

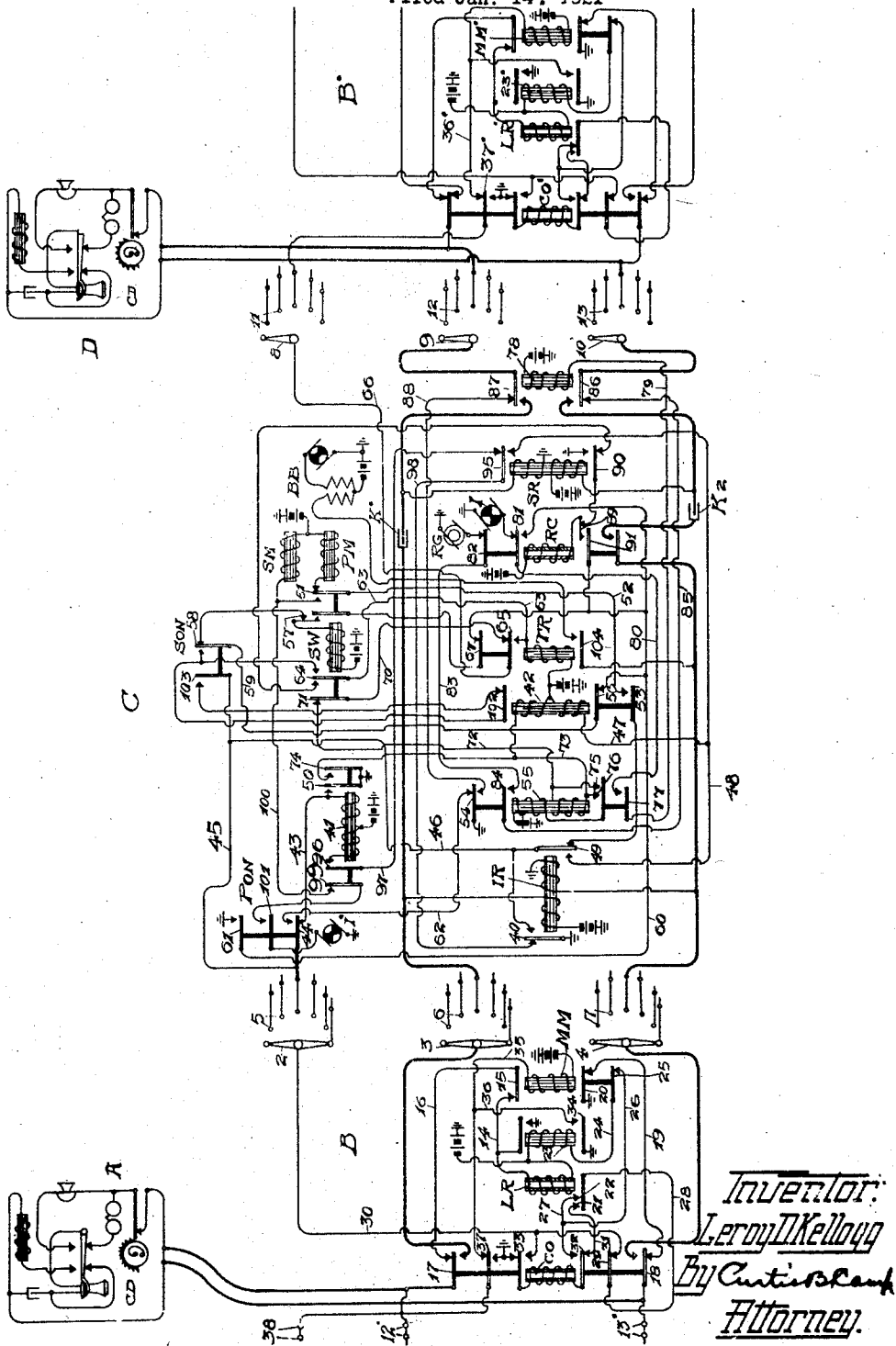
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L. D. KELLOGG

TELEPHONE SYSTEM

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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, LEROY D. KELLOGG, a citizen of the United States of America, residing at Deerfield, county of Lake, and State of Illinois, having invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with automatic or semi-automatic systems in which switches are used for connecting a calling line to an idle trunk, and an object of my invention is the provision of an improved arrangement which embodies desirable features and advantages, all in an efficient, simple, economical manner, and in which the switch of my invention is most positive in its operation.

Line switches or individual switches as now most generally used are provided with off-normal contacts which assume their alternate positions during a period of the operation of the switch to bring about circuit changes of the switch for the proper functioning of the same, and a feature of my invention is the provision of an individual switch in which no off-normal contacts are used and in which the circuit changes for the functioning of the switch are brought about entirely by simple relays, excluding all interlocking mechanism between relays or relays that close certain contacts on a partial energization and others on more complete energization.

Another feature of my invention is the provision of a switch of the non-restoring type, that is, one which remains in contact with terminals of the trunk last used when disconnection is effected, and which will again seize the trunk last used when a call is initiated, provided the trunk in the meantime has not been seized by another switch and is in use at the time the call is made.

Another feature of my invention is the provision of a switch with a positive drive circuit that does not permit the wipers of the switch to stop on busy contacts nor to pass over idle contacts. The non-restoring switch may be of the general type illustrated and described in patent to Harry H. Ide, No. 1,512,101, issued Oct. 21, 1924.

The novel features of the invention through the provision of which the above-mentioned and other advantageous results

are attained will be described by reference to the accompanying drawing, in which I illustrate diagrammatically an automatic telephone system including the line switch of my invention.

Referring now more in detail to my invention as illustrated in the accompanying drawing, to the left thereof I illustrate a calling substation A which includes the usual talking equipment, with the addition of a calling device CD. The calling substation A connects at the exchange with the line switch B of my invention, comprising a rotary shaft which carries the test or private 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, and a cut-off relay CO is also provided which is energized when an idle trunk is seized to extend the connection from the calling substation to the seized trunk. The motor magnet MM, through the agency of a ratchet and pawl mechanism steps the shaft in a rotary direction to advance the wipers 2, 3 and 4 over contacts 5, 6 and 7 upon the back stroke of the pawl of the motor magnet MM, as is well understood.

The connector C comprises an impulse relay IR, which relay IR is energized over the line when an idle connector as C is seized and is de-energized and energized by impulses from the calling substation A to bring about the primary movement of the wipers 8, 9 and 10 through the agency of the primary magnet PM. A switching relay SW is provided which, when energized, connects the secondary magnet SM to be acted upon by impulses to step the wipers 8, 9 and 10 in a secondary direction over contacts 11, 12 and 13 to engage the contacts of the called line. A test relay TR is provided which tests the called line as to its idle or busy condition, and when busy connects a suitable busy tone from the busy back apparatus BB to notify the calling subscriber of the busy condition of the called line. A ringing control relay RC is provided which connects the ringing generator RG and interrupter I in circuit to intermittently apply ringing current to the called line, when the said line is idle. A relay SR is also provided which is energized when the subscriber at the called substation answers. Primary off-normal contacts PON are provided which assume their alternate position

upon the first step of the wipers 8, 9 and 10 in a primary direction, and secondary off-normal contacts SON are also provided which assume their alternate position upon the first step of the wipers 8, 9 and 10 in a secondary direction.

To the right of the drawing I illustrate a called substation D similar to the calling substation A and connecting at the exchange with a line circuit B' similar to that of B.

Having described in general the apparatus as illustrated in the accompanying drawing, I will now describe in detail the operation of the system including the individual line switch of my invention.

Assuming now that a call is to be traced from the calling substation A to the called substation D, upon the removal of the receiver by the subscriber at the calling substation A, line relay LR of the individual line switch B energized over a circuit traced from battery through the winding of line relay LR, conductor 14, normal contact 15 of motor magnet MM, conductor 16, normal contact 17 of cut-off relay CO, through the substation A, back through normal contact 18 of cut-off relay CO, conductor 19 to ground at normal contact 20 of the motor magnet MM. Wipers 2, 3 and 4 always rest upon the set of contacts 5, 6 and 7 last used, and assuming that the contacts upon which the wipers now rest are busy due to another subscriber's line circuit having selected the connector last used by the subscriber A, the private contact 5 will be grounded. Energized line relay LR closes its contacts 21 and 22, establishing an energizing circuit for the relay 23, traced from battery through the winding of relay 23, conductor 24, normal contact 25 of motor magnet MM, conductors 26 and 27, alternate contact 22 of line relay LR, conductor 28, normal contact 29 of cut-off relay CO, conductor 30 and wiper 2 to the engaged grounded busy contact 5. The cut-off relay CO is shunted when the wiper 2 is engaging a busy grounded contact 5, the said shunt being traced from ground at the busy contact 5, wiper 2, conductor 30, normal contact 29 of cut-off relay CO, conductor 28, alternate contact 21 of line relay LR, conductor 31, normal contact 32 of cut-off relay CO, through the winding of cut-off relay CO to ground at normal contact 33 of relay CO. A circuit also extends through relays 23, and CO from battery through the winding of relay 23, over conductor 24, normal contact 25, conductors 26 and 27, alternate contacts 22 and 21, conductor 31, normal contact 32 of relay CO, through the winding of relay CO to ground at normal contact 33 of relay CO. This circuit just traced has no energizing effect on the cut-off relay CO at this time due to the shunt about said relay CO as above traced, but when an idle contact 5 is engaged by the wiper 2, the relay CO will energize over

the above traced circuit, as will be more fully hereinafter described, because the engaged contact 5 will not be grounded.

The relay 23 upon energization closes its alternate contact 34, establishing an energizing circuit for the motor magnet MM, traced from battery through the winding of the motor magnet MM, conductors 35 and 36, to ground at alternate contact 34 of relay 23. The motor magnet MM, upon energization, opens its normal contact 25, thus opening the energizing circuit of the relay 23, and the relay 23 upon de-energization opens its alternate contact 34 to open the energizing circuit of the motor magnet MM, and the motor magnet MM upon de-energization steps the wipers 2, 3 and 4 into engagement with the next set of contacts 5, 6 and 7. Should the contacts now engaged by the wipers be busy, relay 23 will again be energized over the previously described path, and the said relay 23 in turn will again close a circuit through the motor magnet MM, as before described. The relay 23 and motor magnet MM are thus alternately energized and de-energized, the motor magnet MM stepping the wipers 2, 3 and 4 from one set of contacts 5, 6 and 7 to the next, as long as busy, i. e., grounded, contacts are encountered. Magnet MM alternately opens and closes contact 25, and thus a vibratory circuit is closed through the winding of relay CO, as before described, but due to the shunt about relay CO, as before described, the cut-off relay CO at this time remains inert. The ground at alternate contact 34 of relay 23 extending over conductors 36 and 35 through normal contact 37 of relay CO to the calling line's private normal contacts 38 at the connectors having access to it to render such contacts busy against selection. This ground will be of a vibratory character, and I accordingly so construct the test relay TR of the connector to be somewhat slow to release its armatures. Consequently, the calling line will test busy while its line switch travels, as will be understood from the general operation of the connector C. The motor magnet MM alternately opens and closes its normal contacts 15 and 20 during the selecting operation of the switch B, interrupting the energizing circuit of the line relay LR, but due to the slow-to-release construction of the line relay LR it is not affected by the rapid interruptions of motor magnet MM.

When an idle private contact 5 is encountered by the wiper 2, the relay 23 and motor magnet MM remain unoperated, because the private contact 5 now engaged is free from ground and the shunt about cut-off relay CO is removed and the circuit from battery through the windings of relays 23 and CO to ground at normal contact 33 of relay CO, as before described, allows the cut-off relay CO to energize, but the

relay 23 does not energize over this circuit on account of the resistance of relay CO and remains inert. The relay CO upon energization opens its normal contacts 29 and 33 and thus opens its initial energizing circuit, but the said relay CO being slow to release is held up momentarily until a substitute circuit is established for it, as will presently be described. The relay CO also upon energization shifts its contacts 17 and 18, opening the energizing circuit of the line relay LR, which now restores to normal, and the relay CO, also closes its alternate contact 37, connecting ground to the contacts 38, keeping them busy until the termination of the conversation.

Should the substation A be sized as a called line by a connector engaging contacts 38, 12' and 13', ground will be extended to the private contact 38 from the connector, as will be more fully hereinafter described, and this ground extends from the contact 38 through normal contact 37 of relay CO, conductor 35, to battery through the winding of motor magnet MM. The motor magnet MM energizes and opens its normal contacts 15 and 20 so that when the subscriber at the substation A removes his receiver from the switch-hook as a called line, no energizing circuit for the line relay LR is established and the motor magnet MM, upon energization, thus removes the substation control of the line switch B when the line is a called line. Upon release the motor magnet MM deenergizes and as the motor magnet MM advances the wipers upon its back stroke they are stepped into engagement with the next set of contacts.

The relay CO having energized, its contacts 17 and 18 assume their alternate positions, the wipers 2, 3 and 4 of the individual switch B are now connected to the contacts 5, 6 and 7 of the idle connector C, thus extending the calling line to the seized idle connector C. A circuit is established for the impulse relay IR of the connector C, traced from battery through left-hand winding of relay IR, contact 6, wiper 3, alternate contact 17 of relay CO, through substation A, back through alternate contact 18 of relay CO, wiper 4, contact 7, to ground through the right-hand winding of relay IR. The closing of alternate contact 40 of the impulse relay IR establishes an energizing circuit for the relays 41 and 42, the circuit of relay 41 extending from battery through the right-hand winding of relay 41, conductor 43, normal contact 44 of primary off-normal contacts PON, conductors 45 and 46, to ground at alternate contact 40 of relay IR. The circuit of relay 42 extends from battery through the lower winding of relay 42, conductors 47 and 48, alternate contact 49 of relay IR

to ground at alternate contact 40 of relay IR. The relay 41 upon energization closes a locking circuit for itself, traced from battery through the right-hand winding of relay 41 to ground at its alternate contact 50 of relay 41. The closing of alternate contact 40 of relay IR establishes a substitute energizing circuit for the relay CO of the line switch B before it had time to deenergize, which may be traced from battery through the winding of relay 23, conductor 24, normal contact 25 of motor magnet MM, conductor 26, alternate contact 32 of relay CO, through the winding of relay CO, its alternate contact 33, conductor 30, wiper 2, contact 5, conductors 45 and 46 to ground at alternate contact 40 of the impulse relay IR. Relay 23 does not operate over this circuit for reasons as before described.

If the private contact 5 engaged by the wiper 2 is idle when the subscriber initiates a call, the line relay LR is energized, as before described, and operates to close its alternate contacts 21 and 22. There being no ground on the private contact 5, no shunt will be closed about the relay CO, as before described, and relay 23 will not energize, and in remaining inert its alternate contact 34 remains open and therefore no energizing circuit is established and motor magnet MM does not energize and the wipers 2, 3 and 4, therefore, remain in engagement with the contacts 5, 6 and 7, that were last used by the switch B in establishing a connection. The cut-off relay CO, is, therefore, immediately energized from battery through relay 23 and winding of relay CO to ground at normal contact 33, as before described, and the operation of the circuit from this point on is the same as above described. Thus, the switch only travels when its wipers 2, 3 and 4 are in engagement with a busy trunk when a call is initiated.

The energization of relay IR having brought about the energization of relays 41 and 42, as already described, assuming that the called subscriber's number at substation D is 45, the subscriber A now operates his calling device CD to send four impulses of current over the line. These four impulses bring about four de-energizations and energizations of the relay IR, causing the primary magnet PM to energize and de-energize four times to step the wipers 8, 9 and 10 in a primary direction to the fourth group of contacts, that group containing the contacts of the called line. The circuit of the primary magnet PM may be traced from battery through the winding of the said magnet, normal contact 51 of switching relay SW, conductor 52, alternate contact 53 of relay 42, normal contact 49 of re-

lay IR, conductor 46, conductor 45, and normal contact 44 of the primary off-normal contacts PON, conductor 43 to ground at alternate contact 50 of relay 41.

- 5 After the primary off-normal contact 44 has moved on the first step of the switch shaft, the ground fed from normal contact 54 of relay 55 is substituted for the ground fed through contact 50 of relay 41. After
10 the last impulse of the series has been sent, the steady flow of current through both windings of relay 42 causes the said relay 42, due to its differential action, to neutralize and restore its contacts to normal. Relay
15 42 does not restore during the sending of impulses due to its adjustment, construction, and the rapidity of the interruptions of contact 49. It will be noted that the relay when first energized had its upper winding immediately energized by contact 50 of relay 41,
20 and was in a neutral condition with its armatures retracted when relay IR sent the first impulse, but immediately energized when relay IR opened the circuit through the lower winding of relay 42. The closing
25 of normal contact 56 of relay 42 brings about the energization of the switching relay SW, by current traced from battery through the winding of said relay SW, its
30 make-before-break contact 57, normal contact 58 of secondary off-normal springs SON, conductor 59, normal contact 56 of relay 42, and conductor 60 to ground at alternate contact 61 of primary off-normal
35 contacts PON, the said primary off-normal contacts PON having been moved to their alternate position on the first step of the wipers 8, 9 and 10 of the connector switch. The closing of alternate contact 51 of the
40 switching relay SW now renders the secondary magnet SM operative so that when the calling subscriber at the substation A actuates his call device to send the last set of impulses, which we have assumed are five
45 in number, the said magnet SM will be energized and de-energized by the impulse relay IR five times over a circuit traced from battery through the winding of the said magnet SM, alternate contact 51 of relay
50 SW, conductor 52, alternate contact 53 of relay 42, normal contact 49 of relay IR, conductor 46, conductor 45, and alternate contact 44 of the primary off-normal contacts PON and conductor 62 to ground at normal contact 54 of relay 55. The secondary
55 magnet SM now steps the wipers 8, 9 and 10 in a secondary direction to engage contacts 11, 12 and 13 of the called line. Upon the first impulse of the last set, the
60 relay 42 again energizes to permit the secondary magnet SM to be operated, and after the last impulse the relay 42 is again de-energized, as previously described. The restoration of the relay 42 closes a circuit
65 for the test relay TR, traced from battery

through the winding of the said relay, conductor 63, the alternate contact 64 of relay SW, alternate contact 58 of the secondary off-normal contacts SON, (said contacts having been moved to their alternate position upon the first step of the wipers in their secondary direction), conductor 59, normal contact 56 of relay 42; conductor 60 to ground at alternate contact 61 of the primary off-normal contacts PON. The closing
70 of alternate contact 65 of relay TR connects the said relay over conductor 66 to the test wiper 8, and should the called line be busy the private contact 11 of the called line would be grounded, thus closing a locking
75 circuit for the said relay TR through the private wiper.

Called line idle.

Assuming that the called line is idle,
85 private contact 11 of the called line will have a battery potential upon it, and the relay TR will not remain energized but will de-energize. The opening of normal contact 67 of relay TR opened the circuit of
90 the switching relay SW. The relay SW de-energizing, opens the circuit for relay TR at its contact 64, leaving the relay TR dependent upon the potential found upon the private contact 11 of the called line for its
95 holding potential, and, as assumed, this contact is free from ground potential; therefore, the relay TR de-energizes and returns to normal. The relay TR de-energizing causes the energization of the relay 55 over
100 a circuit which may be traced from battery through the motor magnet MM' of the line switch B' of the called line, conductor 36', normal contact 37' of relay CO', to bank contact 11, through wiper 8, conductor 66,
105 normal contact 65 of relay TR, conductor 70, normal contact 71 of relay SW, conductor 72, through the lower winding of the relay 55, and conductor 73 to ground at alternate contact 74 of relay 41. The closing
110 of alternate contact 75 of relay 55 short-circuits the lower winding of the said relay, and the closing of alternate contact 76 of relay 55 closes a circuit through the upper winding of the said relay, through
115 the alternate contact 76 and conductor 73 to ground at alternate contact 74 of relay 41. The motor magnet MM' of the line switch B' associated with the called line is energized over this circuit and remains
120 energized until conversation has terminated.

The closing of alternate contact 77 of relay 55 connects the interrupter I to the relay 78. The circuit for relay 78 may be
125 traced from battery through the winding of the said relay 78, conductor 79, alternate contact 77 of relay 55, conductor 80, normal contact 81 of relay RC and through the interrupter I to ground. The relay 78 is thus intermittently energized and de-ener-
130

gized by the rotating interrupter I, and upon each de-energization of the relay 78 the ringing generator RG is connected to the called line over a circuit extending from the ungrounded pole of the generator RG, through normal contact 82 of ringing control relay RC, conductor 83, alternate contact 84 of relay 55, conductor 85, normal contact 86 of relay 78, wiper 10, bank contact 13, through the condenser and call bell of the called substation D, back through bank contact 12, wiper 9, normal contact 87, of relay 78, and conductor 88 to ground at alternate contact 54 of relay 55.

The call bell of the called subscriber at the substation D is thus intermittently rung, due to the energization and de-energization of the relay 78 by the interrupter I. When the called subscriber answers and the relay 78 is in its energized position, a circuit for the relay SR is closed, which may be traced from battery through the lower winding of the relay SR, through alternate contact 86 of relay 78, wiper 10, contact 13, through the now closed contacts of the substation switch-hook at the called substation D, back through contact 12, wiper 9, alternate contact 87 of relay 78, and through the upper winding of the relay SR to ground. The relay SR, upon energizing, closes an energizing circuit for the ringing control relay RC, which may be traced from battery through the winding of the said relay RC, its make-before-break contact 89 to ground at alternate contact 90 of relay SR. The closing of alternate contact 91 of relay RC closes a locking circuit for the said relay which may be traced from battery through the winding of said relay, its alternate contact 91 and conductor 60 to ground at alternate contact 61 of the primary off-normal contacts PON. The opening of normal contacts 81 and 82, upon the energization of relay RC, disconnects the interrupter I and the ringing generator RG to prevent further application of ringing current. A substitute circuit for the relay 78 is now established which may be traced from battery through the winding of the relay 78, conductor 79, alternate contact 77 of relay 55, conductor 80, alternate contact 81, of relay RC, and conductor 60 to ground at alternate contact 61 to primary off-normal contacts PON. The subscribers are now in conversational circuit, and the talking circuit may be traced over the heavily marked conductors, said conductors having the condensers K' and K² interposed.

The subscribers having finished conversation, and assuming that the subscriber at the called substation A is first to replace his receiver upon the switchhook, the opening of the switch hook contacts brings about the de-energization of the impulse relay IR of the connector C. The restoration of the

relay IR brings about the opening of the holding circuit of the relay CO of the individual switch B, which relay CO restores and places the individual switch B, in condition to be used in establishing another connection.

The subscriber D restoring his receiver upon its switchhook interrupts the circuit of the relay SR at the switchhook contacts, causing the said relay to de-energize. The closing of normal contact 95 of relay SR closes a circuit through the left-hand winding of the relay 41, which may be traced from battery through the left-hand winding of the said relay 41, alternate contact 96 of relay 41, conductor 97, normal contact 95 of relay SR and conductor 98 to ground at normal contact 40 of relay IR. Due to the differential construction of relay 41, the said relay neutralizes and restores to normal. The closing of normal contact 99 of relay 41 closes an energizing circuit for the secondary magnet SM, which may be traced from battery through the winding of said secondary magnet SM, conductor 100, normal contact 99 of relay 41, alternate contact 101 of the primary off-normal contacts PON, through the interrupter I' to ground. The secondary magnet SM thus steps the wipers 8, 9 and 10 beyond the last set of contacts in the group and the wipers then restore to normal from this position by spring tension. The restoration of the relay 41 brings about the opening of the circuit of the relay 55 at alternate contact 74, and the relay 55 restoring opens the circuit of relay 78 at contact 77 of relay 55, and the primary off-normal contacts PON having restored, upon the restoration of the switch, the opening of the alternate contact 61 of PON brings about the de-energization of the relay RC. The relay 41 also brings about the de-energization of the motor magnet MM' of the line switch B' which is associated with the called subscriber D, and magnet MM' upon release steps the wipers of the switch B' into engagement with the next set of contacts of the switch B', and they rest there whether or not the contacts are busy. All three wipers of switch B are at this time on open circuit. All the apparatus used in establishing a connection between a calling subscriber at the substation A and the called subscriber at the substation D is now at normal and available for use in establishing other connections.

Assuming now that the subscriber at the called substation D was first to replace his receiver upon the switchhook, the opening of the switchhook contacts at the substation D brings about the de-energization of the relay SR. Nothing else happens at this time as the relay IR is still maintained energized over the line of the calling substation A. The calling subscriber at the

substation A replacing his receiver interrupts the circuit of the impulse relay IR at the switchhook contacts. The relay IR de-energizing closes a circuit for the left-hand winding of relay 41, causing the said relay to de-energize, as hereinbefore described. The restoration of the individual switch B and connector C is the same as previously described from this point on. Should the called subscriber D fail to replace his receiver upon the switchhook after the conversation is terminated, the replacing of the receiver at the substation A brings about the de-energization of the impulse relay IR of connector C, the same as before, and the opening of alternate contact 40 of impulse relay IR opens the circuit of the relay CO of individual switch B as before described, and causes the release of switch B.

The subscriber at the called substation failing to replace his receiver, permits the continued energization of the relay SR, this holding the contact 95 of said relay in its alternate position, preventing the differential wound relay 41 from restoring to normal and closing the energizing circuit for the secondary magnet SM. The relay 42 energizes when the line relay IR drops back but is immediately restored to normal due to the closure of an energizing circuit through the lower winding of the said relay 42, which may be traced from battery through the said lower winding, conductor 47, alternate contact 95, connector 98, to ground at normal contact 40 of the now restored impulse relay IR. Relay 42 being differentially wound, restores to normal, and the closing of normal contact 102 of the said relay 42 places a ground upon the private contact of the connector C over a circuit which may be traced from ground at alternate contact 61 of the primary off-normal contact PON, conductor 60, normal contact 56 of relay 42, conductor 59, alternate contact 58, normal contact 102, alternate contact 103 of the secondary off-normal contacts SON, to the private contact 5. The placing of this busy potential upon the private contact prevents any individual switch B from engaging the contacts of this busy connector.

Called line busy.

Assuming now that the called line is busy, the operation of the circuit is the same up to and including the time that the relay TR momentarily energizes. The line being busy, the private contact 11 has a busy potential placed upon it, thus closing a locking circuit for the test relay TR from battery through the winding of the said relay, its alternate contact 65, conductor 66, and the wiper 8 to ground at contact 11. The closing of alternate contact 104 of the test relay TR connects the busy signal

BB to the line to transmit a busy signal to said calling subscriber at substation A, thus notifying him of the busy condition of the said called substation D. The relay TR upon locking up to ground at the private contact 11, closes a circuit for relay RC, traced from battery through the winding of relay RC, make-before-break contact 89, normal contact 90 of relay SR, normal contact 64 of relay SW, conductor 63, alternate contact 65 of relay TR, and conductor 66 to the grounded private contact 11. The relay RC thus closes a locking circuit for itself, traced through the winding of said relay RC, alternate contact 91, conductor 60 to ground at alternate contact 61 of the off-normal contacts PON. Now, should the line called become idle during the time the busy signal is being transmitted to the calling substation, the falling back of relay TR will not cause the called subscriber to be signaled owing to the fact that relay RC is locked up to ground at contact 61. The calling subscriber now replaces his receiver, bringing about the de-energization of the impulse relay IR. The relay IR restoring, opens the circuit of the relay CO of the individual switch B to place the switch in condition for establishing other connections as previously described. The relay IR de-energizing brings about the restoration of the relay 41, due to the fact that the relay SR has not been energized. The closing of the circuit through the left-hand winding of the circuit 41 brings about the neutralization of the said relay 41. The closing of normal contact 99 of the said relay 41 closes a circuit through the secondary magnet SM, which magnet steps the wipers 8, 9 and 10 beyond the last set of contacts. The wipers then restore to normal by spring tension. The primary off-normal contacts PON and secondary off-normal contacts SON are also restored, and the apparatus used in this busy connection is now at normal and available for use in establishing other connections.

While I have shown a system of 100 capacity, it is to be understood that by inserting first selectors, the system may be increased to a 1000 system, etc.

It is to be understood that I do not wish to be limited to the exact matters as shown, as various other arrangements may readily suggest themselves to one skilled in the art. Therefore, I desire to cover all such changes and modifications as come within the spirit and scope of the appended claims.

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

1. A telephone line having an automatic non-restoring selecting switch including a line relay and a travel controlling magnet energized responsive to said relay, means

controlled by said magnet to disconnect said relay from the line when connected to as a called line, and another relay for controlling contacts in the circuits of said line relay and said magnet.

2. A telephone line having an automatic non-restoring switch and a line relay to render the stepping magnet of said switch active to select an idle trunk line, contacts of said magnet in the circuit of said relay, connections to actuate said magnet when the line is called to disconnect said relay, and another relay for controlling contacts in the circuits of said line relay and said magnet.

3. A telephone line having an automatic selecting switch, a relay energized by current over said line to set up travel of said switch in search of an idle trunk, private contacts engaged by said switch and a pair of electromagnets their windings connected together and in series with a source of current, one terminal of said source connected to busy contacts only and between said windings when said switch engages such contacts to short circuit one of said windings, the short-circuited magnet energizing when the short circuit ends, talking contacts controlled by said magnet, and a motor magnet for effecting the travel of said switch, said motor magnet controlled by said electromagnets.

4. A telephone line having an automatic selecting non-restoring switch, and a line relay for energization to initiate travel thereof, a driving magnet for effecting travel of said switch, private contacts successively engaged by said switch in its travel, a relay for said switch in series with battery during travel but short-circuited by a terminal of said battery connected to busy contacts engaged by said switch, the engagement of an idle contact ending such short circuit and actuating said relay, means controlled by said relay on energization to connect its winding to the idle contact and lock itself thereover and talking circuit contacts controlled by said relay, another relay for said switch, said driving magnet controlling a contact in the circuit of said last relay, and said last relay controlling a contact in the driving circuit of said driving magnet, said last relay and said driving magnet energizing and de-energizing alternately in effecting travel of said switch.

5. A telephone line having a selecting switch and a line relay, a travel controlling magnet for the switch having contacts actuated to disconnect the line relay when connection is made to said line as a called line, and another relay having contacts to disconnect said line relay when the line is a calling line, said magnet adapted to drive said switch in its progressive direction.

6. In an automatic telephone system a

line having an automatic switch, a motor magnet for operating said switch when a call is extended from said line and, also operable to prevent the operation of said switch when said line is connected to as a called line, and means for releasing said switch at the end of conversation by causing it to step into engagement with the adjacent contact set.

7. A telephone line having an automatic switch, and a relay energized when the line is a calling line and its switch is engaging idle contacts, switching contacts of said relay actuated on energization to break the normal connections of both its windings' terminals, and a locking circuit controlled by said relay.

8. In an automatic line switch for telephone systems or the like, a stepping magnet, a telephone line, means controlled by said magnet for intermittently applying a busy potential to terminals of said line, a test terminal adapted to be applied to said first terminals, and a sluggish test relay connected to said test terminal.

9. In a line switch for telephone lines, contact wipers for said switch, a stepping magnet for moving said wipers, said magnet being in a circuit organization such that its armature contacts cut off the line wires when the line is called without effecting the movement of said wipers.

10. In a non-restoring line switch for telephone lines having a stepping magnet, a "line cut on" relay, a line relay having its normal circuit through a back contact of said stepping magnet, and through a back contact of said "line cut on" relay.

11. In a non-restoring line switch for telephone lines, a line relay and a stepping magnet having their circuits connected through contacts of a "line cut on" relay, and means including a relay in circuit in series with said "line cut on" relay for short-circuiting said last relay while the switch is traveling and also for controlling the operating circuit of said stepping magnet.

12. A line switch for telephone lines having a stepping magnet serving also as a line cut off relay when the line is called, contact wipers for said switch adapted to be operated by said magnet but not affected by said magnet when the line is called, a "line cut-on" relay for extending said line toward the calling line, means including circuit connections to short-circuit said last relay while the switch travels and to energize it when the switch stops, and a line relay for controlling the initial travel of said switch when the line is calling, said stepping magnet controlling the initial energizing of said line relay.

13. A non-restoring switch for automatic telephone systems having a line relay to

initiate travel of said switch, a driving magnet for driving said switch, a second relay short-circuited during travel of the switch, its short circuit including a contact of the line relay and a contact of said driving magnet, said driving magnet also controlling contacts in the circuit of said line relay, and means for energizing said second relay when the switch stops.

14. An automatic non-restoring line switch for an automatic telephone system including a line relay, a circuit for said line relay, an electromagnet that cuts said line

relay off intermittently during the operation of said switch in extending a call, a "line cut on" relay that cuts said relay off continuously when the call is extended beyond said switch, said electromagnet rendering both said line relay and said "line cut on" relay inoperable when the line associated with said switch is connected to as a called line.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 12th day of January, 1921.

LEROY D. KELLOGG.