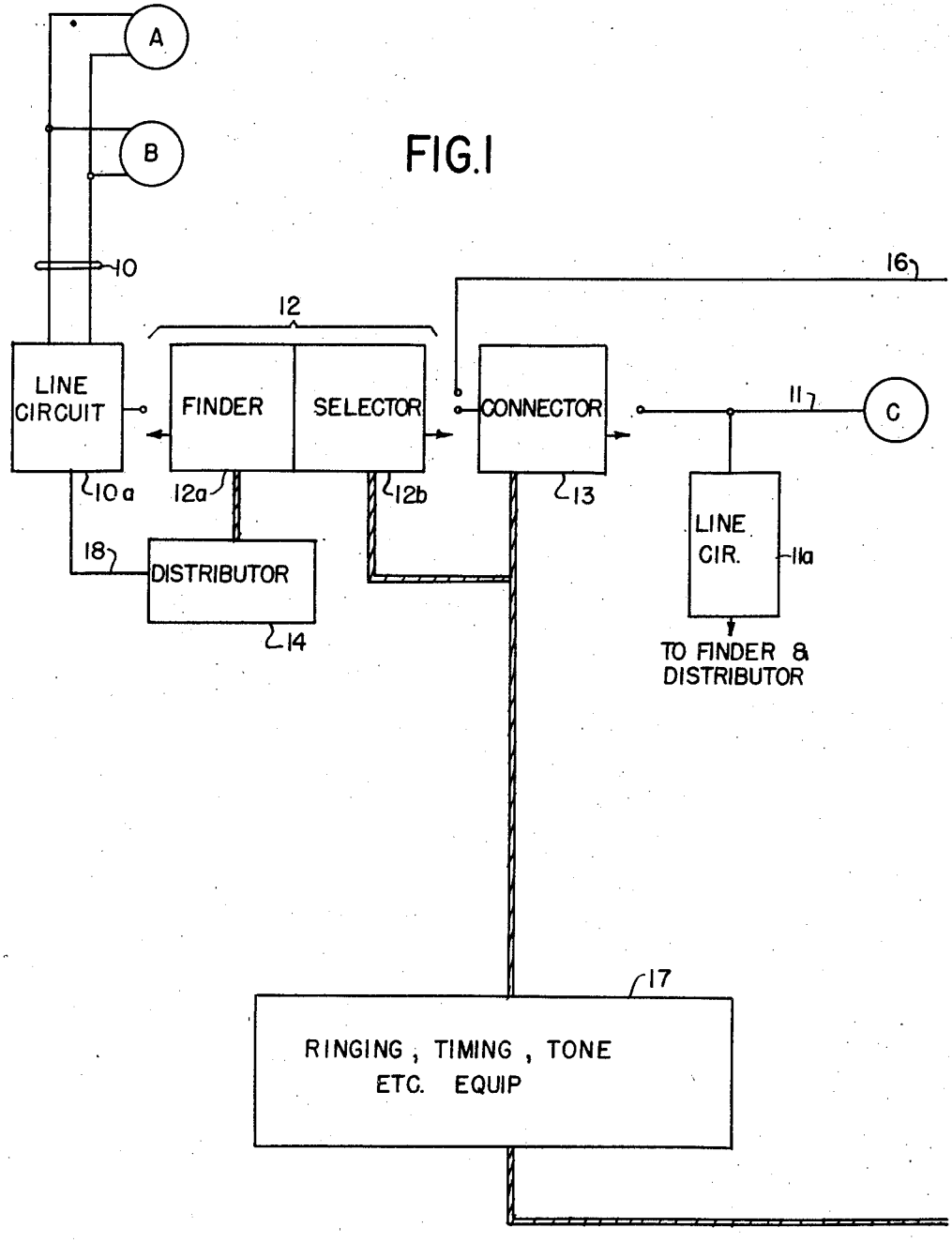
Nov. 30, 1943. P. BAKKER 2,335,473

TELEPHONE SYSTEM

Filed April 2, 1942 5 Sheets-Sheet 1

FIG.1



INVENTOR.
PIER BAKKER

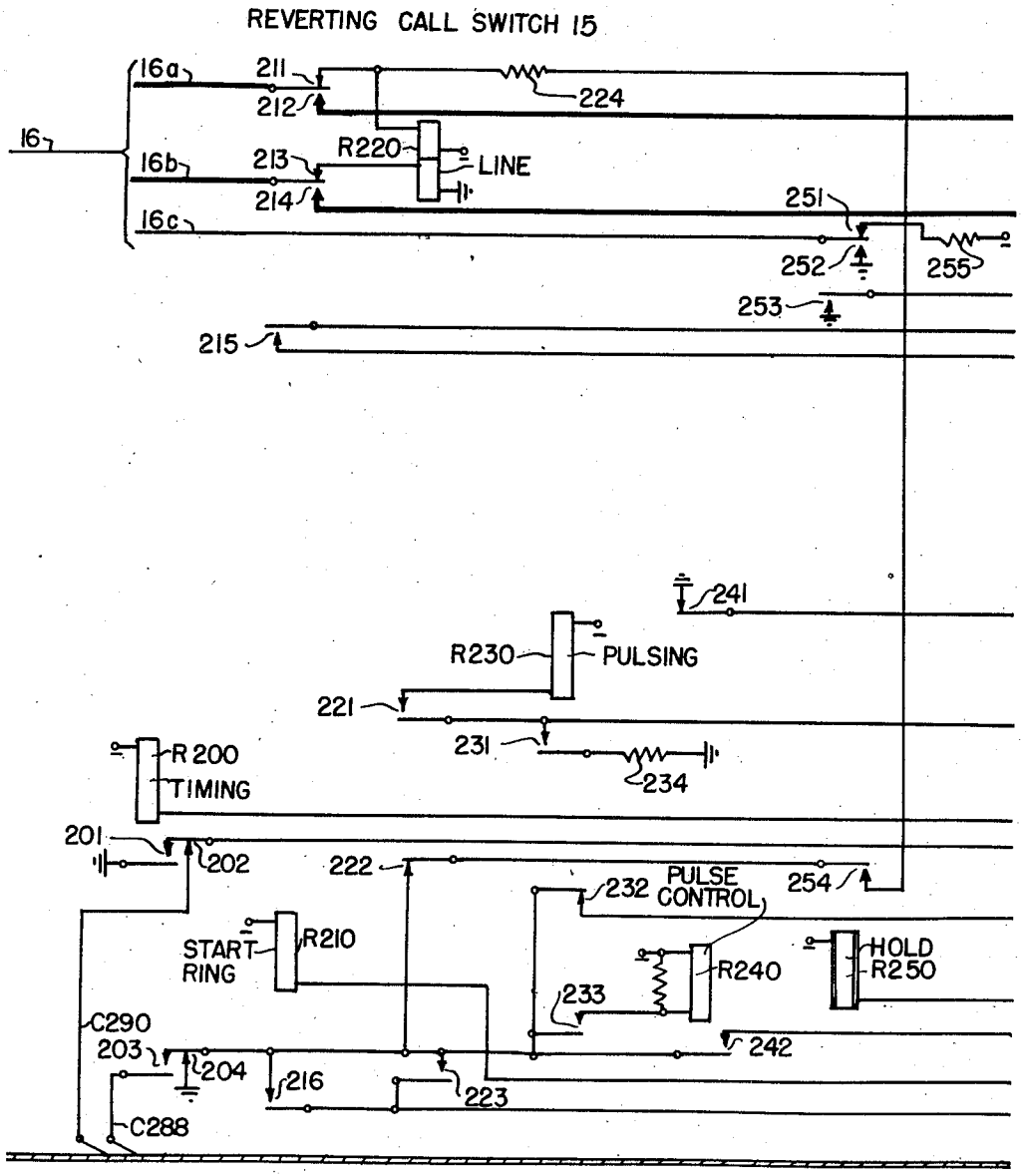
BY Davis, Lindsey, Smith & Shonts
ATTORNEYS

Nov. 30, 1943. P. BAKKER 2,335,473

TELEPHONE SYSTEM

Filed April 2, 1942 5 Sheets-Sheet 2

FIG. 2



INVENTOR.
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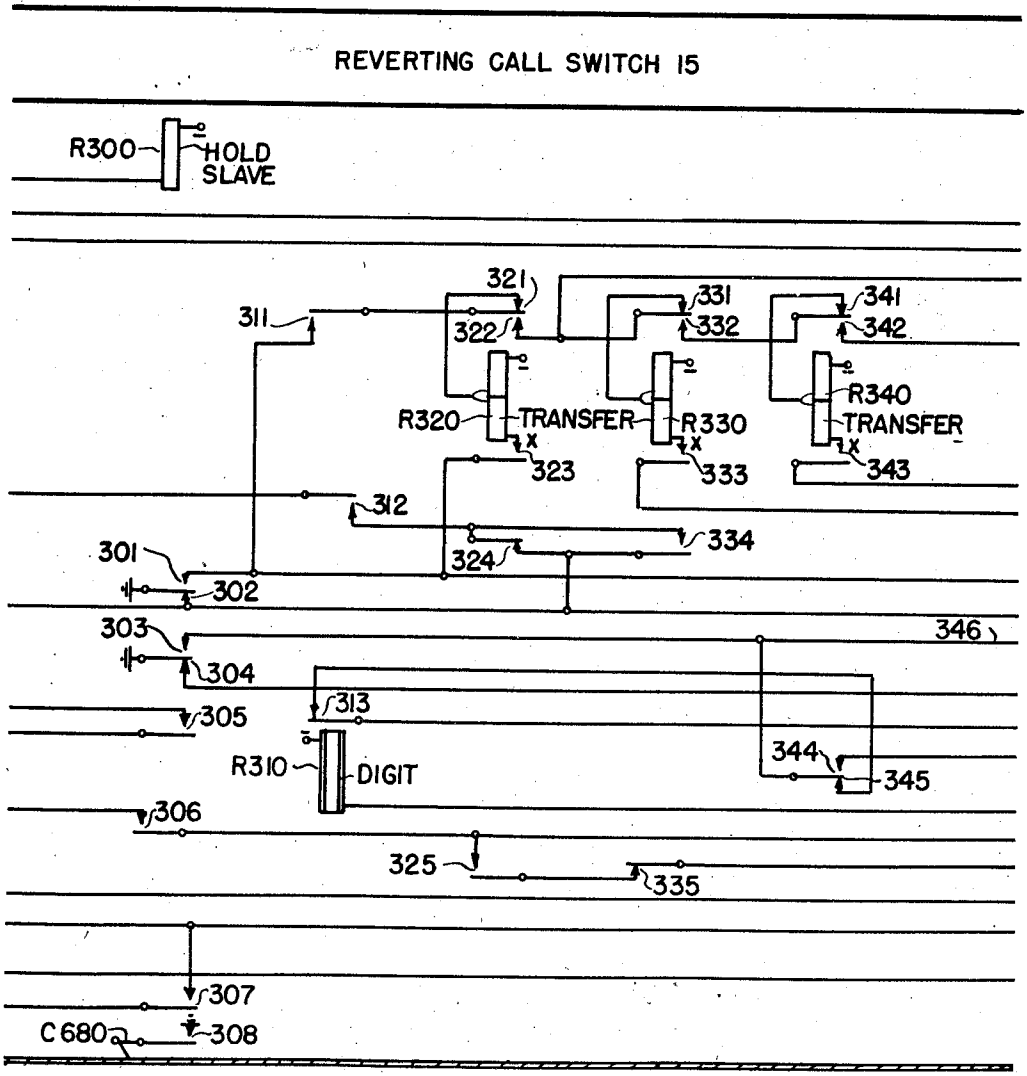
BY Davis, Lindsey, Smith & Shonts
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Nov. 30, 1943. P. BAKKER 2,335,473

TELEPHONE SYSTEM

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FIG. 3



INVENTOR.
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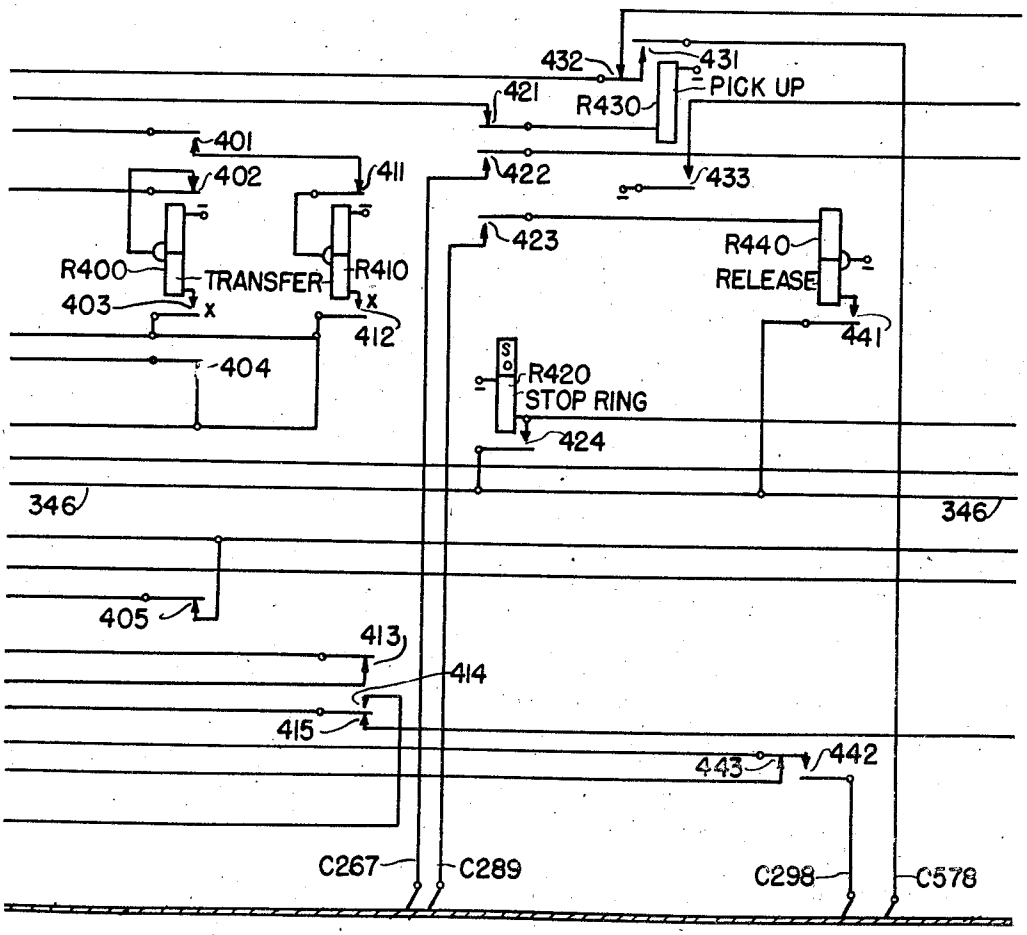
Nov. 30, 1943. P. BAKKER 2,335,473

TELEPHONE SYSTEM

Filed April 2, 1942 5 Sheets-Sheet 4

FIG. 4

REVERTING CALL SWITCH 15



INVENTOR.
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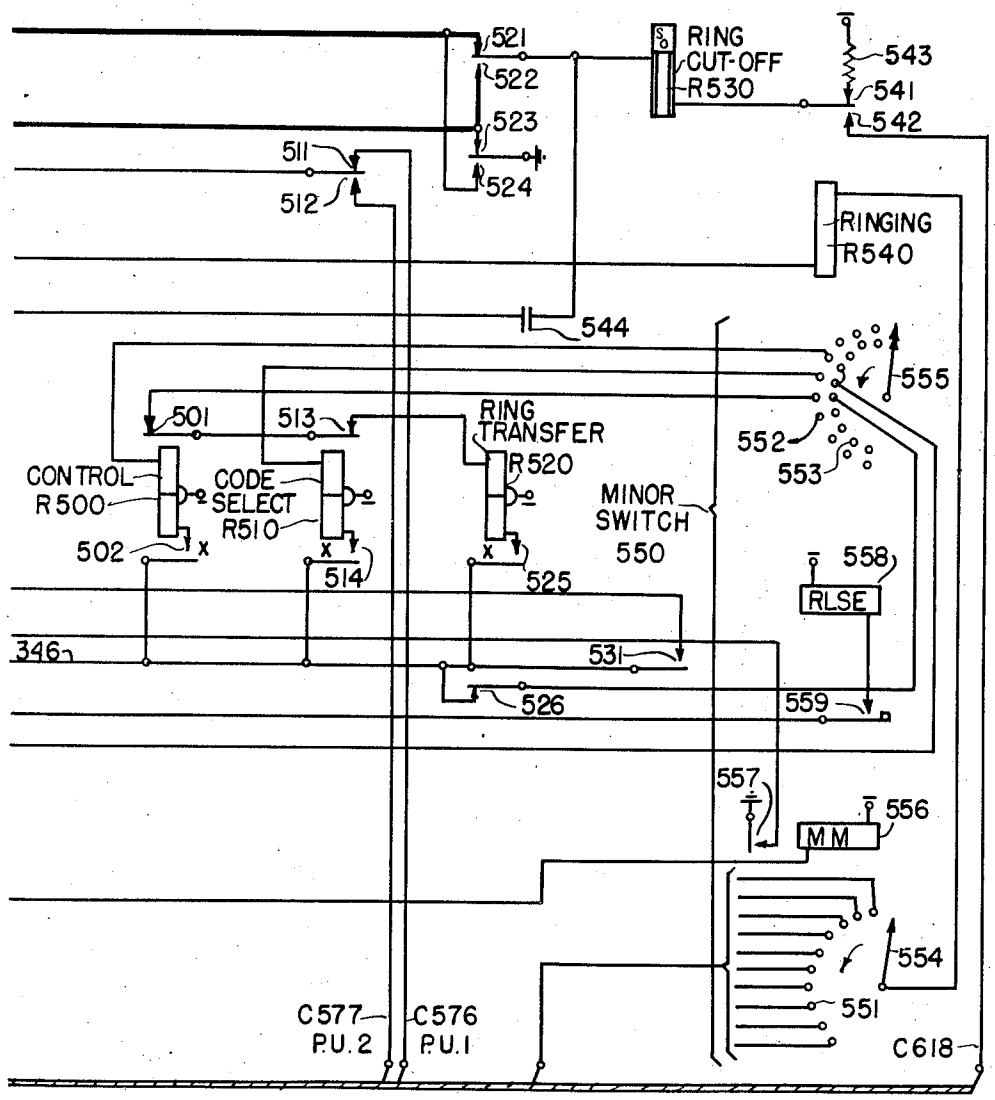
ATTORNEYS

Nov. 30, 1943. P. BAKKER 2,335,473

TELEPHONE SYSTEM

Filed April 2, 1942 5 Sheets-Sheet 5

FIG. 5 REVERTING CALL SWITCH 15



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Patented Nov. 30, 1943

2,335,473

UNITED STATES PATENT OFFICE

2,335,473

TELEPHONE SYSTEM

Pier Bakker, Chicago, Ill., assignor to Automatic Electric Laboratories, Inc., a corporation of Delaware

Application April 2, 1942, Serial No. 437,423

25 Claims. (Cl. 179—17)

The present invention relates to automatic telephone systems and, more particularly, to improved apparatus for setting up reverting call connections between two substations associated with the same multiparty subscriber line.

In existing automatic telephone exchanges, wherein reverting call switches are utilized for selective ringing purposes in the setting up of reverting call connections, it is the usual practice to assign two different directory numbers to each substation connected to a multiparty line. The two directory numbers assigned to a particular substation are usually the same only in the last digit or the last two digits thereof, which digit or digits are used in the selection of the ringing signal designating the particular substation. More specifically, those digits of the regular directory numbers, i. e., those numbers which are dialed in setting up line to line connections through an automatic switch train and are utilized in setting the switches of the train, are omitted from the reverting call directory numbers. Moreover, since the reverting call switches are usually seized through a particular level of the first selectors included in the system, the first digit of the reverting call directory number assigned to a particular substation served by a multiparty line also differs from the first digit of the regular directory number assigned to the same substation. Such wide differences in the directory number designations of the same substation lead to confusion and necessitate duplicate directory number listings for each multiparty substation of the system.

It is an object of the present invention, therefore, to provide improved apparatus for setting up reverting call connections between the substations associated with the multiparty lines of an automatic telephone system, which is so arranged that the reverting call directory number designation assigned each multiparty substation differs from the assigned regular directory number designation only in the addition of a prefix digit.

According to another object of the invention, the improved reverting call signaling arrangement is equipped to transmit to an answering substation a signal which is indicative of the character of the answered call.

It is another object of the invention to provide an improved impulse responsive reverting call switch which is so arranged that only certain of the impulse digits transmitted thereto during a revertive signaling operation are utilized in the selection of the ringing code or frequency assigned to the called substation.

According to another object of the invention, provisions are made in the improved reverting call switch for absorbing those digits transmitted thereto during a revertive signaling operation which are normally utilized for traffic concentration and line selecting purposes in the setting up to regular line to line connections through an automatic switch train.

It is another object of the invention to provide an improved reverting call switch wherein provisions are made for correcting the form of the impulses repeated to the signal selecting means embodied in the switch.

According to still another object of the invention an improved circuit arrangement is provided for holding the switch operated while a revertive signaling operation is in progress.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawings in which Figs. 1, 2, 3, 4 and 5, when placed side by side in the order named, illustrate an automatic telephone system having embodied therein reverting call switches characterized by the features of the invention briefly referred to above.

Referring now more particularly to the drawings, the telephone system there illustrated comprises an exchange at which are terminated a plurality of subscriber lines, including the multiparty line 10 which serves the substations A and B, and the single party line 11 which extends to the substation C. The exchange comprises a plurality of finder-selector links including the selector 12*b*, and a plurality of connectors including the connector 13 for setting up connections between the various subscriber lines. More specifically, the finder-selector links are arranged in groups, each group being adapted to serve a particular group of the lines terminating in the exchange. Each group of links has associated therewith a distributor having the function of assigning idle ones of the links to the use of calling lines in a predetermined order. Thus a distributor 14 is provided for allotting the link 12 and the other links of the same group to the use of calling lines in the associated line group. This distributor is arranged to be controlled over a start circuit commonly extending to the various line circuits at which the subscriber lines are individually terminated, the two illustrated lines 10 and 11 being shown as extending to the line circuits 10*a* and 11*a*, respectively. For the purpose of selectively sig-

naling the substations associated with the multiparty subscriber lines of the system in setting up reverting call connections, there are provided a plurality of reverting call switches, one of which is indicated generally at 15 as being accessible to the selector 12b over a trunk 16. The switching equipment of the exchange has associated therewith power and supervisory apparatus indicated generally at 17, which apparatus includes a ringing current generator, a ringing interrupter, a plurality of tone sources and timing equipment for controlling the links, connectors and reverting call switches in the manner more fully explained below. This apparatus may be of any desired construction and arrangement, although preferably of the character disclosed and claimed in copending application Serial No. 414,252, filed October 9, 1941, Clarence E. Lomax and Pier Bakker. The finder, selector and connector switches of the exchange, as well as the line circuits and distributors, may be of any desired commercial construction, although preferably the indicated switches are of the well-known Strowger type. In this regard it is noted that the selector 12b is of the well-known battery searching type such that the selection of an idle trunk thereby is dependent upon the marking of the release conductor of the trunk with negative battery potential. Since the connectors of the exchange must be equipped selectively to signal the substations associated with called lines of the multiparty type, each thereof is provided with code ringing facilities. More specifically, these connectors are, in the system arrangement illustrated, of the four digit type and may be used in selectively signaling over lines serving as many as twenty substations and arranged for either bridged or divided ringing. In so far as the ringing control circuits are concerned, this connector may be wired in accordance with the disclosure of the above-cited copending application Serial No. 414,258, filed October 9, 1941, Pier Bakker. As thus arranged, four digits are required by the connector in order to effect the selection of a desired line and the selection of a particular ringing code for use in signaling over the selected line. The first of these digits, when of a particular numerical value, is utilized in the partial selection of the ringing code, the second and third digits are utilized in the selection of the desired line, and the fourth and final digit is utilized to select the side of the line over which ringing current is to be transmitted and the particular ringing code to be used in signaling the desired substation.

Each of the reverting call switches embodied in the system may be identical with the reverting call switch 15, which is illustrated in Figs. 2, 3, 4 and 5 of the drawings as comprising a minor switch 550 through operation of which ringing current of the code corresponding to a desired substation may be selected under the control of a calling subscriber. This switch is of the well-known minor type and includes three sets of contacts 551, 552 and 553 of eleven points each, a wiper 554 arranged to traverse the contacts of the contact set 551, a wiper 555 arranged to traverse the contacts of the two contact sets 552 and 553, an operating magnet 556, a release magnet 558, and a set of off-normal springs 559 which are operated into engagement when the wipers 554 and 555 are moved off normal. The control equipment of the switch 15 comprises a line relay R220, a pulsing relay R230, a pulse control relay R240, a slow-acting hold relay R250, a hold slave relay R300, a slow-acting digit relay R310, five digit transfer relays R320, R330, R340, R400 and R410, a slow-to-operate stop ring relay R420, a ring pickup relay R430, a release relay R440, a control relay R500, a code select relay R510, a ring transfer relay R520, a slow-acting ring cut-off relay R530, a ringing relay R540, a timing relay R200 and a start ring relay R210. It is noted that each of the five relays R320, R330, R340, R400 and R410 is of the well-known two-step type, such that it operates to close only its preliminary make or X contacts when its lower winding is energized and only operates fully when its two windings are energized in series.

In the operation of the system, if a call intended for the substation C, for example, is initiated at the substation A, a calling loop circuit is established by way of the line 10 when the calling subscriber removes the receiver provided at the calling substation from its associated supporting hook or cradle. When this loop circuit is completed the line circuit 10a operates in the usual manner to mark the calling line in the bank contacts of the finders having access thereto, and to impress starting ground potential upon the start lead 18 extending to the link distributor 14. When this lead is grounded the finder of the previously assigned link operates in a well-known manner to seize the calling line. Assuming that the illustrated link 12 is utilized in setting up the connection, the wipers of the finder 12a are first elevated to a marked position opposite the level of bank contacts terminating the group of ten lines which includes the calling line 10, following which they are automatically rotated to a position wherein they engage the contacts terminating the conductors of this line. When the calling line 10 is thus seized the calling loop circuit is extended through the finder 12a to the selector portion 12b of the link, ground potential is impressed upon the private conductor of the calling line for the purpose of guarding this line against seizure, and the cut-off relay conventionally embodied in the line circuit 10a is energized and operates to disconnect the start lead 18 from ground. Further, the line and hold relays embodied in the selector portion 12b of the link operated to complete a marking path whereby the link 12 is identified as busy in the link distributor 14. These relays, in operating, also function to complete a circuit for transmitting the usual dial tone signal, as derived from the common equipment 17, over the calling end of the connection, thereby to inform the calling subscriber that the dialing operation may be started.

The first digit dialed at the calling substation is utilized for the purpose of directing the selector 12b in its operation to select an idle connector having access to the desired line 11. More specifically, when the first digit of the directory number designating the substation C is dialed, the wipers of the selector 12b are elevated to a position opposite the level of bank contacts through which the connectors having access to the desired line 11 may be seized. Incident to the off-normal movement of the selector wipers, the dial tone signaling circuit is interrupted by the control relays of the selector to terminate the signal being transmitted to the calling substation A. At the end of this digit, the selector 12b automatically operates to test the connectors of the selected group in succession, until an idle connector is found. Assuming, for

example, that the connector 13 is the first available idle connector of the selected group, the step-by-step operation of the selector 12b in its rotary movement is arrested when the wipers of this selector engage the contacts terminating the conductors of the trunk extending to the conhector 13. When this connector is found, the test relay of the selector 12b is energized in a circuit which extends to the negative terminal of the exchange battery over the release conductor of the trunk incoming to the connector 13. This relay, in operating, switches the calling loop circuit through to the connector 13, free of attachments, whereby the line and hold relays of this connector are operated in the usual manner. These two relays, upon operating, provide locking circuits for the operated relays of the selector 12b, the finder 12a and the line circuit 10a, and condition the associated control equipment of the connector 13 to respond to the second, third, fourth and fifth digits of the directory number designating the desired substation C.

The first digit dialed into the connector 13 is either absorbed or is utilized in the selection of a group of ten codes, which group includes the code normally used in signaling the substation C. The second digit dialed into the connector 13 from the calling substation A is utilized to position the wipers of this connector opposite the level of bank contacts terminating the lines forming the ten line subgroup in which the desired line 11 is included. The third digit dialed into the connector 13 is used to step the wipers of this connector in the rotary direction into engagement with the contacts terminating the conductors of the line 11. The fourth digit dialed into the connector 13 is used to select the particular ringing code assigned for use in signaling the called substation C. Either before, during or after the dialing of the final digit into the connector 13, the control equipment of this connector functions to test the line 11 for the purpose of determining the idle or busy condition thereof. If this line tests busy, the usual busy tone signal is transmitted to the calling substation to inform the calling subscriber that the desired connection cannot be obtained immediately after the dialing operation is terminated. In this case no further operation of the switching apparatus occurs until the call is abandoned at the calling substation. If the call is abandoned the connector 13, the link 12, and the line circuit 10a are released in the usual manner when the calling subscriber replaces the receiver provided at the calling substation A upon its supporting hook or cradle. If the called line tests idle, the control equipment embodied in the connector 13 is operated to its ringing setting wherein ground potential is applied to the private conductor of the line 11 to mark this line as busy; the cut-off relay of the line circuit 11a is operated to disconnect the windings of its associated line relay from the conductors of the line 11; and interrupted ringing current of the selected code, as derived from the common equipment 17, is transmitted over the conductors of the line 11 to energize the ringer provided at the called substation C. This equipment also operates to transmit ringing current over the calling end of the connection to inform the calling subscriber that the called substation is being rung. The desired talking circuit between the two substations A and C is completed when the call is answered at the called substation. More particularly, when the receiver provided at the called substation is removed from its supporting hook or cradle, an answering loop circuit is completed by way of the line 11 for energizing the ring cut-off relay conventionally embodied in the connector 13. This relay, in operating, opens the ringing current circuits and completes a talking circuit which extends through the link 12 and the connector 13, and connects the calling line 10 with the called line 11.

Preferably, the arrangement of the control apparatus embodied in the connector 13 is such that the release of the connection is entirely under the control of the calling subscriber. As thus arranged, when the calling party replaces the receiver provided at the calling substation A upon its supporting hook or cradle to interrupt the loop circuit extending to the connector 13, this connector, the link 12 and the line circuits 10a and 11a are released in a manner well understood in the art.

In the event the above-described call originating at the substation A and routed to the finder-selector link 12 is intended for the substation B also associated with the calling line 10, the calling party after initiating the call dials the reverting call directory number designating the substation B. This directory number is exactly the same as the regular directory number assigned the substation B, except that an additional prefix digit is added which is utilized to control a seized selector in its operation to select an idle reverting call switch. More specifically, when the first digit is dialed into the selector 12b, this selector elevates its wipers to a position opposite the level of bank contacts terminating the group of trunks, including the trunk 16, which extends to the reverting call switches. During the inter-digit pause between the first and second digits the selector 12b operates in a well-known manner to select an idle one of the reverting call switches. Assuming that the reverting call switch 15 is the first available idle switch of the group, the selector 12b upon positioning its wipers upon the contacts terminating the conductors of the trunk 16, arrests its operation and extends the calling loop circuit over the trunk 16 to this reverting call switch. Incident to this operation, the line relay R220 is energized over the calling loop circuit and closes its contacts 221 to complete a circuit through the contacts 302 for energizing the pulsing relay R230. At its contacts 222, the relay R220 opens a point in an incomplete priming circuit for itself. At its contacts 223, the relay R220 prepares a holding circuit for the slow-acting hold relay R250.

The relay R230, upon operating, locks to ground over a path including the contacts 221 and 231, and the resistor 234. At its contacts 232, the relay R230 opens a point in the available but incomplete operating circuit for the digit relay R310 and a point in the available but incomplete circuit for transmitting impulses to the operating magnet 556 of the minor switch 550. At its contacts 233, the relay R230 completes an obvious circuit for energizing the pulse control relay R240.

The relay R240, upon operating, closes its contacts 242 to complete a circuit for energizing the hold relay R250, this circuit extending from ground by way of the contacts 204, 242 and 443, and the winding of R250 to battery. At its contacts 241, the relay R240 opens a point in an available but incomplete circuit for energizing the pulsing relay R230. The hold relay R250, upon operating, closes its contacts 253 to com-

plete an obvious operating circuit for the hold slave relay R300, and opens its contacts 251 to disconnect the test conductor 16c of the trunk 16 from the negative terminal of the exchange battery. In this regard it will be understood that during the trunk hunting operation of the selector 12b, the stop relay of this selector is energized, to arrest the step-by-step movement of the selector wipers, in a circuit which includes the test wiper of the selector, the test conductor 16c, the contacts 251, and the resistor 255. At its contacts 252, the relay R250 completes an obvious path for impressing ground potential upon the test conductor 16c, thereby to provide locking circuits for the operated relays in the selector 12b, the finder 12a, and the line circuit 10a and to guard the reverting call switch against seizure through another of the available selectors in the exchange. At its contacts 254, the relay R250 prepares the above-mentioned priming circuit for the line relay R220.

The hold slave relay R300, upon operating, closes its contacts 301 to prepare the operating and locking circuits for the five transfer relays R320, R330, R340, R400 and R410. At its contacts 302, the relay R300 opens the above-mentioned operating circuit for the pulsing relay R230. At its contacts 303, the relay R300 completes an obvious path for impressing ground potential upon the release conductor 346, thereby to prepare locking circuits for the relays R420, R440, R500, R510 and R520. At its contacts 304, the relay R300 opens a point in the operating circuit for the release magnet 558. At its contacts 305, the relay R300 prepares the operating circuit for the timing relay R200. At its contacts 306, the relay R300 prepares the operating circuits for the digit relay R310 and the operating magnet 556 of the minor switch 550. At its contacts 307, the relay R300 completes the prepared holding circuit for the hold relay R250, this circuit extending from ground by way of the contacts 204, 223, 307 and 443, and the winding of R250 to battery. At its contacts 308, the relay R300 completes an obvious path for impressing ground potential upon the ringing apparatus start conductor C680, thereby to initiate the operation of the ringing apparatus provided in the common equipment 17 providing this apparatus is not already in operation. Following the operation of the hold slave relay R300 to perform the functions just described, the reverting call switch 15 is conditioned to respond to the impulses of the second digit of the reverting call directory number designating the desired substation B.

Although the line relay R220 follows the impulses of the first digit dialed into the reverting call switch 15 and functions to repeat these impulses to the digit relay R310, this digit is absorbed and performs no function other than that of causing the operation of the first transfer relay R320. More specifically, when the relay R220 restores at the beginning of the open-circuit period of the first impulse of the second digit, it opens its contacts 221 to deenergize the pulsing relay R230 and closes its contacts 222 to complete the previously mentioned priming circuit for itself, the latter circuit extending from ground by way of the contacts 204, 222 and 254, the resistor 224, and the upper winding of R220 to battery. The current flow over this circuit is insufficient to cause the reoperation of the relay R220 although it serves to render this relay exceedingly fast to operate when the loop circuit is completed at the end of the open-circuit period of the impulse. At its contacts 223, the relay R220 opens the above-traced holding circuit for the hold relay R250. The pulsing relay R230, upon restoring, opens its contacts 231 further to interrupt its locking circuit and, at its contacts 233, deenergizes the pulse control relay R240. At its contacts 232, the relay R230 completes the prepared operating circuit for the digit relay R310, this circuit extending from ground by way of the contacts 204, 232, 306 and 413 and the winding of R310 to battery. When thus energized, the relay R310 closes its contacts 312 to prepare a second branch of the operating circuit for the pulsing relay R230. At its contacts 313, the relay R310 opens a point in the common portion of the operating circuits for the two relays R500 and R510. At its contacts 311, the relay R310 completes a circuit for energizing the upper winding of the transfer relay R320, this circuit extending from ground by way of the contacts 301, 311 and 321, and the upper winding of R320 to battery. When its upper winding is thus energized the transfer relay R320 closes only its preliminary make contacts 323, thus completing a path through the contacts 321 and 311 for short-circuiting its lower winding.

Shortly following the operation of the digit relay R310 to perform the functions described above, the pulse control relay R240 opens its contacts 242 to interrupt the operating circuit for the hold relay R250, and closes its contacts 241 to prepare or complete the operating circuit for the pulsing relay R230. In the event the line relay R220 is reoperated to close its contacts 221 at the end of the open-circuit period of the impulse before the pulse control relay R240 releases, the operating circuit for the pulsing relay R230 is recompleted at the contacts 241, this circuit now extending from ground by way of the contacts 241, 312, 324 and 221 and the winding of R230 to battery. On the other hand, if the pulse control relay R240 releases before the line relay R220 reoperates at the end of the open-circuit period of the impulse, the operating circuit for the pulsing relay R230 is obviously recompleted at the contacts 221. In reoperating, the line relay R220 also closes its contacts 223 to recomplete the locking circuit for the hold relay R250, and opens its contacts 222 to interrupt the priming circuit for itself. The pulsing relay R230, upon reoperating, recloses its locking circuit as traced above; closes its contacts 233 to again energize the pulse control relay R240; and opens its contacts 232 to interrupt the operating circuit for the digit relay R310.

During each succeeding impulse of the second digit dialed at the calling substation A, the three relays R220, R230 and R240 interact in the exact manner explained above to transmit a current pulse of corrected length to the digit relay R310 and momentarily to open the operating and holding circuits for the hold relay R250. Due to the slow-to-release characteristics thereof, the two relays R250 and R310 remain operated throughout each series of impulses transmitted to the reverting call switch.

During the inter-digit pause between the second and third digits of the reverting call directory number designating the desired substation B, the three relays R220, R230 and R240 remain operated for a sufficient time interval to cause the release of the digit relay R310. This relay, upon restoring, opens its contacts 311 to interrupt the path short-circuiting the lower winding of the first transfer relay R320 and thus per-

mit the two windings of this relay to be energized in series over a circuit which includes the contacts 323 and 301. When thus fully energized the relay R320 opens its contacts 321 further to interrupt its operating circuit and the path for short-circuiting its lower winding, and closes its contacts 322 to prepare the operating circuit for the second transfer relay R330. At its contacts 324, the relay R320 opens the above-traced branch of the operating circuit for the pulsing relay R230. At its contacts 325, the relay R320 further prepares the operating circuit for the magnet 556. Following the operation of the first transfer relay R320, the reverting call switch is conditioned to respond to the impulses of the third digit of the directory number designating the desired substation B.

From a consideration of the circuits involved and the preceding explanation, it will be understood that the digit relay R310 is reoperated at the beginning of the third digit and remains operated until shortly after the digit is ended. Upon reoperating, the relay R310 closes its contacts 311 to complete the prepared circuit for energizing the upper winding of the second transfer relay R330, this circuit extending from ground by way of the contacts 301, 311, 322 and 331, and the upper winding of R330 to battery. In reoperating, the relay R310 also closes its contacts 312 to prepare the above-traced branch of the operating circuit for the pulsing relay R230 and, at its contacts 313, opens a point in the common portion of the operating circuits for the two relays R500 and R510. When its upper winding is alone energized the relay R330 closes only its preliminary make contacts 333, thereby to complete a path including the contacts 311, 322, 331 and 404 for short-circuiting its lower winding.

The three relays R220, R230 and R240, in following the impuulses of the third digit dialed at the calling substation A, also function to repeat these impulses in corrected form to the operating magnet 556 of the minor switch 550. Thus each time the pulsing relay R230 restores during this digit it energizes the magnet 556 in a circuit which extends from ground by way of the contacts 204, 232, 306, 325, 335, and 415, and the winding of the magnet 556 to battery. Each time the magnet 556 is energized in this circuit it advances the wipers 554 and 555 one step, and closes its contacts 557 to prepare or complete the operating circuit for the pulsing relay R230. In this regard it will be understood that if the magnet 556 operates before the end of the open-circuit period of a given impulse, the operating circuit for the pulsing relay R230 is recompleted at the contacts 221 when the line relay R220 reoperates at the end of the open-circuit period of the impulse. On the other hand if the relay R220 is reoperated before the magnet 556 operates, this circuit is prepared at the contacts 221 and subsequently completed at the contacts 557.

When the wipers 554 and 555 are initially stepped away from the illustrated normal positions thereof by the operating magnet 556, the off-normal springs 559 are closed to prepare the operating circuit for the release magnet 558. It will be understood that each time a current pulse is transmitted to the magnet 556 by the three relays R220, R230 and R240 in their response to the impulses of the third digit, the wipers 554 and 555 are advanced an additional step, so that at the conclusion of the digit, these wipers are left standing in an off-normal position which corresponds to the numerical value of the digit. With the illustrated wiring of the contact banks traversed by the wipers 554 and 555, the third digit of the directory number designating the desired substation may comprise either two, three, four or five impulses so that at the end of the digit the indicated wipers will be left standing in engagement with the second, third, fourth or fifth contacts of their associated contact bank.

When the relay R310 restores shortly following the end of the third digit, it opens its contacts 311 to interrupt the path short-circuiting the lower winding of the second transfer relay R330, thus permitting the two windings of this transfer relay to be energized in series over a circuit which includes the contacts 333, 404 and 301. When its two windings are thus energized, the relay R330 opens its contacts 331 further to interrupt its operating circuit and the path for short-circuiting its lower winding, and closes its contacts 332 to prepare the operating circuit for the third transfer relay R340. At its contacts 334, the relay R330 prepares one branch of the circuit for energizing the pulsing relay R230. At its contacts 335, the relay R330 opens the above-traced circuit for transmitting current pulses to the operating magnet 556 of the minor switch 550.

The digit relay R310, in releasing, also closes its contacts 313 to prepare or complete the operating circuit for one of the two relays R500 and R510. In this regard it will be understood that if the third digit "4" is dialed at the calling substation, the wipers 554 and 555 are left standing in engagement with their associated fourth contacts at the end of the digit. Accordingly, the operating circuit for the control relay R500 is completed incident to the release of the digit relay R310 at the end of the digit. This circuit extends from ground by way of the contacts 303, 345 and 313, the wiper 555 and its engaged fourth contacts, and the upper winding of R500 to battery. If energized in this circuit, the control relay R500 locks to the grounded release conductor 346 through its preliminary make contacts 502, and opens its contacts 501 to prevent the subsequent energization of the ring transfer relay R520.

In the event the third digit "5" is dialed at the calling substation, such that the wipers 554 and 555 are left standing in engagement with their associated fifth contacts at the end of the digit, the operating circuit for the code select relay R510 is completed incident to the release of the digit relay R310 at the end of the digit. This circuit extends from ground by way of the contacts 303, 345 and 313, the wiper 555 and its engaged fifth contacts, and the upper winding of R510 to battery. If energized in this circuit, the code select relay R510 first locks to the grounded release conductor 346 through its contacts 514 and then opens its contacts 513 to prevent the subsequent energization of the ring transfer relay R520. At its contacts 511 and 512, the code select relay R510 transfers the operating circuit for the ring pickup relay R430 from a connection with the first pickup lead C576 to a connection with the second pickup lead C577 for a purpose to be described hereinafter. From a consideration of the wiring of the contacts of the contact sets 552 and 553 of the minor switch 550, it will be understood that if the third digit dialed at

the calling substation comprises two or three impulses, neither the operating circuit for the control relay R500 nor that for the code select relay R510 is completed at the end of the digit.

Although the four relays R220, R230, R240 and R310 respond to the impulses of the fourth digit dialed at the calling substation A in the exact manner explained above, this digit is absorbed in the reverting call switch 15; the only operation resulting from the operation of these relays being that of energizing the third transfer relay R340. More specifically, when the digit relay R310 reoperates at the beginning of the fourth digit, it closes its contacts 311 to complete a circuit through the contacts 301, 322, 332 and 341 for energizing the upper winding of the third transfer relay R340. When this circuit is completed, the relay R340 closes only its preliminary make contacts 343, thus short-circuiting its lower winding over a path which additionally includes the contacts 311, 322, 332 and 341. During the dialing of the fourth digit, current for reoperating the pulsing relay R230 at the end of the open-circuit period of each impulse is derived from a circuit which includes the contacts 241, 312 and 334. When the digit relay R310 releases at the end of this digit it opens its contacts 311 to interrupt the path short-circuiting the lower winding of the transfer relay R340, permitting the two windings of this transfer relay to be energized in series over a circuit which includes the contacts 301 and 343. When thus fully energized, the relay R340 opens its contacts 341 further to interrupt its operating circuit and the path for short-circuiting its lower winding. At its contacts 342, the relay R340 prepares the operating circuit for the fourth transfer relay R400. At its contacts 345, the relay R340 opens a point in the common portion of the above-traced operating circuits for the two relays R500 and R510. At its contacts 344, the relay R340 completes the prepared operating circuit for the release magnet 558, this circuit extending from ground by way of the contacts 303, 344 and 405, the off-normal springs 559, and the winding of the magnet 558 to battery. When thus energized the magnet 558 attracts its associated holding pawl, permitting the release of the spring-biased wipers 554 and 555. Incident to the movement of these wipers to their respective normal positions, the off-normal springs 559 are disengaged to deenergize the release magnet 558.

Following the operation of the third transfer relay R340 and the release of the minor switch 550, the reverting call switch 15 is conditioned to respond to the impulses of the fifth digit of the directory number designating the desired substation B. This digit is also absorbed in the reverting call switch 15, the only operation resulting therefrom being that of energizing the fourth transfer relay R400. More specifically, the digit relay R310, upon operating at the beginning of this digit, closes its contacts 311 to energize the upper winding of the transfer relay R400 in a circuit which includes the contacts 301, 311, 322, 332, 342 and 402. In reoperating, the relay R310 also closes its contacts 312 to provide a circuit for reoperating the pulsing relay R230 at the end of the open-circuit period of each impulse of the digit. When its upper winding is alone energized, the transfer relay R400 closes only its preliminary make contacts 403, thereby to complete a path through the contacts 311, 322, 332, 342 and 402 for short-circuiting its lower winding. When the digit relay R310 restores shortly following the end of the fifth digit, it opens its contacts 311 to interrupt the short-circuiting path just described, permitting the two windings of the transfer relay R400 to be energized in a circuit which includes the contacts 403 and 301. When thus fully energized, the transfer relay R400 opens its contacts 402 further to interrupt its operating circuit and the path for short-circuiting its lower winding. At its contacts 401, the relay R400 prepares the operating circuit for the fifth transfer relay R410. At its contacts 405, the relay R400 opens a point in the above-traced operating circuit for the release magnet 558. At its contacts 404, the relay R400 interrupts the locking circuit for the second transfer relay R330. When thus deenergized the relay R330 releases. At its contacts 331, the relay R330 reprepares its own operating circuit. At its contacts 333, the relay R330 opens another point in its own locking circuit. At its contacts 334, the relay R330 opens one branch of the operating circuit for the pulsing relay R230. At its contacts 335, the relay R330 reprepares the previously traced circuit for transmitting current pulses to the operating magnet 556 of the minor switch 550.

The sixth digit dialed at the substation A is utilized in the reverting call switch 15 to effect the operation of the transfer relay R410 and to position the wipers of the minor switch 550 on the contacts corresponding to the code which designates the desired substation B. More specifically, when the digit relay R310 reoperates at the beginning of this digit, it closes its contacts 311 to complete the previously traced circuit for energizing the upper winding of the transfer relay R330 and the above-mentioned circuit for energizing the upper winding of the fifth transfer relay R410. The latter circuit may be traced as extending from ground by way of the contacts 301, 311, 322, 401 and 411, and the upper winding of R410 to battery. When its upper winding is thus energized the relay R410 closes only its preliminary make contacts 412, thereby to complete a path for short-circuiting its lower winding which additionally includes the contacts 411, 401, 322 and 311. The transfer relay R330 similarly only closes its preliminary make contacts 333 when its upper winding is energized in response to the reoperation of the digit relay R310. With the contacts 335 of this transfer relay closed, it will be understood that the three relays R220, R230 and R240 in their response to the impulses of the sixth digit, function to repeat these impulses to the operating magnet 556 of the minor switch 550. Accordingly, the wipers of the minor switch are left standing in an off-normal position which corresponds to the numerical value of the digit after the digit is ended. In this regard it is noted that if neither of the two relays R500 and R510 is operated during the dialing of the third digit and the sixth digit comprises more than five impulses, a circuit is completed for energizing the ring transfer relay R520. More specifically, with the two relays deenergized, the operating circuit for the ring transfer relay R520 is completed by the wiper 555 incident to the operation of this wiper into engagement with its associated sixth contacts. This circuit may be traced as extending from the grounded release conductor 346 by way of the contacts 526, the wiper 555 and its associated sixth contacts, the contacts 501 and 513, and the upper winding of R520 to battery. If energized in this circuit, the relay R520 first locks to the grounded release conductor 346 over

a path including its preliminary make contacts 525. After this locking circuit is completed the relay R520 opens its contacts 526 to deenergize its upper winding. At its contacts 521 to 524, inclusive, the relay arranges the ringing current transmission circuits for the transmission of ringing current over the positive side of the line 10.

When the digit relay R310 restores at the end of the sixth digit, it opens its contacts 311 to deenergize the transfer relay R330 and to interrupt the path short-circuiting the lower winding of the transfer relay R410. The partial release of the relay R330 is without effect. When the path short-circuiting the lower winding of the relay R410 is interrupted, the two windings of this relay are energized in series over a circuit which includes the contacts 412 and 301. The relay R410 now opens its contacts 411 further to interrupt its operating circuit and the path for short-circuiting its lower winding. At its contacts 413, the relay R410 opens the operating circuit for the digit relay R310, thereby to prevent further operation of the latter relay in the event additional impulses are inadvertently transmitted to the reverting call switch 15. At its contacts 415, the relay R410 opens a point in the previously traced operating circuit for the magnet 556 to prevent further operation of this magnet in the event additional impulses are transmitted to the reverting call switch 15. At its contacts 414, the relay R410 prepares the operating circuit for the start ring relay R210. Following the operations just described, no further operation of the apparatus embodied in the reverting call switch 15 occurs until the calling party restores the receiver provided at the calling substation A to its supporting hook or cradle in order to initiate the ringing operation.

From the preceding explanation it will be understood that the numerical value of the second digit dialed into the reverting call switch, i. e., the third digit dialed at the calling substation, determines whether bridged or divided ringing is to be utilized in signaling the desired substation B, and is also used partially to select the ringing code in the event bridged ringing is to be used. Briefly to summarize the available types of ringing, it is pointed out that if the second digit dialed into the reverting call switch 15 comprises two or three impulses and the last digit dialed into this switch comprises not more than five impulses, divided ringing is used in signaling the desired substation, the ringing current is transmitted over the negative side of the calling line, and one of the first five available codes is used in signaling the called substation. On the other hand, if the second digit of two or three impulses is followed by a final digit of from six to ten impulses, whereby the ring transfer relay R520 is operated during the ringing operation, the ringing circuits are arranged for divided ringing, the ringing current is transmitted over the positive side of the calling line, and one of the sixth to tenth available codes is utilized in signaling the called substation. Alternatively, if the second digit dialed into the reverting call switch comprises four impulses, whereby the control relay R500 is operated at the end of this digit, bridged ringing must be utilized in signaling the called substation, the first group of ten codes is selected by the dialing of the second digit, and the particular code designating the desired substation is further selected in response to the dialing of the final digit. Finally, if a second digit of five impulses is dialed into the reverting call switch 15 to cause the operation of the code select relay R510, the operating circuit of the pickup relay R430 is arranged to include the second pickup lead C577, whereby the second group of ten codes is selected from which a particular code is further selected in response to the dialing of the final digit.

Briefly to consider the manner in which the different codes are formed by the code interrupter of the common equipment 17, it is pointed out by reference to Fig. 11 of the drawings in the above-referred-to copending application Serial No. 414,252, filed October 9, 1941, Clarence E. Lomax and Pier Bakker, that the codes respectively forming the two ten code groups are derived from the same set of coding cams and differ only in that the codes of one group include a preliminary short ring which is omitted from the codes of the second group. For example, the code structure of the first code in the second group is identical with that of the first code in the first group except that it is introduced by a preliminary short ring which is absent from the code structure of the first code in the first group. The other codes of the second group are similarly distinguished from the corresponding codes of the first group. This is accomplished by arranging one of the pickup cams of the interrupter to transmit, during each ringing code cycle, a pickup ground pulse over the first pickup lead C576 at a point in the code cycle which follows the short or preliminary ring interval, and by arranging the cam controlling the transmission of pickup pulses over the second pickup lead C577 so that each pickup pulse transmitted over this lead precedes the short ringing interval in each code cycle.

Proceeding now to a consideration of the specific relay operations involved in the transmission of ringing current of the selected code over the line 10, it is pointed out above that the ringing operation is initiated in response to a switch release operation performed at the calling substation A. More specifically when the calling party at this substation restores the receiver thereat to its supporting hook or cradle, the loop circuit extending through the operated finder-selector link 12 to the reverting call switch 15 is interrupted to cause the deenergization and release of the line relay R220. Upon restoring, this relay opens its contacts 221 to deenergize the pulsing relay R230. At its contacts 223, the relay R220 opens the holding circuit for the hold relay R250. The relay R230, upon restoring, opens its contacts 233 to deenergize the pulse control relay R240 and closes its contacts 232 to complete the prepared operating circuit for the start ring relay R210. The latter circuit extends from ground by way of the contacts 204, 232, 306, 325, 335 and 414, and the winding of R210 to battery. The relay R240, upon restoring, opens its contacts 242 to interrupt the operating circuit for the relay R250, and closes its contacts 241 to reprepare the above-traced branch of the operating circuit for the pulsing relay R230.

The start ring relay R210, upon operating, closes its contacts 216 to complete an alternative holding circuit for the hold relay R250, this circuit extending from ground by way of the contacts 204, 216, 307 and 443 and the winding of R250 to battery. Thus, the hold relay R250 and its slave relay R300 are prevented from releasing during the ringing operation. At its contacts 211 and 213, the relay R210 opens two

additional points in the calling loop circuit, thereby to disconnect the winding terminals of the line relay R220 from the talking conductors 16a and 16b of the trunk 16. At its contacts 212 and 214, the relay prepares the available ringing current circuits. At its contacts 215, the relay R210 prepares the operating circuit for the pickup relay R430.

In considering the manner in which the called substation B is signaled, it may first be assumed that the line 10 is arranged for bridged ringing and that the third code of the first group of codes is assigned to this substation. It will be understood that, in such case, none of the three relays R500, R510 and R520 is operated at the end of the dialing operation and further that the wipers of the minor switch 550 occupy their respective third off-normal positions when the dialing operation is completed. With the above assumption in mind, it will be understood that following the operation of the start ring relay R210, and when the ringing interrupter of the common equipment 17 next operates to transmit a ground pulse over the pickup lead C576, the relay R430 is energized. More specifically, the circuit for energizing this relay extends from the grounded pickup lead C576 by way of the contacts 511, 432, 215 and 421, and the winding of R430 to battery. If the code select relay R510 is operated during the dialing operation, indicating that the code assigned to the called substation is in the second group of ten codes, the pickup relay is energized by the first ground pulse transmitted over the second pickup lead C577 following the operation of the start ring relay R210. In this case, the relay is energized in a circuit which includes the lead C577 and the contacts 512, 432, 215 and 421. When energized over either of these circuits, the relay R430 operates and locks to ground over a circuit which includes the contacts 421, 215 and 431 and the hold lead C578, which lead is normally grounded through cam-controlled contacts of the ringing interrupter. More particularly, the cam which controls these contacts is so arranged that the lead C578 is disconnected from ground for a short time interval at the end of each ringing code cycle. After completing its operating circuit as traced above, the relay R430 opens its contacts 432 to disconnect the pickup lead C576 or C577 from ground ,thereby to permit ground pulses transmitted over the connected lead to be utilized in controlling the ring pickup relays of the other reverting call switches. At its contacts 433, the relay R430 prepares the operating circuit for the ringing relay R540.

Following the operation of the ring pickup relay R430, the ringing relay R540 is energized during each ringing interval of the selected code. In the present case the operating circuit for this relay may partially be traced including the third code lead terminated in the contact set 551 of the minor switch 550, the wiper 554, the winding of R540, and the contacts 433, it being understood in this regard that the codes are formed through operation of the ringing interrupter cams to impress ground potential upon the illustrated code leads for intervals which may vary in length, number and combination. Each time the relay R540 is energized, it closes its contacts 542 to project ringing current over the negative side of the calling line 10 and thus energize the ringer provided at the called substation. The path traversed by the ringing current may partially be traced as extending from one terminal of the ringing current generator by way of the ringing current conductor C618, the contacts 542, the winding of R530, the contacts 521 and 212, the negative side of the line 10, the series-connected ringer and condenser bridged between the conductors of the line 10 at the substation B, the positive side of the line 10, the contacts 214 and 523 and the exchange battery to the opposite terminal of the ringing current generator. In the event the ringer provided at the called substation B is bridged between the negative side of the line 10 and ground in series with a condenser, such that divided ringing is utilized in signaling the substations connected to this line, a ground return path is utilized to complete the ringing circuit, rather than the positive side of the line 10. It is pointed out further that if the ringer provided at the called substation B is bridged between the positive side of the line 10 and ground, such that the ring transfer relay R520 is in its operated position during the ringing operation, and one of the sixth to tenth codes of the first group is assigned for use in signaling this substation, the path traversed by the ringing current extends from the ringing current conductor C618 by way of the contacts 542, the winding of R530, the contacts 522 and 214, the positive side of the line 10, the ringer and condenser connected between the positive side of this line and ground at the substation B, the ground return path and the exchange battery to the opposite terminal of the ringing current generator. Aside from the above noted differences between the circuits traversed by the ringing current, the manner in which the ringing relay R540 functions to complete the prepared one of these circuits is exactly the same regardless of the type of ringing used or the particular code utilized in signaling the desired substation.

From the above explanation it will be understood that at the end of each ringing period of each code cycle, the relay R540 restores to interrupt the ringing current circuit. At the end of each code cycle, the ringing interrupter functions in the manner explained above to disconnect the hold lead C578 from ground and thus deenergize the pickup relay R430. This relay, in restoring, opens its contacts 433 to prevent further operation of the ringing relay R540, opens its contacts 431 further to interrupt its locking circuit, and closes its contacts 432 to reprepare its operating circuit. When, thereafter, the ringing interrupter functions to transmit a ground pulse over the selected pickup lead C576 or C577, the pickup relay R430 is reoperated to condition the ringing relay R540 to operate during the ringing intervals of the second code cycle.

After hanging up to initiate the ringing operation in the manner explained above, the calling party may listen to the ringing of the bell at the substation A, provided the ringers at the substations A and B are connected to be energized over the same ringing circuit. If the line 10 is arranged for divided ringing and the ringers at the substations A and B are connected between different sides of the line and ground, the calling subscriber must wait a reasonable time interval during which the called substation B may be signaled, and then remove the receiver provided at the substation A from its supporting hook or cradle.

When the call is answered at one of the substations associated with the line 10, the control equipment embodied in the reverting call switch 15 operates to terminate the transmission of

ringing current over the calling line and to transmit over this line a special signal of limited duration. Thus if the call is answered at the called substation B, for example, a direct current bridge is connected between the conductors of the line 10 to complete the operating circuit for the ring cut-off relay R530. This circuit may take either of four forms, depending upon the positions of the ring transfer relay R520 and ringing relay R540. With the relay R540 in its restored position the operating circuit for the ring cut-off relay R530 may be traced as extending from the negative terminal of the exchange battery by way of the resistor 543, the contacts 541, the winding of R530, the contacts 521 and 212, the negative side of the line 10, the bridge across the conductors of the line 10 at the answering substation B, the positive side of the line 10, and the contacts 214 and 523 to ground. It will be understood that if the ring transfer relay R520 is operated during the ringing operation the operating circuit for the ring cut-off relay R530 is extended through the contacts 522 and the positive side of the line 10 and is returned to ground over a path including the negative side of the line 10 and the contacts 524. In the event the ringing relay R540 is operated at the time the call is answered, the lower winding terminal of the ring cut-off relay R530 is connected to the negative terminal of the exchange battery over a path which includes the contacts 542, C618 and the ringing current generator rather than through the contacts 541 and the resistor 543. Aside from this difference, the operating circuit for the ring cut-off relay R530 may take either of the two forms described above. When energized over any one of the circuits traced above, the relay R530 closes its contacts 531 to complete a circuit including the grounded release conductor 346 for energizing the slow-to-operate stop ringing relay R420. In operating, the latter relay locks to ground over a path including its contacts 424 and the release conductor 346, and opens its contacts 421 to deenergize the pickup relay R430, causing the latter relay and the ringing relay R540 to restore, if operated. At its contacts 422, the relay R420 prepares a path for impressing the voltage of a special tone source upon the established connection extending to the substation B. At its contacts 423, the relay R420 prepares the operating circuit for the release relay R440.

As described in the above referred to copending application Serial No. 414,252, filed October 9, 1941, Clarence E. Lomax and Pier Bakker, the timing apparatus embodied in the common equipment 17 is so arranged that the time cut-off lead C298 is normally connected to ground through interrupter contacts embodied in this apparatus; ground pulses are periodically transmitted over the pulsing lead C289; the time cut-off lead C298 is disconnected from ground a predetermined time interval after each ground pulse is transmitted over the pulsing lead C289; and the special tone lead C267 is intermittently connected to the ringing current generator. Accordingly, interrupted ringing current is transmitted over the established connection to energize the receiver provided at the answering substation B immediately the stop ring relay R420 operates. The path traversed by this current may partially be traced as extending from the tone lead C267 by way of the contacts 422, the condenser 544 and the contacts 521 and 212 or the contacts 522 and 214 to one side of the line 10. From this point the current is transmitted through the windings of the receiver provided at the substation B back over the other side of the established connection and through the closed contacts 523 or 524 and the exchange battery to the other terminal of the ringing current generator. The frequency of interruption of the current traversing this circuit is such that a distinctive signal is produced through the operation of the receiver provided at the substation B. This tone serves to inform the answering party that the call which has been answered is a reverting call. Upon receiving this signal the answering party is informed that the answered call has not been abandoned, and further that a short time interval may elapse before the calling subscriber again removes his receiver from its supporting hook or cradle to complete the desired connection.

The release relay R440 is energized through the contacts 423 by the first ground pulse transmitted over the pulsing lead C289 following the operation of the stop ring relay R420. In operating, this relay locks to the grounded release conductor 346 through its contacts 441. At its contacts 442 and 443, the relay R440 includes the grounded time cut-off lead C298 in the holding circuit for the hold relay R250 and then interrupts the holding circuit for the hold relay as completed through the contacts 307, 216 and 204.

A predetermined time interval after the relay R440 operates, the timing apparatus of the common equipment 17 functions to disconnect the time cut-off lead C298 from ground and thus deenergize the hold relay R250. Upon restoring, the relay R250 opens its contacts 252 to disconnect the test conductor 16c of the trunk 16 from ground and thus initiate the release of the selector 12b and the finder 12a. The manner in which these two switching units are released is entirely conventional. At its contacts 251, the relay R250 connects the test conductor 16c to the negative terminal of the exchange battery through the resistor 255, thereby to mark the reverting call switch 15 as idle. At its contacts 253, the relay R250 opens the operating circuit for the hold slave relay R300. In releasing, the latter relay opens its contacts 301 to deenergize the operated transfer relays R320, R340, R400 and R410. At its contacts 303, the relay R300 disconnects the release conductor 346 from ground, thereby to deenergize the operated ones of the relays R420, R440, R500, R510 and R520. At its contacts 308, the relay R300 disconnects the ringing apparatus start lead C680 from ground in the reverting call switch 15. At its contacts 306, the relay R300 opens the previously traced operating circuit for the start ring relay R210. At its contacts 304, the relay R300 recompletes the operating circuit for the release magnet 558. When this magnet is energized to attract its associated holding pawl, the wipers 554 and 555 are returned to normal. Incident to the release of these wipers the off-normal springs 559 are opened to deenergize the release magnet 558. Following the release of the minor switch 550 and the release of the relays which are deenergized in response to the restoration of the hold slave relay R300, the reverting call switch 15 is fully restored to normal.

It will be understood that the desired talking circuit between the substations A and B is completed when the calling subscriber at the substation A again removes the receiver provided at this substation from its supporting hook or cradle. In this regard it may be pointed out that when the test conductor 16c of the trunk 16 is

disconnected from ground in the reverting call switch 15 the line circuit 10a is operated to its line lockout setting in the usual manner. With the relays of this circuit in the setting required to lock the line 10 out of service, talking battery is supplied to the line 10 through the windings of the line relay embodied in this circuit, the distributor start lead 18 is disconnected from ground to prevent the reseizure of one of the finder-selector links, and ground potential is maintained upon the private conductor of the line 10 to guard this line against seizure on calls incoming thereto. It will also be understood that when the connection is cleared out at both the calling and called substations to cause the release of the operated relays in the line circuit 10a, the private conductor of the line 10 is marked with negative battery potential to identify this line as idle in the usual manner.

From the preceding explanation it will be understood that the ringers respectively provided at the calling and called substations associated with the same multiparty line may, in certain instances, be arranged for energization over different sides of the line. In such case the ringer provided at the calling substation is not energized during the ringing operation and the calling subscriber is not signaled as to when the call is answered. Accordingly, the calling subscriber after hanging up to initiate the ringing operation in the manner explained above, waits a reasonable time interval and then picks up his receiver to again establish a connection with the line. If during this interval the call is answered at the called substation the special signal transmitted to the answering substation serves to inform the answering party that the call is of the revertive type. On the other hand, if the subscriber at the calling substation removes the receiver provided at this substation from its supporting hook or cradle before the call is answered, the interrupted current transmitted through the receiver provided at this substation from the ringing current source serves to signal the calling subscriber that the call has not been answered. In such case the calling subscriber may either abandon the call or may hold the connection until the call is answered.

Provisions are made in the reverting call switch 15 for forcibly releasing this switch and the preceding switch train through which it is seized in the event a revertive signaling operation is not completed by the switch within a predetermined time interval after the switch is seized. The equipment for this purpose includes the timing relay R200, which is arranged to be controlled by the timing apparatus provided in the common equipment 17. More specifically this apparatus, as disclosed in the above referred to copending application Serial No. 414,252, is arranged normally to maintain ground potential upon the release conductor C288 and functions periodically to transmit ground pulses over the pulsing lead C290. A predetermined time interval after each ground pulse is transmitted over the lead C290, the timing apparatus functions to disconnect the release conductor C288 from ground.

In considering the operation of the timing relay R200 forcibly to release the reverting call switch, it will be recalled from the preceding explanation that when the hold slave relay R300 operates incident to the seizure of this switch, the operating circuit for the timing relay R200 is prepared at the contacts 305. Following this operation and when the timing apparatus of the common equipment 17 next functions to transmit a ground pulse over the pulsing lead C290, the relay R200 is energized in a circuit which includes this lead and the contacts 202 and 305. When thus energized the relay R200 locks up in a circuit which includes its contacts 201 and the contacts 305, and then opens its contacts 202 to disconnect the lead C290 from ground. At its contacts 203 and 204, the relay R200 first includes the normally grounded release conductor C288 in the operating and holding circuits for the hold relay R250 and then interrupts the initially completed circuits for energizing the hold relay. If the reverting call operation is not completed and the reverting call switch 15 released in the normal manner explained above within a period of approximately two minutes following the operation of the timing relay R200, it is forcibly released. Thus at the end of the two minute interval the timing apparatus of the common equipment 17 disconnects the release conductor C288 from ground to deenergize the hold relay R250. In releasing, the relay R250 opens its contacts 252 to disconnect the test conductor 16c of the trunk 16 from ground and thus initiate the release of the operated finder-selector link 12. At its contacts 253, the relay R250 deenergizes the hold slave relay R300. Incident to the release of the finder-selector link 12 the connection between the line 10 and the trunk 16 is broken to cause the sequential release of the three relays R220, R230 and R240, if operated. When the hold slave relay R300 restores it initiates the release of the operated relays in the reverting call switch 15, in the exact manner explained above with reference to the normal release of this switch. In this regard it will be noted that when the hold slave relay R300 restores, the locking circuit for the timing relay R200 is broken at the contacts 305. Incident to the release of the finder-selector link 12 and the reverting call switch 15, the line circuit associated with the calling line is operated to its line lockout setting. This line circuit remains in its lockout setting until such time as the call present on the associated line is abandoned.

While one embodiment of the invention has been disclosed, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, a multiparty line, an impulse controlled reverting call switch accessible to said line and including facilities directively controllable over said line selectively to signal the substations associated with said line, and means for absorbing at least one of the digits transmitted to said switch during a selective signaling operation.

2. In a telephone system, a multiparty line, an impulse controlled reverting call switch accessible to said line and including facilities directively controllable over said line selectively to signal the substations associated with said line, and means for absorbing the first digit transmitted to said switch during a selective signaling operation.

3. In a telephone system, a multiparty line, a plural digit reverting call switch controllable over said line and including impulse controlled means for selectively signaling the substations associated with said line, and means for absorbing a plurality of the digits transmitted to said switch over said line during a selective signaling operation.

4. In a telephone system, a multiparty line, a plural digit reverting call switch controllable

over said line and including impulse controlled means for selectively signaling the substations associated with said line, and means for absorbing the first, third and fourth digits transmitted to said switch over said line during a selective signaling operation.

5. In a telephone system, a multiparty line, a plural digit reverting call switch controllable over said line and including means for absorbing the first, third and fourth digits transmitted to said switch over said line, and means controlled in accordance with the numerical values of the second and fifth digits transmitted to said switch over said line for selectively signaling the substations associated with said line.

6. In a telephone system, a multiparty line, a plural digit reverting call switch controllable over said line and including means for absorbing at least one of the digits transmitted to said switch over said line, means controlled in accordance with the numerical values of the remaining digits transmitted to said switch over said line for signaling a predetermined one of the substations associated with said line, and means operative in response to the answering of the call at one of the substations associated with said line for transmitting a special signal to the answering substation.

7. In a telephone system, a multiparty line, a plural digit reverting call switch controllable over said line and including means for absorbing the first digit transmitted to said switch over said line, means controlled in accordance with the numerical value of at least one other digit transmitted to said switch over said line for signaling a predetermined substation associated with said line, and means operative in response to the answering of the call at one of the substations associated with said line for transmitting a special signal to the answering substation.

8. In a telephone system, a multiparty line, a plural digit reverting call switch controllable over said line and including means for absorbing the first, third and fourth digits transmitted to said switch over said line, means controlled in accordance with the numerical values of the second and fifth digits transmitted to said switch over said line for signaling a predetermined one of the substations associated with said line, and means operative in response to the answering of the call at one of the substations associated with said line for transmitting a special signal to the answering substation.

9. A reverting call switch including selective signaling means, impulse responsive means operative to control said selective signaling means, and means for preventing said impulse responsive means from controlling said selective signaling means in the response of said impulse responsive means to a portion of the impulses transmitted to said switch during a selective signaling operation.

10. A plural digit reverting call switch including means for absorbing at least a portion of the digits transmitted to said switch during a selective signaling operation, and selective signaling means operative in response to the other digits transmitted to said switch during said selective signaling operation.

11. A plural digit reverting call switch comprising an incoming trunk, a signal selecting switch, means responsive to one digit transmitted to said reverting call switch for operating said signal selecting switch, means controlled by said signal selecting switch in its response to said one digit for partially selecting the signal to be revertively transmitted over said trunk, means responsive to a subsequent digit transmitted to said reverting call switch for operating said signal selecting switch to complete the selection of the signal to be used in revertively signaling over said trunk, and means for absorbing at least one digit transmitted to said reverting call switch between said one digit and said subsequent digit.

12. A plural digit reverting call switch comprising an incoming trunk, a signal selecting switch, means responsive to one digit transmitted to said reverting call switch for operating said signal selecting switch, means controlled by said signal selecting switch in its response to said one digit for partially selecting the signal to be revertively transmitted over said trunk, means responsive to a subsequent digit transmitted to said reverting call switch for operating said signal selecting switch to complete the selection of the signal to be used in revertively signaling over said trunk, and means for absorbing a digit transmitted to said reverting call switch before said one digit and for absorbing at least one digit transmitted to said reverting call switch between said one digit and said subsequent digit.

13. A plural digit reverting call switch comprising a plurality of transfer relays which are successively operative in response to succeeding digits transmitted to said switch, a signal selecting switch, an impulse repeating relay operative to control said transfer relays and said signal selecting switch, and means controlled by said transfer relays for limiting the response of said signal selecting switch to only a portion of the digits transmitted to said reverting call switch.

14. A plural digit reverting call switch comprising a plurality of transfer relays which are successively operative in response to succeeding digits transmitted to said switch, a signal selecting switch, an impulse repeating relay operative to control said transfer relays and said signal selecting switch, means controlled by one of said transfer relays and said impulse repeating relay for operating said signal selecting switch to a predetermined setting in response to one digit transmitted to said reverting call switch, means responsive to operation of said signal selecting switch to said predetermined setting for partially selecting the signal to be transmitted from said reverting call switch, means controlled by another of said transfer relays for releasing said signal selecting switch, and means controlled by a third of said transfer relays and said impulse repeating relay for again operating said signal selecting switch to a predetermined setting, thereby to complete the selection of the signal to be transmitted from said reverting call switch.

15. In an automatic telephone system which includes a multiparty line and wherein an automatic switch train may be controlled by the digits of a plural digit directory number to route a connection to said line from another line of the system and to then signal one of the substations associated with said line, means controlled by the transmission of at least one predetermined prefix digit followed by the digits of said directory number over said multiparty line for signaling said one substation.

16. In an automatic telephone system, a multiparty line, a substation associated with said line and having a plural digit directory number designation, a reverting call switch accessible

to said line and including means controlled by the transmission of all of the digits of said directory number thereto over said line for signaling said substation, and means responsive to the answering of the call at said substation for transmitting a special signal to said substation.

17. In an automatic telephone system, a multiparty line, a substation associated with said line, said substation having a plural digit directory number assigned thereto, at least a portion of the digits of said directory number normally being utilized as line selecting digits in the control of automatic switches to extend connections to said line, a reverting call switch accessible to said line and adapted to respond to the transmission of all of the digits of said directory number to said switch over said line, means included in said switch for absorbing the line selecting digits of said number, and means included in said switch and controlled by the remaining digits of said number for signaling said substation.

18. A reverting call switch comprising impulse controlled signal selecting means, a hold relay, impulse responsive relays for energizing said hold relay when said switch is seized and for repeating impulses of corrected length to said signal selecting means, and means responsive to the release of said impulse responsive relays after said signal selecting means is operated to select a signal for holding said hold relay operated.

19. A reverting call switch comprising an impulse controlled signal selecting switch having an operating magnet, a hold relay, impulse responsive relays operative to energize said hold relay when said reverting call switch is seized, said relays being controlled by said magnet and by impulses transmitted to said reverting call switch to repeat said impulses in corrected form to said magnet, thereby to operate said signal selecting switch to select a particular signal, and means responsive to the release of said impulse responsive relays after said signal selecting switch is operated to select a signal for holding said hold relay operated.

20. A reverting call switch comprising impulse controlled signal selecting means, means for repeating impulses transmitted to said switch to said signal selecting means, and means for controlling said last-named means so that the closed circuit period of each impulse repeated to said signal selecting means endures for not less than a predetermined time interval regardless of the duration of the corresponding portion of the impulse transmitted to said switch.

21. A reverting call switch comprising an impulse controlled signal selecting switch having no operating magnet, means for repeating impulses transmitted to said switch to said magnet, and means comprising said magnet for controlling said last-named means so that the closed circuit period of each impulse repeated to said magnet endures for not less than a predetermined time interval regardless of the duration of the corresponding portion of the impulse transmitted to said switch.

22. In a telephone system, a multiparty line, a reverting call switch accessible to said line and including means adapted to be controlled by switch directing signals transmitted to said switch over said line to selectively signal the substations associated with said line, and means for absorbing at least one of the switch directing signals transmitted to said switch during a selective signaling operation.

23. In a telephone system, a multiparty line, a reverting call switch accessible to said line and including means adapted to be controlled by switch directing signals transmitted to said switch over said line to selectively signal the substations associated with said line, means for absorbing at least one of the switch directing signals transmitted to said switch during a selective signaling operation, and means operative in response to the answering of the call at one of the substations associated with said line for transmitting a special signal to the answering substation.

24. In an automatic telephone system, a multiparty line, a substation associated with said line, said substation having a directory number assigned thereto which includes a plurality of switch directing signals, at least a portion of the signals of said directory number normally being utilized as line selecting digits in the control of automatic switches to extend connections to said line, a reverting call switch accessible to said line and adapted to respond to the transmission of all of the signals of said directory number to said switch over said line, means included in said switch for absorbing the line selecting signals of said number, and means included in said switch and controlled by the remaining digits of said number to signal said substation.

25. In an automatic telephone system, a multiparty line, a substation associated with said line, said substation having a directory number assigned thereto which includes a plurality of switch directing signals, at least a portion of the signals of said directory number normally being utilized as line selecting digits in the control of automatic switches to extend connections to said line, a reverting call switch accessible to said line and adapted to respond to the transmission of all of the signals of said directory number to said switch over said line, means included in said switch for absorbing the line selecting signals of said number, means included in said switch and controlled by the remaining digits of said number to signal said substation, and means operative in response to the answering of the call at one of the substations associated with said line for transmitting a special signal to the answering substation.

PIER BAKKER.

CERTIFICATE OF CORRECTION.

Patent No. 2,335,473. November 30, 1943.

PIER BAKKER.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 12, first column, line 59, claim 21, for "no" read --an--; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 25th day of January, A. D. 1944.

Henry Van Arsdale,
Acting Commissioner of Patents.

(Seal)