open or when it is connected to battery of the same polarity at each end, the relay armature will be operated to its right-hand or spacing contact under the influence of its biasing winding. When the armature of relay 419 is on its left-hand or marking contact, relay 418 is operated over a path from negative battery, through the front contact and lower armature of key 415, resistance 416, winding of relay 418 to positive battery, operating relay 418. When relay 419 is on its spacing contact, the path through relay winding 418 is shunted to positive battery through the spacing contact and armature of relay 419 to positive battery. Relay 418 is slow to release, and is held operated on ordinary spacing signals, releasing only when the relay 419 armature remains on its spacing contact for a relatively longer interval, as when a break signal is sent. With relay 418 operated and relay 419 on its left-hand or marking contact, a circuit may be traced from positive battery, through relay 419 armature and left-hand contact, armature and front contact of relay 418, printer magnet 420 winding, resistance 417, lower armature and front contact of key 415 to negative battery, operating printer magnet 420. When relay 419 armature is operated to its right-hand or spacing contact, the path through printer magnet 420 is open and the magnet releases. Magnet 420 will therefore follow the marking and spacing signals of relay 419. During a break signal, or when the lockout device operates to prevent the first operator from communicating and relay 419 remains on its right-hand or spacing contact, relay 418 releases. Positive battery is then connected through the make-before-break contacts of relay 418 to printer magnet 420 to hold the magnet energized and prevent spinning.

Under certain special circumstances, although the board at which cords per Fig. 3 and position circuits per Fig. 4 are located will be used to extend outgoing calls only, it may be necessary for an operator at said board to call a local subscriber connected to said board. To do this the operator will first operate key 308 of a cord, Fig. 3 and then test the subscriber's line jack to see if the line is busy at some one of the positions in the same switchboard, on a call originated by the subscriber in which he is the calling party, or at some position in the associated switchboard, on a call in which he is the called party.

If the line is busy, due to one of such calls, there will be negative potential impressed on the sleeve of all multiple jacks, due to the cord already connected to the line. The operator will first operate key 308 of a particular cord, and touch the tip of plug 301 connected to said cord to the sleeve of the jack associated with the line she wishes to call. A circuit will thus be closed, from negative potential on said sleeve,

through the tip of plug 301, the upper outer armature and back contact of relay 303, the relay being unoperated, the lower armature and front contact of key 308 into Fig. 4, through the upper armature and back contact of relay 411, relay 411 also being unoperated, through relay 407 winding to ground. Relay 407 is a polar relay, operating on negative potential. It will therefore operate, closing a circuit from ground, through its armature, lamp 413, resistance 425 to battery, lighting lamp 413, indicating a busy line.

When a subscriber's line is out of order it is a practice to so arrange the line that an operator making a busy test on said line may be informed of the out-of-order condition. This is performed by imposing on the sleeve circuit of said line a condition differing from the busy condition. An out-of-order cord, not shown, is plugged into any one of the jacks associated with the subscriber's line which is out of order. Positive battery is connected to the sleeve of the plug of said cord. The sleeves of all of the jacks connected to the line both in the originating board and in the completing board are multiplied together. The positive battery condition on the sleeve is therefore available wherever a jack appears. When an operator tests the line under these circumstances by touching the tip of plug 301 to the sleeve of the jack, relay 406 operates. Relay 406 is a polar relay in parallel with relay 407 and operates on positive potential. The operation of relay 406 in turn operates relay 408 and lights lamp 413 over an obvious circuit. The operation of relay 408 in turn operates buzzer 412. The operation of the buzzer and the lighting of the lamp together indicates an out-of-order as distinguished from a busy condition.

If the line is neither busy nor out of order, the operator will insert plug 301 into the line jack. Ground on the tip of the jack will operate relay 306. Relays 303, 304, 305 and 309 will operate as heretofore described. A circuit will be closed from negative battery through resistance 339, left-hand outer armature and make contact of relay 313, upper armature and make contact of relay 306, lower armature and front contact of relay 309 into Fig. 4 to the lower armature of key 402 to terminate the repeater over a circuit heretofore traced. The operator will then operate key 402 in Fig. 4. The operation of key 402 will close a circuit from ground through a source of ringing voltage 414, through the upper front contact and armature of key 402 into Fig. 3, through the make-before-break contact combination associated with the upper middle armatures of relays 309 and 303 in series, to the ring of plug 301, where it is extended through the ring of the subscriber's line jack to the subscriber's line, to operate the subscriber's station ringer in any of a number of well-known manners. The operation of key 402 will also remove the negative battery furnished from relay 313 to terminate the repeater and apply terminating negative battery directly through the make-before-break contact combination of key 402 over the transmission conductor through the position and cord circuit, heretofore traced to positive battery on the right-hand contact of relay 312 to hold the calling end of the line closed. This transfer is made during ringing to guard against the opening of the repeater when the subscriber answers and the ground on the tip of the line jack is removed which would release relay 306 and remove the

negative battery opening the repeater and sending a false signal toward the calling side of the cord.

In extending a call, the cord circuit per Fig. 3 may be connected either to a long distance trunk to a distant office, or to a local trunk to a switchboard in the same office for completion to a local subscriber. The connection to the long distance, or toll trunk as it is otherwise known, is the more frequent and the manner in which Fig. 3 functions on such a connection will be described first. The long distance trunk itself, with which the cord functions, is not new, and, as it operates in its usual well-known manner, it is not shown, as it is not necessary to an understanding of the invention herein.

When the operator has received the number of the desired subscriber, and a toll connection is required, she will insert the calling cord plug into the toll line jack, if idle, as indicated by the idle indicators, associated with the toll line trunk jack. Ground is connected to the sleeve of the trunk jack. A circuit will be closed from this ground through the sleeves of the jack and plug 321, resistance 324, winding of relay 320 to battery, operating relay 320. Relay 320 operated, closes an obvious circuit to operate relay 319. The operation of relay 319 will disconnect the transmission lead from negative battery, through resistance 338, and connect it, through the front contact and middle armature of relay 319, the ring of plug 321, over the transmitting conductor of the toll trunk, to the distant office. The operation of relay 319 also transfers the tip of the cord, from the lead to the busy test and out-of-order relays, to a path, through the right-hand armature and lower contact of key 314, relay 317 winding, to battery. Relay 317 does not operate at this time, however, as the tip connection is open in the trunk circuit. The operator now calls over the toll trunk, by operating the left-hand armatures of non-locking key 314. A circuit will thereupon be closed, from ground, through the front contact and bottom armature of key 314, through relay 315 winding, to battery, operating relay 315. The operation of relay 315 will open the line towards the toll line and close negative battery through resistance 338, upper outer armature and front contact of relay 315, resistance 326, upper winding of relay 312, armature and right-hand contact of relay 311, resistance 333 to positive battery, to hold the repeater and the subscriber's line in the marking condition. The operation of key 314 will also furnish battery, through its front contact and top armature, to the winding of relay 316, but relay 316 will not operate as the connection to ground is open at relay 317, which is unoperated. The open to the toll line brings up a lamp at the distant office, in any of a number of well-known manners. When key 314 is restored to normal, relay 315 will release. When the distant operator answers, the circuit is ready for transmission.

If the call is to be completed over a trunk to the switchboard in the same office which completes calls to local subscribers, since Fig. 5 has multiple jack appearances at each end, plug 321 is inserted into jack 501 of the first idle trunk. If a trunk is busy, lamp 502 is lighted, from ground, through a source of potential 504, through lamp 502 to ground. The chain circuit which controls the idle indicating feature, indicated by 525, is well understood in the art, and functions in its well-known manner. Upon plugging in, a circuit is closed, from battery, through

relay 320 winding in Fig. 3, resistance 324, sleeve of plug 321 into Fig. 5, sleeve of jack 501, through relay 505 winding to ground, operating relay 505. Relay 505, on operating, furnishes ground, through its bottom armature and front contact, for the parallel circuits, through relay 515 left-hand winding to battery and through relay 517 winding, the left-hand break contacts of the make-before-break contact combination on relay 516 to battery, operating relays 515 and 517. Relay 505 also extends the ring circuit of the cord, which is the communication conductor, through its upper inner armature and front contact, resistance 511, upper winding of relay 506, relay 507 armature and right-hand contact, through resistance 521 to negative battery.

Relay 505 also connects the tip of the trunk to ground, at the upper outer armature and back contact of relay 508. This provides the ground necessary for the operation of relay 317 in the cord over a circuit heretofore traced. The operation of relay 317 lights lamp 322, over a circuit, from ground, through the lower outer front contact and armature of relay 317, through the filament of lamp 322, into the position circuit per Fig. 4 through the winding of relay 403 to battery.

Relay 515, when operated, connects ground, through the inner armature of relay 515, to the lower or balancing windings of relays 506 and 507, through resistances 512 and 514 respectively. The operation of relay 515 also connects positive battery, through resistance 520, right-hand outer armature and front contact of relay 515, the break contacts of the make-before-break contact combination of relay 508, resistance 513, upper winding of relay 507, armature and make contact of relay 506, resistance 523, to negative battery, to hold relay B operated. Relay 517, operated, applies ground to the night alarm, over a circuit, from the left-hand inner armature and front contact of relay 517, through relay 518 winding, to battery, operating relay 518. The operation of relay 518 operates the alarm 519 over an obvious circuit. Relay 517 connects battery, through its left-hand outer armature, in parallel, to the idle indicating circuit, which functions in a well-known manner and through the right-hand armature and back contact of relay 516, through lamp 510 filament, to ground. The answering lamp 510 is lighted as a signal to the operator at the completing board, otherwise known as inward board, to answer the call.

The cord circuit per Fig. 3 of Lane Patent 1,965,383, mentioned above, will serve as the cord circuit at the inward board. This circuit is well known in the art and functions in a well-known manner. It will be used at the inward board to interconnect the incoming end of the local completing trunk per Fig. 5 and the multiple jack of the subscriber's line circuit. This operation will not be described in detail here. But the manner in which the completing trunk functions when this connection is made will now be described.

The inward operator answers by inserting plug of her cord circuit into jack 509. There is battery on the connected sleeve of the inward cord. A circuit is extended from this battery, through the sleeve of jack 509, through relay 503 winding, to ground, operating relay 503. Relay 503, operated, transfers the ring, which is the transmission circuit, from positive battery on the back contact of the make-before-break contact combination of relay 508, to the upper inner armature of relay 508 and extends the circuit, through

the ring of jack 509, into the cord and through a line winding of a repeater relay to positive battery on the marking contact of a repeater relay in the cord.

5 Relay 508, operated, also applies ground through its lower front contact and armature to the right-hand winding of relay 515 and to the winding of relay 516 in parallel, operating relay 516. Relay 515 which is already operated is now
10 under control of both sleeve relays 505 and 508. Relay 508 also disconnects ground from the tip of outward jack 501 and the multiple connection of that jack, to the tip of inward jack 509 and its multiple connections. Relay 516, operated, ex-
15 tinguishes answering lamp 510 and locks up, through its left-hand innermost armature and front contact under control of the bottom front contact and armature of relay 505 and hence re-
20 lays 505 and 508 must both be released before relay 516 will release. Relay 516 also opens the circuit, heretofore traced, through the winding of relay 517 which is slow to release. Before relay
25 517 releases, it connects battery, momentarily, from the left-hand outer armature and front contact of relay 516, through relay 517 right-hand armature and front contact, to the sleeve of
30 jack 501, shunting the battery on the sleeve of the cord Fig. 3, through relay 320 winding and resistance 324, to release relay 320. Relay 320 released, momentarily releases relay 319, which
35 breaks the holding path of the calling cord, flashing lamp relay 318, from battery through the lower winding of relay 318, through the lower outer back contact and armature of relay 316, the
40 top inner front contact and armature of relay 319, through the top inner back contact and armature of relay 305 to ground, by opening the circuit at the top inner front contact and armature of relay 319. This prevents lamp 322 from
45 flashing, if the operator has withdrawn from the connection, for, as will be hereinafter explained, in a description of the cord lamp flashing recall feature, the flashing recall is obtained by momentarily operating relay 317, by providing a momentary ground. This operates and locks the
50 flashing recall relay 318 for the calling cord. Upon the removal of the momentary ground the calling lamp 322 is transferred from the steady ground, on the lower outer front contact and
55 armature of relay 317, to the flashing lamp circuit, from interrupter 310, through the top armature and front contact of relay 318, the lower outer back contact and armature of relay 317, through the lamp filament, to battery through relay 403 winding in Fig. 4. All of the other functions performed by relay 517 are now performed by relay 516 when relay 517 releases.

Relays 506 and 507, with their associated resistances and battery connections, form a tele-
60 graph repeater, which permits the connecting together of two cord repeaters both of which are equipped for positive battery marking. Reference to Fig. 3 and the above description discloses, that when the answering plug 301 is connected to
65 the line jack, and relay 313 is operated, battery flows through both windings of the repeater relays and the repeater assumes the position shown, which is the marking position. With the armature of relays 311 and 312 on their right-
70 hand contacts, positive battery is connected to the line windings of each relay. For the marking condition, therefore, the cooperating repeater connection in the trunk is terminated in negative battery for the marking condition. The
75 cord in the inward board is arranged with posi-

tive battery on the marking contacts of its repeater relays. Therefore the repeater connection in the trunk cooperating with the cord has negative battery on its marking contact. Signals received from the outward board will operate relay 506 which will apply negative and positive battery to the inward board but will not operate relay 507 because of its differential characteristic. Likewise, signals from the inward side will operate relay 507 but will not operate relay 506.

Reference to Fig. 5 discloses that when relays 505 and 508 are operated, the tip connection between the boards is continuous. This path is therefore available for supervisory signaling between operators. When the operator at the in-
15 ward or completing board recalls the outward board, ground is applied momentarily to the tip of jack 509 and then the tip circuit is opened. When the ground is applied a circuit is closed from ground, through the tip of jack 509, the
20 top front contacts and armatures of relays 508 and 505, through the tip of jack 501, into Fig. 3, through the tip of plug 321, the top armature and front contact of relay 319, the right-hand armature and break contact of key 314, through relay
25 317 winding to battery, operating relay 317. Relay 317, operated, operates relay 318 over an obvious circuit and terminates the repeater in the cord in negative battery, through resistance 338 and the distant repeater in positive battery, through
30 resistance 325. Relay 318 operated, locks, through its lower winding over a circuit heretofore traced. When relay 318 releases, a circuit may be traced, from ground, through the interrupter 310, the top armature and front contact of relay 318, the bottom armature and back
35 contact of relay 317, the filament of lamp 322, into Fig. 4, through the winding of relay 403 to battery, flashing the lamp. To stop the flashing, the operator operates her typing key, actuating
40 relay 305 and removing the ground from the holding path of relay 318 at the upper inner armature of relay 305. Relay 318 releases, opening the flashing lamp circuit.

When the inward operator in disconnecting
45 removes the plug of her cord from jack 509, relay 508 will release, applying ground to the tip conductor of the trunk, at the upper outer armature and back contact. This will operate and hold relay 317 in the cord, Fig. 3, and light lamp
50 322 over circuits heretofore traced. The release of relay 508 will also connect positive battery to the line winding of relay 507. The operator at the outward board disconnects plug 321 from
55 jack 501, releasing relays 505, 515 and 516 and restoring the circuit per Fig. 5 to the idle condition. The disconnection may be started in the reverse order, plug 321 being first disconnected, releasing relay 505. This, similarly, places
60 ground on the tip conductor, at the top outer armature and back contact of relay 505, which lights a lamp in the cord at the inward board. The release of relay 505 also connects positive battery to the line winding of relay 506, to hold
65 its armature on its right-hand contact. When the outward cord lamp lights, the plug is disconnected from jack 509. Relays 508, 515 and 516 release, restoring the circuit per Fig. 5 to the idle condition.

The subscriber may recall the operator at the
70 outward board. For this condition ground is connected momentarily to the tip conductor of plug 301, operating relay 306. The operation of relay 306 operates relay 307, from ground on the bottom front contact of relay 306, through the
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bottom armature, upper winding of relay 307, to battery. Relay 307 locks, from battery, through the lower winding of relay 307, the bottom armature and front contact of relay 303, back contact and top armature of relay 305, to ground. This closes a circuit, which remains closed after relay 306 releases, from ground, through interrupter 310, the top armature and front contact of relay 307, the lower inner armature and back contact of relay 306, the filament of lamp 302 into Fig. 4, through the winding of relay 403 to battery, flashing lamp 302. The flashing may be stopped by operating key 308, which in turn operates relay 305, opening the holding path of relay 307 and breaking the circuit of the flashing lamp.

For the subscriber disconnect condition, a permanent, instead of a momentary, ground is connected to the tip of jack 301, operating relay 306, which remains operated and closes a circuit, from ground on the lower inner front contact of relay 306, through the lower inner armature, lamp 302 filament, into Fig. 4, through the winding of relay 403, to battery, lighting lamp 302 and operating relay 403, which in turn operates the alarm over an obvious circuit.

The functioning of the cord circuit per Fig. 3 on recall and disconnect signals received from a toll trunk is the same as described for the local completing trunk.

It has been shown that for flashing on either end of the cord, the locking path through the flashing relays is completed to ground through a contact on relay 305. This path is available only when relay 305 is released. The relay is under control of typing key 308, being operated whenever the key is operated. Therefore, when the typing key is operated, neither lamp 302 nor 322 can be flashed. Flashing under these circumstances is unnecessary, because the operator's position circuit is connected into the circuit by the operation of typing key 308 and is available for communication. The position circuit is equipped with a splitting key 401, which is arranged to split the cord and connect the operator's teletypewriter equipment to either the calling or answering end of the cord, while terminating the opposite end in battery of the proper polarity. When the cord is so split the end of the cord to which the position circuit is not connected may be flashed. This is performed in the following manner.

For splitting the cord and connecting the position teletypewriter equipment to one side or the other, typing key 308 is first operated, operating relays 305 and 309. To communicate with the subscriber, the left-hand armatures of key 401 are actuated. This connects negative battery through resistance 431, the left-hand upper armature of key 401, into Fig. 3, through the upper outer make-before-break contacts of relay 309, upper winding of relay 311, armature and right-hand contact of relay 312, resistance 331, to positive battery, holding relay 311 on its right-hand or marking contact. The operation of the key also connects positive battery, through resistance 430, the left-hand lower armature and front contact of key 401, typing keys 422, break key 421, upper winding of relay 419, right-hand lower and upper break contacts of key 401 in parallel, upper break contact and armature of key 402 into Fig. 3, through the make-before-break contacts associated with the upper middle armature of relay 309, the make-before-break contacts associated with the upper middle armature of relay 303, through the ring of plug 301, and thence over

the transmitting conductor of the subscriber's line. If the right-hand armatures of key 401 are actuated, positive battery is connected to the answering side of the cord and subscriber's line, and negative battery is connected through the position teletypewriter circuit in series with the repeater on the calling side of the line over paths that should be obvious from the circuits last traced. When the cord is split and the position teletypewriter equipment is connected through the answering end of the cord to the subscriber's line, the circuit is arranged so that it is possible to flash lamp 322 associated with the calling end of the cord. This is accomplished by transferring the ground for the holding path of the calling cord flashing relay 318, from the upper inner armature of relay 305, which is not available as it is operated as a result of the operation of the typing key, through the make-before-break contacts associated with the upper inner armature of relay 305, to ground on the left-hand top make contact and armature of key 401 in Fig. 4. Similarly, when the cord is split and the position teletypewriter circuit is associated with the calling end of the cord, it is possible for the subscriber to flash lamp 302 to attract the operator. This is accomplished by transferring ground for the holding path of the answering cord flashing relay 307 from the top armature of relay 305 through the make-before-break contact associated with this armature, to ground through the right-hand top front contact and armature of key 401.

What is claimed is:

1. In a telegraph switching system, a switchboard, a telegraph line circuit connected to said switchboard, a first operator's position and a second operator's position in said switchboard, a jack connected to said line at each of said positions, a first cord circuit and a first operator's circuit at said first position, a second cord circuit and a second operator's circuit at said second position, means in said jack, cord and operator's circuits at said first and at said second position for forming with said line a continuous operable telegraph path, including said line, said first jack, said first cord and said first operator's circuits or said line, said second jack, said second cord and said second operator's circuits, and automatic relay means in said position circuits preventing the establishing of either operable path when both cords are connected to both jacks simultaneously.

2. In a telegraph switching system, a switchboard, a first and a second position at said switchboard, a telegraph circuit connected to said switchboard, a first answering jack at said first and a second answering jack at said second positions connected to said circuit in multiple, a telegraph communication link circuit including one operator's position circuit at each of said positions, means in said links for connecting said link to said jacks at either of said positions to form of said line, link and position circuits, a continuous operable telegraph path, and automatic relay means in said position circuits cooperating to make both paths inoperable when both of said links are connected to said jacks simultaneously.

3. In a telegraph system, a switchboard, an operator's position at said switchboard, a telegraph circuit connected to a jack in said position, a plurality of cord circuits, and an operator's position circuit at said position, a telegraph communication path in each of said cord circuits, a

telegraph communication path in said position circuit, means in said cord and position circuits for connecting said position circuit individually to any one of said cord circuits, independent automatic relay means in said position circuit cooperating with relay control means connected to said jack for interconnecting or preventing the interconnection of said telegraph circuit, one of said cord circuits and said position circuit to form an operable telegraph path when one of said cords is inserted in said jack.

4. In a telegraph switching system, a switchboard, a plurality of operators' positions at said switchboard, a plurality of communication link circuits at a plurality of said positions, a continuous communication channel through each of said links, a position circuit at each of said positions, a communication channel in each of said position circuits, means in said circuits for dividing any of said link channels and means for connecting said position channel in said division to form with said link channel a continuous operable telegraph path at each position, a telegraph circuit connected to said switchboard, a plurality of jacks connected to said telegraph circuit, one of said jacks at each of said positions, automatic relay means also in said position circuits barring the interconnection of any of said continuous operable paths when more than one of said links is connected to said jacks simultaneously.

5. In a telegraph switching system, a switchboard, an operator's position in said switchboard, a plurality of cord circuits and a single operator's circuit individually connectable to said cords at said position and an operator's lockout device in said position circuit.

6. In a communication switching system, a line circuit, a plurality of jacks in multiple connected to said line circuit, a plurality of cords connectable individually to said plurality of jacks, a plurality of operators' circuits connectable individually to said cords, said line circuit cooperating with any of said cords and its associated operator's circuit to form an operable communication path, and automatic relay means in said operators' circuits preventing communication over any of said paths while more than one cord is connected to said jacks.

7. In a communication switching system a plurality of cord circuits, a plurality of operators' circuits connected to said cord circuits individually, and automatic relay lockout means in said operators' circuits to prevent interference between operators when said cords are interconnected.

8. In a teletypewriter switching system, a first central station, a second central station, a third central station, a first and second switchboard in said first central station, a plurality of subscribers' stations associated with said first central station, a plurality of subscribers' line circuits connecting said subscribers' stations and said first central station, a plurality of answering jacks and line signals connected to said line circuits in said first switchboard, a plurality of calling jacks connected to said line circuits in said second switchboard, a plurality of long distance trunk circuits connecting said first switchboard and said second central station, a plurality of long distance trunks connecting said third central station and said second switchboard, a plurality of local trunks connecting said first and said second switchboards, universal cord circuits at said first switchboard for extending long distance calls from said answering jacks to said long distance

trunks, and for extending local calls from said answering jacks to said local trunks to said second switchboard and a plurality of universal cord circuits at said second switchboard for completing calls from said local trunks through said calling jacks to said subscribers' stations and for completing calls from said long distance trunks from said third central station through said calling jacks to said subscribers' stations.

9. In a manual teletypewriter switching system comprising a plurality of local subscribers' stations in a first local area connected individually over telegraph circuits to calling signals and to answering jacks at a first switchboard and to completing jacks at a second switchboard, both of said switchboards at a first central station, manual cord circuits at said switchboards, local trunks connecting said switchboards, a plurality of other subscribers' stations connected to switchboards in other areas remote from said first area and long distance trunk circuits connecting said switchboards directly or in tandem, the method of operation which comprises: (1) switching manually all calls originating in said first switchboard intended for subscribers in the local area served by said first central station to said second switchboard; (2) switching manually all local calls incoming to said second switchboard to the called party's completing jack; (3) switching manually all calls originating in said first switchboard intended for subscribers in remote areas directly from said first switchboard to switchboards in said remote areas over long distance trunks and (4) switching manually all calls originating in remote areas and incoming over long distance trunks to said second switchboard and intended for subscribers served by said first central station directly from said trunks to the called party's completing jack.

10. In a manual teletypewriter switching system comprising an originating and a completing switchboard in one local area and a plurality of switchboards in remote areas connected to said originating and completing switchboards directly by long distance trunks, the method of handling local and long distance calls which comprises: (1) switching all local calls from an originating to a completing switchboard; (2) switching all long distance calls from said originating switchboard directly to a completing or through switchboard in a distant area; (3) completing all calls intended for subscribers in a local area whether originated locally or in a distant area in a separate completing switchboard.

11. In a manual teletypewriter switching system comprising a central station equipped with a first and a second switchboard, the method of traffic operation whereby all outgoing calls only both local and long distance are interconnected from line circuits through cord circuits to trunk circuits at said first switchboard and all incoming calls only both local and long distance are interconnected from trunk circuits through cord circuits to subscribers' line circuits for completing calls and trunk circuits for through long distance calls at said second switchboard.

12. In a teletypewriter switching system, a first telegraph station, a second telegraph station, a four-wire telegraph trunk circuit connecting said stations and a single line repeater in said circuit.

13. In a teletypewriter switching system, a first switchboard, a second switchboard, a four-wire telegraph trunk circuit connecting said switchboards, a single line telegraph repeater in said trunk and a supervisory wire in said four wires,

continuous between switchboards, when said trunk is in condition for communication.

14. In a teletypewriter switching system, a first switchboard, a second switchboard, a jack and a
5 signal at said first switchboard, a jack and a signal at said second switchboard, trunk relay equipment intermediate said jacks, a tip, a ring,

a sleeve and a signal conductor connecting said jacks and said lamps at said first and said second switchboards with said relay equipment and a single line telegraph repeater in said relay equipment.

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