June 2, 1942. R. W. JONES 2,285,282

TELEPHONE SYSTEM

Filed Nov. 16, 1940 4 Sheets-Sheet 1

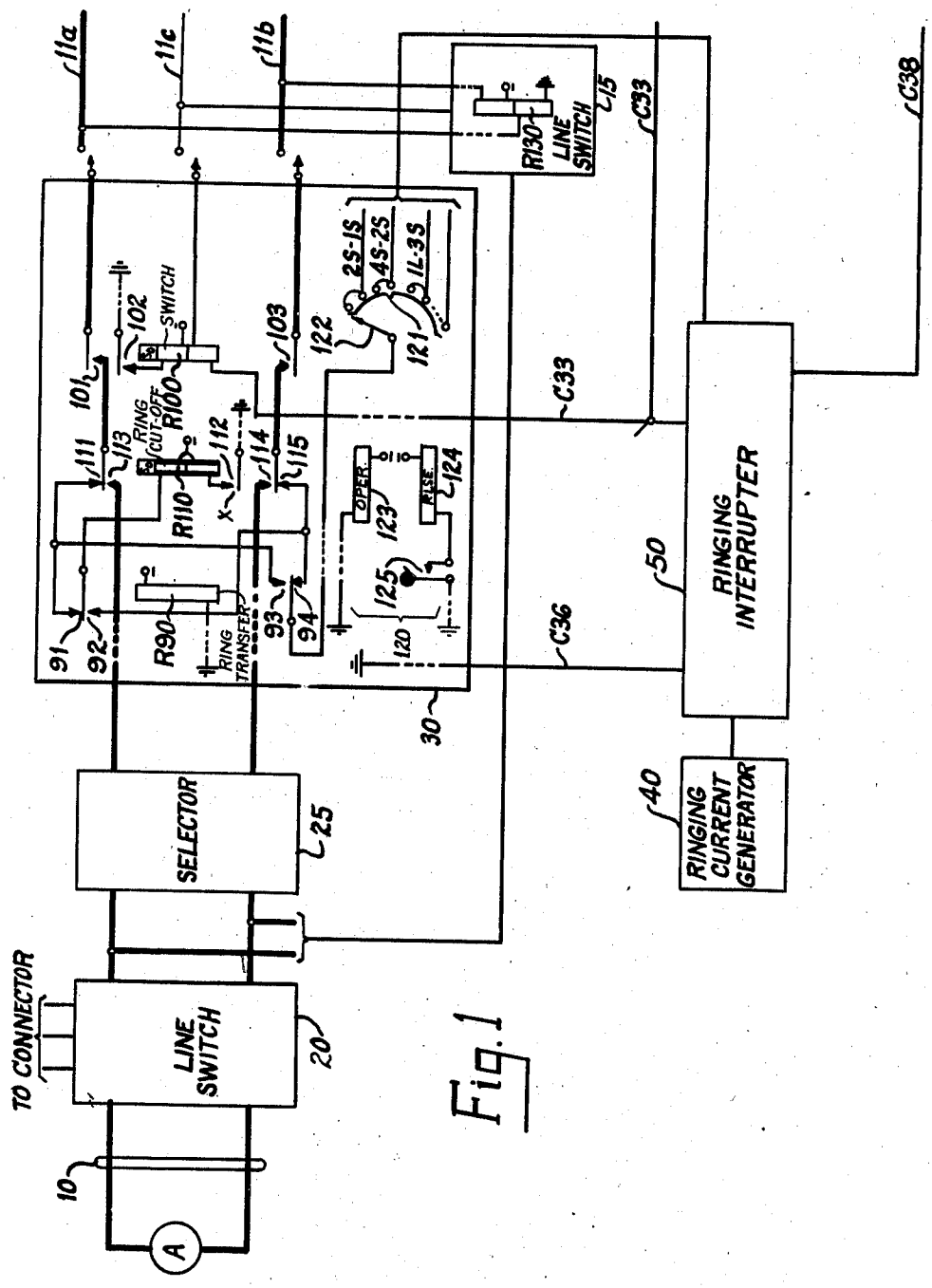



Fig. 1

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TELEPHONE SYSTEM

Filed Nov. 16, 1940 4 Sheets-Sheet 2

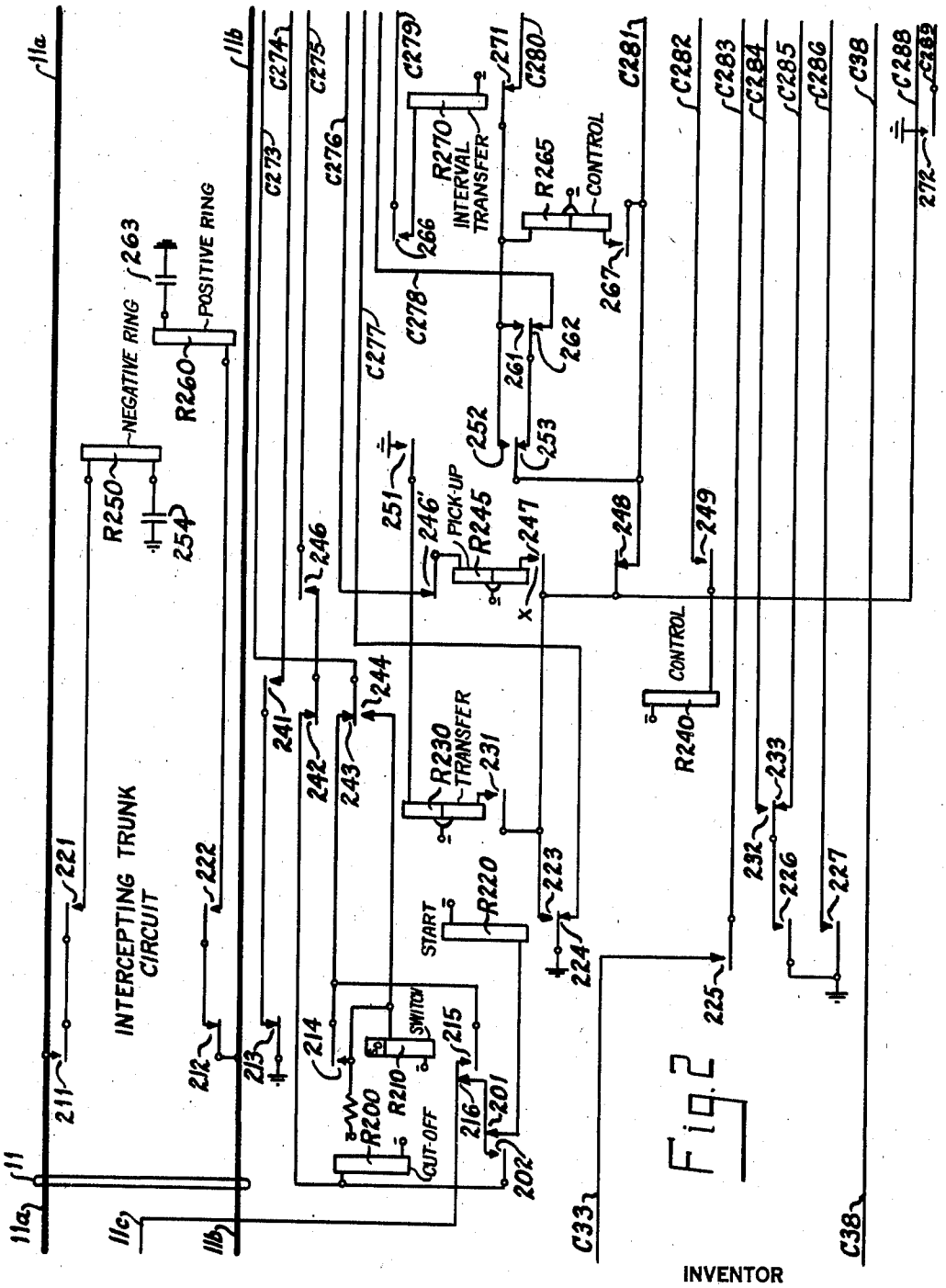



Fig. 2

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TELEPHONE SYSTEM

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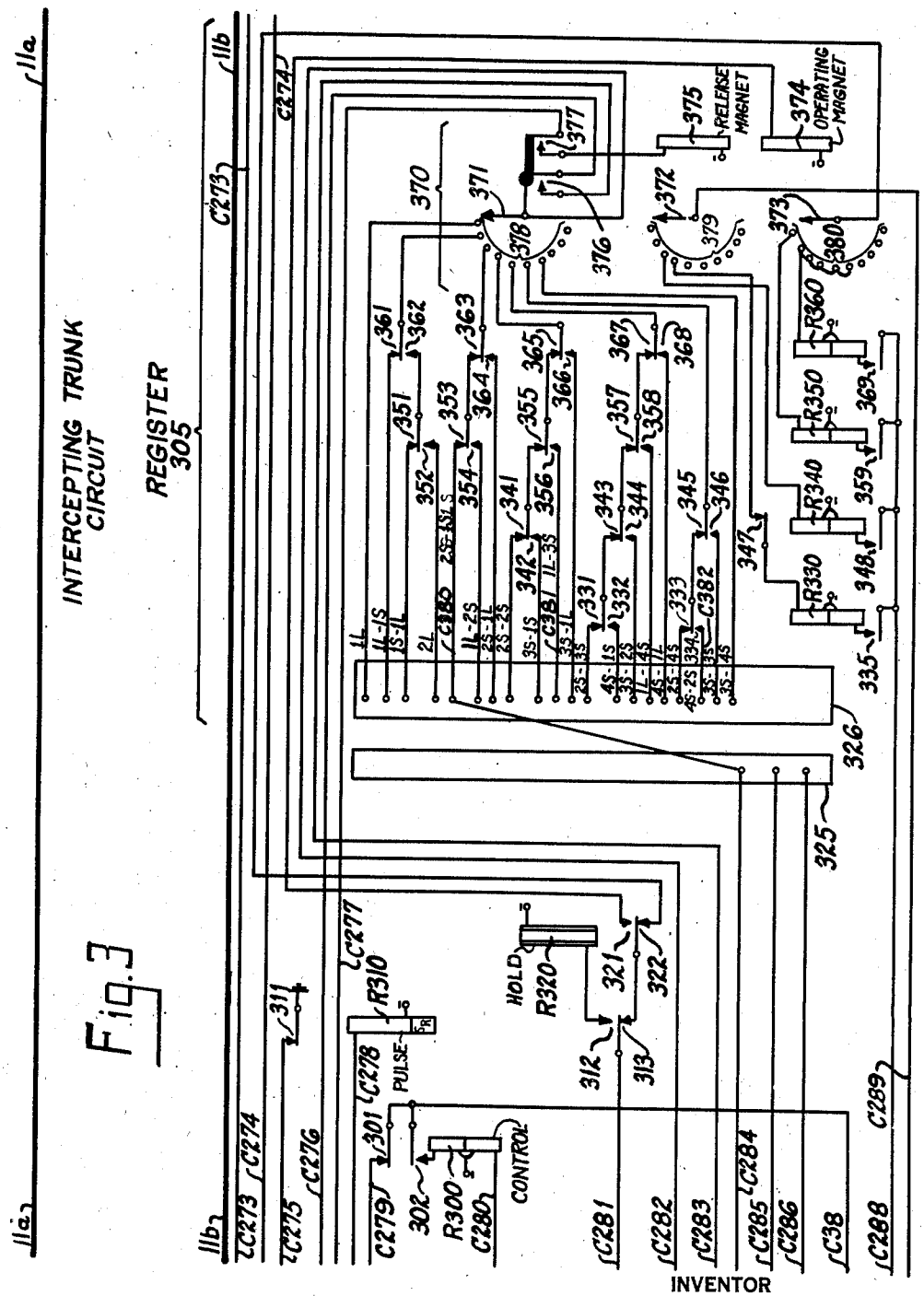



Fig. 3

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TELEPHONE SYSTEM

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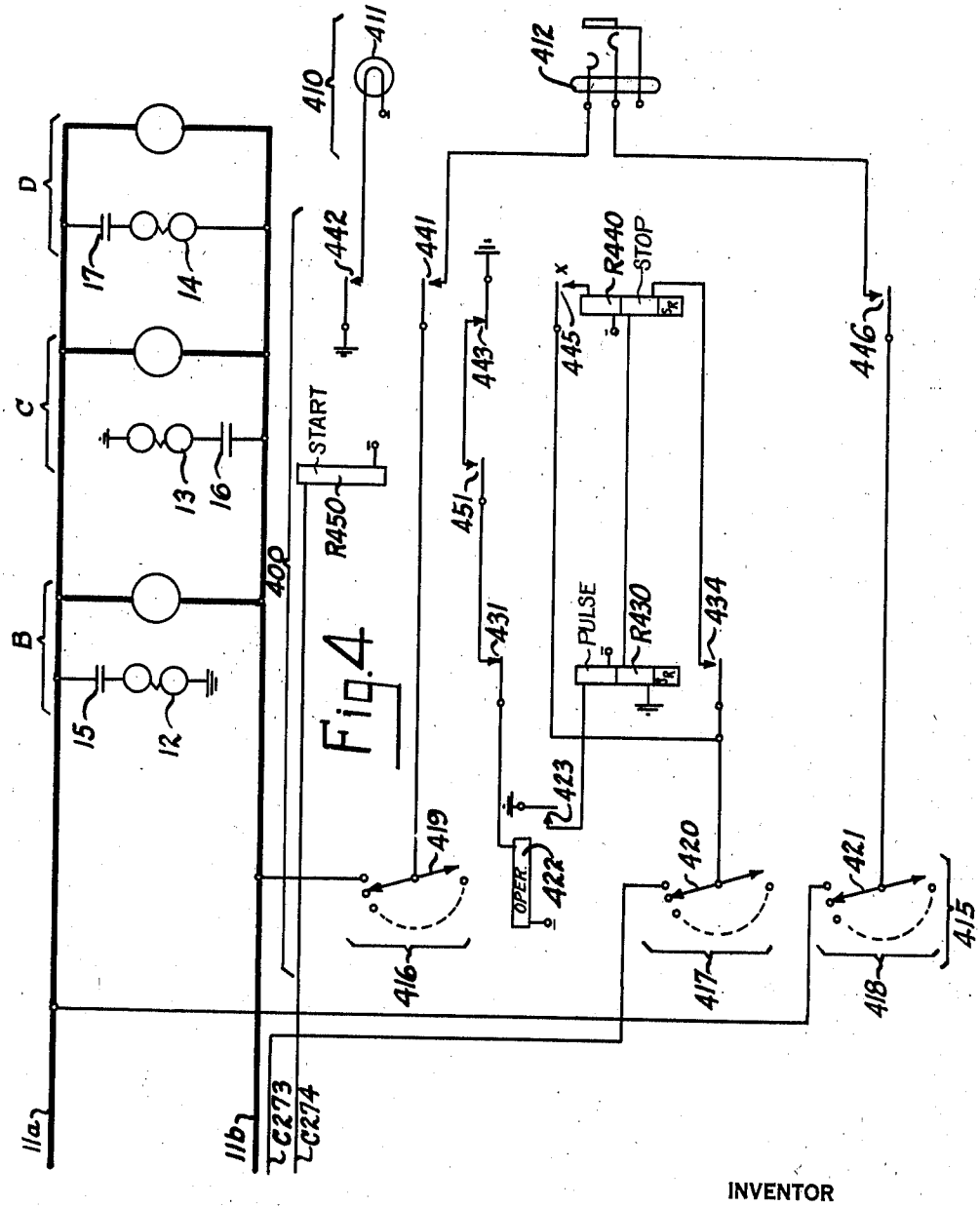



Fig. 4

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# UNITED STATES PATENT OFFICE

2,285,282

## TELEPHONE SYSTEM

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Application November 16, 1940, Serial No. 365,850

34 Claims. (Cl. 179—27)

The present invention relates to telephone systems and, more particularly, to improvements in call intercepting facilities, provided in telephone systems of the automatic type, for the purpose of intercepting calls routed to certain of the multiparty subscriber lines of the system.

It is an object of the present invention to provide improved call intercepting apparatus which is of simple and economical arrangement and operates in a new and improved manner to intercept calls to one or more of the substations associated with a multiparty subscriber line and automatically to route such calls to an operator's position.

It is another object of the invention to provide improved apparatus of the character described, which is arranged to operate on a selective code basis through the provision of code register apparatus which is apart from the regular exchange switching equipment, is controlled over the talking leads of the lines arranged for call interception, and functions to distinguish between calls which are to be intercepted and calls which are not to be intercepted.

It is a further object of the invention to provide for use in a call intercepting arrangement of the character described, improved call-code registering equipment, which functions to distinguish between codes having different numbers of ringing periods of the same or different lengths, and also to distinguish between codes having the same number of ringing periods, certain of which differ in length.

The invention is illustrated in its embodiment in an automatic telephone system which comprises a plurality of subscriber lines, several of which are of the multiparty type, together with automatic switching equipment for setting up connections between the lines. The system further comprises ringing apparatus of the selective code type for selectively signaling the substations served by the multiparty lines. More particularly, this apparatus includes a ringing interrupter which functions to produce ringing codes consisting solely of different numbers of short rings, and also codes consisting of long rings and codes having included therein a plurality of short rings supplemented by one or more long rings. In accordance with conventional practice, this ringing interrupter functions in a cyclic manner such that the start of each ringing code is indicated by the production of a pickup pulse, and each code is divided into two halves, the ringing periods of which are separated by a relatively long spacing interval. The automatic switching equipment of the system includes a plurality of connector switches having access to the subscriber lines of the multiparty type. Each of these connector switches is equipped with impulse responsive ringing control apparatus which functions to select the ringing code designating the desired substation, and also to select the side of the called line over which ringing current is to be transmitted in signaling the desired substation.

In accordance with the present invention, there is provided in association with each of the multiparty subscriber lines, with respect to which calls are to be intercepted, call intercepting apparatus which comprises a register operative in response to ringing signals transmitted over the line and having settings individually corresponding to the differently coded signals. Additional means controlled by the register are provided for routing calls which are to be intercepted to an operator's position. The arrangement of the register is such that different settings are imparted to the marking paths controlled thereby, depending upon the side of the line over which ringing current is transmitted during a signaling operation. Different settings are also imparted to the marking paths, depending upon whether bridged or divided ringing is utilized during a signaling operation. The apparatus which functions to forward calls to the operator's position is directly controlled over one or more of these marking paths. The arrangement of the register is such that it functions as a counting device, different settings being imparted thereto, depending upon the number of ringing periods making up a ringing code used in signaling over the associated line. Different settings are also imparted to this register, depending upon the length of the individual ringing periods in the selected code. By virtue of these various selective functions characterizing the operation of the register, the apparatus is particularly useful when used in conjunction with multiparty lines serving a large number of substations.

The novel features believed to be characteristic of the invention are set forth with particularity in the appended claims. 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 and 4, inclusive, when laid end to end in the order named, illustrate an automatic telephone system having incorporated therein call intercepting ap-

paratus characterized by the features of the invention briefly outlined above. More specifically, a portion of the automatic switching equipment provided in the system is illustrated in schematic form in Fig. 1 of the drawings. A call intercepting trunk circuit connected and arranged in accordance with the present invention is illustrated in Figs. 2 and 3 of the drawings, and Fig. 4 illustrates an intercepting trunk circuit finder and the apparatus provided at the intercepting operator's position to which the intercepted calls are routed.

Referring now to the drawings, the system there illustrated comprises, in general, an exchange, a plurality of single party subscribers' lines, one of which is indicated at **10**, extending to the exchange, and a plurality of subscriber-controlled automatic switches including line switches indicated at **15** and **20**, respectively, a selector switch **25**, and a connector switch **30**, for setting up connections between the various subscribers' lines. The system also includes a plurality of multiparty lines, one of which is indicated at **11** as terminating in the line switch **15** and also in the bank contacts of the connector switch **30**. This line has associated therewith a plurality of substations B, C and D which individually include signal devices in the form of ringers **12**, **13** and **14**. More specifically, the ringer **12** is connected in series with a condenser **15'** between the negative side of the line **11** and ground, the ringer **13** is connected in series with a condenser **16** between the positive side of the line **11** and ground, and the ringer **14** is bridged across the conductors of the line **11** in series with a condenser **17**. The end of the line **10** remote from the exchange terminates at a subscriber's substation A of the usual common battery type. The line switches **15** and **20** and the other similar switches of the system are non-numerical switches in the sense that they are ineffective to perform any line selecting functions other than those of selecting idle ones of the selector switches. The selector and connector switches, on the other hand, are commonly known as numerical switches in that they are operative to perform particular line selecting functions in response to impulses transmitted thereto. It will be understood that a plurality of switches of each type, namely, a plurality of line switches, a plurality of selector switches, and a plurality of connector switches, are provided in the system for performing the usual line switching functions. The switches of each type are respectively arranged in groups and, in accordance with universally followed practice, the number of switches in each group is determined by the maximum volume of traffic the particular switch group is required to handle. Further in accordance with conventional practice, each of the subscribers' lines is multiplied between the corresponding bank contacts of a group of connector switches, whereby a plurality of such switches are rendered available for setting up connections between each line and every other line of the system. The line switches, on the other hand, are individually associated with the respective subscribers' lines.

Each of the line switches **20**, **35**, etc., is preferably of the well-known rotary type, of which there are several commercial embodiments. Each of the selector and connector switches is preferably of the well-known Strowger type having embodied therein a wiper carriage structure adapted to be translated vertically to bring the wipers thereof to a position opposite a particular level of bank contacts and then rotated to bring the wipers into engagement with a particular set of bank contacts in a selected level; vertical, rotary and release magnets; and control relays suitably connected and arranged to control the energization of the various magnets and the line switching in accordance with the particular functions of the switch. Obviously, the particular arrangement of the control apparatus embodied in the switches of different type is different in each instance, depending upon the character of the switch.

In order more clearly to explain the operation of the circuits to which the invention pertains, a portion of the relay equipment embodied in the connector switch **30** has been shown in detail. More particularly, this equipment comprises a transfer relay R**90**, a slow-to-operate ringing control relay R**100**, a slow-acting ring cut-off relay R**110**, and a ringing code selecting switch **120** of the well-known minor type. In brief, the switch **120** comprises a plurality of sets of bank contacts, wipers individually associated with the contact sets, means comprising an operating magnet **123** for driving the wipers over the contacts of the associated contact sets, a release magnet **124** for causing the wipers to be returned to normal, and a pair of off-normal contacts **125** for controlling the operating circuit for the release magnet **124**. The twenty code leads extending to the contacts of the code selecting switch **120** may be divided into groups of five each, with the leads in each group terminated at different sets of contacts in the code selecting switch **120**. With this arrangement the operation of the switch **120** to any desired position serves to select four different codes and in order to narrow the selection to the particular code identifying the called substation, an additional impulse responsive switch either of the rotary or relay type is provided in the connector switch. This additional switch may be controlled by the impulses of the third or fourth digit transmitted to the connector switch **30**. Arrangements of this character for providing twenty party code selecting facilities in a connector switch are well-known in the art and accordingly the details theerof have not been illustrated in the drawings. As indicated previously, the line switches individually associated with the subscribers' lines are of the well-known rotary type. The switch **25** includes a line relay R**130** which is illustrated in the drawings in order to facilitate an explanation of certain of the circuits referred to hereinafter.

The equipment provided in the line terminating exchange also comprises a ringing current generator **40** and a cyclically operating ringing interrupter **50** which functions to deliver to the various connector switches a total of twenty differently coded ringing signals. The arrangement of the ringing interrupter is such that all codes are produced during each cycle of operation of the apparatus and the differently coded signal voltages are impressed upon different ringing leads which extend to the contacts of the code selecting switches provided in the connector switches. The interrupter also includes provisions for transmitting a ground pulse over the pickup lead C**33** during each interval separating two ringing cycles. More specifically, the arrangement of the interrupter **50** is such that the major portion of the ringing codes are each divided into two halves which are separated by a spacing interval. The halves of the various

codes may comprise different numbers of ringing periods, or the same number of ringing periods certain of which differ in length. For example, the code designating the substation B may comprise two short ringing periods, a spacing interval and one short ringing period; the substation C may be designated by a code comprising four short ringing periods, a spacing period and two short ringing periods; and the code designating the substation D may comprise one long ringing period, a spacing interval and three short ringing periods. Provisions are also made in the interrupter **50** for transmitting a ground pulse over the control lead **C38** during each short ringing period of all codes. More specifically, the arrangement is such that each pulse transmitted over this lead starts shortly after the corresponding short ringing period begins and ends shortly after the termination of the corresponding short ringing period. The interrupter **50** also functions to transmit a ground pulse over the control lead **C38** during the spacing interval separating the two halves of each ringing code. Physically, the ringing interrupter **50** may be of the well-known all relay type or of the conventional motor driven commutator type, the wiring of the various commutating contacts to provide the desired timed relationship of the ringing periods, the pickup pulses and the control pulses transmitted over the control lead **C38**, being obtained in accordance with well-known design principles.

The system further comprises a call intercepting operator's position **410**, to which predetermined calls, routed to certain of the lines of the system, may automatically be extended through operation of the improved trunk circuit apparatus illustrated in Figs. 2, 3 and 4 of the drawings. The apparatus provided at the operator's position **410** includes an answer jack **412**, through which connections are made to the operator's cord circuit, and an incoming call signal lamp **411**.

Neglecting for the present the details of the call interrupting apparatus, the system as described above is, in general, entirely ocnventional in form and its operation is well understood in the art. In brief, when a subscriber, such, for example, as the subscriber at the substation A, lifts his receiver from its hook to initiate a call intended for a second subscriber's substation, such, for example, as the substation B, a loop circuit is completed for initiating the operation of the line switch **20** to select a trunk line leading to an idle selector switch. Assuming, for example, that the selector switch **25** is selected by the line switch **20**, when the trunk line leading to his selector switch is seized, the calling loop circuit is extended to this selector switch and the switch is conditioned to respond to the first series of impulses dialed at the calling substation. With the selector switch **25** in this condition, the usual dial tone signal is returned over the established loop circuit to the calling subscriber to indicate that the dialing operation may be started. When the first digit is dialed at the calling substation, the switch **25** elevates its wipers to a position opposite the level of bank contacts terminating the trunks leading to the connector switches having access to the called line **11**. Following this operation and during the interdigit pause between the first and second digits, the wipers of the switch **25** are automatically stepped over the contacts of the selected level until a trunk line leading to an idle connector switch of the selected group is found. Assuming that the connector switch **30** is the first available idle connector switch in the selected group, when the wipers of the selector switch **25** are stepped into engagement with the contacts terminating the trunk line extending to this connector switch, the subscriber's loop circuit is extended to the switch **30**, thereby to cause this connector switch to be conditioned to respond to the second series of impulses dialed at the calling substation. When the connector switch **30** is seized in the manner just described, certain of the control relays embodied therein, and more particularly the line and hold relays, operate to complete a path for impressing ground potential upon the start conductor **C36** extending to the ringing interrupter **50**, thereby to initiate the operation of the interrupter in the event it is not already in operation. When operation of the interrupter **50** is initiated, differently coded ringing voltages are impressed upon the code leads in the manner previously explained. In response to the dialing of the second digit, the wipers of the connector switch **30** are stepped vertically to a position opposite the level of bank contacts at which are terminated the lines of the subgroup including the called line **11**. Following this digit and during the interdigit pause between the second and third digits, the connector switch is conditioned to rotate its wipers step by step in accordance with the impulses of the third digit to be dialed at the calling substation. When this third digit is dialed, the wipers of the switch **30** are operated into engagement with the set of bank contacts terminating the called line **11**. During the interdigit pause betwen the third and fourth digits, circuits are prepared for energizing the operating magnet or the relays of the first code selecting switch, not shown. This switch responds to the impulses of the impulses of the fourth digit by selecting the group of five codes which includes the code designating the pause between the fourth and fifth digits dialed desired substation B. During the interdigit at the calling substation, circuits are prepared for energizing the operating magnet **123** of the code selecting switch **120** in accordance with the impulses of the fifth and final digit. The indicated operating magnet responds to the impulses of the fifth digit by operating the wiper **122** into engagement with the contact of the contact set **121** having impressed thereon ringing voltage of the particular code required to signal the called substation B. Depending upon the odd or even character of the fifth digit, the relay **R90** is operated or remains in its restored position, thus selecting the side of the line **11** over which ringing current is to be transmitted. If desired the code selecting switch **120** may be provided with an extra contact bank and wiper for the purpose of controlling the relay **R90** in accordance with the odd or even character of the fifth digit. If it be assumed, for example, that the code designating the called substation B comprises two short ringing periods, a spacing interval and one short ringing period, and that the relay **R90** is operated when a fifth digit comprising an even number of impulses is transmitted to the connector switch **30**, the fifth digit dialed at the calling substation will comprise two impulses so that at the conclusion thereof the wiper **122** will be left standing in engagement with the contact terminating the second code lead. During the operation of the switch **120** and when the wiper **122** is stepped to its first off-normal position, the

off-normal springs 125 are closed to prepare an incomplete circuit for energizing the release magnet 124, this circuit being held open until the switch 30 is released.

In accordance with conventional practice, suitable provisions are made for testing the selected called line 11 to determine the idle or busy condition thereof, for returning the usual busy tone signal over the established loop circuit to the calling subscriber in the event the called line is busy, and for projecting ringing current of the selected code over the selected side of the called line in the event this line is idle at the time it is selected. Assuming that the called line is idle, a circuit is prepared, through operation of certain of the relays embodied in the connector switch 30, for energizing the lower winding of the slow-to-operate ringing control relay R100. This circuit is thereafter completed at the beginning of the next cycle of operation of the ringing interrupter 50 when ground is impressed upon the pick-up conductor C36 and may be partially traced as extending from ground by way of C36, the lower winding of R100, the test wiper of the connector switch 30, the private conductor of the line 11, and through the winding of the cut-off relay conventionally embodied in the line switch 15 to battery. When this circuit is completed, the cut-off relay embodied in the line switch 15 partially operates to disconnect the windings of the line relay R130 from the conductors 11a and 11b of the called line 11, thereby to clear this line of the shunt impedance represented by these windings. Completion of the circuit just traced also results in the energization and operation of the ringing control relay R100. This relay, upon operating, completes, at its preliminary make contacts 102, a prepared holding circuit for itself, this holding circuit having been previously prepared through operation of certain of the other relays, not shown, but embodied in the connector switch 30. At its contacts 101 and 103, the relay R100 completes the prepared circuit for projecting ringing current of the selected code over the negative side of the line 11. In the present case, the circuit traversed by the ringing current may be traced as extending from the ungrounded terminal of the generator 40 by way of the interrupter 50 and the selected code lead, the second contact of the set 121, the wiper 122, the wiper and engaged contact of the second code selecting switch, the contacts 93, 111 and 101, the conductor 11a, the condenser 15', the windings of the ringer 12, and over a ground return path to the grounded terminal of the generator 40. Portions of this current are obviously shunted through the ringers respectively provided at the other substations associated with the line 11 which are connected between the negative side of this line and ground. The coded character of the signals produced by these ringers indicates, however, that only the substation B is being called. A portion of the ringing current is also shunted, in the usual manner, over the calling end of the connection to energize the receiver provided at the calling substation, thereby to indicate to the calling subscriber that the called substation is being signaled. In the event the ringer provided at the called substation is bridged across the conductors of the line 11, the circuit traversed by the ringing current in signaling the called substation is, with the relay R90 operated, substantially the same as that traced above, except that the return portion of the circuit extends by way of the conductor 11b, the contacts 103, 115 and 92, the upper winding of R110 and the exchange battery to the grounded terminal of the ringing current generator 40. In the event the ringer provided at the called substation is bridged between the positive side of the line 11 and ground, a fifth or ringing digit is dialed at the calling substation which comprises an odd number of impulses, whereby the relay R90 remains in its restored position during the ringing operation. With this relay restored, the ringing current circuit may be traced as extending from the ungrounded terminal of the ringing current generator 40 through the commutating contacts of the ringing interrupter 50, over the selected code lead, and by way of the wiper 122, the wiper and engaged contact of the second code selecting switch, the contacts 94, 115 and 103, the conductor 11b, the condenser and ringer provided at the called substation, and over a ground return path to the grounded terminal of the ringing current generator 40.

The desired conversational circuit between the calling and called substations is, in the case under consideration, fully completed when the call is answered at the called substation B. More particularly, when the receiver at the substation is removed from its supporting hook or cradle, a direct current conductive bridge is connected across the conductors 11a and 11b of the line 11, to complete a circuit for energizing the upper winding of the slow-acting ring cut-off relay R110. This circuit, with the relay R90 operated, may be traced as extending from ground by way of the ringing current generator 40, the commutating contacts of the ringing interrupter 50, the selected code lead, the wiper 122, the wiper and engaged contact of the second code selecting switch, the contacts 93, 111 and 101, the conductor 11a, the bridge established across the conductors of the line 11 at the called substation, the conductor 11b, the contacts 103, 115 and 92, and the upper winding of R110 to battery. In the event the relay R90 occupies its restored position during the ringing operation, the circuit for energizing the upper winding of the relay R110 may be traced as extending from ground through the ringing current generator 40 and the ringing interrupter 50, and by way of the selected code lead, the wiper 122, the wiper and engaged contact of the second code selecting switch, the contacts 94, 115 and 103, the conductor 11b, the bridge established across the conductors of the called line at the called substation, the conductor 11a, the contacts 101, 111 and 91, and the upper winding of R110 to battery. When its upper winding is energized over either of the circuits just traced, the relay R110 operates to close its preliminary make contacts 112, thereby to complete a prepared holding circuit for itself. Thereafter the relay R110, at its contacts 111 and 115, opens two points in its operating circuit and two points in the above-traced circuit for projecting ringing current over the line 11. At its contacts 113 and 114, the relay R110 completes the desired conversational circuit between the calling and called substations. When the relay R110 operates, it also functions to open the path, not shown, by way of which ringing current is projected over the calling end of the connection, thus terminating ring-back tone signal in the usual manner.

Preferably, the control relays of the connector switch 30 are so arranged that the release of the operated switch train is entirely under the control of the calling subscriber at the substation A. With such an arrangement, when the connection

is cleared out at the calling substation, the loop circuit extending through to the operated connector switch 30 is interrupted, thus causing the release of the line and hold relays conventionally embodied in this switch, in the usual manner. When these relays restore, the line and selector switches 20 and 25, respectively, are released and the control apparatus embodied in the connector switch 30 is restored to normal, all in a manner well understood in the art. During the release of the control apparatus embodied in the connector switch 30, the previously traced holding circuits for the relays R90, R110 and R100, are interrupted, causing these relays to restore. Also, ground potential is removed from the private conductor 11c of the called line, whereby the cut-off relay embodied in the line switch 15 is released to reconnect the windings of the line relay R130 to the conductors 11a and 11b of the line 11. When ground potential is removed from the private conductor of the line 11, battery potential is impressed upon this conductor through the windings of the cut-off relay embodied in the line switch 15, thereby to mark the line as idle in the bank contacts of the connector switches having access thereto. When the line and hold relays embodied in the connector switch 30 restore, a circuit is also completed for energizing the release magnet of the Strowger switching mechanism embodied in this switch, thereby to cause the wiper carriage structure of this mechanism to be restored to rotary and vertical normal. Similarly, a circuit is completed by way of the off-normal springs 125, for energizing the release magnet 124 of the code selecting switch 120, whereby the wipers of this switch are restored to normal. When these wipers attain their normal positions, the off-normal springs 125 are opened to interrupt the operating circuit for the release magnet 124. Thus the switch train is fully released.

Referring now more particularly to the apparatus illustrated in Figs. 2, 3 and 4 of the drawings, and provided to intercept predetermined calls routed to the line 11, this apparatus comprises a register 305, intercepting trunk finder apparatus 400, and a group of control relays. More specifically, the register 305 comprises four register relays, R330, R340, R350 and R360, and a marking switch 370 of the well-known minor type. This switch includes three sets of contacts, 378, 379 and 380, wipers 371, 372 and 373 individually associated with the enumerated contact sets, an operating magnet 374, a release magnet 375, and two sets of off-normal springs 376 and 377. The intercepting trunk finder apparatus 400 includes a finder switch 415 of the well-known rotary type, a start relay R450, a slow-to-release pulsing relay R430 and a slow-to-release stop relay R440. The switch 415 also includes three contact sets 416, 417 and 418, wipers 419, 420 and 421 individual to the enumerated contact sets, and an operating magnet 422 for driving the wipers over the contacts of their associated contact sets under the control of the pulsing relay R430. The relay equipment provided for controlling the operation of the register 305 and the finder apparatus 400 comprises a cut-off relay R200, a slow-to-operate switching relay R210, a start relay R220, a marking circuit transfer relay R230, a control relay R240, a pickup relay R245, a negative ring relay R250, a positive ring relay R260, a control relay R265, an interval transfer relay R270, a control relay R300, a slow-to-release pulsing relay R310, and a slow-acting hold relay R320. There is also provided in the intercepting trunk circuit a cross-connecting frame comprising the two sections 325 and 326, whereby the marking conductors C284, C285 and C286 may be cross-connected in any desired manner to the marking leads corresponding to the different codes and identified by the code designations appearing thereon. This equipment also includes control circuits for the various relays and operating magnets, which circuits are connected and arranged to be controlled in the manner described immediately hereinafter.

*Call interception*

In considering the operation of the call intercepting equipment, it may be assumed that the substation B has been disconnected from service, and that a call intended for this substation is routed through the line switch 20, selector switch 25 and the connector switch 30 to the line 11, at a time when this line is idle. It may also be assumed that the code assigned to the substation B comprises two short ringing periods, a spacing interval and one short ringing period. With this code assigned to the substation B, the conductor C284, which corresponds to the negative side of the line 11, is cross-connected through the frames 325 and 326 to the conductor C380 in order to arrange the intercepting apparatus for the interception of calls intended for the substation B.

Incident to the seizure of the line 11 by the connector switch 30, the control equipment provided in this switch functions to impress ground potential upon the private conductor 11c, in the manner pointed out above. When this conductor is grounded, a circuit including the contacts 216 and 201 is completed for energizing the start relay R220. In operating, the relay R220 closes its contacts 221 and 222 to prepare the respective operating circuits for the negative and positive ring relays R250 and R260, and closes its contacts 225 to prepare the operating circuit for the pickup relay R245. At its contacts 224, the relay R220 opens a point in the operating circuit for the release magnet 375. At its contacts 226 and 227, the relay R220 completes obvious paths for impressing ground potential upon the marking conductors C285 and C286. At its contacts 223, the relay R220 prepares locking circuits for the relays R230, R245 and R265, and completes a circuit for energizing the slow-to-release pulsing relay R310. The last-mentioned circuit extends from ground by way of the contacts 223, 248, 253 and 262, C278 and the winding of R310 to battery. When thus energized the relay R310 operates and closes its contacts 312 to complete a circuit for energizing the slow-acting hold relay R320, this circuit extending from ground by way of the contacts 223 and 248, C281, the contacts 312 and the winding of R320 to battery. At its contacts 313, the relay R310 opens a point in the operating circuit for the operating magnet 374 of the minor switch 370. At its contacts 311, the relay R310 opens a point in the operating circuit for the cut-off relay R200. The relay R320, upon operating, closes its contacts 321 to prepare the operating circuit for the magnet 374, and opens its contacts 322 to prevent the register relays R330, R340, R350 and R360 from responding to short splashes of ringing current transmitted over the line 11. Following the operation of the three relays, R220, R310 and R320, no further operation of the intercepting trunk circuit apparatus occurs until the ringing operation is started.

When the first short splash of ringing current is transmitted over the negative side of the line

11, in the manner previously explained, the relay R250 is energized over a circuit including the condenser 254, the contacts 211 and 221, and the negative line conductor 11a. In the case under consideration, ringing current is not transmitted over the positive line conductor 11b and, accordingly, the positive ring relay R260 remains in its restored position throughout the ringing operation. When energized by ringing current traversing the circuit just traced, the negative ring relay R250 operates and opens its contacts 253 to interrupt the above-traced operating circuit for the pulsing relay R310. At its contacts 252, the relay R250 completes the prepared operating circuit for the control relay R300, this circuit extending from ground by way of the contacts 223, 248, 252 and 271, C280 and the lower winding of R300 to battery. At its contacts 252, the relay R250 also completes the prepared operating circuit for the control relay R265, this circuit extending from ground by way of the contacts 223, 248, 252 and the upper winding of R265 to battery. At its contacts 251, the relay R250 completes an obvious circuit for energizing the upper winding of the transfer relay R230. The relay R230, in operating, locks to ground over a path including the contacts 231 and 223, and opens its contacts 233 to interrupt the above-traced path for impressing ground potential upon the marking lead C285. At its contacts 232, the relay R230 completes an obvious path for impressing ground potential upon the marking lead C284, which corresponds to the negative side of the line 11. The control relay R265, in operating, locks to ground over a path including the contacts 267, 243 and 223, and closes its contacts 266 to prepare the operating circuit for the interval transfer relay R270. The relay R300, upon operating, closes its contacts 302 to prepare a circuit for energizing its upper winding. At its contacts 301, the relay R300 opens a point in the prepared operating circuit for the interval transfer relay R270.

Shortly following the operation of the control relay R300, the ringing interrupter 50 functions to impress ground potential upon the control lead C38, in the manner previously pointed out. When this lead is grounded, the upper winding of the relay R300 is energized over a circuit including this lead and the contacts 302. Since ground potential is maintained upon the lead C38 for a short time interval after the short ringing period expires, the relay R300 is held operated until shortly after the short ringing period expires, regardless of the position of the negative ring relay R250.

The pulsing relay R310 restores shortly following the operation of the negative ring relay R250, and opens its contacts 312 to interrupt the operating circuit, for the hold relay R320. At its contacts 311, the relay R310 reprepares the operating circuit for the cut-off relay R200. At its contacts 313, the relay R310 completes the prepared circuit for energizing the operating magnet 374 of the switch 370. This circuit extends from ground by way of the contacts 223 and 248, C281, the contacts 313 and 321 and the winding of the magnet 374 to battery. When the operating magnet 374 is energized, the associated ratchet and pawl mechanism functions to advance the wipers 371, 372 and 373 one step from the normal position. When these wipers are moved off normal, the off-normal springs 376 and 377 are respectively operated into engagement. At the springs 377, the operating circuit for the release magnet 375 is prepared. At the springs 376, the previously mentioned operating circuit for the pickup relay R245 is prepared.

At the end of the first short splash of ringing current transmitted over the negative line conductor 11a, the negative ring relay R250 is deenergized and restores. In releasing, this relay opens its contacts 251 to interrupt the operating circuit for the transfer relay R230, opens its contacts 252 to interrupt the operating circuits for the relays R265 and R300, and closes its contacts 253 to recomplete the operating circuit for the pulsing relay R310. Shortly following the release of the negative ring relay R250, the interrupter 50 functions to disconnect the control lead C38 from ground, whereby the control relay R300 is deenergized and restores. When its operating circuit is recompleted the pulsing relay R310 again operates, and opens its contact 313 to interrupt the previously traced circuit for energizing the operating magnet 374. At its contacts 312, the relay R310 recompletes the operating circuit for the hold relay R320. Due to its slow-to-release characteristic, the hold relay R320 remains operated for the duration of the first short ringing period.

At the beginning of the second short ringing period the negative ring relay R250 again operates to open the operating circuit for the pulsing relay R310 and to complete the operating circuit for the control relay R300. The relay R300, in operating, again locks through its contacts 302 to the grounded control lead C38, and opens its contacts 301 to interrupt the operating circuit for the interval transfer relay R270. The pulsing relay R310, in restoring, opens its contacts 312 to interrupt the operating circuit for the hold relay R320, and closes its contacts 313 to recomplete the operating circuit for the magnet 374. The magnet 374, in operating, advances the wipers of the switch 370 to their second off-normal positions. At the end of the second short ringing period the relay R250 restores to open the operating circuit for the control relay R300, and to recomplete the operating circuit for the pulsing relay R310. The relay R310, in reoperating, opens the circuit for energizing the magnet 374 and recompletes the operating circuit for the hold relay R320. Due to its slow-to-release characteristic, the relay R320 remains operated during the second and any succeeding ringing periods. When ground potential is removed from the control lead C38, shortly following the end of the second short ringing period, the control relay R300 is deenergized and restores.

As indicated above, the second short ringing period is followed by a spacing period, during which a ground pulse is impressed upon the lead C38 by the ringing interrupter 50. When the lead C38 is grounded, the interval transfer relay R270 is energized over a circuit including this lead, the contacts 301, C279 and the contacts 265. In operating, the relay R270 opens its contacts 271 further to interrupt the operating circuit for the control relay R300, and closes its contacts 279 to impress ground potential upon the conductor C289. In the present case the momentary operation of the interval transfer relay during the spacing interval separating the first two short rings and the three short rings is without effect. In this regard it will be understood that the relay R270 is deenergized and restores before the expiration of the spacing in-

terval, and in response to the operation of the ringing interrupter 50 to disconnect the control lead C38 from ground.

When the third short ring is transmitted over the negative line conductor 11*a*, the relays R250 and R310 function in the exact manner described above, to transmit another current pulse to the operating magnet 374, whereby the wipers of the switch 370 are advanced to engage their associated third contacts. At the end of the third short ringing period, the relays R250 and R300 are caused to restore, and the relay R310 is caused to reoperate, in the exact manner pointed out above.

At the beginning of the second code cycle following seizure of the line 11 by the connector switch 30, the ringing interrupter 50 operates to impress a pickup ground pulse upon the pickup lead C33. When this lead is connected to ground, the pickup relay R245 is energized over a circuit which extends by way of the grounded pickup lead C33, the contacts 225, C283, the off-normal springs 376, C276, the contacts 246', and the upper winding of R245 to battery. When thus energized the relay R245 closes its preliminary make contacts 247 to complete an obvious locking circuit for itself. After this locking circuit is completed, the relay R245 opens its contacts 246' to interrupt its operating circuit, as traced above. At its contacts 246, the relay R245 prepares the operating circuit for the cut-off relay R200. At its contacts 248, the relay R245 opens the operating and locking circuits for the relays R265, R300, R310 and R320, causing the relays R265, R310 and R320 to restore. At its contacts 248, the relay R245 also opens a point in the operating circuit for the release magnet 375. At its contacts 249, the relay R245 completes a circuit, including the marking path established through the contacts of the register 305, for energizing the control relay R240. In the present case this path may be traced as extending from ground by way of the contacts 226 and 232, the marking lead C284, the cross-connection between the leads C284 and C380 at the frames 325 and 326, C380, the contacts 353 and 363, the wiper 371 and its engaged third contact, C282, the contacts 249 and the winding of R240 to battery. When energized over this circuit the control relay R240 operates. At its contacts 242, the relay R240 opens a point in the operating circuit for the cut-off relay R200. In this regard it is pointed out that, due to the slow-to-release characteristic of the pulsing relay R310, the control relay R240 operates to open the operating circuit for the cut-off relay R200 prior to the release of the pulsing relay R310. Thus the cut-off relay R200 is, in this case wherein the call is to be intercepted, prevented from operating. At its contacts 244, the relay R240 completes a path including the winding of the switching relay R210, for impressing negative battery potential upon the marking conductor C273, thereby to mark the illustrated intercepting trunk circuit in the finder switch 415 as being occupied with a call which is to be intercepted. At its contacts 241, the relay R240 completes a path including the contacts 213, for impressing ground potential upon the finder start lead C274. When the start lead C274 is connected to ground, a circuit including this lead is completed for energizing the lower winding of the start relay R450.

In operating, the relay R450 closes its contacts 451 to complete the prepared operating circuit for the magnet 422, this circuit extending from ground by way of the contacts 443, 451 and 431, and the winding of the magnet 422 to battery. When energized over this circuit, the magnet 422 closes its contacts 423 to complete an obvious circuit for energizing the upper winding of the slow-to-release pulsing relay R430. The relay R430, in operating, opens its contacts 431 to interrupt the operating circuit for the magnet 422. When the magnet 422 is deenergized it operates to advance the wipers of the switch 415 one step, and opens its contacts 423 to interrupt the operating circuit for the pulsing relay R430, causing the latter relay to restore. The relay R430, in releasing, recompletes the operating circuit for the magnet 422. The interrelated operation of the magnet 422 and the relay R430 continues until the wipers of the switch 415 are stepped into engagement with the contacts terminating the conductors of the called line 11. More specifically, when the wiper 420 is operated into engagement with its associated first contact, a circuit is immediately completed for energizing the lower winding of the pulsing relay R430 in series with the lower winding of the stop relay R440 and the winding of the relay R200, this circuit extending from ground by way of the lower winding of R430, the lower winding of R440, the contacts 434, the wiper 420 and its engaged first contact, C273, the contacts 244 and the winding of R210 to battery. When energized over this circuit, the relay R430 remains in its operated position, to prevent further energization of the magnet 422, and the relay R440 operates and locks to ground over a path including the contacts 445 and 434, the lower winding of R440 and the lower winding of R430. At its contacts 443, the relay R440 opens another point in the operating circuit for the magnet 422. At its contacts 442, the relay R440 completes an obvious circuit for energizing the incoming call signal lamp 411 provided at the operator's position 410. At its contacts 441 and 446, the relay R440 connects the line conductors 11*a* and 11*b* of the line 11 to the tip and ring contacts of the jack 412.

When the above-traced circuit for energizing the relay R210 in series with the lower winding of the pulsing relay R430 is completed, the relay R210 operates and locks to the grounded private conductor 11*c* over a path including the contacts 214 and 215. At its contacts 214 and 215, the relay R210 also completes a path for short-circuiting the series connected lower windings of the relays R430 and R440, and closes a multiple holding circuit for the relay R440. This short-circuiting path may be traced as extending by way of the grounded private conductor 11*c*, *the* contacts 215, 214 and 244, C273, the wiper 420, and its engaged first contact, the contacts 434, the lower winding of R440 and the lower winding of R430 back to ground. It will be observed that a branch of this path extends from the wiper 420 through the contacts 445 and the upper winding of the relay R440 to battery, thus providing the above-mentioned multiple locking circuit for the relay R440. At its contacts 211 and 212, the relay R210 opens the operating circuits for the negative and positive ring relays R250 and R260. At its contacts 213, the relay R210 disconnects the start conductor C274 from ground, thereby to cause the deenergization and release of the start relay R450. At its contacts 216, the relay R210 opens the previously traced operating circuit for the start relay R220, causing the latter relay to restore.

The relay R220, in releasing, opens its contacts

223 to interrupt the locking circuits for the relays R230 and R245. At these same contacts, the relay R220 opens a point in the common portion of the operating and locking circuits for the relays R265, R300, R310 and R320. At its contacts 226 and 227, the relay R220 disconnects the marking leads C284 and C286 from ground, thereby to deenergize the control relay R240. Thus the relays R230, R240 and R245 are deenergized and restore in response to the release of the start relay R220. At its contacts 225, the relay R220 opens another point in the operating circuit for the pickup relay R245. At its contacts 224, the relay R220 completes the prepared operating circuit for the release magnet 375, this circuit extending from ground by way of the contacts 224, C277, the off-normal springs 377, and the winding of the magnet 375 to battery. When thus energized the magnet 375 attracts its holding pawl, whereby the wipers of the switch 370 are restored to normal in the usual manner. When these wipers reach their normal positions, the off-normal springs 377 are disengaged to deenergize the release magnet 375, and the off-normal springs 376 are disengaged to open another point in the operating circuit for the pickup relay R245. The relay R240, upon restoring, opens its contacts 244 to interrupt the above-traced multiple holding circuit for the relay R440, and closes its contacts 243 to complete an obvious alternative multiple holding circuit for the relay R440. Following the release of the register 305 in the manner just explained, no further operation of the apparatus in the intercepting trunk circuit occurs until the calling party disconnects to initiate the release of the operated switch train.

When the lower winding of the pulsing relay R430 is short-circuited in the manner pointed out above, this relay restores and closes its contacts 431 to reprepare the operating circuit for the magnet 422. At its contacts 434, the relay R430 opens a point in the path for short-circuiting its lower winding, and a point in the above-traced operating circuit for the stop relay R440. The start relay R450, upon restoring in the manner explained above, opens its contacts 451 further to interrupt the above-traced operating circuit for the magnet 422. Following the release of the two relays R430 and R440, no further operation of the finder apparatus 400 occurs until the connection is released at the calling substation.

Assuming that the call is answered at the operator's position 410, when the operator inserts the answer plug terminating her cord circuit in the jack 412, a direct current bridge is connected between the tip and ring contacts of this jack to complete a circuit for energizing the upper winding of the ring cut-off relay R110 embodied in the operated connector switch 30. This circuit may be traced as extending from ground by way of the ringing current generator 40, the commutating contacts of the ringing interrupter 50, the selected code lead, the wiper 122, the wiper and engaged contact of the second code selecting switch, the contacts 93, 111 and 101, the conductor 11*a*, the wiper 421 and its engaged first contact, the contacts 446, the bridging path between the tip and ring contacts of the jack 412, the contacts 441, the wiper 419 and its engaged first contact, the conductor 11*b*, the contacts 103, 115 and 92, and the upper winding of R110 to battery. When this circuit is established, the ring cut-off relay R110 operates to arrest the ringing operation and to establish the desired talking circuit between the calling subscriber and the operator's position 410.

The release of the finder apparatus 400 is under the control of the calling subscriber. The release of the operated switch train, including the connector switch 30, is effected in the exact manner previously explained. During the release of this switch train, ground potential is removed from the private conductor 11*c*, whereby the switching relay R210 and the stop relay R440 are deenergized and restore. Following the release of these two relays all of the equipment embodied in the illustrated intercepting trunk circuit and the finder apparatus 400, is fully restored to normal.

From the preceding explanation it will be apparent that if the register 305 is, during the ringing operation, operated to a setting which does not correspond to a marking path that has been set up by cross-connecting one of the three leads, C284, C285 and C286 with one of the marking leads terminating at the frame section 326, no circuit is provided for energizing the control relay R240 and, accordingly, the call is not intercepted. For example, if a ringing signal comprising two short ringing periods, a spacing interval and two additional short ringing periods, is transmitted over the negative side of the line 11, the wipers of the switch 370 will be left standing in engagement with their associated fourth contacts at the end of the first ringing cycle. In this case the control relay R240 is not energized over any of the marking paths controlled by the register 305 and, hence, remains in its restored position. At the end of the first ringing cycle, the pickup relay R245 operates to prepare the operating circuit for the cutoff relay R200 in the manner pointed out above. In operating, the pickup relay R245 also opens its contacts 248 to cause the release of the relays R265, R310 and R320. The relay R310, upon restoring, completes the prepared operating circuit for the cutoff relay R200, this circuit extending from ground by way of the contacts 311, C275, the contacts 246 and 242 and the winding of R200 to battery. In operating, the relay R200 locks to the grounded private conductor 11*c* over a path including the contacts 202 and 216. At its contacts 201, the relay R200 opens the circuit for energizing the start relay R220, causing the latter relay to restore. The relay R220, in releasing, opens its contacts 221 and 222 to interrupt the operating circuits for the negative and positive ring relays R250 and R260, respectively. At its contacts 223, the relay R220 opens the operating and locking circuits for the relays R230, R245, R265, R300, R310 and R320. Thus the two relays, R230 and R245, are caused to restore. At its contacts 224, the relay R220 completes the previously traced operating circuit for the release magnet 375, whereby the register 305 is restored to normal in the manner pointed out above. Following the release of this register it will be noted that only the cut-off relay R200 is energized in the intercepting trunk circuit. This relay is deenergized and restores when the calling party disconnects to cause the release of the operated switch train, it being pointed out that this relay is deenergized when ground potential is removed from the private conductor 11*c*.

From the above explanation it will be apparent that the illustrated intercepting trunk circuit discriminates between codes designating calls which are to be intercepted and codes designating calls which are not to be intercepted, even

though the ringing signals are transmitted over the same side, i. e., the negative side, of the line 11. The manner in which the intercepting trunk circuit functions in response to ringing current transmitted over the positive line conductor 11b is substantially the same as set forth above, it being noted that in this case the positive ring relay R260 is energized by the ringing current transmitted over the line 11. The circuit for energizing the relay R260 includes the condenser 263 and the contacts 222 and 212. In this case the negative ring relay R250 is not energized during the ringing operation. It will also be noted that the relay R260, in operating and restoring, performs all of the functions described above with reference to the negative ring relay R250 except that of completing the operating circuit for the transfer relay R230. Accordingly, the relay R230 remains in its restored position throughout the ringing operation. With this transfer relay restored, ground potential is maintained upon the marking lead C285, corresponding to the positive side of the line 11, and is not impressed upon the marking lead C284, corresponding to the negative side of the line 11. Hence, if the call is to be intercepted, the lead C285 must be cross-connected at the frame 325, 326 to the marking lead which corresponds to the code of the ringing current transmitted over the line conductor 11b. The manner in which the call is intercepted, or the intercepting trunk circuit equipment is released without intercepting the call in the event the call is not to be intercepted, is exactly the same as described above. It will be apparent from the above explanation that when divided ringing is used, the same code may be utilized to designate two different substations, one of which is in service and is provided with a ringer connected between one side of the line and ground, and the other of which is out of service but is normally equipped with a ringer connected between the other side of the line and ground. It will further be apparent that in such case the transfer relay R230 as selectively controlled by the negative and positive ring relays R250 and R260, controls the marking paths so that calls to the substation which is out of service are intercepted, whereas calls intended for the substation which is in service, and which is designated by the same code as the disconnected substation, are not intercepted.

In the event bridged ringing is utilized in signaling a called substation, both the negative and positive ring relays R250 and R260 are energized during a ringing operation. In this case the marking lead C286 is utilized as the lead which is cross-connected to the marking leads terminating at the frame section 326 for the purpose of determining which calls are to be intercepted, and the leads C284 and C285 are not used. The manner in which the intercepting trunk circuit functions to intercept predetermined calls routed to a line arranged for bridged ringing is exactly the same as described above.

As indicated in the introductory portion of the specification, different settings are imparted to the register 370, depending upon whether or not the code of a ringing signal transmitted over the line 11 contains a long ringing period. When a long ring constitutes a part or all of the transmitted ringing code, the operation of the intercepting trunk circuit is similar to that described above with reference to the transmission of a code consisting of short rings only. When, however, a transmitted code includes a long ringing period, the negative ring relay R250 or the positive ring relay R260 remains operated during this period to hold the pulsing relay R310 deenergized. Such a period is in excess of the release period of the hold relay R320. Accordingly, the relay R320 restores during the long ringing period to complete a circuit for energizing the relay R350 or the relay R360, depending upon the setting of the wipers 371, 372 and 373. Thus, if these wipers are moved into engagement with their associated first contacts in response to the release of the relay R310 at the beginning of the long ringing period, the operating circuit for the relay R350 is completed. This circuit extends from ground by way of the contacts 223 and 248, C281, the contacts 313 and 322, the wiper 373 and its engaged first contact, and the upper winding of R350 to battery. In operating, the relay R350 locks to ground over a path including its contacts 359, C288 and the contacts 223. It will be observed from the circuit wiring the relay R350, at its contacts 352, 354, 356 and 358, prepares certain of the marking paths which correspond to codes including a first long ringing period. For example, the marking path corresponding to the code including two long ringing periods and the marking path corresponding to the code including one long ringing period, a spacing interval and three short ringing periods, are prepared. At its contacts 351, 353, 355 and 357, the relay R350 opens certain of the marking paths that correspond to codes the first ringing periods of which are short.

In the event the long ringing period is not the first ringing period of the code, the relay R320, upon restoring, during the long ringing interval, completes the operating circuit for the relay R360, this circuit extending from ground by way of the contacts 223 and 248, C281, the contacts 313 and 322, the wiper 373 and its engaged second, third, fourth or fifth contact, and the upper winding of R360 to battery. In operating, the relay R360 locks to ground over a path including its contacts 369, C288, and the contacts 223. At its contacts 361 to 368, inclusive, the relay R360 rearanges the marking paths controlled by the register 305, so that those paths are prepared which correspond to codes containing more than one long ring, or to codes in which the long ring is in each instance disposed in the final portion of the code.

It will be understood that the operation of one or both of the relays R350 and R360 in no way interferes with the operation of the register switch 370 to count the number of ringing periods of the code, in the manner explained above. Thus, when the pulsing relay R310 restores at the beginning of a long ringing period, it completes the previously traced operating circuit for the magnet 374 so that the wipers of the switch 370 are advanced one step, prior to the release of the hold relay R320. The subsequent release of the hold relay R320 results in the deenergization of the magnet 374 and the concurrent operation of one or the other of the relays R350 and R360. Further, at the expiration of the long ringing period the relays R310 and R320 are sequentially reoperated in response to the release of one or both of the negative and positive ring relays R250 and R260, in a manner clearly apparent from the preceding explanation.

As indicated in the introductory portion of the specification, the arrangement of the register 305 is such that if the first half of a ringing code utilized in signaling over the line 11 comprises

more than a predetermined number of ringing periods, the setting of the register is changed accordingly. More specifically, if the first half of a transmitted code comprises three or four ringing periods, one of the register relays R340 and R330 is caused to operate during the spacing interval separating the two halves of the code. Thus, if the wipers of the register switch 370 are operated to engage their associated third contacts during the first half of the ringing code, thereby indicating that the first half of the code comprises three ringing periods, the relay R340 is energized during the spacing interval. The operating circuit for this relay is completed in response to the operation of the interval transfer relay R270, which occurs during the spacing interval, in the manner explained above. This circuit extends from ground by way of the contacts 272, C289, the wipers 372 and its associated third contact, and the upper winding of R340 to battery. When thus energized, the relay R340 locks to ground over a path including the contacts 348, C288 and the contacts 223. At its contacts 341 to 346, inclusive, the relay R340 rearranges the marking paths so that all of the paths which correspond to codes including three ringing periods in the first halves thereof, are prepared. At its contacts 347, the relay R340 opens a point in the operating circuit for the relay R330. In the event the wipers of the switch 370 are operated to engage their associated fourth contacts during the first half of the transmitted code, the relay R330 is energized in response to operation of the interval transfer relay during the spacing interval separating the two halves of the code. The operating circuit for this relay extends from ground by way of the contacts 272, C289, the wiper 372 and its associated fourth contact, the contacts 347 and the upper winding of R330 to battery. In operating, the relay R330 locks to ground over a path including the contacts 335, C288 and the contacts 223. At its contacts 331 to 334, inclusive, the relay R330 rearranges the marking paths so that all paths which correspond to codes including four ringing periods in the first halves thereof, are prepared.

From the preceding explanation with reference to the release of the intercepting trunk circuit it will be apparent that any operated ones of the register relays, R330, R340, R350 and R360, are deenergized and restore in response to the release of the start relay R220 to disconnect the holding lead C288 from ground. By providing these relays connected and arranged in the manner just described, a maximum code registering capacity of the register 305 is attained with a minimum amount of equipment and without undue complication of the circuits involved.

While there has been described what is at present considered to be the preferred embodiment of the invention, it will be understood that various modifications may be made therein, and it is contemplated to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. In a telephone system, a multiparty line, means for transmitting any one of a plurality of different ringing signals over said line, a register operative in response to ringing signals transmitted over said line and having different settings individually corresponding to the different signals, an operator's position, and means operative to route a call to said operator's position when said register assumes a predetermined setting.

2. In a telephone system, a multiparty line, means for transmitting any one of a plurality of differently coded ringing signals over said line, a register operative in response to ringing signals transmitted over said line and having different settings individually corresponding to the different codes, an operator's position, and means operative to route a call to said operator's position when said register assumes a predetermined setting.

3. In a telephone system, a multiparty line, cyclically operating ringing apparatus for providing interrupted ringing voltage, means for routing a call to said line from another line of the system and for impressing ringing voltage upon said line, a register operative to a predetermined setting in response to the ringing voltage impressed on said line during one cycle of operation of said apparatus, an operator's position, and means jointly controlled by said register and said apparatus for routing the call to said operator's position at the end of said one cycle of operation of said apparatus.

4. In a telephone system, a multiparty line, cyclically operating apparatus operative to provide a plurality of different ringing signals during each cycle of operation thereof, a register having different settings individually corresponding to said signals, means for routing a call to said line from another line of the system and for transmitting a selected one of said signals over said line, means responsive to said one signal for operating said register to the position corresponding to said one signal during one cycle of operation of said apparatus, an operator's position, and means jointly controlled by said register and said apparatus for routing the call to said operator's position at the end of said one cycle of operation of said apparatus.

5. In a telephone system, a multiparty line, cyclically operating apparatus operative to provide a plurality of differently coded ringing signals during each cycle of operation of said apparatus, a register having different settings individually corresponding to said codes, means for routing a call to said line from another line of the system and for transmitting a selected one of said signals over said line, means responsive to said one signal for operating said register to the setting corresponding to the code of said one signal during one cycle of operation of said apparatus, an operator's position, and means jointly controlled by said register and said apparatus for routing the call to said operator's position at the end of said one cycle of operation of said apparatus.

6. In a telephone system, a line, ringing apparatus operative to transmit call signals over said line during call periods of uniform or non-uniform length, a register operated in accordance with the call signals transmitted over said line, means for imparting different settings to said register depending upon the uniform or non-uniform length of the call periods, and call intercepting means controlled in accordance with the setting of said register to intercept predetermined calls routed to said line.

7. In a telephone system, a line, ringing apparatus operative to transmit over said line coded ringing signals consisting solely of short ringing periods or call signals comprising at least one long ringing period, a register controlled in accordance with the code of the ringing signal

transmitted over said line, means controlled in accordance with the duration of the ringing periods for in part determining the setting of said register, and call intercepting means controlled in accordance with the setting of said register to intercept predetermined calls routed to said line.

8. In a telephone system, a line, ringing apparatus operative to transmit call signals over said line during call periods of uniform or non-uniform length, a register at least partially controlled in accordance with the length of the periods during which call signals are transmitted over said line, and call intercepting means controlled by said register to intercept predetermined calls routed to said line.

9. In a telephone system, a line, ringing apparatus operative to provide coded ringing signals consisting solely of short rings and coded ringing signals consisting at least in part of long rings, means for transmitting a ringing signal of a selected code over said line, a register controlled in accordance with the character of the selected code, means operative in the event the selected code includes a long ring for changing the setting of said register, and call intercepting means controlled by said register to intercept predetermined calls routed to said line.

10. In a telephone system, a line, ringing apparatus operative to transmit call signals over said line during call periods having the same or different lengths, and call intercepting apparatus at least partially controlled in accordance with the lengths of the call periods utilized in the transmission of call signals over said line for intercepting predetermined calls routed to said line.

11. In a telephone system, a line, ringing apparatus operative to transmit over said line coded ringing signals consisting solely of short rings and coded ringing signals comprising at least one long ring, means for transmitting a selected ringing signal of a particular code over said line, and call intercepting apparatus controlled by the transmission of said selected ringing signal over said line and operative in different manners depending upon whether or not the particular code of the selected signal includes a long ring.

12. In a telephone system, a line, ringing apparatus operative to transmit ringing current pulses of uniform or non-uniform length over said line, and call intercepting apparatus operative in one manner in response to the transmission of ringing current pulses of uniform length over said line and in a different manner in response to the transmission of ringing current pulses of non-uniform length over said line.

13. In a telephone system, a line, ringing apparatus operative to provide a plurality of differently coded ringing signals, certain of the codes including ringing periods of substantially uniform length and others of the codes including at least one ringing period of different length, means for transmitting ringing signals of a selected code over said line, a register operative in response to ringing signals transmitted over said line, means for imparting one setting to said register in the event the selected code includes ringing periods of uniform length and for imparting a different setting to said register in the event the selected code includes a ringing period of said different length, and call intercepting means controlled in accordance with the setting of said register to intercept predetermined calls routed to said line.

14. In a telephone system, a multiparty line, cyclically operating apparatus for transmitting a variable number of call signal pulses over said line during each cycle of operation thereof, a register operative to a different setting as each call signal pulse is transmitted over said line during one cycle of operation of said apparatus, and call intercepting apparatus controlled in accordance with the setting of said register and operative to intercept predetermined calls routed to said line.

15. In a telephone system, a line, cyclically operating apparatus operative to transmit a variable number of call signal pulses over said line, a device operative to count the number of call signal pulses transmitted over said line during one cycle of operation of said apparatus, and call intercepting apparatus controlled in accordance with the setting of said device and operative to intercept predetermined calls routed to said line.

16. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, predetermined parts of said codes comprising different numbers of ringing periods, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in said predetermined part of the selected code, and means operative to change the setting of said register in the event said predetermined part of the selected code includes a predetermined number of ringing periods.

17. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, predetermined parts of said codes comprising different numbers of ringing periods, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in said predetermined part of the selected code, means operative to change the setting of said register in the event said predetermined part of the selected code includes a predetermined number of ringing periods, and call intercepting means controlled in accordance with the setting of said register and operative to intercept predetermined calls routed to said line.

18. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, the first parts of said codes comprising different numbers of ringing periods, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in the first part of the selected code, and means operative to change the setting of said register during the spacing interval separating the two parts of the selected code in the event the first part of the selected code includes a predetermined number of ringing periods.

19. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, the first parts of said codes comprising different numbers of ringing periods, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in the first part of the selected code, means operative to change the setting of said register during the spacing interval separating the two parts of the selected code in the event the first part of the selected code includes a predetermined num-

ber of ringing periods, and call intercepting means controlled in accordance with the setting of said register and operative to intercept predetermined calls routed to said line.

20. In a telephone system, a multiparty line, cyclically operating ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, the first parts of said codes comprising different numbers of ringing periods, means for routing a call to said line from another line of the system and for transmitting a ringing signal of a selected code over said line, a register operative during one cycle of operation of said apparatus to register the number of ringing periods in the first part of the selected code, means operative to change the setting of said register during the spacing interval between the two parts of the selected code in the event the first part of the selected code includes a predetermined number of ringing periods, an operator's position, and means operative to extend said call to said operator's position at the end of said one cycle of operation of said apparatus in the event said register is operated to a predetermined setting during said one cycle of operation of said apparatus.

21. In a telephone system, a multiparty line, cyclically operating ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, the first parts of said codes comprising different numbers of ringing periods, means for routing a call to said line from another line of the system and for transmitting a ringing signal of a selected code over said line, a register having a plurality of different settings and including marking paths individually corresponding to the different settings, said register including a device operative to count the number of ringing periods in the first part of the selected code and having control contacts individually corresponding to different numbers of the counted ringing periods, means controlled over a circuit including one of the control contacts of said device for changing the setting of said register during the spacing period between the two parts of the selected code in the event the first part of the selected code includes a predetermined number of ringing periods, an operator's position, and means in part controlled by said ringing apparatus and in part controlled over one of said marking paths for extending said call to said operator's position at the end of said one cycle of operation of said ringing apparatus in the event said register is operated to a predetermined setting during said one cycle of operation of said apparatus.

22. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, predetermined corresponding parts of said codes comprising different numbers of ringing periods which may be of the same or different lengths, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in said predetermined part of the selected code, means operative to change the setting of said register in the event said predetermined part of the selected code includes a predetermined number of ringing periods, and means for imparting different settings to said register depending upon whether the ringing periods of the selected code are of the same or different lengths.

23. In a telephone system, a line, ringing apparatus operative to produce ringing signals having different codes each including two parts separated by a spacing interval, predetermined corresponding parts of said codes comprising different numbers of ringing periods which may be of the same or different lengths, means for transmitting a ringing signal of a selected code over said line, a register operative to register the number of ringing periods in said predetermined part of the selected code, means operative to change the setting of said register in the event said predetermined part of the selected code includes a predetermined number of ringing periods, means for imparting different settings to said register depending upon whether the ringing periods of the selected code are of the same or different lengths, and call intercepting means controlled in accordance with the setting of said register and operative to intercept predetermined calls routed to said line.

24. In a telephone system, a multiparty line, a source of ringing current, means for selectively transmitting ringing current from said source over the two sides of said line in series or over one side of said line, a register controlled by the ringing current transmitted over said line, marking paths controlled by said register, means for imparting different settings to said marking paths depending upon whether said one side or both sides of said line are traversed by the ringing current, and call intercepting means controlled over at least one of said marking paths.

25. In a telephone system, a multiparty line, a source of ringing current, means for selectively transmitting ringing current from said source over the two sides of said line in series or over one side of said line, a register controlled by the ringing current transmitted over said line, marking paths controlled by said register, means for imparting one setting to said marking paths when ringing current is transmitted over the two sides of said line in series, means for imparting a different setting to said marking paths when ringing current is transmitted over said one side of said line, and call intercepting means controlled over at least one of said marking paths.

26. In a telephone system, a multiparty line, means for selectively transmitting coded ringing current pulses over one side of said line or over the two sides of said line in series, a register operative to a different setting as each ringing current pulse is transmitted over said line, marking paths controlled by said register, means for imparting one setting to said marking paths when ringing current is transmitted over the two sides of said line in series, means for imparting a different setting to said marking paths when ringing current is transmitted over said one side of said line, and call intercepting means controlled over at least one of said marking paths.

27. In a telephone system, a multiparty line, cyclically operating ringing apparatus operative to produce differently coded ringing current pulses during each cycle of operation thereof, means for transmitting ringing current pulses of a selected code over the two sides of said line in series or over one side of said line, marking paths, a register controlled in accordance with the number and duration of the pulses constituting said selected code and operative to impart a different setting to said marking paths each time a ringing current pulse is transmitted over said line during one cycle of operation of

said apparatus, means for imparting one setting to said paths in the event said ringing current pulses are transmitted over the two sides of said line in series, means for imparting a different setting to said paths in the event said ringing current pulses are transmitted over said one side of said line, and call intercepting means controlled over at least one of said paths and operative at the end of said one cycle of operation of said apparatus.

28. In a telephone system, a multiparty line, a source of ringing current, means for selectively transmitting ringing current from said source over either side of said line, a register controlled by the ringing current transmitted over said line, marking paths controlled by said register, means for imparting different settings to said marking paths depending upon the side of the line over which ringing current is transmitted, and call intercepting means controlled over at least one of said marking paths.

29. In a telephone system, a multiparty line, a source of ringing current, means for selectively transmitting ringing current from said source over either side of said line, a register controlled by the ringing current transmitted over said line, marking paths controlled by said register, means for imparting one setting to said marking paths when ringing current is transmitted over one side of said line, means for imparting a different setting to said marking paths when ringing current is transmitted over the other side of said line, and call intercepting means controlled over at least one of said marking paths.

30. In a telephone system, a multiparty line, means for selectively transmitting coded ringing current pulses over either side of said line, a register operative to a different setting as each ringing current pulse is transmitted over said line, marking paths controlled by said register, means for imparting one setting to said marking paths when ringing current is transmitted over one side of said line, means for imparting a different setting to said marking paths when ringing current is transmitted over the other side of said line, and call intercepting means controlled over at least one of said paths.

31. In a telephone system, a multiparty line, cyclically operating ringing apparatus operative to produce differently coded ringing current pulses during each cycle of operation thereof, means for transmitting ringing current pulses of a selected code over either side of said line, marking paths, a register controlled in accordance with the number and duration of the pulses constituting said selected code and operative to impart a different setting to said marking paths each time a ringing current pulse is transmitted over said line during one cycle of operation of said apparatus, means for imparting one setting to said paths in the event said ringing current pulses are transmitted over one side of said line, means for imparting a different setting to said paths in the event said ringing current pulses are transmitted over the other side of said line, and call intercepting means controlled over at least one of said paths and operative at the end of said one cycle of operation of said apparatus.

32. In a telephone system, a line, cyclically operating means for transmitting a variable number of signaling pulses over said line during each cycle of operation thereof, and call intercepting means operative in response to the transmission of a predetermined number of signaling pulses over said line during one cycle of operation of said apparatus.

33. In a telephone system, a line, cyclically operating means for selectively transmitting signaling pulses of uniform or non-uniform length over said line, and call intercepting means controlled in accordance with the length of the signaling pulses transmitted over said line to intercept predetermined calls routed to said line.

34. In a telephone system, a line, cyclically operating means for selectively transmitting a variable number of signaling pulses of uniform or non-uniform length over said line during each cycle of operation thereof, and call intercepting means selectively controlled in accordance with the number and length of the signaling pulses transmitted over said line during one cycle of operation of said apparatus for intercepting a call routed to said line.

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