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SIGNALING SYSTEM

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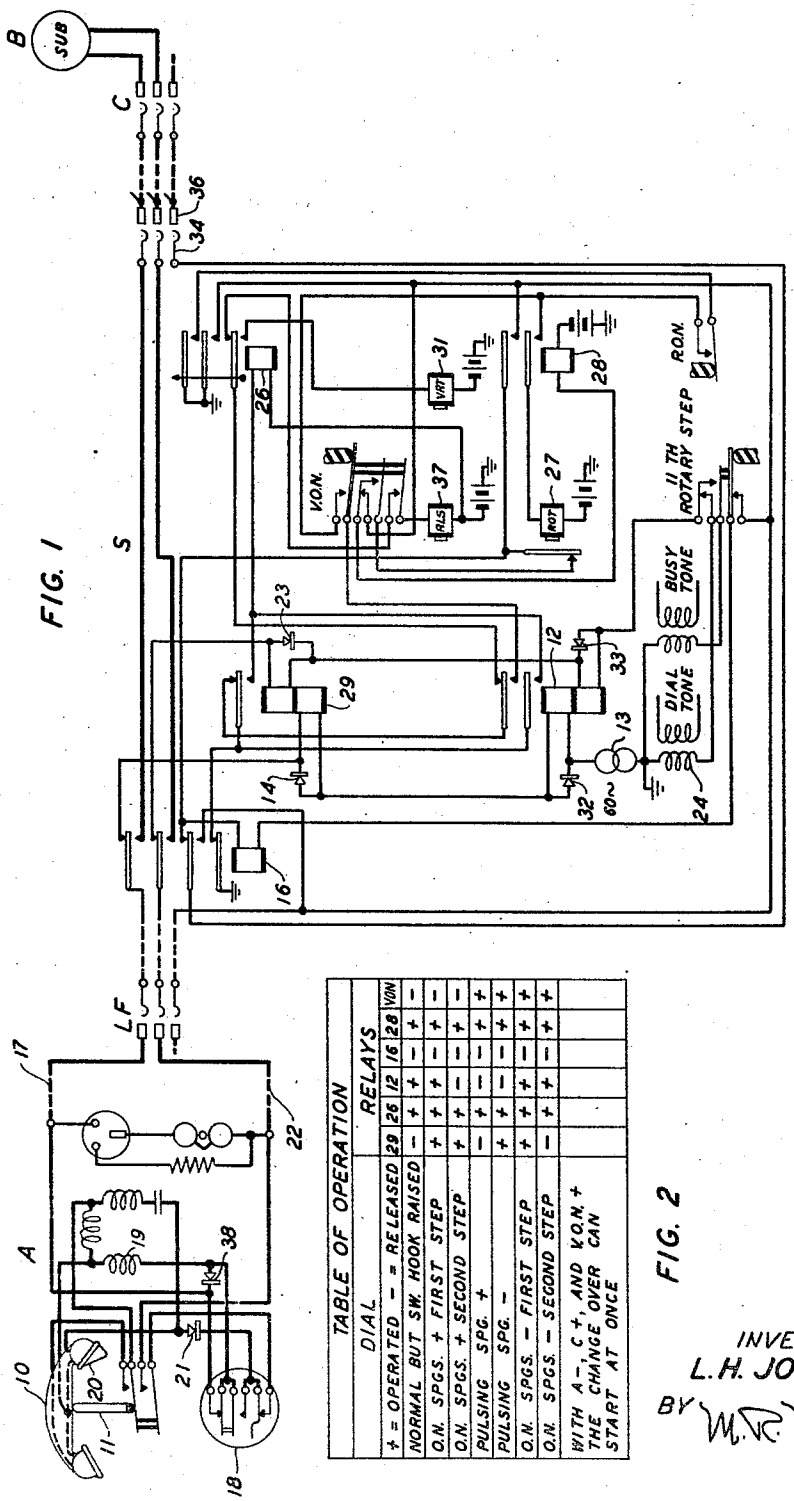

FIG. 1

TABLE OF OPERATION							
DIAL	RELAYS						
+ = OPERATED — = RELEASED	29	26	12	16	28	V.O.N.
NORMAL BUT SW. HOOK RAISED	—	+	+	—	+	—
O.N. SPGS. + FIRST STEP	+	+	+	—	+	—
O.N. SPGS. + SECOND STEP	+	+	—	—	+	—
PULSING SPG. +	—	+	—	—	+	+
PULSING SPG. —	+	+	—	—	+	+
O.N. SPGS. — FIRST STEP	+	+	+	—	+	+
O.N. SPGS. — SECOND STEP	—	+	+	—	+	+
WITH A —, C +, AND V.O.N. + THE CHANGE OVER CAN START AT ONCE						

FIG. 2

INVENTOR
L. H. JOHNSON
BY W. D. McKenney
ATTORNEY

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SIGNALING SYSTEM

Lewis H. Johnson, Madison, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

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20 Claims. (Cl. 179—18)

This invention relates to telephone systems and particularly to improvements in signaling and switching arrangements therefor whereby means are provided for reducing the signaling interval.

In telephone systems employing dials for signaling purposes it has been customary to employ a slow release relay, called a change-over relay, for distinguishing between the pulses of one digit of a called number and the pause between these pulses and the pulses of a succeeding digit, so that there will be no danger of transmitting current impulses pertaining to a succeeding digit before the switching operation brought about by the preceding digit has been completed. The change-over relay is capable of operating during the very first pulse of the digit, however short, and holding throughout all the intervals between pulses of the same digit, however long. Such a relay may hold from as much as .150 second following the last impulse of a digit before the release thereof signals the switching mechanism that the digit has been completed. The switching mechanism is therefore delayed an interval of time, before it can begin preparation for the next digit, or before it can begin preparation for ringing the called party at the end of the last digit of a series. In a seven digit number this delay interval would occur seven times.

It is therefore an object of this invention to reduce the time required for seizing a called number.

It is another object of the invention to permit an increase in the speed of dialing.

It is a further object of the invention to eliminate the delay occasioned by the slow release change-over relay.

It is still a further object of the invention to signal the switching mechanism immediately upon termination of a digital impulse.

With the above objects in view an embodiment of the invention discloses a system of the step-by-step type wherein current of one polarity is employed during the pulsing period and current of another polarity is employed during the inter-digital interval, so that upon termination of each digital impulse, that is, return of the dial to normal, the change-over apparatus immediately functions to set the switching mechanism for receipt of the next digit.

A more complete understanding of the invention will be obtained from the detailed description which follows and by reference to the appended drawing which shows one embodiment thereof.

Referring to the drawing,

Fig. 1 shows schematically an automatic telephone system of the step-by-step type having subscriber stations A and B interconnected by the usual central office switching mechanism including a selector S employing the present invention; and

Fig. 2 shows a tabular operation of the dial and principal relays involved in the circuit operation.

The subscribers' stations A and B are of the type customarily employed in automatic telephone systems and each station includes a dial for use in obtaining connections with any other station. While the circuit of station A is shown in detail, that of station B is merely shown symbolically, since it is identical with that of station A. Each station is connected by a subscriber's line to a central office containing line finder, selector, and connector switches of the well-known two motion step-by-step type.

In order to reduce the time required for seizing a called number the subscribers' stations and central office switching circuits are provided with rectifiers for rectifying an alternating current and for directing the resulting current through proper channels during different stages of the dial operation, which will be explained hereinafter in greater detail. The pulsing and change-over relays, which are connected in a serial loop, are poled oppositely so that normal current flows in a direction to first operate the change-over relay but not the pulsing relay. Movement of the dial from its normal position operates the pulsing relay and releases the change-over relay, the pulsing relay then responding to dial contact openings in the usual manner. Upon restoration of the dial to its normal position the pulsing relay releases and the change-over relay operates immediately to condition the switching apparatus for receipt of the next digit.

The invention will be more readily understood from a detailed description of the operation.

Assuming a call to have been originated at subscriber's station A, a circuit (not shown) is closed through the switchhook contacts thereof upon removal of handset 10 from mounting 11 whereupon line finder LF seizes the line of station A and switches it through to selector S in a normal manner, which is familiar to those versed in the telephone switching art. Upon station A being connected to selector S the usual dial tone is projected over the line to the subscriber and a circuit is closed for change-over relay 12, which is energized by direct current supplied through rectifiers from an alternating current source 13.

Source 13 is shown as comprising 60 cycles per second but any other suitable frequency may be employed. Alternating current, as is well known, comprises a current which reverses periodically in the direction of flow, one-half cycle thereof being positive and the other half cycle being negative. In the discussion hereinafter reference will be made to the positive and negative half cycles of alternating current in order to more clearly trace the circuits involved and also to visualize more quickly the operation of relays due to the poling of the relay windings by the various rectifiers. It is also well known that rectifiers present a comparatively high resistance to current of one direction and a comparatively low resistance to current of the opposite direction. The direction of current for which the rectifier offers a low resistance is indicated by the arrow-head. In other words, positive half cycles of alternating current will flow through the rectifier in the direction of the arrow while negative half cycles of alternating current will be blocked thereby. However, it is well to note in tracing circuit paths involving alternating currents and rectifiers that negative one-half cycles of alternating current readily flow through rectifiers having the arrow-heads pointing oppositely to the flow thereof.

The energizing circuit for change-over relay 12 may be traced from alternating current source 13, using the positive half cycle thereof, as the negative half cycle is ineffective at this instant, through the upper winding of relay 12, rectifier 14, uppermost back contact of relay 16, upper brush and terminal of line finder LF, over line conductor 17, through upper back contact of dial 18, winding 19, transmitter 20, rectifier 21, pulsing contact (bottom back contact) of dial 18, lower front switchhook contact of mounting 11, and back over line conductor 22, through intermediate terminal and brush of line finder LF, intermediate back contact of relay 16, rectifier 23, lower winding of relay 12, upper back contact of 11th rotary step switch, and through transformer winding 24 to the grounded side of source 13. Change-over relay 12 in operating closes at its innermost front contact an energizing circuit for relay 26 by connecting ground from innermost back contact of relay 16, through winding of relay 26 to the negative pole of grounded battery.

Relay 26, which is a slow release relay and which remains energized during the pulsing period, at its uppermost front contact prepares an operating circuit for rotary magnet 27; at its intermediate front contact connects the usual holding ground to the line finder circuit LF over the lower brush and terminal thereof and energizes relay 28 in a circuit that can be traced from ground through normally closed contact of VON switch and winding of relay 28 to grounded battery; and at its innermost front contact prepares a circuit for vertical magnet 31. Relay 28 operates in an obvious circuit but its operation is ineffective at this instant.

When the calling subscriber hears the aforementioned dial tone he will proceed to wind up the dial 18 in the customary manner. It may be noted that dial 18 has the usual number of contacts comprising the off-normal contacts, which consist of a break contact at the top and a make-before-break contact thereunder, and the impulse contact at the bottom. Immediately upon movement of dial 18 from its position of rest, the make-before-break contact closes and for a very short period of time both off-normal contacts are closed, thereby enabling the negative half cycle of alternating current source 13 to energize pulsing relay 29. This circuit can be traced from source 13 through rectifier 32, winding of relay 29, uppermost back contact of relay 16, upper brush and terminal of line finder LF, over line conductor 17, through break contact, make-before-break contact, and impulse contact of dial 18, lower front switchhook contact of mounting 11, and back over line conductor 22, through intermediate terminal and brush of line finder LF, intermediate back contact of relay 16, upper winding of relay 29, rectifier 33, upper back contact of 11th rotary step switch, and through transformer winding 24 to the grounded side of source 13. Thus in the first step of the movement of dial 18, both the change-over relay 12 and the pulsing relay 29 are in an energized state, change-over relay 12 being energized by the positive half cycle of alternating current and pulsing relay 29 being energized by the negative half cycle of alternating current. Relay 29 in operating closes a locking circuit for relay 26, which can be traced from grounded battery through winding of relay 26, front contact of relay 29, and innermost back contact of relay 16 to ground.

However, in the second step of the wind-up movement of dial 18 the top off-normal contact thereof opens the above-traced circuit for change-over relay 12, which releases without affecting the circuit operation.

Upon reaching the finger stop (not shown) of dial 18 the subscriber releases the dial, which then starts to return to its normal position and in doing so opens the impulse contact thereof intermittently, thereby releasing and reoperating pulsing relay 29 a number of times corresponding to the number pulled on the dial, as is well known in the art. During each release of relay 29 vertical magnet 31 is energized and accordingly steps the switch mechanism (not shown) to a level corresponding to the number dialed. The circuit for magnet 31 can be traced from the negative pole of grounded battery through winding thereof, inner front contact of relay 26, back contact of relay 12, and back contact of relay 29 to ground through back contact of relay 16. The VON switch is actuated immediately upon movement of the switch mechanism from its normal position and at its uppermost front contact prepares a circuit for rotary magnet 27; at its bottom front contact prepares a circuit for release magnet 37 and at its intermediate make-before-break contact combination transfers the original operating circuit for relay 28 to one that can be traced from grounded battery through winding of relay 28, intermediate front contact of VON switch, back contact of rotary magnet, and thence in parallel, one path continuing over top front contact of relay 28 and intermediate front contact of relay 26 to ground, and the other path continuing through winding of relay 16, lower back contact of 11th rotary step switch, and intermediate front contact of relay 26 to ground. Relay 16 cannot operate in this circuit since the winding thereof is short-circuited by the upper front contact of relay 28.

As dial 18 aproaches its normal position of rest the top break contact thereof closes before the intermediate off-normal contact opens, and, as in the first step of winding up the dial, both off-normal contacts are closed and both relays 12 and 29 are operated, as before, relay 12 being operated by the positive half cycle and relay 29 by the negative half cycle of alternating current. Change-over relay 12 in operating at its uppermost back contact opens a further point in the operat-

ing circuit for vertical magnet 31; at its upper front contact prepares a circuit for rotary magnet 27; and at its inner front contact recloses the original operating circuit, previously traced, for relay 26. In the next step as the dial 18 reaches its final point of rest, the intermediate off-normal contact thereof opens and releases pulsing relay 29, which in turn closes an operating circuit for rotary magnet 27. This circuit can be traced from grounded battery through winding of rotary magnet 27, inner front contact of relay 28, uppermost front contact of VON switch, upper front contact of relay 12, back contact of relay 29, and back contact of relay 16 to ground. It is thus to be noted that the change-over relay 12 is operatively effective immediately upon return of dial 18 to its normal position, thereby eliminating the delaying feature required in the change-over relays of the previous systems and consequently providing a reduction in the signaling interval.

Rotary magnet 27 in operating opens, at the back contact thereof, the alternate operating circuit for relay 28, which in releasing opens, at its inner front contact, the above-traced circuit for rotary magnet 27. During the operation of rotary magnet 27 the switching mechanism (not shown) takes one rotary step and places sleeve brush 34 in contact with one of the multiple bank terminals 36. As is well known, if this terminal is busy, ground will be connected thereto and relay 28 will reoperate in a circuit that can be traced from grounded battery through winding of relay 28, intermediate front contact of VON switch, back contact of magnet 27, back contact of relay 16, and thence to ground over the above-mentioned sleeve brush 34 and multiple terminal 36. Upon the initial operation of rotary magnet 27 the RON switch is immediately actuated to close an alternate operating path for rotary magnet 27 in order to permit the selector sleeve brush 34 to continue hunting for a free trunk should the subscriber start rotation of dial 18 for the second digit before seizure of a free trunk. Upon reoperation of relay 28 rotary magnet 27 operates over the previously traced circuit or over the above-mentioned circuit, which can be traced from grounded battery through winding of magnet 27, inner front contact of relay 28, RON contact, and thence to ground through uppermost front contact of relay 26. The switching mechanism is rotated another step and assuming that an idle (ungrounded) terminal is found the relays 28 and 16 are connected in series thereto. Relay 28, being a marginal relay, cannot operate in series with the winding of relay 16 but relay 16 energizes, since a grounded bank terminal no longer short-circuits the winding thereof, over a circuit that can be traced from grounded battery through winding of relay 28, intermediate front contact of VON switch, back contact of magnet 27, winding of relay 16, back contact of 11th rotary step switch, to ground through intermediate front contact of relay 26.

Relay 16 in operating, at the three upper front contacts thereof cuts through the talking and sleeve leads to the corresponding brushes of the selector S and thence to the selector terminals seized for the free trunk; at the two upper back contacts opens the operating circuit for change-over relay 12; at the intermediate back contact opens a point in the alternate operating circuit for relay 28 and also opens a point in the operating circuit of release magnet 37; and at the innermost back contact opens a point in the holding circuit for relay 26. Relay 12 in restoring, at the inner front contact opens another point in the holding circuit for relay 26; at the upper front contact opens a point in the operating circuit of the now retracted rotary magnet 27; and at the back contact closes a point in the operating circuit for release magnet 37. Relay 26 being of a slow to release type releases after a sufficient interval and at the top front contact thereof opens another point in the alternate operating circuit for rotary magnet 27; at the intermediate front contact removes holding ground from the line finder LF, but not before ground has been returned from the succeeding switching mechanism, and opens a point in the original operating circuit for relay 28; at the inner front contact opens a point in the operating circuit for vertical magnet 31; and at the back contact thereof closes another point in the operating circuit for release magnet 37.

Upon connection to a free trunk the talking and sleeve leads are extended in the usual manner to a succeeding switching mechanism (not shown) which places busy ground upon sleeve terminal 36, whereby a locking circuit is provided for relay 16 and a holding ground for line finder LF, the previous holding ground therefor being disconnected upon release of relay 26. This locking circuit may be traced from grounded battery through winding of relay 28, intermediate front contact of VON switch, back contact of magnet 27, winding of relay 16, lower back contact of 11th rotary step switch, lower front contact of relay 16, selector sleeve brush 34, and thence to ground (not shown) via selector terminal 36.

The circuit is further extended through succeeding selectors (not shown) and connector C, which may have the above inventive features included therein, to the called subscriber B in the usual manner and conversation may then take place between subscribers A and B. It may be noted in view of the use of rectifying devices, such as rectifiers 21 and 38 in the station circuit of subscriber A, that talking currents are transmitted by modulation of a steady current through transmitter 20 and therefore pass through the circuit path in which the rectifying device offers a low resistance to the steady current. As the variation in the current due to speech is small compared with the normal value of the steady current itself, the whole of the speech waves will pass the rectifying device with consequent full reproduction in the telephone receiver.

When both subscribers have completed their conversation and have restored their handsets, the holding ground provided by the succeeding switches is removed from sleeve terminal 36 and as a result relay 16 restores and at its inner back contact closes an operating circuit for switch release magnet 37. This circuit may be traced from grounded battery through winding of release magnet 37, lower front contact of VON switch, back contact of relay 26, back contact of relay 12, back contact of relay 29, and to ground through back contact of relay 16. Relay 37 in operating restores the selector switching mechanism to its normal position and when the VON switch is retracted to its normal position the lower front contact thereof opens the operating circuit for release magnet 37 which thereupon releases. The circuit is now in readiness for another call.

While this invention has been shown and described as embodying certain features in a first selector circuit of a step-by-step system merely for the purpose of illustration, it is, of course, understood that various modifications may be

made in the details of the circuit and that the features thereof may be applied to the succeeding selectors and connector thereof as well as to many other and widely varied fields without departing from the scope of the invention as defined in the appended claims. For example, the dialing time reduction features of this invention may be similarly applied to panel systems as well as to cross bar systems.

What is claimed is:

1. In a telephone system, a device for dialing digital impulses, automatic means adapted for connection with said device, a source of current for operating said automatic means, and means for directing one component of said current source through said automatic means while impulses are being transmitted by said device whereby said automatic means is responsive, said means also effective for directing another component of said current source through said automatic means immediately at the termination of the last impulse of a digit transmitted by said device.

2. In a telephone system, a device for dialing digital impulses, automatic means adapted for connection with said device, a source of current for operating said automatic means, and means for directing one component of said current source through said automatic means during the pulsing period of said dialing device whereby said automatic means is operatively responsive, said means also effective for directing another component of said current source through said automatic means immediately at the termination of the last impulse of a digit transmitted by said device whereby said automatic means is further responsive.

3. In a telephone system, a device for transmitting impulses according to the digits of a called number, automatic means adapted for connection with said device, a source of current for energizing said automatic means, and means associated with said device for directing current of one characteristic derived from said source operatively through said automatic means during the pulsing period of said device, said means also effective to direct current of another characteristic from said source immediately upon termination of the pulsing period for further energizing said automatic means.

4. In a telephone system, a device for transmitting impulses according to the digits of a called number, automatic means adapted for connection with said device, a source of alternating current for operating said automatic means, and means associated with said device for directing a half cycle of said alternating current through said automatic means during the pulsing period of said device whereby said automatic means is operatively responsive, said means also effective to direct the other half cycle of said alternating current through said automatic means immediately at the termination of the last impulse of a digit transmitted by said device, whereby said automatic means is immediately further responsive.

5. In a telephone system, a dial for transmitting impulses according to the digits of a called number, automatic means adapted for connection with said device, a source of alternating current for operating said automatic means, and rectifying means connected to said dial for directing a half cycle of said alternating current through said automatic means during the pulsing period of said dial whereby said automatic means is operatively responsive, said rectifying means also effective to direct the other half cycle of said alternating current through said automatic means immediately at the termination of the last impulse of a digit transmitted by said dial, whereby said automatic means is immediately further responsive.

6. In a telephone system, a station circuit, an impulsing device in said station circuit for transmitting impulses according to the digits of a called number, automatic means adapted for connection with said impulsing device, a source of current for controlling the operation of said automatic means, and means in said station circuit for directing current therethrough so that current of one characteristic controls the said automatic means during the pulsing period and current of a distinctive characteristic is effective immediately upon termination of the pulsing period for differently controlling the said automatic means.

7. In a telephone system, a device for transmitting digital impulses, a stepping relay responsive to impulse currents of one polarity transmitted by said device, a change-over relay responsive to current of another polarity transmitted by said device immediately at the termination of the last impulse of a digit, automatic means actuated in response to operation of said stepping relay, and means immediately responsive to energization of said change-over relay.

8. In a telephone system, a source of alternating current, a transmitting device adapted for dividing said alternating current into opposite polarities, and an automatic switch responsive to said current of one polarity for advancement thereof in one direction and responsive to said current of opposite polarity for advancement thereof in another direction.

9. In a telephone system, a stepping relay responsive to impulse currents of one polarity, a change-over relay responsive to current of another polarity, said change-over relay being connected in series relationship with said stepping relay, a progressively movable switch actuated in a primary direction in response to operation of said stepping relay, and means responsive to energization of said change-over relay following operation of said stepping relay, whereby said switch is actuated in a secondary direction immediately upon cessation of said impulse currents of one polarity.

10. In a telephone system, an automatic switch, a source of alternating current for controlling said switch, two relays connected to said source of current, each of said relays being polarized to respond to current of a different polarity, a circuit arrangement responsive to an initial energization of one of said relays for preparing said switch for operation, said circuit arrangement thereafter responsive to the interrupted operation of the other of said relays for a stepping operation of said switch, and means responsive to a second operation of the first one of said relays for changing over from said stepping operation to a further subsequent automatic operation of said switch.

11. In a telephone system, a line, a dial for transmitting impulses according to the digits of a called number connected to one end of said line, an automatic switch capable of vertical and rotarial movement having access to the other end of said line, said switch comprising a source of alternating current, and a pair of serially connected oppositely poled relays interconnecting

said source with said line, one of said relays vibratorially operative during the transmission of impulses by said dial for driving said switch in a vertical direction, and the other of said relays immediately operative upon termination of the last impulse of a digit for driving said switch in a rotarial direction.

12. In a telephone system, a station circuit, a reciprocating dial in said station circuit for transmitting impulses, an automatic switch adapted for connection with said dial, a source of alternating current for controlling said switch, means in said station circuit for controlling the polarity of said alternating current, said switch comprising a pulsing relay and a change-over relay connected with said source, means for poling said pulsing relay to respond to current of one characteristic while pulses are being transmitted by said dial and for poling said change-over relay to respond to current of another characteristic immediately at the termination of a digital impulse train projected by said dial, a circuit responsive to operation of said pulsing relay for actuating said switch step by step in one direction, and means responsive to operation of said change-over relay for automatically actuating said switch in another direction.

13. In a telephone system, a station circuit, a dial in said station circuit for transmitting impulses, an automatic switch capable of vertical and rotarial movement adapted for connection with said station circuit, a source of alternating current for controlling said switch, rectifying means in said station circuit for controlling the polarity of said alternating current, said switch comprising a pulsing relay and a change-over relay in series relationship with said source, means for poling said pulsing relay to respond to current of one polarity while a series of impulses pertaining to one digit is being transmitted by said dial and for poling said change-over relay to respond to current of a different polarity immediately at the termination of said series of impulses, a circuit responsive to operation of said pulsing relay for actuating said switch vertically, a second circuit responsive to operation of said change-over relay for actuating said switch rotarily in order to extend said subscriber's station to a second switch, and means for preventing interruption to the rotarial operation of said first switch by said second circuit in the event said dial is reoperated for a succeeding digit.

14. In a telephone system, a step-by-step selector switch, a source of positive and negative current for controlling said switch, a pair of relays connected with said source of current, one of said relays responsive to positive current and the other of said relays responsive to negative current, a circuit arrangement responsive to an initial energization of said relay responsive to positive current for preparing said switch for operation, said circuit arrangement thereafter responsive to the interrupted operation of the other of said relays for a stepping operation of said switch, and means responsive to a second operation of said first responsive relay for changing over from said stepping operation to a further subsequent operation of said switch immediately upon release of said other responsive relay.

15. In combination, a step-by-step selector switch, a source of alternating current for controlling said switch, two direct current relays serially connected to said source of current, one of said relays being adapted for response to current of one polarity and the other of said relays being adapted for response to current of an opposite polarity, a slow release relay responsive to an initial energization of one of said relays for preparing said switch for operation, said slow release relay thereafter being steadily responsive during the interrupted operation of the other of said relays for a stepping operation of said switch, and means responsive to a second operation of said first relay for transferring from said stepping operation to a further subsequent operation of said switch immediately upon completion of said stepping operation of said switch.

16. In combination, an automatic switch, a source of alternating current for controlling said switch, a pair of oppositely poled relays serially connected with said source, a rectifier for shunting a winding of each of said relays, said rectifiers so disposed that each of said relays is responsive to current in a different direction, a circuit arrangement responsive to an initial energization of one of said relays for conditioning said switch preparatory to operation, said arrangement thereafter responsive to vibratory operation of the other of said relays for a stepping operation of said switch, and change-over means thereafter responsive to a second operation of said first relay for switching said stepping operation to a further subsequent automatic operation of said switch.

17. In combination, an automatic switch, a source of alternating current for controlling said switch, a pair of relays connected with said source, a pair of windings on each of said relays, said pair of windings of one relay serially connected with a corresponding pair of windings of the other relay to said source, a rectifier shunting each winding of said pairs of windings serially interconnected, said rectifiers for each of said pairs of windings being oppositely poled so that each of said relays is responsive to current in a different direction, one of said relays vibratorially responsive to impulses for driving said switch in a primary direction, and the other of said relays immediately effective upon release of said one relay for driving said switch in a secondary direction.

18. In a telephone system, a station circuit, a dial in said station circuit for transmitting impulses according to the digits of a called number, automatic means adapted for connection with said dial, a source of alternating current for controlling the operation of said means, said means comprising a pair of relays for interconnecting said source with said station circuit, and means in said station circuit for directing current therethrough so that upon operation of said dial current of one characteristic is effective during the pulsing period thereof while current of another characteristic is effective immediately upon termination of the last impulse of a digit and during the interdigital period, one of said relays being responsive to current of said one characteristic for operating said automatic means, and the other of said relays being responsive to current of the other characteristic, whereby said automatic means is rendered effective to further operation immediately upon termination of the last impulse of a digit.

19. In a telephone system, a subscriber's station circuit, a dial in said station circuit for transmitting impulses according to the digits of a called number, an automatic switch adapted for connection with said dial, a source of alternating current for controlling the operation of said switch, said switch comprising a pair of serially connected oppositely poled relays for intercon-

necting said source with said station circuit, rectifying means in said station circuit for directing current therethrough so that upon operation of said dial current of one characteristic is effective during the pulsing period thereof while current of another characteristic is effective during the interdigital period, and second rectifying means for polarizing said relays, one of said relays vibratorially operative during the pulsing period of said dial for driving said switch in one direction, and the other of said relays immediately operative upon termination of the last impulse of a digital number for driving said switch in a different direction.

20. In a telephone system, an incoming line including means for transmitting digital impulses, an outgoing line, a switch for interconnecting said incoming and outgoing lines, said switch comprising a source of alternating current, an impulse relay interconnecting said incoming line and said source, said relay being responsive to one digital series of impulses transmitted over said incoming line and being responsive to current of one polarity, a second relay interconnecting said incoming line and said source, said second relay being operative by current of an opposite polarity, and means for polarizing said relays whereby said current of one polarity is effective during transmission of said one digital series of impulses and said current of opposite polarity is effective during an interdigital period.

LEWIS H. JOHNSON.