April 20, 1926. 1,581,244

S. SUEKOFF

TELEPHONE SYSTEM

Filed Sept. 10, 1919 3 Sheets-Sheet 1

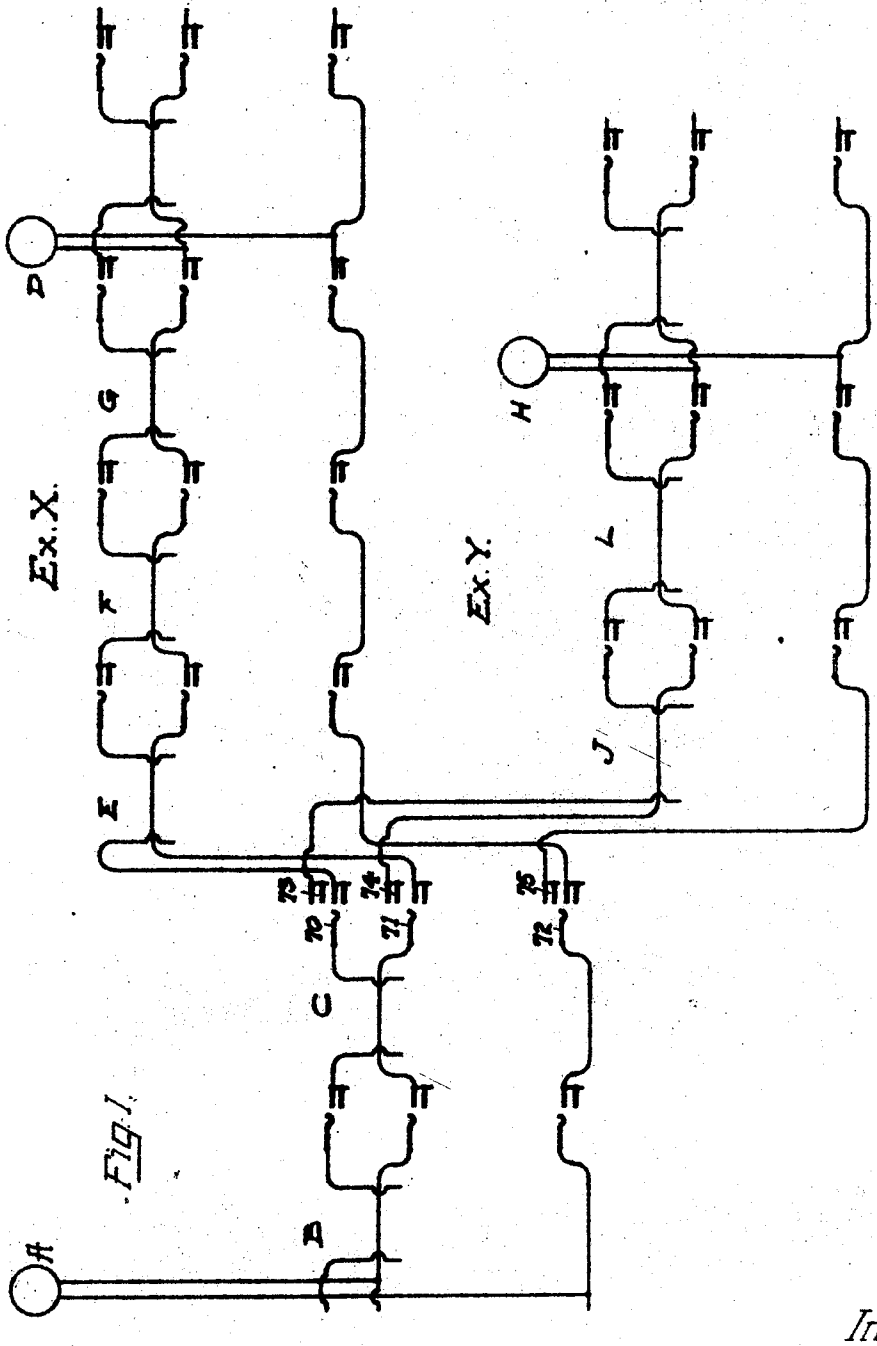

Fig. 1.

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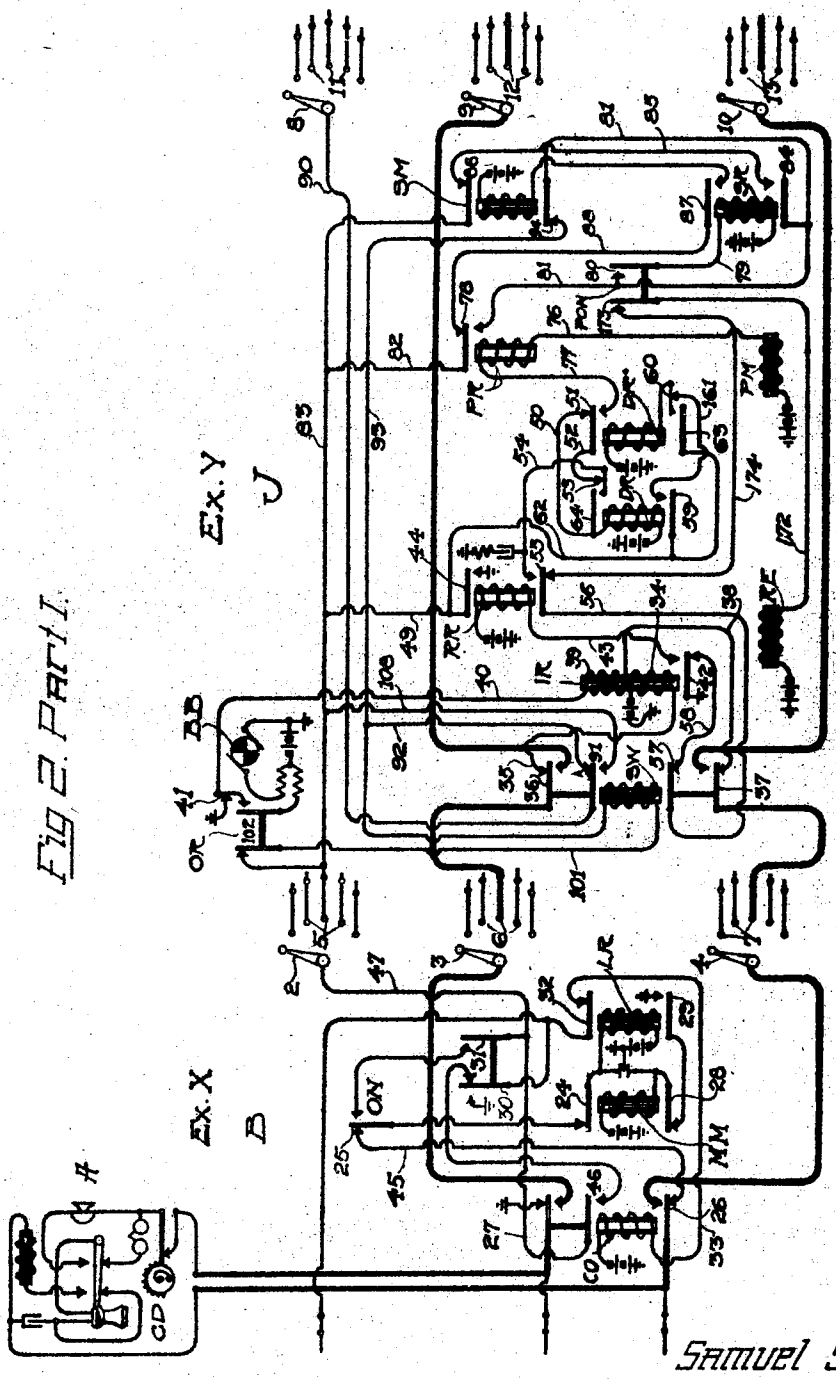

Fig 2. Part I.

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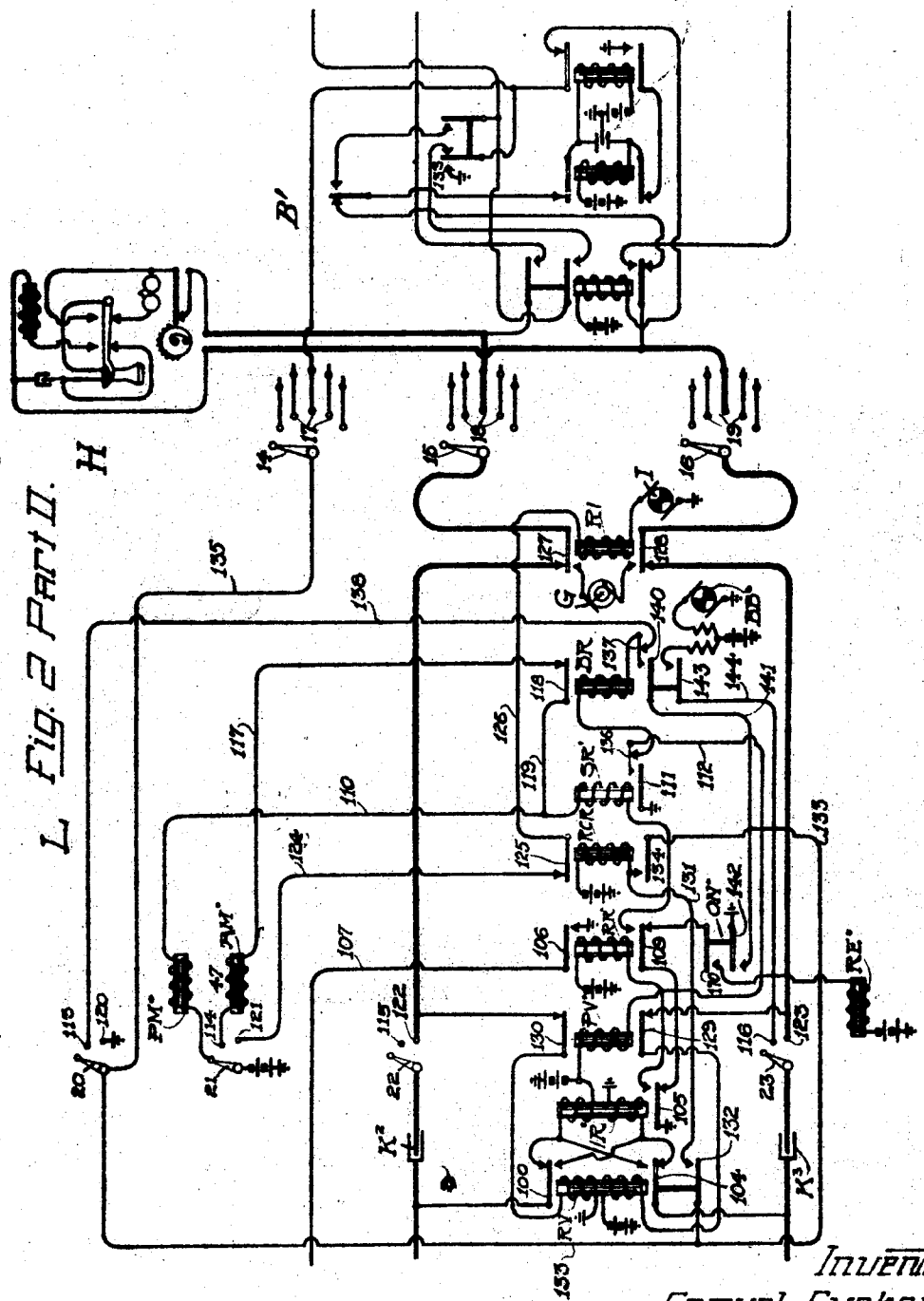

Fig. 2 Part II.

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Patented Apr. 20, 1926. 1,581,244

UNITED STATES PATENT OFFICE.

SAMUEL SUEKOFF, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed September 10, 1919. Serial No. 322,780.

To all whom it may concern:

Be it known that I, SAMUEL SUEKOFF, a citizen of the United States of America, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems in which automatically controlled switches are provided for completing connections between subscribers' lines, and more particularly to the trunking methods employed in such systems.

In a multi-exchange system, the different exchanges that form the complete system are generally of different size and capacity. For example, some of the exchanges may be of the 100,000 line type; part may be of the 10,000 line type and part may be of the 1,000 line type.

In the 100,000 line type of exchange, first, second and third selectors are provided, while in the 10,000 line type only first and second selectors are provided, and in the 1,000 line type only first selectors need be provided. Of course, it is necessary to furnish connector switches, and non-numerical switches with these different types of systems.

In the 100,000 line type of system, the subscribers' numbers must contain five figures. In the 10,000 line type the subscribers' numbers must contain at least four figures, and in the 1,000 line type the subscribers' figures must contain at least three figures. It has been found desirable, and the reason is thought to be apparent, to have all the subscribers' numbers in a system contain the same number of figures or digits.

Heretofore it has been necessary to insert extra selector switches, for which there was no use, in the 1,000 and 10,000 line type exchanges, so that all the subscribers' numbers in the complete system would have the same number of digits, thus causing a great and needless expense and outlay in selector switches that were really not needed in the system to complete the calls.

It is the object of my invention to overcome this objectionable feature, as well as many other objectionable features.

A feature of my system is the provision of a selector switch which is adapted to absorb or render useless one or more digits of a called number, thereby taking the place of several selector switches used in the old type of trunking systems.

I so arrange my selector switch that when a call goes into a 10,000 line type exchange in a 5 digit system, the selector switch will absorb or render ineffective one digit or series of impulses of the called number and then respond to the next digit or series of impulses of the called number. Likewise, my selector, in a smaller type of exchange, is arranged to render ineffective two series or more of impulses of the called number.

In the accompanying drawings I have omitted all unnecessary and well-known apparatus, showing only the necessary apparatus for obtaining a full and clear understanding of my invention.

The above features, as well as others, will be more particularly pointed out in the ensuing specification and appended claims.

For a more complete understanding of my invention reference may be had to the accompanying drawing in which—

Fig. 1 is a skeleton circuit diagram illustrating the application of my invention to a multi-office system; and

Fig. 2, which comprises parts 1 and 2, illustrates diagrammatically the arrangement embodying my improved circuit arrangement.

Referring now particularly to Fig. 1, I here illustrate diagrammatically a trunking arrangement between an exchange X and an exchange Y. The substation A terminates in an individual line switch B at the exchange X, which switch may be of any suitable type, as the switch illustrated and described in a copending application of Harry H. Ide, filed July 29, 1918, Serial No. 247,122. Upon the initiation of a call at the substation A, switch B selects an idle first selector switch C. The exchange X, as illustrated, is of the 100,000 line type, and the exchange Y is of the 10,000 line type. With this size and type of system it will be necessary to have 5 digit numbers. Should the subscriber at the substation A wish to converse with the substation D in his own exchange, a series of five groups of impulses will be transmitted to actuate the different switches. The first set of impulses will actuate the first selector C to select an idle second selector E in the exchange X, and the second set of impulses will actuate the

second selector E to select an idle third selector F. The third set of impulses will actuate the third selector F to select an idle connector switch G, which connector switch G contains the contacts of the called line D. The last two sets of impulses actuate the connector G to engage the contacts of the wanted line, as is well understood. Now should the subscriber at the substation A wish to converse with a subscriber at the substation H which terminates in the exchange Y, the subscriber at the substation A in initiating a call actuates his line switch B to select an idle first selector C in the exchange X, and then actuates his impulse device to send five sets of impulses to select the contacts of the wanted substation H at the exchange Y. The first set of impulses actuates the first selector C at the exchange Y to select an idle incoming second selector J at the exchange Y. The second selector J at the exchange Y is provided with the digit absorbing feature of my invention, and the next set of impulses is absorbed and does not affect the switch mechanism, as will be more fully hereinafter described. The next set of impulses, which is the third set, now actuates the second selector J to select an idle connector L which connector L contains the contacts of the wanted substation H. The last two sets of impulses actuate the connector L to select the contacts of the wanted substation H. It may thus be seen that a system as above outlined with a digit absorber selector installed in an outlying exchange eliminates the use of a third selector, this allowing a uniform numbering system in addition to eliminating the third selectors.

It is, of course, understood that my invention is applicable to a system or systems of any size and that the switches may all be located in one exchange or any number of exchanges, the main feature being to keep the subscribers' numbers uniform, that is, to have the same number of digits in each figure. In case it is desirable to absorb or render useless two digits, two of my digit reducing selectors will be provided. It is further to be understood that a repeater may be provided between the first selector C and the second selector J in the distant exchange, if it is found desirable, of the general type illustrated and described in United States Letters Patent to Alfred H. Dyson No. 1,148,665, granted August 3, 1915.

The selectors and connectors shown may be of any approved type.

Referring now to Fig. 2, which comprises parts 1 and 2, and more particularly to part 1, I illustrate a well known type of substation including the usual substation apparatus, and in addition I show a calling device CD. The substation A terminates at the exchange, which we will assume is the exchange X of Fig. 1, in an individual line switch B. The line switch B is provided with a rotary shaft and carries a private test wiper 2 and a pair of line wipers 3 and 4. A line relay LR is provided which is energized over the subscriber's line conductors in series. A cut-off relay CO is also provided for disconnecting the subscriber's line circuit from the line relay LR and for connecting the switch wipers to the subscriber's line circuit. A motor magnet MM is provided for stepping the switch wipers 2, 3 and 4 step-by-step over the bank contacts 5, 6 and 7. An off-normal contact ON is provided which moves to its alternate position upon the first step of the wipers off normal. The wipers 2, 3 and 4 are spring restored, and are adapted to be released to normal when the cut-off relay CO de-energizes. In Fig. 2, part 1, I do not show the first selector C associated with the exchange X as the operation of the selector switch is well known and for the sake of simplicity I have omitted it and for a detailed description of the same reference may be had to U. S. Patent No. 1,402,936 granted January 10, 1922, to Harry H. Ide. The selector switch J is a combined second and digit absorbing selector and is provided with a private wiper 8 and line wipers 9 and 10, which connect with an idle connector. A primary relay PR and a primary magnet PM are provided, which magnet PM steps the wipers 8, 9 and 10 in a primary direction to a pre-determined group of contacts. A secondary relay SR and a secondary magnet SM are provided, which magnet SM steps the wipers 8, 9 and 10 in a secondary direction over the contacts 11, 12 and 13 to seek an idle set of contacts in the selected group. A combined line and interrupter relay IR, which when de-energized and energized, due to the interruptions of current at the calling substation, brings about the de-energization and energization of the primary magnet PM to step the wipers 8, 9 and 10 in a primary direction. Digit absorbing or reducing relays DR and DR' are provided for purposes as will be more fully hereinafter described. A switching relay SW is also provided, and energizes when an idle connector is encountered to extend the calling line to the said idle connector. A release relay RR and release magnet RE are provided, which magnet RE upon energization releases the switch J to normal when disconnection is desired. The primary off normal contacts PON are provided, which assume their alternate position upon the first step of the wipers 8, 9 and 10 off-normal, and are again restored upon the restoration of the switch J to normal. Overrun contacts OR are provided, which assume their alternate position upon the eleventh secondary step of the wipers 8, 9 and 10,

that is, when all of the contacts of the selected group are busy, in which event the busy back apparatus BB is connected to transmit a busy signal back to the calling subscriber.

The connector switch L illustrated in Fig. 2, part 2, comprises the impulse relay IR′, a private relay PV′, a secondary relay SR′ and a primary magnet PM′. A rotary magnet RM′ is also provided, which is energized by the last set of impulses to step the wipers 14, 15 and 16 of the connector L in a rotary direction over contacts 17, 18 and 19 to select the contacts of the wanted line. A busy relay BR is associated with the connector and connects the busy back apparatus BB′ to the calling line in case the called line is busy. A ringing relay RI is intermittently energized and deenergized by the interrupter I to connect the ringing generator G to the called-for line to actuate the call signal thereat. A ringing control relay RCR is energized when the subscriber at the called substation answers to disconnect the ringing generator G from the called line. A release relay RR′ and a release magnet RE′ are associated with the connector, the magnet RE′ being energized upon the de-energization of relay RR′ to release the switch mechanism. A reversing relay RV is also shown for the usual battery reversing purposes, as is well understood. Off-normal contacts ON′ are provided and assume their alternate position upon the first step of the wipers 14, 15 and 16 off normal. The side switch wipers 20, 21, 22 and 23 are stepped to their different positions by the restorations of the relay PV′.

A substation H is shown at the right of Fig. 2, part 2, and is similar to that of A and is connected at the exchange with its associated line switch B′, similar to B.

Having described in general the apparatus associated with my invention, the operation of the system will now be described more in detail. As before mentioned, it is to be assumed that a first selector is to be provided and inserted between the line switch B and the digit reducing selector J.

Assuming now that a call is to be traced from the calling substation A in the exchange X to a called substation H at the exchange Y, the removal of the receiver by the subscriber at the substation A closes an energizing circuit for the line relay LR, traced from battery through the winding of relay LR, normal contact 24 of motor magnet MM, normal contact 25 of off-normal contacts ON, normal contact 26 of cut-off relay CO and through the closed contacts of the substation switch hook to ground at normal contact 27 of cut-off relay CO. The line relay LR upon energizing establishes an energizing circuit for motor magnet MM traced from battery through the winding of magnet MM, its normal contact 28 to ground at alternate contact 29 of relay LR, and the opening of normal contact 24 of motor magnet MM opens the energizing circuit of line relay LR, and magnet MM steps the wipers 2, 3 and 4 of the line switch B into engagement with the first set of contacts 5, 6 and 7, which lead to a first selector (not shown) of the type previously referred to. Upon the first step of the wipers off normal, the off-normal contacts ON assume their alternate position and the contacts 30 and 31 are also moved to their alternate position. The opening of alternate contact 29 of line relay LR brings about the de-energization of the magnet MM and should the private wiper 2 of the line switch B engage a busy private contact 5 upon this first step, a substitute circuit for the line relay LR is established, traced from battery, through the winding of relay LR, normal contact 24 of magnet MM, alternate contact 25 of off-normal contacts ON and alternate contact 31 to ground to the busy contact engaged by the private wiper 2. The closure of alternate contact 29 of relay LR again establishes a circuit for the magnet MM as previously described, causing the switch wipers 2, 3 and 4 to take another step and engage the second set of contacts 5, 6 and 7. If the next private contact 5 is busy, motor magnet MM and line relay LR are again energized and de-energized to step the wipers 2, 3 and 4 step by step until an idle private contact 5 is encountered. When a contact 5 leading to an idle first selector has been seized, the line relay de-energizes, bringing about the de-energization of the magnet MM. The closing of normal contact 32 of relay LR establishes an energizing circuit for the cut-off relay CO, traced from battery through the winding of said cut-off relay CO, conductor 33, normal contact 32 to ground at alternate contact 30. The energization of cut-off relay CO brings about the restoration of the contacts 30 and 31 to their normal position, opening the initial energizing circuit of the cut-off relay CO, but as the cut-off relay CO is slow to release a substitute circuit is established for the said relay CO before it has time to de-energize and its contacts restore to normal, from ground which is transmitted back from the idle first selector which has been seized.

I have not shown in detail a local first selector, as a selector of any well-known type may be employed as the selector illustrated in Patent No. 1,344,195, issued to G. A. Yanochowski, June 22, 1920.

Assuming that the number of the called subscriber at substation H in the exchange Y is 23456, the subscriber at the calling substation A in the exchange X actuates his calling device CD to send two impulses of

current, which impulses represent the first digit of the called number of the called subscriber at substation H. The impulses of current actuate means which bring about the movement of the first selector switch wipers 70, 71 and 72 (see Fig. 1), in a primary direction to select a group of trunks, which lead to the exchange in which the called substation H terminates. The selector switch is then stepped in a secondary direction over the contacts 73, 74 and 75 to select an idle set of contacts leading to an idle incoming second selector in the exchange in which the called substation terminates. The wipers 70, 71 and 72 engage contacts 73, 74 and 75, which lead to an idle incoming second selector J at the exchange, which selector is provided with a digit reducing means and the engagement of wipers with said contacts brings about the energization of the combined line and impulse relay IR, over a circuit traced from battery through the lower winding 34 of the impulse relay IR (switch J, Fig. 2, part 1), conductor 35, normal contact 36 of the switching relay SW, contact 74, wiper 71, contact 6, wiper 3, alternate contact 27 of the cut-off relay CO, through the substation A, back through alternate contact 26 of relay CO, wiper 4, contact 7, wiper 72, contact 75, normal contact 37 of the switching relay SW, conductor 38, through the upper winding 39 of relay IR, conductor 40 to ground at the make-before-break contact 41 of the overrun contacts OR. The relay IR upon energizing closes its alternate contact 42, establishing an energizing circuit for the release relay RR, traced from battery, through the winding of relay RR, conductor 43 to ground at alternate contact 42 of relay IR. The calling subscriber at the substation A now actuates his calling device CD to send three impulses of current which bring about three de-energizations and energizations of the impulse relay IR. Upon the first de-energization of relay IR, the closing of normal contact 42 of relay IR establishes an energizing circuit for the digit absorbing relay DR over a circuit traced from battery, through the winding of relay DR, conductor 50, normal contact 51 of the digit absorbing relay DR′, conductor 52, make-before-break contact 53 of relay DR, conductor 54, alternate contact 55 of relay RR, conductor 56, normal contact 57 of relay SW and conductor 58 to ground at normal contact 42 of relay IR. The closing of alternate contact 59 of relay DR closes an energizing circuit for the digit absorbing relay DR′ traced from battery through the winding of the relay DR′, its make-before-break contact 60, conductor 161, alternate contact 59 of relay DR, conductor 62 to ground at alternate contact 44 of relay RR. Relay DR′ now closes a locking circuit for itself traced from battery, through the winding of the relay DR′, its alternate contact 63, conductor 62 to ground at alternate contact 44 of relay RR. The opening of alternate contact 51 of relay DR′ opens the initial energizing circuit of relay DR, but a substitute circuit is established for relay DR, traced from battery, through the winding of the said relay DR, its alternate contact 64, conductor 54, alternate contact 55, conductor 56, alternate contact 57, and conductor 58 to ground at normal contact 42 of relay IR, which circuit is established upon each de-energization of the relay IR. The relay IR is de-energized and energized three times, due to the three impulses of current, but relays DR and RR remain energized during the rapid interruptions of the impulse relay IR, due to their slow-to-release construction, and thus the second set of impulses which constitute the second digit of the called number of the called subscriber at substation H is absorbed with no movement of the switch mechanism as make-before-break contact 53 is open, preventing the impulses from reaching primary magnet PM. After the last impulse of current, relay IR is again held in an energized position and contact 42 assumes its alternate position and the digit absorbing relay DR restores to normal. The calling subscriber at substation A now actuates his calling device to send four impulses of current, which bring about four de-energizations and energizations of relay IR. Upon the first de-energization of relay IR, its normal contact 42 is closed, thus establishing a series energizing circuit for the primary relay PR and the primary magnet PM, traced from battery, through the winding of the magnet PM, conductor 76, through the winding of the primary relay PR, conductor 77, the alternate contact 51, conductor 52, make-before-break contact 53 of relay DR, conductor 54, alternate contact 55, conductor 56, normal contact 57, and conductor 58 to ground at normal contact 42 of relay IR. The contact 42 of relay IR is closed and opened four times, due to the four impulses of current causing four energizations and de-energizations of the magnet PM, the said magnet PM stepping wipers 8, 9 and 10 in a primary direction to the fourth group of contacts leading to the four-hundred group of connectors.

The primary relay PR is held energized during the rapid interruptions of relay IR, due to its slow-to-release construction. Primary relay PR upon energization closes its alternate contact 78 establishing an energizing circuit for the secondary relay SR, the circuit being traced from battery through the winding of relay SR, conductor 79, alternate contact 80 of primary off-normal contacts PON, said primary off-normal contacts having assumed their alternate position upon the first step of the switch wipers

off-normal, conductor 81, alternate contact 78, conductors 82, 83 and 49 to ground at alternate contact 44 of relay RR. The closing of alternate contact 84 of relay SR closes a locking circuit for said relay SR, traced from battery, through the secondary relay SR, conductor 79, alternate contact 80 of primary off-normal contacts PON, conductor 81, alternate contact 84, conductor 85, normal contact 86 of secondary magnet SM, conductors 83 and 49 to ground at alternate contact 44 of relay RR. After the last impulse of current, relay IR remains energized and primary relay PR restores. The closing of normal contact 78 establishes an energizing circuit for the secondary magnet SM, the circuit being traced from battery, through the winding of magnet SM, alternate contact 87 of secondary relay SR, conductor 88 normal contact 78, conductors 82, 83 and 49 to ground at alternate contact 44 of relay RR. The secondary magnet SM upon energization steps the wipers 8, 9 and 10 into engagement with the first set of contacts 11, 12 and 13 and the opening of normal contact 86 of secondary magnet SM opens the locking circuit of secondary relay SR, which restores and should the first private contact 11 engaged by the private wiper 8 be busy, a ground potential will be found by the wiper 8, and a circuit is established for the secondary relay SR, traced from ground at the busy contact 11, through wiper 8, conductor 90, normal contact 91 of switching relay SW, conductors 92 and 93, normal contact 94 of secondary magnet SM, conductor 81, alternate contact 80 of primary off-normal contacts PON, conductor 79 and through the winding of secondary relay SR to battery. The secondary relay SR upon energization closes its alternate contact 87, establishing a circuit for the secondary magnet SM over a path as previously described. The secondary magnet SM upon energization steps the wipers 8, 9 and 10 into engagement with the second set of contacts 11, 12 and 13, and magnet SM energizing opens the circuit for the secondary relay SR at 94 and the secondary relay SR restoring opens the circuit for the secondary magnet SM at contact 87. If the second contact 11 is busy, secondary relay SR is again energized, bringing about the energization of magnet SM, and this see-saw action of the secondary relay SR and secondary magnet SM continues until an idle contact 11 is engaged, which is free from ground.

The circuit of relay SR is now maintained opened, thereby preventing further energizations of the secondary magnet SM.

An idle set of contacts 11, 12 and 13 having been engaged by the wipers 8, 9 and 10 of the second selector, an energizing circuit for the switching relay SW is established, traced from battery, through the secondary relay SR, conductor 79, alternate contact 80 of primary off-normal contacts PON, normal contact 94 of secondary magnet SM, conductor 93, through the winding of the switching relay SW, conductor 101, normal contact 102 of overrun contacts OR, conductors 83 and 49 to ground at alternate contact 44 of release relay RR. The switching relay SW is of comparatively high resistance, and the secondary relay SR being a relay of low resistance, the said relay SR fails to energize. The opening of normal contacts 36 and 37 of switching relay SW opens the energizing circuit of the interrupter relay IR, the relay IR restoring to normal. The opening of its alternate contact 42 interrupts the circuit of the release relay RR. The release relay RR upon restoration opens its alternate contact 44 to open the locking circuit for the digit absorbing relay DR′. The opening of alternate contact 44 of relay RR also opens the initial energizing circuit of the switching relay SW, but the relay RR being slow to release, the circuit of the switching relay SW is held momentarily closed until a substitute energizing circuit for the switching relay SW is established, as will presently be described. The second selector having seized the idle connector L, the energizing circuit for the line and interrupter relay IR′ is established, traced from battery, through the upper winding of the relay IR′, normal contact 100 of reversing relay RV, contact 12, wiper 9 to the calling substation, through the substation, back to wiper 10 contact 13, alternate contact 104 of reversing relay RV, and through the lower winding of relay IR′ to ground. Relay IR′ upon energization closes its alternate contact 105, establishing an energizing circuit for the release relay RR′, traced from battery, through the winding of the relay RR′, to ground at alternate contact 105 of relay IR′. The closing of alternate contact 106 of relay RR′ closes a substitute energizing circuit for the switching relay SW, traced from ground, through alternate contact 106, conductor 107, contact 11, wiper 8, conductor 90, alternate contact 91 of the switching relay SW, conductor 108, conductor 83, normal contact 102 of overrun contacts OR, through the winding of the switching relay SW, conductor 93 normal contact 94 of the secondary magnet SM, alternate contact 80 of primary off-normal contact PON, conductor 79, and through the winding of the secondary relay SR to battery. The switching relay SW is thus held energized until conversation is terminated and the connection released.

The subscriber at the calling substation A now actuates his calling device CD to send five impulses of current, which impulses de-energize and energize the line and

interrupter relay IR′ five times. On the first de-energization of relay IR′, an energizing circuit for secondary relay SR′ is established, traced from ground at normal contact 105 of relay IR′, through alternate contact 109 of relay RR′, through the winding of the secondary relay SR′, conductor 110, the winding of the primary magnet PM′ and through the side switch wiper 21 to battery. The relays RR′ and SR′ being slow acting do not de-energize in response to the rapid interruptions of the relay IR′, but the primary magnet PM′ being quick acting is responsive to the said impulses and steps wipers 14, 15 and 16 to the fourth level of the switch contacts. The secondary relay SR′ remains energized while the impulses are being sent. The closure of alternate contact 111 of relay SR′ establishes an energizing circuit for the private relay PV′, traced from battery, through the winding of the relay PV′, conductor 112 to ground at alternate contact 111 of secondary relay SR′. After the last impulse, the private relay PV′ de-energizes, having its circuit opened at alternate contact 111 of relay SR′. The said relay PV′ de-energizing brings about the stepping of the side switch wipers 20, 21, 22 and 23 to their second position to engage contacts 113, 114, 115 and 116. The side switch wiper 21 engaging contact 114 now places the secondary magnet RM′ in series circuit with the relay SR′.

The subscriber at the substation A next actuates his calling device CD to send six impulses, said impulses energizing and de-energizing the interrupter relay IR′ six times. Upon each de-energization of relay IR′, relay SR′ and secondary magnet RM′ are connected in series, the circuit being traced from battery, through the side switch wiper 21, contact 114, through the winding of secondary magnet RM′, conductor 117, normal contact 118 of the busy relay BR, conductor 119, through the winding of secondary relay SR′, alternate contact 109 of release relay RR′ to ground at normal contact 105 of interrupter relay IR′. The secondary magnet SM′ being a quick-acting relay is responsive to the quick interruptions of relay IR′ and steps the wipers 14, 15 and 16 to the sixth set of contacts of the fifth level, which are the contacts of the wanted line. The off-normal contacts ON′ assume their alternate position upon the first step of the switch wipers off normal. The relay PV′ again restores, having its circuit interrupter at contact 111 of the relay SR′. The de-energization of the said relay PV′ steps the side switch wipers 20, 21, 22, and 23 into their third position, engaging contacts 120, 121, 122 and 123. The wiper 21 engaging contact 121 closes an energizing circuit for the ringing relay RI traced from battery through the side switch wiper 21, contact 121, conductor 124, normal contact 125 of ringing control relay RCR, conductor 126, through the winding of the ringing relay RI, through the interrupter I to ground. The relay RI is energized and de-energized by the interrupter I to alternately connect and disconnect the ringing generator G at alternate contacts 127 and 128 of the relay RI to intermittently ring the call bell of the called-for substation H. When the party at substation H removes his receiver from the switch hook in response to the call, the reversing relay RV operates, the circuit being traced from battery, through the lower winding of relay RV, normal contact 129 of relay PV′, normal contact 128 of relay RI, wiper 16, contact 19, through the now closed contacts of the substation switch hook, back through contact 18, wiper 15, normal contact 127 of relay RI, normal contact 130 of relay PV′, to ground through the upper winding of the reversing relay RV. The operation of the reversing relay RV reverses the original battery flow through the calling substation A and the reversal of this battery current may be used for various purposes, as is well understood in the art. The operation of the reversing relay RV also closes the energizing circuit of the ringing control relay RCR, traced from battery, through the winding of the relay RCR, conductor 131, alternate contact 132 of relay RV, conductor 133, and wiper 20 to ground at the engaged contact 120. The energization of relay RCR opens the circuit of the ringing relay RI at its contact 125; the ringing relay RI remains de-energized, preventing further application of ringing current to the called subscriber's line. Relay RCR closes a locking circuit for itself traced from battery, through the winding of the said relay RCR, its alternate contact 134, over conductor 133, through wiper 20 to ground at contact 120, the said relay remaining locked up to prevent ringing current being connected to the called line when conversation is going on. The conversational circuit may be traced over the heavily marked conductors, the said conductors having the condensers K^2 and K^3 interposed.

When conversation has been completed, the subscribers at the substations A and H restore their respective receivers and the restoration of the switch hook at the called substation H brings about the de-energization of reversing relay RV again reversing the battery flow. The replacing of the receiver at the calling substation A opens the energizing circuit of impulse relay IR′ of connector L and the restoration of relay IR′ opens the circuit of release relay RR′ at contact 105. Release relay RR′ restoring to normal closes an energizing circuit for the release magnet RE′ traced from battery,

through the winding of magnet RE′, alternate contact 170 of off-normal contacts ON′, normal contact 109 of relay RR′ to ground at contact 105 of impulse relay IR′, which magnet RE′ upon energization restores the connector switch L. The opening of alternate contact 106 of relay RR′ removes ground from conductor 107 and private contact 11, opening the circuit of switching relay SW, and the said relay restoring closes its normal contact 57 closing a circuit for the release magnet RE traced from battery through the winding of relay RE, conductor 172, alternate contact 173 of primary off-normal contacts PON, conductor 174, normal contact 53 of relay RR, conductor 56, normal contact 57 of relay SW, conductor 58 to ground at normal contact 42 of relay IR. Magnet RE upon energization restores the switch J. The restoration of the first selector C at exchange X removes ground from the cut-off relay of individual switch B, which relay upon restoration restores the switch B. The apparatus used in establishing the connection is now at normal and is available for establishing other connections.

Assuming that the subscriber at the substation A has operated his calling device CD to send the last set of impulses, which are six in number, and that the called substation L is busy, a ground will be found connected to the engaged contact 17. The engaged ground closes an energizing circuit for the busy relay BR, traced from the battery, through the winding of the private relay PV′, conductor 112, make-before-break contact 136 of relay SR′, through the winding of the relay BR, make-before-break contact 137 of relay BR, conductor 138, contact 113, side switch wiper 20 and conductor 135 to ground through wiper 14 of the busy engaged contact 17. The last set of impulses, six in number, having been sent, and the busy line encountered by the connector wipers, it is seen that the private relay PV′ remains energized. The operation of the relay BR closes its alternate contact 140, establishing a locking circuit for itself, traced from battery, through the winding of relay PV′ conductor 112, contact 136, through the winding of relay BR, alternate contact 140, and conductor 141 to ground at alternate contact contact 142 of off-normal contacts ON′. The closing of alternate contact 143 connects the busy back apparatus BB′ over conductor 144, contact 116, side switch wiper 23, which is in its second position, and back to the calling substation, this busy signal notifying the calling subscriber that the called line is busy. The subscriber at substation A receiving the busy signal replaces his receiver and brings about the restoration of the apparatus, as before described.

A connection established between subscribers in exchange X is established by use of the local first, second, third selectors and connector switches in exchange X.

If it is found desirable, the extra relays may be duplicated in selector J, so that any desired number of digits may be absorbed. The selector switch J may also be used as a third or fourth selector, if found desirable, as is readily understood from the previous description.

While I have illustrated my invention operating in connection with a certain type of apparatus, it is to be understood that it is for the purpose of illustration only, and changes and modifications will readily suggest themselves to those skilled in the art, and I, therefore, aim to cover all such changes and modifications as come within the spirit and scope of the appended claims.

Having described my invention, what I claim as new and desire to secure by United States Letters Patent, is:

1. A telephone system including a subscriber's impulse-sending device for transmitting series of impulses, and automatic side-switchless switches responsive to said device, one of said automatic switches being provided with means for rendering ineffective one of said series of impulses of any number of impulses to maintain said one of said switches inert during the transmission of said one of said series of impulses and for operatively responding to another of said series of impulses to effect the operation of said one of said automatic switches.

2. A telephone system including a pair of subscriber's telephone lines, an impulse-sending device for one of said lines for transmitting series of impulses, and automatic progressively movable side-switchless switches responsive to said series of impulses for extending connection from one of said lines to the other, one of said automatic switches being provided with means for rendering ineffective one of said series of impulses regardless of the number of impulses of said one series to render said one of said automatic switches inert during the transmission of said one of said series of impulses.

3. A telephone system including a calling subscriber's line provided with an impulse-sending device for transmitting series of impulses, a called subscriber's line, an automatic selector switch responsive to a series of impulses for extending a connection from said calling subscriber's line towards the called subscriber's line, and a second automatic side-switchless selector switch, provided with electromagnetic means for rendering ineffective one of said series of impulses regardless of the number of impulses in said one series of impulses to render said second automatic selector inert during the transmission of said one of said series of impulses and for responding to another of said series

of impulses to render said second automatic switch operative to extend said connection from said first mentioned selector switch towards the called subscriber's line.

4. A telephone system including a central exchange, a calling subscriber's line terminating thereat, a called subscriber's line terminating in a second exchange, another called subscriber's line terminating in a third exchange, an automatic calling impulse-sending device at the calling substation for transmitting series of impulses, selector switches each responsive to a series of impulses for extending connection from said calling subscriber's line to said first called subscriber's line, and other side-switchless selector switches for extending connection from said calling subscriber's line to said second called subscriber's line, one of said latter selector switches being provided with means including a pair of slow-acting relays cooperatively associated for rendering ineffective one of said series of impulses regardless of the number of impulses in said one series to render said one of said latter selector switches inert during the transmission of said one series.

5. A telephone system including a central exchange, a calling subscriber's line terminating thereat, a called subscriber's line terminating in a second exchange, another called subscriber's line terminating in a third exchange, an automatic impulse-sending device at the calling substation for transmitting series of impulses, selector switches each responsive to a series of impulses for extending connection from said calling subscriber's line to said first called subscriber's line, other side-switchless selector switches for extending connection from said calling subscriber's line to said second called subscriber's line, one of said latter selector switches having electromagnetic means for rendering one of said series of impulses ineffective to render said one of said latter selector switches inert during the transmission of said one of said series of impulses and for responding to a series of impulses thereafter to render said one of said latter selector switches operative, an impulse relay, and a single slow-acting release relay for maintaining the operation of said electromagnetic means.

6. An automatic side-switchless selector switch provided with a movable contact adapted to be moved to a pre-determined position, impulse transmitting means for sending series of impulses, an impulse relay for said switch responsive to said series of impulses, and electromagnetic means comprising a pair of slow-acting relays and a slow-acting release relay in said automatic switch whereby said movable contact is not affected by one of said series of impulses but is affected by one of said series to be moved to its pre-determined position.

7. An automatic side-switchless selector switch provided with a movable contact, a motor magnet for said switch for controlling the movement of said contact, impulse transmitting means for supplying series of impulses to said selector switch, and electromagnetic means comprising a pair of slow-acting relays and a slow-acting release relay associated with said selector switch for rendering ineffective a certain one of said series of impulses whereby the said motor magnet does not move said movable contact from its normal position, said motor magnet however being responsive to another series of impulses to move said movable contact.

8. A side switchless selector switch provided with a movable contact, motor means for moving said contact, impulse generating means for supplying series of impulses to said selector switch, and electromagnetic means comprising a pair of slow-acting relays and a slow-acting release relay for absorbing one of said series of impulses whereby said movable contact remains inert and whereby said motor means responds to a subsequent series of impulses to actuate said movable contact.

9. A telephone system including a calling subscriber's telephone line and an automatic side switchless selector switch, a movable contact for said switch, impulse sending means at said calling subscriber's line for transmitting series of impulses to said selector switch, electromagnetic means for said selector switch responsive to one of said series of impulses but not operable to move said movable contact from its normal position and other electromagnetic means for said selector switch responsive to a series of said impulses for causing the operation of said movable contact to a pre-determined position.

10. A telephone system including a calling subscriber's line and an automatic switch provided with a line relay and a motor magnet, an interrupter at said calling subscriber's line for transmitting series of impulses to said line relay, and means including a pair of slow-acting relays for said switch operative when the first series of impulses is transmitted to said line relay by said interrupter to render said motor magnet unresponsive thereto and thus maintain said automatic switch inert and for rendering said motor magnet responsive to a subsequent series of impulses transmitted to said line relay to operate said automatic switch.

11. An automatic side switchless switch provided with a line relay adapted to be operated over the two sides of a circuit in

series, a stepping magnet for said switch, a device for interrupting said circuit, means including a pair of slow-acting relays and a slow-acting release relay in said switch whereby when said device interrupts said circuit a predetermined number of times said line relay does not operatively affect said stepping magnet to operate said automatic switch, and means whereby when said device interrupts said line relay at a subsequent time said line relay actuates said stepping device to operate said automatic switch.

12. A system of the character described including an automatic switch having a line relay, movable contacts for said automatic switch, a motor device for moving the said contacts of said automatic switch, an impulse transmitter for sending series of impulses to said line relay, means comprising a release relay and a pair of slow-acting relays for rendering said motor device unresponsive to one series of impulses transmitted to said line relay to maintain said automatic switch inert, and for rendering said motor device responsive to another series of impulses transmitted to said line relay to operate said automatic switch.

13. An automatic switch of the character described including a line relay, active contacts for said switch, a motor device for moving said active contacts, means for intermittently operating said line relay, and control means including a release relay and a pair of slow-acting relays for said switch whereby when said line relay is operated by the first operation of said first means the same does not operatively affect said motor device to move said active contacts, and for rendering said motor device responsive to a subsequent operation of said line relay by a subsequent operation of said first means to operatively affect said motor device to move said active contacts.

14. In a telephone system, a subscriber's line, a series of switches comprising group selectors, hundreds selectors, and connectors directively controllable by the subscriber on said line for connecting with a second line, a second series of switches comprising group selectors, thousands selectors, hundreds selectors, and connectors similarly controlled for connecting with a third line, automatic telephone numbers assigned to said lines all having the same number of digits, said hundreds selectors of said first series of switches provided with means for rendering one of said digits ineffective to prevent the movement of said hundreds selectors of said first series of switches when transmitting said digits to connect said first and second lines.

15. In a telephone system, a first line, a second line, means including a plurality of serially related directively controlled automatic switches for setting up a connection from said second line to said first line, means including a different number of similar switches for setting up a connection from said first line to said second line, means for operating said switches according to a uniform numbering arrangement such that said first line and said second line are both called by means of the same number of digits, one of said different number of similar switches provided with means for rendering one of said digits ineffective to prevent the movement of said one of said different number of similar switches when transmitting said digits to connect said first and second lines.

16. In a telephone system, a first line, a second line, means including a plurality of serially related directively controlled automatic switches for setting up a connection from any calling line to said first line, means including a smaller number of similar switches for setting up a connection from any calling line to said second line, means for operating said switches according to a uniform numbering arrangement such that said first line and said second line are both called by means of the same number of digits, one of said smaller number of similar switches provided with means for rendering one of said digits ineffective to prevent the movement of said one of said smaller number of switches when transmitting said digits to connect said first and second lines.

17. In a telephone system, a connector switch and a line accessible thereto, another similar connector and a second line accessible thereto, means including a plurality of serially related directively controlled automatic trunk selecting switches for setting up a connection from any calling line to said first line by way of the first mentioned connector, means including a different number of similar switches for setting up a connection from any calling line to said second line by way of the second mentioned connector, means for operating said switches according to a uniform numbering arrangement such that said first line and said second line are both called by means of the same number of digits, one of said different number of similar switches provided with means for rendering one of said digits ineffective to prevent the movement of said one of said different number of similar switches when transmitting said digits to connect said first and second lines.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 8th day of September, 1919.

SAMUEL SUEKOFF.