June 29, 1937. C. V. COLLINS 2,085,637

TELETYPEWRITER EXCHANGE SYSTEM

Filed Nov. 14, 1936 4 Sheets-Sheet 1

FIG. 3

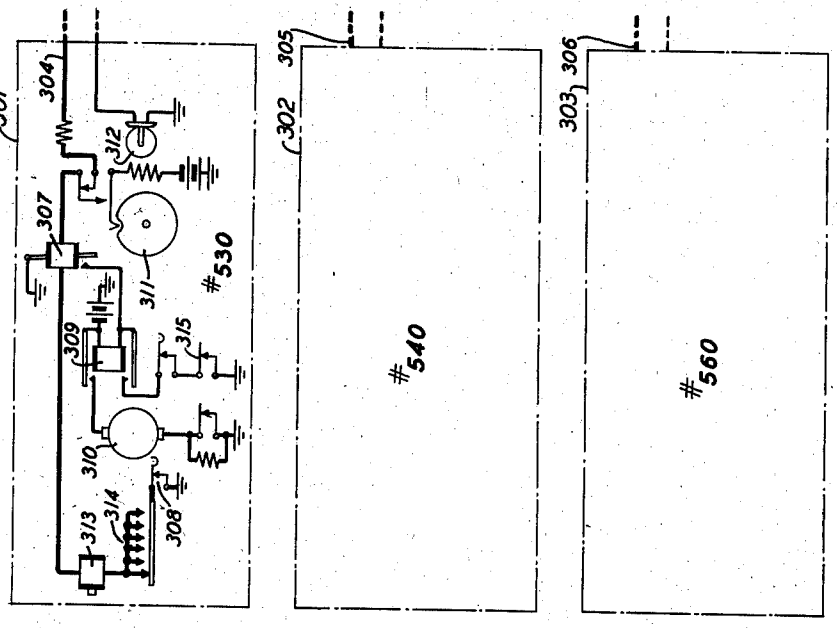


FIG. 1

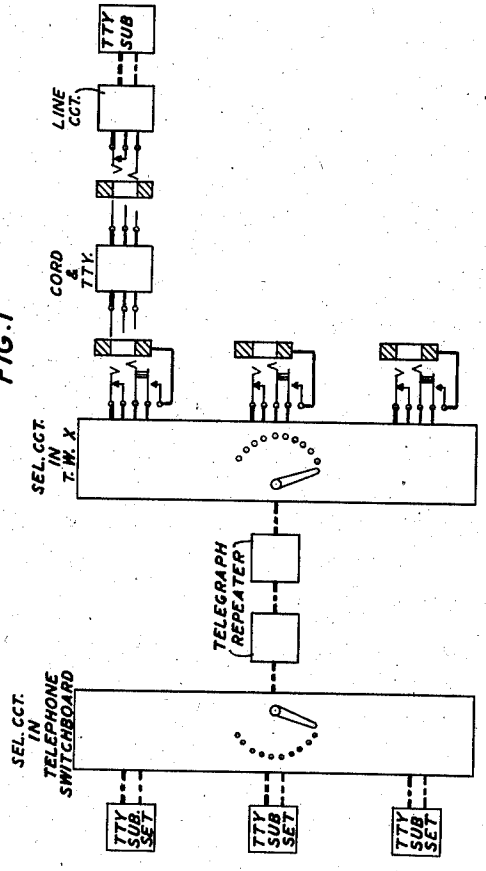


FIG. 2

FIG. 6
FIG. 5
FIG. 4
FIG. 3

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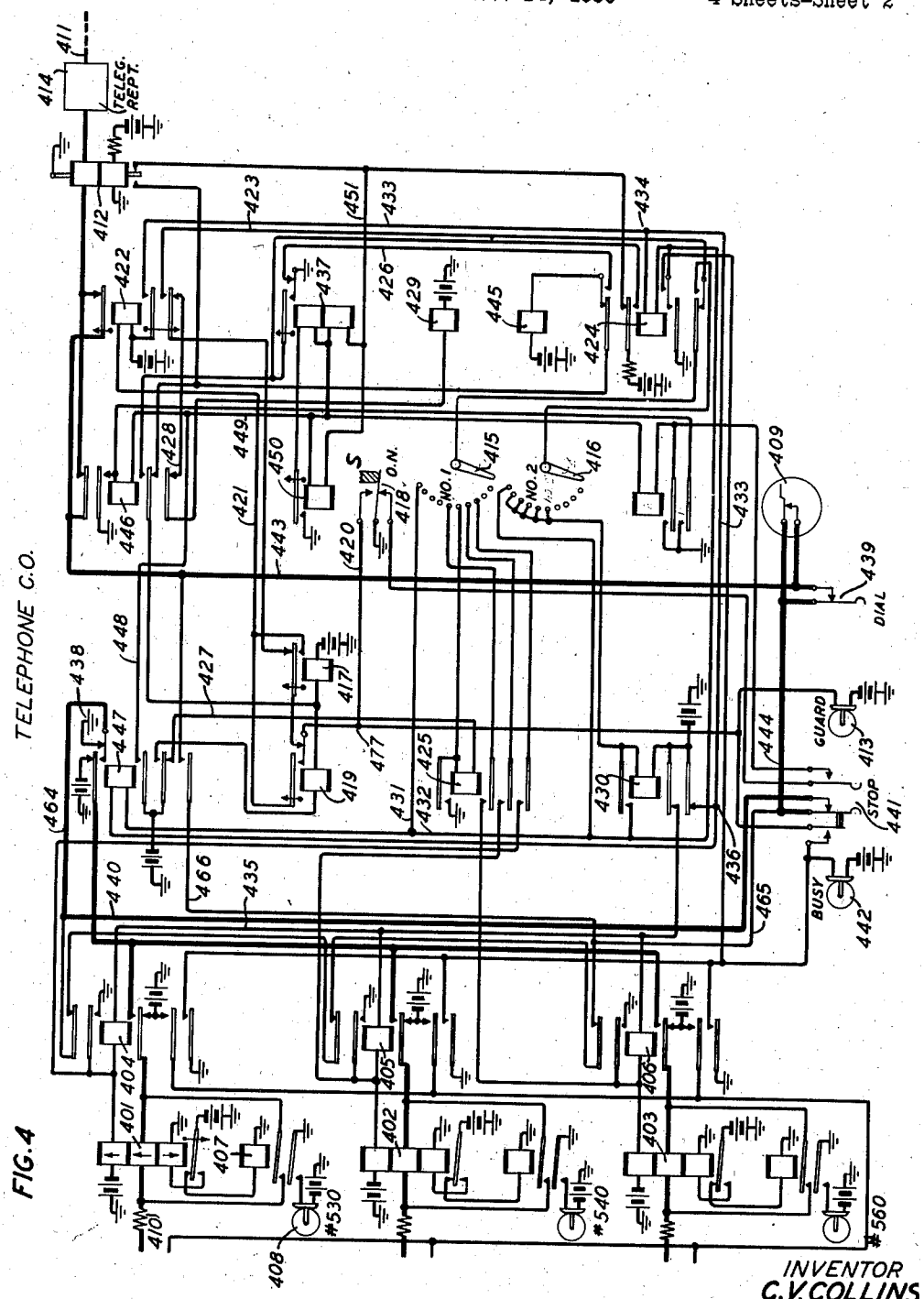


FIG. 4

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TELETYPEWRITER EXCHANGE SYSTEM

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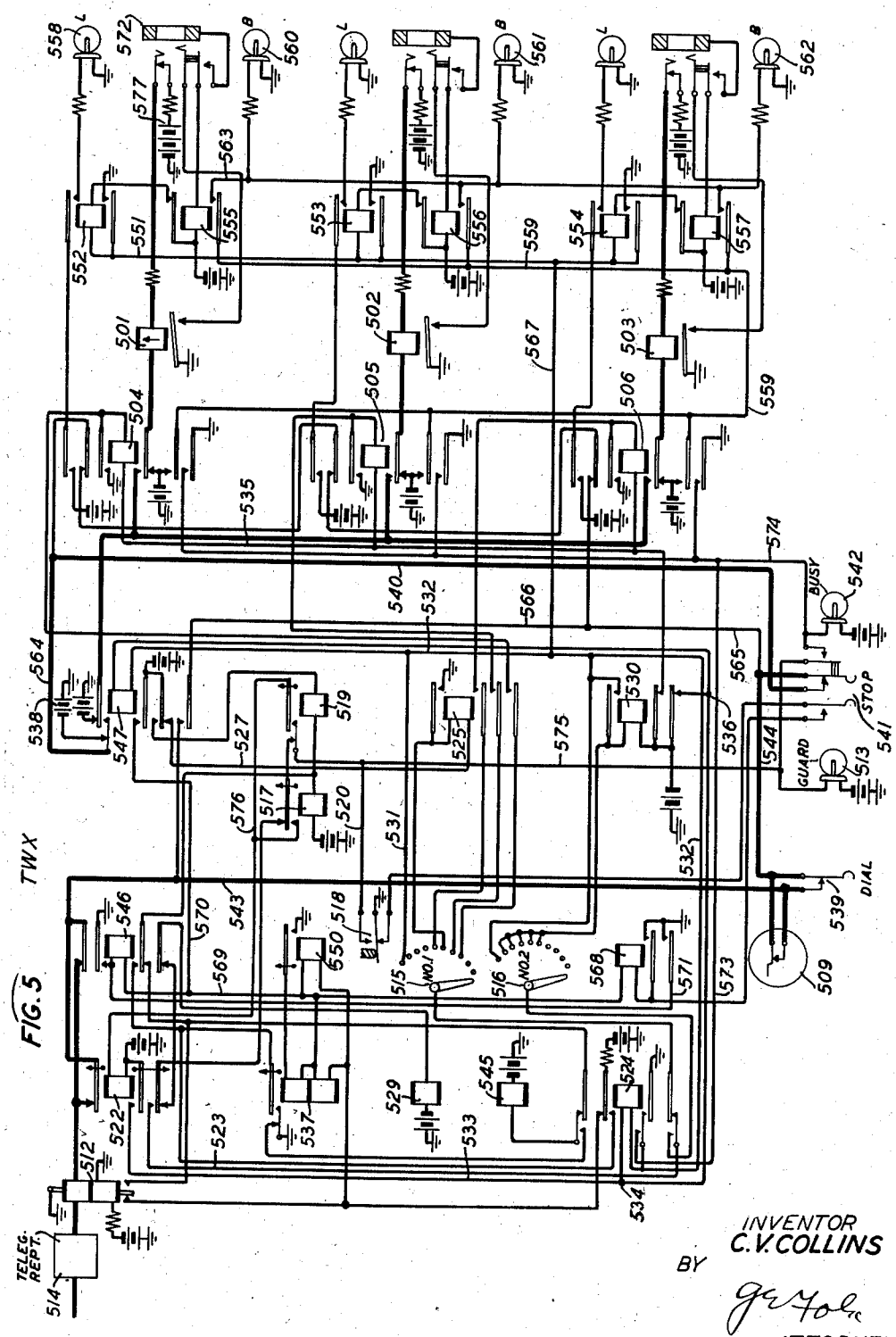


FIG. 5

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TELETYPEWRITER EXCHANGE SYSTEM

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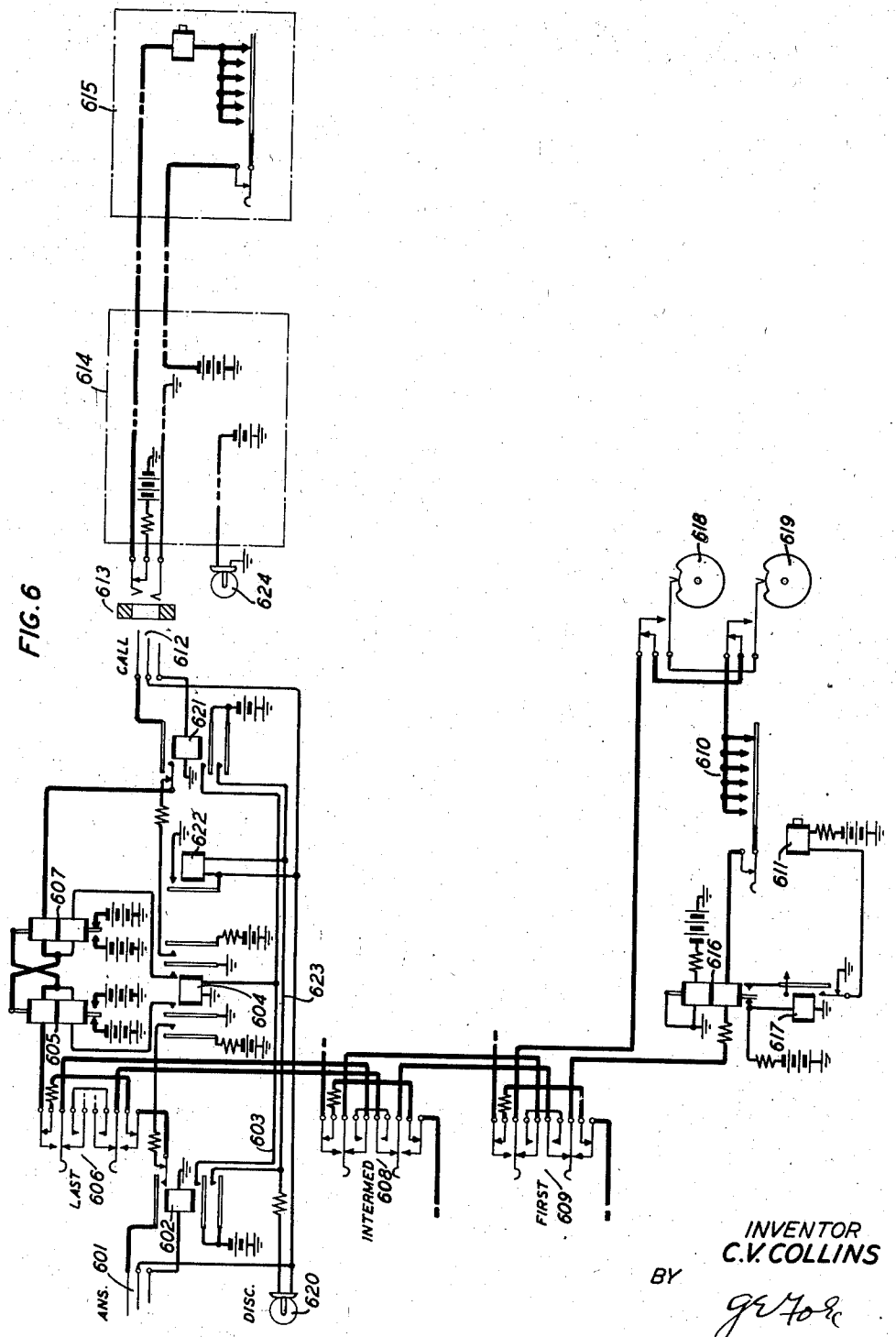


FIG. 6

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UNITED STATES PATENT OFFICE

2,085,637

TELETYPEWRITER EXCHANGE SYSTEM

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Application November 14, 1936, Serial No. 110,922

4 Claims. (Cl. 179—4)

This invention relates to telegraph systems and more particularly to a system arranged to operate in conjunction with a telephone exchange office located at a distant point from the teletypewriter exchange office, for establishing communication connections with teletypewriter subscribers' stations.

An object of the invention is to furnish teletypewriter exchange service to a town having a small number of teletypewriter subscribers' stations to which connections are established through a local central office telephone switchboard.

According to the present invention a system is provided for furnishing teletypewriter service to more than one subscriber at an outlying point, over a lesser number of telegraph lines, or channels, extending from a teletypewriter switchboard. The connections between the teletypewriter subscribers' stations and the teletypewriter switchboard are established by an operator at the telephone central office switchboard located nearest to the outlying point. When a call is originated by a subscriber at an outlying teletypewriter station a lamp associated with the subscriber's line and located at an operator's position in the telephone office switchboard, lights. If the associated telegraph line or lines to the teletypewriter switchboard are not busy, the operator dials the number of the calling teletypewriter subscriber's station. The number consists of one or more digits and is shown on a plate associated with the lighted lamp. Dialing the last digit of the number connects the calling subscriber's line to a telegraph channel and a lamp located at the teletypewriter switchboard, lights, indicating the number of the teletypewriter subscribers at the outlying point that desires service. Upon receiving the line lamp signal at the teletypewriter switchboard the teletypewriter operator connects her teletypewriter to the telegraph line, using her cord circuit, and proceeds to transmit a code informing the subscriber that he is prepared to receive the number of the called teletypewriter subscriber's station or the message. Disconnection is effected by the calling subscriber operating a call-disconnect key, momentarily opening the line circuit, thereby causing the operation of a supervisory lamp at the operator's position in the teletypewriter switchboard. The operation of the supervisory lamp is a signal for the teletypewriter operator to cut in on the line with customary challenge and if there is no response, to operate the stop key and then disconnect. The operated equipment at the telephone central office and the teletypewriter exchange is then automatically restored to normal.

A preferred embodiment of the invention will now be described in more detail with reference to the accompanying drawings in which like parts in similar circuit arrangements are identified by corresponding reference numerals in the 400 and the 500 series, respectively.

Referring to the drawings:

Figure 1 shows a diagrammatic layout of the complete system wherein three teletypewriter subscriber stations are connected to an outlying manually operated telephone central office. Facilities are provided at the switchboard in the telephone central office for connecting any one of the three teletypewriter subscriber stations to an associated channel line extending to a teletypewriter exchange. At the teletypewriter exchange are provided for interconnecting by means of any one of a plurality of cord circuits, the associated channel and any one of a plurality of teletypewriter subscriber stations associated with all other teletypewriter exchanges. Also calls originating in any one of the teletypewriter subscriber stations connected with a teletypewriter exchange may be established through the associated teletypewriter exchange, over an associated channel line and through the telephone central office to any one of the teletypewriter subscriber stations connected to a distant telephone central office.

Fig. 2 is a relative arrangement of Figs. 3 to 6;

Fig. 3 represents three teletypewriter subscriber stations to which are respectively assigned code numbers 530, 540, and 560. The station having code number 530 is shown in detail and the stations having code numbers 540 and 560, respectively, are shown in diagrammatic form;

Fig. 4 shows three line circuits respectively extending from the teletypewriter subscriber stations of Fig. 3 and terminating in a selector circuit at the telephone central office whereat a telephone operator may upon receipt of a calling signal connect the calling line circuit to an associated channel extending to the distant teletypewriter exchange whereat a selector circuit similar to that at the telephone central office, is also operated, the operation of both selector circuits being simultaneous;

Fig. 5 shows a channel terminating at the distant teletypewriter exchange whereat the selector circuit extends it automatically to any one of the associated spring jacks in a manually operated switchboard. By means of a teletypewriter operator's cord circuit, the connection continued

through the selector circuit is extended to the called teletypewriter subscriber station; and

Fig. 6 shows a teletypewriter operator's cord circuit, a calling spring jack and a teletypewriter subscriber station for connection thereto through selector circuit shown in Figs. 4 and 5, to the called teletypewriter subscriber's station.

Referring to Fig. 3 whereat three teletypewriter subscriber stations **301**, **302**, **303** are shown as representing those having code numbers 530, 540, and 560, respectively, the three stations are shown respectively connected by line circuits **304**, **305**, and **306** extending to the selector circuit at the telephone central office. The selector circuit is similar to that disclosed in United States Patent 1,946,216 granted to F. S. Kinkead, October 6, 1934, except for a few minor changes required to adapt it to the system described herein. A selector circuit is common to the three line circuits except for the line relays **401**, **402**, and **403** and the subscribers' busy relays **404**, **405**, and **406**, the relays of both groups being respectively individual to the line circuits **304**, **305**, and **306**. Relays **404**, **405**, and **406** correspond to relays "P" in the Kinkead patent, supra, wherein only a single "P" relay is required.

For the purpose of describing the invention it is assumed herein that a call is initiated at station **301** to a subscriber's station connected to a distant teletypewriter exchange shown in Figs. 5 and 6 of the drawings, the called subscriber's station being station **615**. The line circuit **304** is normally closed and relays **307** and **401** of Figs. 3 and 4 are normally operated. The subscriber's station **301** in initiating the call momentarily operates start key **308** and then operates the call-disconnect key **311** by turning the handle in a clockwise direction as far as possible and then releasing it whereby the line circuit **304** is opened for a period of five seconds to allow the release of relay **401** at the telephone central office. Relay **307** is energized during the open interval of the line, as will be hereinafter described. By means of the make-before-break contact operated by the time key **311**, the teletypewriter set at station **301** is maintained in a closed circuit during the open interval caused by key **311**. The release of relay **401**, Fig. 4, at the telephone central office releases at its armature and contact signal relay **407**. Signal relay **407** releases to thereby light lamp **408** at the telephone switchboard at the central office. Signal relay **407** in operating shunts relay **401** so that the latter relay remains released when the call-disconnect key **311** again closes the line circuit after the five-second interval. Relay **401** through its lowermost winding is now energized by an obvious auxiliary circuit extending over its armature and back contact to battery to thereby hold the relay in a released position. The line circuit is now closed through to the telephone central office through resistance **410**, back contact and inner lower armature of relay **407**, innermost lower armature and back contact of relay **404** to battery.

Normally all relays of the selector circuits shown to the right of the line relays **401**, **402**, **403** of Fig. 4 and to the left of line relays **501**, **502**, **503** of Fig. 5, except relays **412** and **512**, are in their released position. Relays **501**, **502**, and **503** are normally in their operated position.

The operator at the outlying telephone central office upon observing the lighted lamp **408**, which has a number plate associated therewith bearing the numeral 530, the code number of calling station **301**, operates dial key **439** which is of the non-locking type, and proceeds to operate dial **409** to send the three digits of the code number 530 of station **301**. However, should the associated channel circuits extending through the teletypewriter exchange be busy, one of the busy relays **404**, **405**, and **406** would be operated and therefore busy lamp **442** at the telephone central office and the supervisory lamp, such as lamp **312** at each of the subscribers' stations **301**, **302**, and **303** would be lighted indicating that the calling subscriber at station **301** must wait for an idle condition of a channel circuit. Guard lamp **413** may also be lighted if the associated channel circuit **411** is busy, and selector switch S_1 is at the time in an off-normal position.

In response to the transmission of the five pulses representing the first digit of the code number of the calling station, relays **412** and **512** follow the pulses and respectively apply ground intermittently to the rotary magnets **413** and **513**. These magnets operate comparatively simultaneously taking into consideration the delay factor, or lag, necessitated by transmission through the signal repeaters **414** and **514**. Repeaters **414** and **514** may be of any suitable type well known in the art, such as those disclosed in United States Patent 1,479,430 granted to J. M. Fell on January 1, 1924. The operating circuit for the relays **412** and **512** may be traced from ground **438**, make-before-break contact of relay **447**, conductors **464** and **440**, normally closed contact of stop key **441**, conductor **444**, dial **409**, (dial key **439** is held operated while dialing) conductor **443**, outer upper armature and contact of relay **446** and upper armature and contact of relay **422** in parallel, through the upper winding of relay **412**, telegraph repeater **414**, associated channel line **411**, telegraph repeater **514**, through the upper winding of relay **512**, contact and upper armature of relay **522**, contact and outer upper armature of relay **546** in parallel, conductor **543**, contact of dial key **539**, conductor **544**, normally closed contacts of stop key **541**, conductors **540** and **564**, make-before-break contact of relay **547** to grounded negative battery **538**.

The operation of the selector circuit shown in Fig. 4 will be described first. The ground applied over the left contact and armature of relay **412** during each open period of the line circuit **304** is extended over parallel paths, one through the winding of rotary magnet **413** to grounded negative battery and the other over the back contact and inner lower armature of relay **446**, through the winding of relay **417** to grounded battery. The wipers **415** and **416** of the selector switch S_1 will be stepped up one contact, or terminal, for each pulse of relay **412**, but relay **417** which is of the slow-release type will remain operated for the duration of the five pulses. The off-normal spring **418** will transfer ground from its lower to its upper contact on the first step of the selector switch S_1. Relay **417** in operating closes a circuit extending from ground on the upper contact of off-normal spring **418**, conductor **420**, normally closed contact of relay **419**, armature and front contact of relay **417**, conductor **421**, through the winding of relay **422**, to grounded battery, thereby operating relay **422**. Relay **422** also is of the slow-release type and remains operated for the duration of the five pulses. After the last, or fifth, pulse relay **417** will release and apply ground to a circuit extending from conductor **420**, normally closed contact of relay **419**, armature and

back contact of relay 417, outer lower armature and front contact of relay 422, conductor 423, back contact and outer lower armature of relay 424, wiper 415, resting on the fifth terminal of bank No. 1 through the winding of relay 425, conductor 427, back contact and outer lower armature of relay 447 to grounded battery. Relay 425 operates and locks to ground over its upper armature and contact. When stepper switch S_1 is operated, ground conductor 428 is connected to guard lamp 413 indicating to the operator that the switch is functioning and it is in off-normal position.

After the last, or fifth, pulse slow-release, or non-pulsing, relay 417 releases and ground is thereby removed from the winding of slow-release relay 422 which, in turn, releases a short time later. Relay 422, in releasing, transfers ground from the circuit including conductor 423, to a circuit including conductor 428, contact and outer lower armature of relay 446, through the winding of release magnet 429, to grounded battery. Release magnet 429 operates and wipers 415 and 416 are restored to their normal positions and off-normal spring 418 transfers ground from its upper contact to its lower contact. Then release magnet 429 is deenergized and the guard lamp 413 is extinguished.

Similarly, when the second digit "3" of the calling code No. 530 is dialed, the wipers 415 and 416 will step up to their respective third terminals on banks Nos. 1 and 2 and guard lamp 413 again lights. Relays 417 and 422 and off-normal spring 418 will again operate as hereinbefore described. Relay 417 will release after the dial 409 returns to its normal position. The release of relay 417 closes a circuit traceable from ground at the armature and upper contact of off-normal spring 418, normally closed contacts of relay 419, armature and back contact of relay 417, outer lower armature and front contact of relay 422, conductor 423, back contact and outer lower armature of relay 424, wiper 415, in engagement with its third terminal, outermost lower armature and contact of relay 425, through the winding of relay 404, conductor 435, contact and inner lower armature of relay 430, to grounded battery. Relay 404 which is individual to subscriber's station 301 operates and then locks to ground at its inner upper armature and contact. Relay 404, in operating, causes at its outermost lower armature and contact an obvious operating circuit for lighting busy lamp 442. After the release of relay 417, relay 422 releases and thereby closes a circuit for operating release magnet 429 as hereinbefore described. Magnet 429 operates and thereby causes the wipers of the selector stepping switch S_1 and the movable member of vertical off-normal spring 418 to return to normal. The guard lamp 413 is now extinguished. Relay 404 in operating disconnects grounded battery at its back contact and inner lower armature from the line circuit of station 301 and substitutes the grounded battery at the upper armature and back contact of relay 447, in parallel with the operating circuit for relay 404 in the path extending through the uppermost winding of relay 401 to grounded battery. Relay 401 in response to the current in its uppermost winding reoperates thereby causing the reoperation of signal relay 407. Relay 407 in reoperating opens the shunt path around the middle winding of relay 401 and extinguishes lamp 408 because the operator has now only to dial the third digit "0" which is the last digit of the code number of all teletypewriter subscriber stations connected to the distant telephone central office.

Similarly, when the third digit "0" of the code number 530 of the calling subscriber's station No. 301 is dialed, the wipers 415 and 416 will step up to their respective tenth terminals on banks Nos. 1 and 2 and guard lamp 413 again lights. As stated hereinbefore, the response of relay 412 to the dialing pulses in addition to operating the rotary magnet, operates relay 417 which remains operated during the pulsing. The operation of relay 417 operates relay 422. After pulsing is completed, relay 417 releases and closes a circuit extending from ground on the operated vertical off-normal spring 418, normally closed contact of relay 419, armature and back contact of relay 417, outer lower armature and front contact of relay 422, conductor 423, back contact and outer lower armature of relay 424, wiper 415 on its tenth terminal, conductors 431 and 432, through the winding of relay 424, conductor 433, front contact and inner lower armature of relay 422 to grounded battery. A parallel path is closed from connection 434 on conductor 433 to connector 436 also on conductor 433, to the contact and outer lower armature of relay 430, to grounded battery. Another parallel path is closed from connection 436 through the winding of relay 447, conductors 432 and 431, to the tenth terminal on bank No. 1 engaged by the grounded wiper 415. Relays 424 and 447 operate. Slow release relay 422 releases. Relay 424 in operating closes a circuit to ground at its inner lower armature and associated contacts thereby short-circuiting the operating circuit for busy lamp 442 which circuit extends to ground at the contact and outer lower armature of relay 404 and the busy lamp 442 is maintained lighted independently of relay 404. Relay 424, in operating, also closes at its upper make-before-break contact, a circuit extending to ground at the normally closed contacts of relay 437. The grounded conductor 423 at the back contact of the outer lower armature of relay 424 is at this time transferred at the outer lower make-before-break contact of relay 424, from the wiper 415 to the wiper 416 which is in engagement with the tenth terminal on bank No. 2 to hold relays 424 and 447 operated. When relay 447 operated, it effected at its outer lower armature and back contact the release of relay 425, and removed ground at its make-before-break contact from the normally energized associated channel line 411 and substituted the subscriber's line circuit. Relay 447, in operating also short-circuited dial 409 at its outermost lower armature and contact. Relay 447, in operating, performs other functions such as closing a circuit from grounded battery at its inner lower armature and front contact, extending over conductors 448 and 449, through the winding of slow-release relay 450 and the lower winding of relay 437 in parallel, conductor 451, right contact and armature of relay 412 after the tenth pulse, to ground. Relays 450 and 437 operate. Relay 437 in operating locks through its upper winding to ground at the armature and front contact of relay 450 and disconnects ground from conductor 426 and the winding of rotary magnet 413.

The operation of the selector switch shown in Fig. 5 will now be described. As hereinbefore stated, relay 512 follows the three sets of pulses 5—3—10 transmitted by dial 409. In response

to the first pulse of the set of five, the grounded armature of relay 512 moves to its right-hand contact and closes two parallel paths, one extending over a conductor connected to the outer upper armature and back contact of relay 524, through the winding of rotary magnet 513 to grounded battery, and the other over the back contact and inner lower armature of relay 546 to the winding of slow-to-release relay 517 to grounded battery. Rotary magnet 513 operates five times to set wipers 515 and 516 of selector switch S_2 to their respectively associated fifth terminals on banks Nos. 1 and 2. Relay 517 being slow to release, remains operated for the duration of the five pulses repeated by relay 512. In response to the first operation of S_2 the vertical off-normal spring 518 transfers ground from its lower to its upper contact and thereby closes two parallel paths, one extending over the normal contacts of relay 519, armature and front contact of slow-to-release relay 517, through the winding of relay 522 to grounded battery, and the other to grounded battery at guard lamp 513. Guard lamp 513 lights indicating that selector switch S_2 is in an off-normal position. Relay 522 being slow to release, operates and remains operated for a short interval after relay 517 releases. When relay 517 releases at a time when wiper 515 is on its fifth terminal, a circuit is closed from the ground on vertical off-normal spring 518 over its upper contact, normal contacts of relay 519, armature and back contact of relay 517, outer lower armature and front contact of relay 522, conductor 523, back contact and outer lower armature of relay 524, wiper 515 on its fifth terminal, through the winding of relay 525, conductor 527, back contact and outer lower armature of relay 547, to grounded battery. Relay 525 operates and locks at its upper contact to ground. Relay 522 then releases and transfers ground at the upper contact of vertical off-normal spring 518 to the lower armature and back contact of relay 522, contact and outer lower armature of relay 546, through the winding of release magnet 529 to grounded battery. Release magnet 529 operates and restores the wipers 515 and 516 of selector switch S_2 to normal and consequently the vertical off-normal spring 518 is restored to normal, that is, to the lower contact to cause the deenergization of release magnet 529.

Similarly, when the second digit "3" of the calling code number 530 is dialed wipers 515 and 516 will step up to their respective third terminals on banks Nos. 1 and 2 and guard lamp 513 will again light. Relays 517 and 522 and vertical off-normal spring 528 will again operate as hereinbefore described. Relay 517 will release after dial 409 returns to its normal position. The release of relay 517 causes a circuit traceable from ground at the armature and upper contact of vertical off-normal spring 518, normally closed contacts of relay 519, armature and back contact of relay 517, outer lower armature and front contact of relay 522, conductor 523, back contact and outer lower armature of relay 524, wiper 515 in engagement with its third terminal, outermost lower armature and contact of relay 525, through the winding of relay 504, contact and inner lower armature of relay 530 to grounded battery. Relay 504 operates. Relay 504 in operating closes at its outermost lower armature and contact an obvious operating circuit for lighting busy lamp 542 and at its innermost upper armature and contact a locking circuit for itself to ground. Relay 504 in operating also disconnects at its innermost lower armature grounded negative battery from the tip conductor of jack 572 and substitutes therefor the grounded negative battery at the make-before-break contact of relay 547. At its outermost upper armature and contact it connects grounded battery to a conditioning circuit for line lamp 558 which will be lighted after the third digit of the calling code number is dialed, as will be hereinafter described. After release of relay 517, relay 522 releases and thereby closes a circuit for operating release magnet 529 as hereinbefore described. Magnet 529 operates and thereby causes the wipers 515 and 516 of stepper switch S_2 and the movable member of vertical off-normal spring 518 to return to normal. The guard lamp 513 is again extinguished.

Similarly, when the third digit "0" of the calling code number 530 is dialed, the wipers 515 and 516 will step up to their respective tenth terminals on banks Nos. 1 and 2 and guard lamp 513 again lights. As hereinbefore stated, the response of relay 512 to the dialing pulses in addition to operating the rotary magnet 513, operates relay 517 which remains operated during the pulsing. The operating of relay 517 operates relay 522. After pulsing is completed, relay 517 releases and closes a circuit extending from ground at the operated vertical off-normal spring 518, normal contact of relay 519, armature and back contact of relay 517, outer lower armature and front contact of relay 522, conductor 523, back contact and outer lower armature of relay 524, wiper 515 on its tenth terminal, conductors 531 and 532, through the winding of relay 524, conductor 533, front contact and inner lower armature of relay 522 to grounded battery. A parallel path is closed from connection 534 on conductor 533 to connection 536 also on conductor 533, through the contacts and outer lower armature of relay 530, to grounded battery. Another parallel path is closed from connection 536 through the winding of relay 547, conductors 532 and 531 to the tenth terminal on bank No. 1 engaged by grounded wiper 515. Relays 524 and 547 operate and are locked through the front contacts and inner lower armature of relay 524. Relay 524, in operating, closes a circuit from ground at its inner lower armature and contact and thereby short-circuits the path extending to ground at the contacts and outer lower armature of relay 504, and busy lamp 542 remains lighted. Relay 524, in operating, also closes at its upper make-before-break contact a circuit extending to ground at the normal contacts of relay 537 to hold rotary magnet 513 operated. The grounded outer lower armature in engagement with the front contact of relay 522 will be transferred at the outer lower make-before-break contact of relay 524 from wiper 515 to wiper 516 which is in engagement with the tenth terminal of bank No. 2 to hold relays 524 and 547 operated. When relay 547 operated it removed grounded negative battery 538 at its make-before-break contact from the channel line 411 in a normally energized condition, and connected the channel line 411 to the tip conductor of spring jack 572 which at this time is connected to grounded positive battery 577. Relay 547, in operating, closes a circuit extending from grounded positive battery, tip of jack 572, through the winding of relay 501, innermost lower armature and front contact of busy relay 504, upper armature and front contact of relay 547, conductors 564 and 540, normally

closed contact of stop key 541, conductors 565 and 566, outermost lower armature and front contact of relay 547, conductor 543, outer upper armature and contact of relay 546, and upper armature and contact of relay 522 in parallel, through the upper winding of relay 512, telegraph repeater 514, channel line 411, telegraph repeater 414, through the upper winding of relay 412, contact and upper armature of relay 422 and contact and outer upper armature of relay 446 in parallel, conductor 443, front contact and outermost lower armature of relay 447, conductors 446 and 465, normally closed contact of stop key 451, conductors 440 and 464, front contact and upper armature of relay 447, front contact and innermost lower armature of relay 404, through the middle winding of relay 401, subscriber's line 304, break contact of key 311, through the winding of relay 307 and printer magnet 313, sending contact 314, start key 308, to ground. The reversal of current through relay 307 which was effected when grounded positive battery connected over the normally closed contact of the tip spring of jack 572 was connected over the tip conductor, through the innermost lower armature and front contact of relay 504 and upper armature and front contact of relay 547, was connected to conductor 540, operates relay 307 to thereby close and lock the motor control circuit as well understood. Motor 310 operates. Relay 547, in operating, short-circuited dial 509 as will be seen by tracing the circuit just described.

At the time when wiper 516 engages the tenth terminal on bank No. 2 a parallel path is closed extending from grounded wiper 516, conductors 567 and 549, over three other parallel paths respectively extending through the windings of relays 552, 553, and 554, contacts and upper armatures of relays 555, 556, and 557 to grounded battery. Relays 552, 553, and 554 operate and close locking circuits for themselves extending over their lower armatures and contacts to ground. Relay 552 in operating completes a circuit prepared by relay 504 and thereby lights line lamp 558. The teletypewriter exchange operator upon seeing lamp 558 light, inserts the answering plug 606 of the associated cord circuit into jack 572. The sleeve relays 602 and 555 operate in an obvious circuit. Relay 555, in operating, opens at its upper armature and contact the locking circuit for relay 552 which releases to cause lamp 558 to be extinguished, and at its lower armature and contact closes a circuit extending from grounded battery at the lower armature and contact of relay 504, conductor 559, lower armature and contact of relay 555, conductor 563, through three parallel paths respectively extending through lamps 560, 561, 562 to ground. Lamps 560, 561, and 562 light indicating that single channel line 411 is busy. Relay 602, in operating, closes at its inner lower armature and contact a circuit extending from grounded battery, conductor 603, through the winding of relay 604 to ground. Relay 604 operates. Relay 602, in operating, also closes at its upper armature and front contact the communication circuit extending from ground on the line circuit of subscriber's station 301 as hereinbefore traced, over the lowermost and uppermost normally closed contacts, in series, of typing key 606, through the upper winding of repeater relay 605, armature and right contact of repeater relay 607 to grounded negative battery. The extension of the communication circuit to grounded negative battery at the right contact of repeater relay 607 reverses the polarity of the current that was previously impressed on the line by grounded positively battery connected to the tip spring of jack 572, the latter battery being removed from the line when plug 601 was inserted into jack 572. The grounded negative battery normally connected to the right contact and armature of repeater relay 607 is also connected through the lower winding of repeater relay 605 to the contact and inner left armature of relay 604 to ground. Relay 604 in operating closes at its inner right armature and contact a circuit extending from ground through the lower winding of repeater relay 607 to the armature and left contact of repeater relay 605 to grounded negative battery and its outer right armature and contact a circuit extending from grounded negative battery through the make-before-break contact of sleeve relay 621 through the upper winding of repeater relay 607 to armature and left contact of repeater relay 605 to grounded negative battery. The operation of relay 604 therefore places the repeater relays 605 and 607 in condition for operation.

The operator then operates typing key 606 which, in operating, connects the operator's teletypewriter set comprising transmitting contact 610 and printer magnet 611 to the cord circuit shown in detail in Fig. 6. Other typing keys such as keys 608 and 609 are shown and may be employed for connecting other cord circuits, not shown, to the operator's teletypewriter. The operator now challenges the subscriber at station 301 by transmitting signals corresponding to "OPR" to which the subscriber replies by transmitting signals corresponding to the code number of the desired subscriber's station. The operator upon receiving the signals corresponding to the code number of the desired subscriber's station inserts the calling plug 612 into a jack which is connected to the line circuit of the desired subscriber. In some cases it may be desired to have the line circuit of a calling jack connected through another selector circuit such as either of those shown in Figs. 4 and 5, or some other kind of a circuit that may be adapted for use with an individual subscriber's station or a group of subscribers' stations. Rectangles 614 and 615 respectively represent in diagrammatic form a selector circuit and a subscriber's station connected to the teletypewriter exchange by means of jack 613.

The operator's circuit shown in the lower part of Fig. 6 provides, as stated hereinbefore, for associating the operator's teletypewriter with an associated cord circuit by means of a typing key such as 606, 608, and 609. Provision is also made for preventing the teletypewriter running idle, that is, the printer motor is running when no punched tape is prepared for transmitting signals. Relay 616 is connected in series with the sending contact 610 of the teletypewriter and with the communication circuit of the connected cord circuit. Relay 616 follows the teletypewriter signals and actuates through a holding front contact and armature of relay 617, the printer magnet 611. Relay 617 is of the slow-release type and is held operated during the time that teletypewriter signals are being received, but releases upon timed open signals. Upon release, relay 617 holds the teletypewriter magnet to prevent the teletypewriter running idle. The operator's circuit comprises two timing keys 618 and 619. Key 618 identified as the toll discon-

nect key, provides for opening the transmission circuit of the operator's set approximately ten seconds to transmit a ten-second disconnect signal. Key 619 identified as the toll recall key provides for opening the transmission circuit for approximately seven seconds to transmit a recall signal. As these keys are serially connected, both keys should not be operated at the same time.

Disconnection

When communication is completed and it is desired to clear the selection preparatory to the next call the disconnect signal is preferably sent from the station of the calling subscriber. The calling subscriber operates the call-disconnect key 311 which opens the channel line 411 for a period of five seconds. The prolonged open interval causes the pulsing relays 412 and 512 to operate to their off-normal position, deenergizes the middle winding of slow-release relay 401 which relay does not release because its uppermost winding is energized and releases the slow-release relay 501 to close a circuit at its lower armature and contact from ground, ring conductors of jack 572 and plug 601, over two parallel paths, one through the disconnect lamp 620 and the other through the winding of relay 622, conductor 623, contact and outer lower armature of relay 602 to grounded battery. Disconnect lamp 620 lights and relay 622 operates to close a locking circuit for itself over its armature and contact to ground. Also, the operation of pulsing relays 412 and 512 through their off-normal positions causes the selector switches S_1 and S_2 to operate to their first contacts, respectively. The operation of the switches S_1 and S_2 causes the guard lamps 413 and 513 to operate. The operator at the telephone exchange ignores any momentary lighting of the guard lamp 413, but the operator at the teletypewriter exchange, upon observing the lighted lamps 620 and 513, reoperates typing key 606 to again connect her teletypewriter to the engaged cord circuit and acknowledges the disconnect and guard signals with the customary challenge of "OPR" and the calling subscriber at station 301 advises "CLR" meaning clear. The teletypewriter operator then sends a "stop" signal "H" which automatically opens motor control contact 315 in the well known manner and stops the calling subscriber's teletypewriter motor. The transmission of the "H" signal from transmitting contact 610 also stops the operation of the printer motors at the teletypewriter exchange and station 615. The teletypewriter exchange operator then operates the stop key 541. The operation of the stop key 541 initiates the restoration of the operators' equipment in both Figs. 5 and 4 simultaneously. The equipment in Fig. 5 will be described first. The off-normal spring 518 in normal position connects ground at its lower contact through the left-hand operated contact of stop key 541, through the winding of relay 568, conductors 569 and 570, contact and inner lower armature of relay 547 to grounded battery. Relay 568 operates and closes a locking circuit for itself over its inner lower armature and contact to ground and at its outer lower armature a circuit from ground over conductor 571, through the winding of relay 546, conductor 570 to grounded battery at the inner lower armature and contact of relay 547. Relay 546 operates and closes at its inner upper armature and contact a locking circuit to ground, opens the operating circuit for release magnet 529, opens a short circuit across the upper armature and contact of relay 522, which relay will later open the line, or communication circuit, and transfers the operating circuit for relays 517 and 519 from the right-hand contact of relay 512 to the armature and front contact of relay 537 to ground. Inasmuch as relay 537 is operated at this time, relays 517 and 519 operate. Stop key 541 on being operated causes the communication circuit to be opened at the normally closed middle contact and therefore relay 512 releases to its right-hand position to thereby cause the release of relays 537 and 550. Also, stop key 541 upon being operated closes at its outermost right-hand contact a circuit extending from ground at the inner lower armature and associated contact of relay 524, conductors 573 and 574, outermost right-hand contact of stop key 541, conductor 575, front contact and armature of relay 519, conductor 576, through the winding of relay 522 to grounded battery. Relay 522 operates to open at its upper armature and contact the communication circuit. If stop key 541 is operated for a short period only, the slow-release action of relay 522 maintains the open condition in the communication line circuit for a sufficient time after the release of stop key 541 to assure the complete release of relay 537 and the operation of rotary magnet 523. Selector switch S_2 operates one step. At this time, that is, after stop key 541 is released, off-normal spring 518 in its operated position connects ground to a circuit extending over front contact and armature of relay 519, conductor 576 through the winding of relay 522 to grounded battery. Relay 522 which released when stop key 541 was released, will reenergize as long as relays 517 and 519 are held in their operated position. The reopening of the communication circuit by the operation of relay 522 causes the armature of relay 512 to open the operating circuit for relays 537 and 550. Relays 537 and 550 release and thereby cause the subsequent release of relays 517 and 519 which in turn cause the subsequent release of relay 522 which again closes the line. By this sequence of operations the line has been opened for a period equal to the sum of the release time of relays 512, 550, 537, 519, and 522 plus the operate time of relay 546. Upon the closure of the line the whole chain of relays will reoperate and the action will be repeated. Subsequent breaks, however, will not include the operate time of relay 546. At each release of relay 537 the wipers 515 and 516 are advanced one step. This sequence of operations continues until the selector reaches the fifth segment, or terminal, on bank No. 2 to which the winding of relay 530 is connected. While the wiper 516 is on the fifth terminal, relays 519 and 517 release and apply the ground at the upper contact of off-normal spring 518, to the make-before-break contact of relay 519, back contact and upper armature of relay 517, outer lower armature and front contact of relay 522, conductor 523, make-before-break contact of relay 524, wiper 516 on its associated fifth terminal through the winding of relay 530 to grounded battery. Relay 530 operates and locks over its upper armature and contact, conductor 532, contact in engageable relation with the lower inner armature of relay 524 to ground. Relay 530 in operating, opens the holding circuit for relay 504 and relay 504 releases. Relay 530, in operating, also opens one side of a parallel holding circuit

for relays 524 and 547. When relay 522 releases after the release of relays 517 and 519, it closes the communication circuit and opens the other side of a parallel holding circuit for relays 524 and 547 thereby releasing relays 524 and 547. Relay 547 in releasing opens the operating circuit for relays 568 and 546 and the holding circuit for relay 530. Relays 568, 546, and 530 release. Relay 522 in releasing also prepares a circuit over its outer lower armature and back contact, which is completed by the release of relay 546 to operate release magnet 529 which operates to thereby restore the selector switch to normal. Relay 546 in releasing, short-circuits the upper armature and contact of relay 522 which had served to interrupt the communication circuit and then transfers the windings of relays 517 and 519, through the right-hand contact of relay 512. The entire selecting circuit is now normal and ready for the next call.

The operation of the equipment associated with selector switch S_1, shown in Fig. 4, is identical with that shown in Fig. 5 and may be readily traced by following the description just given for the selector arrangement shown in Fig. 5. To facilitate the comparison of operation for the release of selector switch equipment shown in Fig. 4 with that shown in Fig. 5, the reference characters used in Fig. 4 correspond with those used in Fig. 5 except that the hundreds digit corresponds to the number of the figure.

Call originating at a teletypewriter subscriber's station connected to the teletypewriter exchange and terminating at a teletypewriter subscriber's station connected to the telephone central office

A call originating, say at station 615, is initiated in any well known manner and the teletypewriter exchange operator, in response to line lamp 624 which is lighted by the initiation of the call, operates typing key 606 and challenges the subscriber at station 615 in the usual manner. The subscriber then transmits to the operator's printer set the code number of the desired teletypewriter subscriber's station connected to the telephone central office. Assuming that the requested call is to teletypewriter subscriber's station 301, the teletypewriter exchange operator upon observing the recordation of the called number, say code number 530 for subscriber's station 301, inserts plug 612 into jack 572. The teletypewriter exchange operator then operates dial 539 in the same manner as the operator at the telephone office operated dial 409 in establishing a call to the teletypewriter exchange as hereinbefore describd. The selector circuit shown in Figs. 5 and 4 operates as hereinbefore described in response to three sets of impulses, namely 5—3—10. After the last set of impulses (10) is dialed, relays 412, 417, 424, and 494 in Fig. 4, and relays 512, 517, 524, and 594 in Fig. 5 remain operated and the communication circuit is connected through the teletypewriter exchange and the telephone central office to the subscriber's station 301 and communication may begin. Busy lamps 442 and 542 are lighted to indicate that channel 411 is busy.

After the completion of the message the disconnect signal is transmitted by the subscriber at station 615 and lamp 620 is thereby lighted. The teletypewriter exchange operator then operates stop key 541 to effect the release of the selector switch equipment shown in Figs. 4 and 5. The release of busy relay 504 opens the operating circuit for busy lamps 560, 561, and 562. The operator at the teletypewriter exchange may at this point remove answering plug 601 from jack 572 and call plug 612 from jack 613 and the system is now normal and ready for the next call.

What is claimed is:

1. In a communication system, a plurality of subscriber's stations, a telephone switchboard, a telegraph switchboard, line circuits respectively connecting said subscribers' stations to said telephone switchboard, one or more channels interconnecting said telephone and said telegraph switchboard, means at each of said subscribers' stations for originating a call, a signal located at said telephone switchboard and responsive to the operation of said means, an impulse device located at said telephone switchboard for transmitting over said channel to said telegraph switchboard groups of impulses corresponding to the number of the subscriber's station originating a call, a signal at said telegraph switchboard responsive to one of said groups of impulses, a message transmitting and receiving device at said telegraph switchboard, and manually operated means for connecting said transmitting and receiving device to an associated channel when said signal at said telegraph switchboard is operated.

2. In a communication system, a plurality of subscribers' stations, a telephone switchboard, a telegraph switchboard, line circuits respectively connecting said subscribers' stations to said telephone switchboard, one or more channels interconnecting said telephone and said telegraph switchboard, means at each of said subscribers' stations for originating a call, a signal located at said telephone switchboard and responsive to the operation of said means, an impulse device located at said telephone switchboard for transmitting over an associated channel to said telegraph switchboard, groups of impulses corresponding in number to the code number of the subscriber's station originating a call, a second signal at said telephone switchboard responsive to the first of said groups, a signal at said telegraph switchboard responsive to the second of said groups, circuit means responsive to the second of said groups for restoring the first-mentioned signal to normal, other circuit means for interconnecting in response to the third of said groups an associated channel and said originating subscriber's station line circuit.

3. In a printing telegraph switching system, a plurality of subscribers' stations, a telephone central office, a manually operated switchboard at said central office, a plurality of line circuits respectively connecting said subscribers' stations to said central office, line signals located at said switchboard and respectively associated with said line circuits, a current impulse device at said switchboard and a source of current therefor, for transmitting groups of impulses corresponding in number to the code number of any one of said subscribers' stations, a teletypewriter exchange, one or more channel circuits interconnecting said central office and said exchange, a selector circuit at said central office and at said exchange simultaneously responsive to said groups of impulses transmitted by said transmitting device, a manually operated switchboard at said exchange, connecting devices at the second mentioned switchboard and respectively associated with said subscribers' line circuits for terminating said channel circuit or circuits in accordance

with the code number of the calling subscriber's station, line signals located at the second mentioned switchboard and respectively associated with said connecting devices, means responsive to the operation of the selector circuit at said exchange for operating at said exchange the line signal corresponding to the calling subscriber's station connected to said telephone central office, a plurality of other subscribers' stations, a plurality of other line circuits respectively connected to said other subscribers' stations, other connecting devices at the second mentioned switchboard for respectively terminating said other line circuits, link circuits at the second mentioned switchboard for interconnecting any one of said connecting devices respectively associated with the first mentioned line circuits and the connecting devices respectively associated with the second mentioned line circuits, a transmitting and a receiving device common to said link circuits, switching means at each of said link circuits for connecting said transmitting and receiving device for communication purposes to any one or more of said connecting devices engaged by one of said link circuits.

4. In a printing telegraph switching system, according to claim 3, wherein each of said subscribers' stations comprises switching means for transmitting a disconnect signal, each of said link circuits comprises a disconnect lamp responsive to said disconnect signal switching means, said transmitting and receiving device common to said plurality of cord circuits comprises means for transmitting to each of two interconnected subscribers' stations a signal for disabling said interconnected subscribers' stations, and each of said selector circuits comprises a stop key, when operated, for restoring said selector circuits in operated positions at said central office and said exchange to normal.

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