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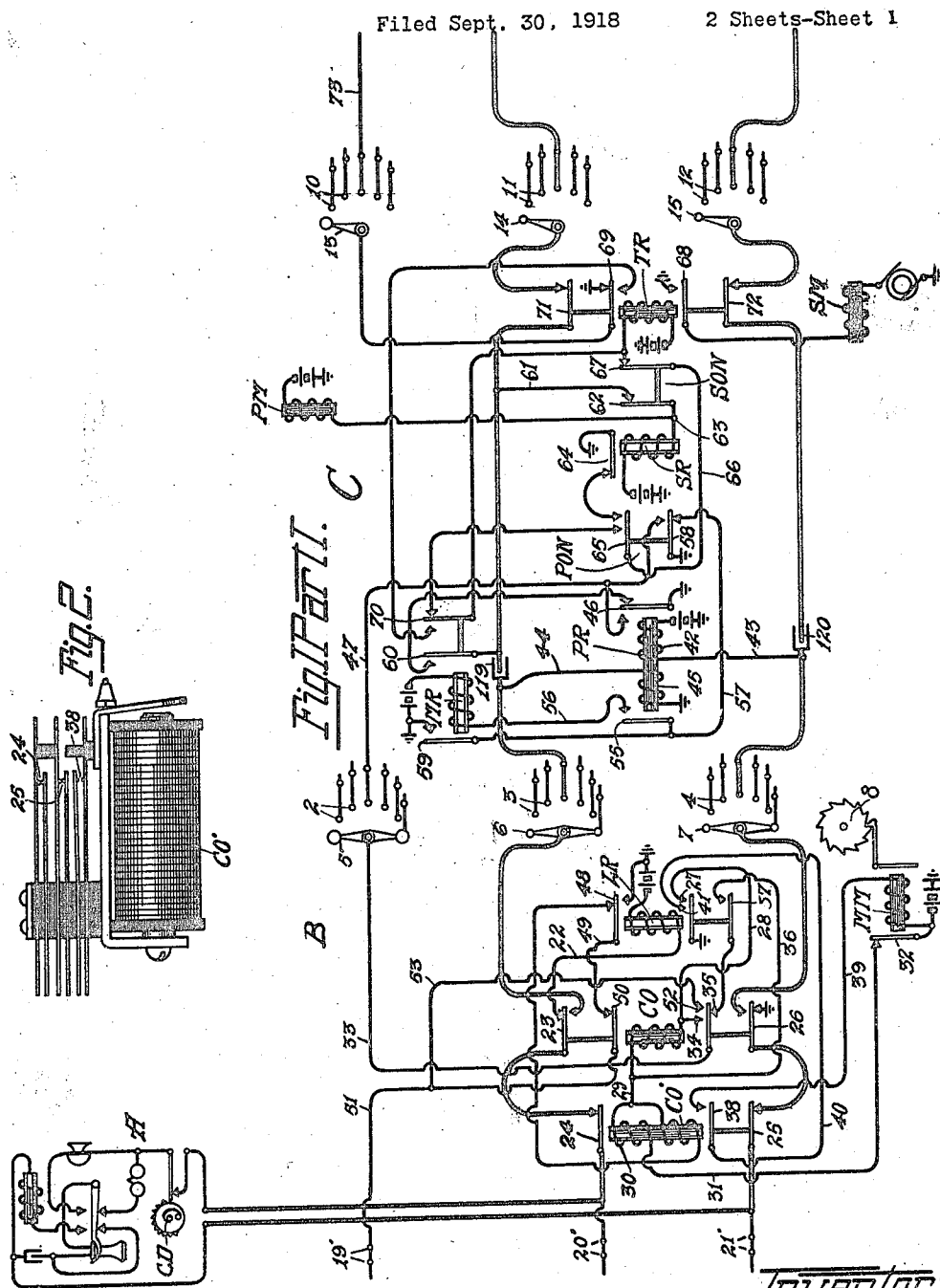
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G. A. YANOCHOWSKI

TELEPHONE SYSTEM

Filed Sept. 30, 1918

2 Sheets-Sheet 1



Inventor:

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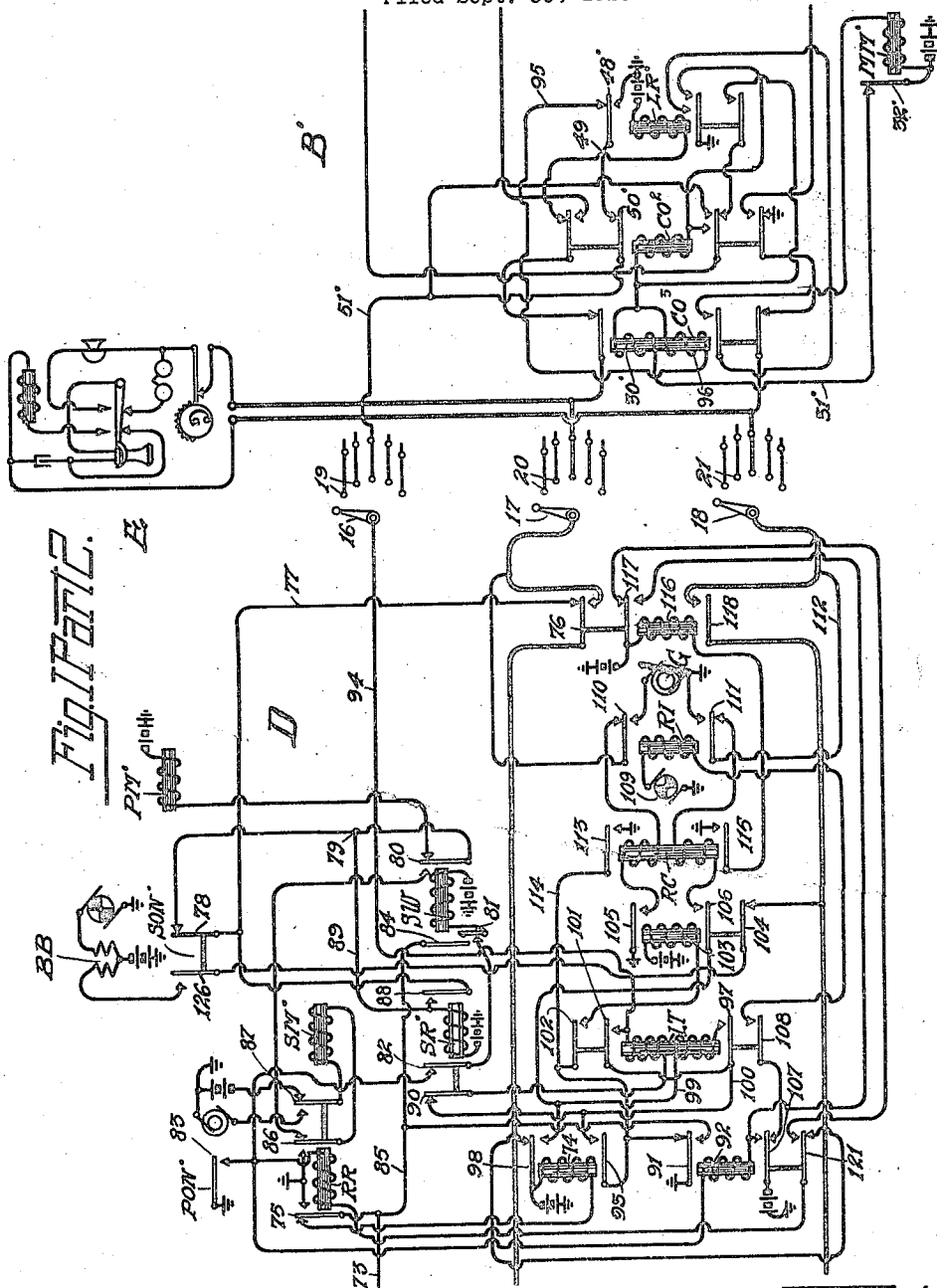
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TELEPHONE SYSTEM

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE.

GEORGE A. YANOSCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

TELEPHONE SYSTEM.

Application filed September 30, 1918. Serial No. 256,175.

To all whom it may concern:

Be it known that I, GEORGE A. YANOSCHOWSKI, a citizen of the United States of America, residing in Chicago, 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 and has to do more particularly with automatic telephone systems of the two-wire type in which the switches are controlled over the two sides of the calling line in series.

An object of my invention is the provision of an improved non-numerical or line switch for use in such systems as above described.

A feature of my invention is the reduction of the number of magnets, relays and switch contacts required for a switch of the non-restoring type, that is, a switch of the type which remains in contact with the last trunk used when disconnection is desired, 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 in use at the time the call is made.

Another feature of my invention is the provision of a switch of the above-described type which is not provided with any interlocking mechanical parts.

A still further feature of my invention is the provision of a switch of this type which is provided 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.

And a still further feature of my invention is the novel details of construction, parts, and combination of parts.

For a better understanding of my invention, reference may be had to the accompanying drawings which illustrate diagrammatically the apparatus used in establishing a connection between a calling and a called subscriber's line, and in which,

Fig. 1, which includes Parts 1 and 2, illustrates diagrammatically the circuit arrangement embodying my invention, and

Fig. 2 illustrates a combined test and cut-off relay, associated with the line switch.

Referring now more particularly to the system as shown in Fig. 1, which includes Parts 1 and 2, the substation A comprises

the usual substation apparatus, and in addition includes a calling device CD. The substation A is connected by the two line limbs, as shown, to the individual line switch B.

The individual line switch B of my invention is preferably a ten-point rotary switch, comprising ten sets of contacts 2, 3 and 4 circularly disposed in a well-known manner. However, it is to be understood that the switch may have any desired number of sets of bank contacts. The switch is provided with wipers 5, 6 and 7 for cooperation with said bank contacts. Each wiper is preferably arranged with two oppositely extending arms, while the associated contacts are so disposed with relation to these arms that when the wiper is positioned as illustrated, one step thereof will cause the lower wiper arm to leave the last contact of the bank as the upper arm engages the first contact of this bank. Wipers 5, 6 and 7 are secured to a single shaft, which shaft carries a ratchet wheel 8 that is adapted to be actuated by the pawl mechanism controlled by the motor magnet MM. For each actuation of motor magnet MM, ratchet wheel 8 is stepped ahead one tooth, thereby moving wipers 5, 6 and 7 from one contact set to the next. In the selecting operation of the switch B, the wipers 5, 6 and 7 are advanced to an idle set of contacts, and they remain in connection with such contacts when the connection is released. Should the wipers be in engagement with an idle set of contacts when a call is made, the motor magnet will not be energized, but the subscriber's line will be connected through to the trunk connected to said set of contacts.

The individual line switch B also includes a line relay LR which is adapted to be energized upon the initiation of a call, which relay LR upon energization closes a series circuit through the relays CO and CO' if the wipers are in engagement with an idle trunk. The relay CO energizes in series with relay CO' owing to the fact that its winding is higher in resistance than the winding of relay CO'. The combined test and cut-off relay CO' is provided with two windings and is so constructed that when a circuit is closed through its one winding only that it will simply operate to close its contact 38 without opening its contacts 24 and 25. When a circuit is closed through the two windings of relay CO' in series,

said relay operates to not only actuate its contact 38, but also its contacts 24 and 25. Should the wipers 5, 6 and 7 rest on a busy contact, upon the initiation of a call, the motor magnet MM will be operated to step the said wipers over the contacts 2, 3 and 4 until an idle set of contacts leading to an idle first selector are engaged, at which time the motor magnet MM will have its circuit opened to prevent further operations of the motor magnet MM. The cut-off relay CO' is adapted to be completely energized when connection is made with the substation A as a called line, to remove the substation control of individual line switch B.

The first selector switch C may be of a type as disclosed in an application of Wm. Kaisling for automatic switch for telephone systems, Patent No. 1,131,140. The first selector switch C comprises one hundred sets of bank contacts 10, 11 and 12 divided into ten groups of ten contacts each, and a set of wipers 13, 14 and 15 are adapted for co-operation with the said contacts 10, 11 and 12 respectively. For adjusting the wipers 13, 14 and 15 in a primary direction, a primary magnet PM is provided and for adjusting the wipers 13, 14 and 15 in a secondary direction, a secondary magnet SM is provided. Primary off normal springs PON are provided and are adapted to be moved to their alternate position upon the first primary step of the wipers, while secondary off normal contacts SON which are provided, are moved to their alternate position upon the first secondary step of the wipers. For controlling the operation of the magnets PM and SM, a primary relay PR is provided, which relay is energized when the individual line switch B selects the idle first selector by current flowing over the calling line. The relay PR is responsive to any interruptions of its circuit effected at the substation of the line by means of the calling device CD. A slow-acting secondary relay SR controlling the starting of the secondary movement of the switch, is also provided, as is also a main release relay MR which is adapted to control the release of the switch. A test relay TR is adapted to be energized after the primary movement of the switch, and controls the secondary movement of the switch in selecting an idle set of contacts.

The connector switch D comprises a switch structure similar to the switch structure of the first selector C, and comprises a primary magnet PM' for stepping the wipers 16, 17 and 18 in a primary direction, and a secondary magnet SM' is provided which steps the said wipers in a secondary direction over the contacts 19, 20 and 21 to select the contacts of the called line. Primary and secondary off-normal contacts PON' and SON' are also provided,

and assume their alternate position upon the first step of the wipers in a primary and secondary direction, respectively. The connector switch F also includes a line test relay LT which is adapted, following a connection with the terminals of the called line, to cause ringing current to be applied through the medium of a ringing relay RI to the terminals of the called line if idle, while if the called line is busy, a characteristic busy signal from the busy back apparatus is transmitted to the calling substation A. A ringing control relay RC is provided which is adapted upon the response of the called subscriber to disconnect the ringing current from the called line. A switching relay SW is arranged to disconnect the primary magnet PM' after it has been operated, and to connect secondary magnet SM in circuit whereby it is operated.

The called substation E is equipped similar to substation A, and is connected to an individual line switch B' similar to that of B.

Having described in a general way the apparatus used in the system of my invention, a complete operation thereof in establishing a connection from calling substation A to called substation E will now be described, and we will assume that the number of called substation E is 234.

To initiate a call, the subscriber at substation A removes his receiver from its switch-hook, whereby a circuit for line relay LR is established over a path traced from battery through the winding of relay LR, conductor 22, normal contact 23 of relay CO, normal contact 24 of relay CO' through the closed contacts of the sub-station switch-hook back through normal contact 25 of relay CO' to ground at normal contact 26 of relay CO. The closing of alternate contact 27 of relay LR establishes a circuit for relays CO and CO', traced from ground at alternate contact 27 of relay LR, over conductor 28 through the winding of relay CO, conductor 29, through the upper winding 30 of relay CO', and over conductor 31 to battery and ground at normal contact 32 of relay MM, if the trunk upon which wipers 5, 6 and 7 are resting is idle. The individual switch of my invention, as before mentioned, is so constructed that the wipers 5, 6 and 7 always rest upon the last set of contacts 2, 3 and 4 used, and assuming the contacts upon which the wipers now rest are busy, due to another subscriber of the group with which the subscriber A is associated having selected the same first selector last used by the subscriber A, a busy or ground will be upon the private contact 2. This ground is connected to one terminal of relay CO and to one terminal of relay CO' over a path extending from a bank contact 2 through wiper 5, over

conductor 33, through back contact 35 of relay CO, and alternate contact 37 of relay LR to middle point between relays CO and CO'. These two ground circuits to relay CO shunt the said relay CO, preventing it from energizing at this time. The closing of alternate contact 48 of relay LR places a ground over conductor 51 to the private normal 19' of line A. As before stated, relay CO' does not energize in series with relay CO, but the closing of contact 37, connecting direct ground to one terminal of relay CO' causes the same to be energized over a circuit traced from battery through normal contact 32 of magnet MM, over conductor 31, through winding 30 of relay CO', conductor 29, conductor 36, alternate contact 37 of relay LR, normal contact 35 of relay CO, conductor 33, and wiper 5 to ground at the busy private contact 2. The relay CO' is so constructed that the current which passes through winding 30 only brings about a partial energization of the relay CO', as hereinbefore mentioned. Upon this partial energization of relay CO', contact 38 of the said relay CO' assumes its alternate position to close an energizing circuit for the motor magnet MM traced from battery through the winding of the said magnet MM, over conductor 39, alternate contact 38 of relay CO' and over conductor 40 to ground at alternate contact 41 of relay LR. The magnet MM, upon energizing, opens its normal contact 32, thereby opening the energizing circuit for the winding 30 of relay CO' allowing the relay CO' to restore. Relay CO', restoring, opens its alternate contact 38, thereby opening the energizing circuit of the motor magnet MM, causing it to de-energize. The operations of magnet MM cause the wipers 5, 6 and 7 to be advanced one step to the next set of contacts, and should the private contact now engaged, be busy, the relay CO' will again be energized through its winding 30 over the previously described path to bring about the re-energization of the motor magnet MM. The motor magnet MM again energizing, again opens the circuit of relay CO'. This see-saw action of the test relay CO' and the motor magnet MM causes the wipers 5, 6 and 7 to be advanced from one set of contacts 2, 3 and 4 to the next set until an idle set of contacts leading to an idle first selector is encountered. When an idle set of contacts 2, 3 and 4 are engaged, the private contact 2 engaged by the private wiper 5 is free from ground, thus preventing the re-energization of relay CO', allowing the relay CO' to remain at normal, thereby preventing further operations of magnet MM. If during the energization and de-energization of relay CO' its contacts 24 and 25 should accidentally be opened, it would not effect the operation of the switch, owing to the fact that the said relay LR is slow-acting. When the wiper 5 engages an idle contact 2 free from ground, the shunt about relay CO is opened, allowing the said relay CO to energize over a circuit traced from battery at normal contact 32, over conductor 31, through winding 30 of relay CO', conductor 29, winding of relay CO, and over conductor 28 to ground at alternate contact 27 of relay LR. Relay CO energizes over this circuit, but not relay CO'. When relay CO energizes, its normal contacts 23 and 26 assume their alternate positions extending the line of substation A to the first selector C, which brings about the energization of the primary relay PR of the first selector C over a circuit traced from battery through the right hand winding 42 of relay PR, over conductor 43, through contact 4, wiper 7, alternate contact 26 of relay CO, normal contact 25 of relay CO' through the closed contacts of the switch hook at sub-station A back through normal contact 24 of relay CO', alternate contact 23 of relay CO, wiper 6, contact 3, conductor 44 and through the winding 45 of relay PR to ground. The opening of contacts 23 and 26 of relay CO opens the circuit of relay LR, but it being slow to release, is momentarily held energized until a locking circuit for the cut-off relay CO is established, as will be described. The closing of alternate contact 46 of relay PR establishes a locking circuit for relay CO traced from battery at normal contact 32 of magnet MM, over conductor 31, through winding 30, conductor 29, through the winding of relay CO, its alternate contact 34, conductor 33, wiper 5, contact 2 and conductor 47 to ground at alternate contact 46 of relay PR. Upon the initial energization of relay LR, a ground is placed upon the private contact 19' of the connector bank contacts 19', 20' and 21' associated with the calling sub-station A from ground at alternate contact 48 of relay LR, making the contact 19' busy, thus preventing any subscriber from seizing the subscriber A as a called line. When the relay LR restores, due to the energization of relay CO, its alternate contact 48 restores removing the original busy from the contact 19', but a substitute ground is connected which may be traced from ground at alternate contact 46 of relay PR over conductor 47, through contact 2, wiper 5, conductor 33, alternate contact 52 of relay CO, and over conductors 53 and 51 of the contact 19'. The ground upon contact 2 also makes this contact busy, preventing any other subscriber's individual line switch from seizing this busy contact which leads to the first selector C now associated with the substation A.

Should the private contact 2 which is

engaged by the wiper 5 be idle when the subscriber at substation A initiates a call, no ground will be connected to the contact 2, and as no shunt is formed about relay CO, the said relay CO operates, but not relay CO'. The closing of alternate contacts 23 and 26 extends the subscriber's line to the first selector C and brings about the energization of relay PR as previously described to close a locking circuit for the relay CO as also described. This immediate energization of relay CO due to no shunt being established about itself causes the said relay CO to open its alternate contact 35 to prevent relay CO' from being energized when ground is sent back through private wiper 5 and over conductor 33 to said contact 35. From the foregoing it is at once apparent that the wipers of the switch B are only moved when the wipers of switch B are in engagement with a busy trunk when a call is initiated.

It will thus be seen that the subscriber at substation A is now connected to the first selector C and as the relay PR is energized as described, the closing of its alternate contact 55 establishes an energization circuit for the main release relay MR traced from battery through the winding of the said relay MR over conductor 56, and through alternate contact 55 to ground at normal contact 58 of the primary off-normal contacts PON. The relay MR upon energization establishes another circuit for itself traced from battery through the winding of the said relay MR over conductor 56, through alternate contact 55 and over conductor 57 to ground at alternate contact 59 of relay MR. The said relay MR, being slow acting, remains energized until the termination of conversation. Assuming now that the subscriber at the called substation E is wanted and that the number assigned to the substation E is 234, the first numerical act of the calling subscriber at the substation A to complete the connection is to operate calling device CD to cause two interruptions of the line which results in two de-energizations of relay PR. Although the operations of relay PR cause the interruption of the circuit of relay MR at contact 55, relay MR being a sluggish relay does not retract its armature until a continued de-energization of relay PR is effected, as will be readily seen. The said operations of relay PR which are effected by the calling device as stated, cause two current impulses to be transmitted through the primary magnet PM and secondary relay SR over a path traced from ground at normal contact 46, through alternate contact 60 of MR, over conductor 61, normal contact 62 to point 63 dividing and flowing through the windings of relay SR and magnet PM to battery. Relay SR, being a slug-

gish relay, is energized responsive to the first impulse and maintains its armature attracted until the cessation of the impulses, maintaining its normal contact 64 interrupted. Two operations of magnet PM resulting from the two current impulses as described, effect two primary steps of wipers 13, 14 and 15 to the second group of contacts which are the contacts 10, 11 and 12 illustrated and lead to connectors E.

After the said two impulses have been transmitted, secondary relay SR retracts its armature closing its normal contact 64, and as switch PON moved to its alternate position upon the first primary step of the wipers, a circuit for test relay TR is established traced from ground at said normal contact 64, through alternate contact 65, conductor 66, normal contact 67 and the winding of relay TR to battery. Relay TR is thereupon energized closing its alternate contact 68 to establish an energizing circuit for secondary magnet SM whereby the wipers 13, 14 and 15 are stepped into engagement with the first set of contacts 10, 11 and 12 of the group. Upon this first secondary step of the wipers, switch SON moves to its alternate position opening its contact 67 and interrupting the initial energizing circuit for relay TR. Assuming that the first set of contacts 10, 11 and 12 lead to a busy connector, the first test contact 10 will be grounded through the multiple contact of another switch. Under these conditions, relay TR does not de-energize, as a substitute or maintaining circuit is established for said relay traced from ground at contact 10, through wiper 13, alternate contacts 69, 70, and the winding of relay TR to battery, thus maintaining the operating circuit for the secondary magnet SM. Therefore, magnet SM is again operated to advance wipers 13, 14 and 15 another step, and continues to do so until an idle set of contacts are reached, at which time the circuit for relay TR is interrupted allowing it to de-energize and interrupt the circuit for magnet SM. Upon de-energization of relay TR, ground is connected to the multiple test contacts 10 from normal contact 69, thereby rendering the selected set of contacts 10, 11 and 12 busy and preventing any other switch from connecting thereto. It will be noted that during the secondary movement of the wipers 13, 14 and 15 while they are wiping over bank contacts, the circuit of the line wipers 14 and 15 are interrupted at normal contacts 71, 72, thus preventing interference with any existing connections.

Referring now to connector switch D, upon connection therewith by first selector C and the grounding of test conductor 73, relay 74 of the connector switch D is energized by current flowing from battery through the winding of relay 74 and normal

contact 75 of relay RR to grounded conductor 73. Although relay 74 is energized when connection is made with switch D, it has no effect upon switch D at this time.

5 The subscriber at substation A actuates calling device CD for the second time, causing three impulses of current to be transmitted, thereby effecting three operations of primary relay PR. Three impulses
10 of current are therefore transmitted through primary magnet PM' and secondary relay SR' of connector switch D, the circuit thereof being traced from ground at normal contact 46, through alternate contact 60, normal
15 contact 71, wiper 14, contact 11, normal contact 76, conductor 77, normal contact 78 to point 79, the circuit dividing at this point, part of the current flowing through secondary relay SR' and part through normal contact 80 and magnet PM'. Responsive to the
20 first impulse of current, relay SR' is energized and being a sluggish relay, maintains its armature attracted until the cessation of the three impulses. The three impulses of current flowing through magnet PM' causes
25 three operations of the said primary magnet PM' and effecting three primary steps of wipers 16, 17 and 18 to the third group of contacts which includes contacts 19, 20 and
30 21, this row of contacts including the terminals of the line of the called substation E. Following the cessation of said three impulses, secondary relay SR' is de-energized to close a path for current through switching relay SW, over a circuit traced from
35 battery through the winding of said relay SW, normal contacts 81, 82 and contact 83 of PON' (which closed upon the first primary step of the switch) to ground whereby said relay SW is energized and a locking
40 circuit for itself is established through its alternate contact 84 and conductor 85 to the grounded test conductor 73. The operation of relay SW disconnects the primary magnet PM' and connects secondary magnet
45 SM' in circuit to receive the next set of impulses.

The calling subscriber now actuates calling device CD to send four impulses of current, thereby causing four operations of primary relay PR. Responsive to these four
50 operations, four impulses of current are transmitted through secondary relay SR' and secondary magnet SM', traced from ground at normal contact 46 of relay PR over the previously described path through
55 normal contact 76, conductor 77, normal contact 78, connection 79, dividing at this point and part of the current flowing through relay SR' and part through alternate contact 80, normal contact 86, and magnet SM' to
60 battery at normal contact 87. It will be noted that relay SR' is energized upon the first impulse, closing its alternate contact 88 so
65 that the following impulses flow through

this alternate contact 88. Upon the first secondary step of the switch, contacts SON' are moved to their alternate position, thereby interrupting the initial path for the current impulses through normal contact 78. 70 Also due to the interruption of normal contact 78 responsive to the first impulse, a new path for the impulses flowing through magnet SM' is provided, being from conductor 77 through alternate contact 88, conductor 75
89, connection 79, alternate contact 80, then over a previously traced path through magnet SM'.

The result of these four impulses of current is that magnet SM' steps wipers 16, 17 80 and 18 into engagement with the fourth set of contacts 19, 20, 21 respectively, of the group, which are the terminals of the line of called substation E, relay SR' of course being maintained energized by these four 85 impulses. Following the last impulse, relay SR' de-energizes closing its normal contact 90, thereby connecting the upper winding of line test relay LT to the test terminal 19 of the called line for the purpose of testing 90 said line for its idle or busy condition.

Called line idle.

Up to this period in the operation of the system, the operation is the same whether 95 connecting to an idle or busy line. Assuming now that the called line is idle, a path for current through the upper winding of relay LT is provided by the closing of said normal contact 90, being traced from ground 100 at normal contact 91 of relay 92, through alternate contact 93, normal contact 90, the upper winding of relay LT, conductor 94, test wiper 16, contact 19, conductor 51', normal contact 50' of relay CO², conductor 105 49', normal contact 48' of relay LR', conductor 95, lower winding 96 of relay CO³, upper winding 30' of relay CO³, conductor 31' to battery and ground at normal contact 32' of motor magnet MM'. The 110 energization of relay CO³ removes the substation control of the line switch B'. Upon the energization of relay LT a locking circuit for itself is established through its alternate contact 97, traced from battery at 115 the alternate contact 98 of relay 74, conductor 99, the lower winding of LT, alternate contact 97, conductor 100, and alternate contact 93 to ground at normal contact 91 of relay 92. The closing of alternate contact 120 101 of relay LT shunts its upper winding, and places a direct ground from conductor 100 through alternate contact 101, over conductor 94, to test wiper 16, maintaining relay CO³ energized and also preventing any 125 other connector switch from establishing connection with the terminals of the called line E.

The closing of alternate contact 102 of relay LT establishes an energizing circuit 130

for relay 103 traced from ground at normal contact 91, through alternate contact 102 and the winding of relay 103 to battery, causing its energization whereby its contact 104 is interrupted disconnecting busy back apparatus BB from the secondary conductor of the connector D. The closing of contacts 105, 106 of relay 103 connects battery and ground to the terminals of ringing control relay RC.

The called line being idle as stated, the means for applying ringing current to the terminals thereof will now be described. Also upon energization of relay I/T a circuit for ringing relay RI is established traced from battery at normal contact 107 of relay 92, through alternate contact 108, and the winding of relay RI to the grounded interrupter 109, resulting in a periodic energization and de-energization of relay RI. Upon each closing of alternate contacts 110, 111 of relay RI, ringing generator G is connected in bridge of the called line whereby the call bell at called substation E is operated, the current flowing over a path traced from the ungrounded terminal of generator G, through alternate contact 110, wiper 17, contact 20 through the condenser and call bell of called substation E and returning through contact 21, wiper 18, conductor 112 and alternate contact 111 to ground. Now, upon each de-energization of relay RI the windings of relay RC are connected in bridge of the terminals of the called line, but as long as the receiver is on the switch-hook at substation E, direct current can not flow through the windings of said relay RC due to the condenser at substation E, but upon response from the subscriber thereat, who removes the receiver from its switch-hook, and upon the following de-energization of RI, a path for direct current through the windings of relay RC is established traced from ground at alternate contact 105, through the upper winding of RC, normal contact 110, wiper 17, contact 20 over the previously described path including the line conductors and through the now closed switch-hook contacts at the called substation E back to normal contact 111 of relay RI, through the lower winding of relay RC, and alternate contact 106 to battery at alternate contact 98. Responsive to this circuit relay RC is energized, closing its contact 113, thereby connecting ground to conductor 114 as a substitute for the ground connection at normal contact 91, which is interrupted as will be described. Also, responsive to the energization of RC, its alternate contact 115 is closed, thereby establishing an energizing circuit for relay 116 which now attracts its armature whereby its alternate contact 117 is closed, establishing an energizing circuit for relay 92 traced from battery through said alternate contact 117 and the winding

of relay 92 to ground at closed contact PON'. Relay 92 is therefore energized interrupting its normal contact 107, thereby rendering relay RI inert. Due to the closing of alternate contact 107 of relay 92, a locking circuit for said relay is established whereby it remains energized until primary off-normal contact PON' is restored. The closing of alternate contacts 76 and 118 of relay 116 establishes the continuity of a talking circuit between the substations A and E. Said talking circuit may be traced over the heavily marked conductors. The talking circuit has the condensers 119, 120 interposed at first selector C. Talking circuit for the called substation E is provided through the windings of relay RC, while talking current for the calling substation A is provided through the windings of primary relay PR, over the previously described paths.

Release.

Assuming that the subscribers have finished conversation and that the subscriber at A is the first to restore his receiver to its switch-hook, the circuit for relay PR is interrupted, causing its restoration, the interruption of its alternate contact 55 permits the de-energization of main release relay MR. The de-energization of relay MR establishes a circuit for relay TR effecting the restoration of the switch in the following manner.

The circuit for relay TR established by the de-energization of relay MR is traced from ground at normal contact 64 of relay SR, through alternate contact 65, normal contact 70, the winding of relay TR to battery. Following the energization of relay TR, a circuit for secondary magnet SM is established by the closing of alternate contact 68, whereby wipers 13, 14 and 15 are stepped ahead by the operation of magnet SM until they have passed one step beyond the last contact set in the row. Upon reaching this position a release pawl of the switch is automatically tripped whereby the wipers restore from their primary adjustment by a spring, whereby switch PON is restored interrupting its alternate contact 58 to effect the restoration of switch C. Upon the wipers being restored from their primary adjustment, a second pawl is tripped, whereby they are restored by a spring from their secondary adjustment reaching normal and causing the restoration of switch SON. It will be noted that while wipers 13, 14 and 15 are being advanced in their restoring movement, the line wipers have their circuit interrupted at normal contacts 71, 72, thus preventing interference with any existing connections. Further, it will be remembered that as the wipers restore from their primary adjustment, switch PON restores,

opening its alternate contacts 65 and interrupting the circuit for relay TR which restores.

It will be noted that the initial energizing circuit for release relay MR is traced from ground at normal contact 58 of switch PON. But upon energization of MR and after the switch C has moved off normal, relay MR is maintained energized from its grounded alternate contact 59 during the operations of relay PR as before stated. Thus when relay PR is de-energized by restoration of the receiver to cause release of switch C, its contact 55 is interrupted allowing restoration of MR which in turn causes a restoring operation of the secondary magnet SM. Now, while magnet SM is restoring the wipers 13, 14, 15, should the subscriber at A again remove his receiver, relay PR will again be energized, but as primary off normal switch PON is in its alternate position, it will be seen that MR after once de-energizing can not be energized again by the operation of PR until switch PON is moved to its normal position.

Now, as soon as normal contact 58 of switch PON is interrupted as stated, the locking circuit for relay CO of line switch B is interrupted, as it will be remembered that relay CO has been maintained energized by current flowing over the test conductor to this grounded alternate contact 58. Therefore, relay CO restores and switch C is again available for use in establishing other connections.

To release connector switch D, the subscriber at substation E restores his receiver whereby the circuit for ringing control relay RC is interrupted, causing its de-energization. Its contact 113 is therefore interrupted, disconnecting ground from the conductor 114 thereby interrupting the circuits for relays 103, LT and CO^s, causing their restoration, the restoration of cut-off relay CO^s restores the substation control of line switch B'. Also, upon de-energization of relay RC, its alternate contact 115 is interrupted allowing the restoration of relay 116, whereby a circuit for release relay RR is established, traced from battery at normal contact 117 of relay 116, alternate contact 121 and the winding of relay RR to ground at PON'. Upon energization of said relay RR its normal contact 75 is interrupted, allowing relay 74 to restore, while the closing of its alternate contacts 86, 87, establishes a circuit for secondary magnet SM', traced from grounded alternate contact 86, through the winding of magnet SM', alternate contact 87 to the alternating current generator, whereby magnet SM' is operated by current impulses from said generator to advance wipers 16, 17 and 18 beyond the last contact in the row whereby they are automatically restored by spring tension as in the

case of the first selector. Upon restoration of primary off-normal switch PON', the circuits for relays 92, RR and SW are interrupted causing their restoration. Switch E now being at normal is available for use in establishing other connections.

Called line busy.

Assuming now that the called line is busy, the operation of the system will proceed as previously described up to the final de-energization of the secondary relay SR' of connector D. It will be remembered that at the final de-energization of relays SR' after the wipers have connected with the terminals of line E, relays SW and 74 are in an energized condition. Therefore, upon said de-energization of relay SR' the upper winding of relay LT is connected in circuit with the test wiper 16 and test contact 19 of the called line as before.

Assuming that line E is busy as a calling line, its test contacts 19 have a grounded busy potential as previously described, and if the line E is busy as a called line, its test contacts are connected to ground back over the test conductor 94 as previously described. Therefore, when the upper winding of relay LT is connected in circuit with the test contacts 19, there will be no energizing circuit for the said winding, as its left hand terminal is connected to ground at normal contact 91 as previously described, and as there is a ground busy potential upon contact 19, relay LT does not energize.

Due to the failure of relay LT to attract its armature, neither relays 103 or RI are energized so that busy back BB remains in connection with the secondary conductor through alternate contacts 126 and normal contact 104. Therefore, a characteristic busy signal is transmitted to the calling substation A traced from busy back BB through the said contacts 126, 104, to heavily marked secondary conductor, back over the said conductor and through the receiver of the substation A, returning over the heavily marked primary conductor through the left hand winding of relay PR of first selector C to ground. The subscriber upon placing his receiver to his ear receives this signal and therefore replaces his receiver upon the switch-hook, causing the restoration of the apparatus used in establishing the connection in the following manner.

Due to the replacing of the receiver at substation A, the circuit for relay PR is interrupted causing its de-energization followed by the de-energization of main release relay MR, thereby effecting the restoration of switch C, followed by the restoration of switch B as previously described. It will be remembered in the previously described connection that connector D was restored by the subscriber at the called substation E, but in

this instance its restoration is controlled by the calling subscriber. It will be remembered that relays 74 and SW are the only relays energized at switch D in this instance, being locked up over a circuit including test conductor 73 and the grounded normal contact 69 of relay TR at selector C. Therefore, upon energization of relay TR in the restoration of switch C as described, its normal contact 69 being interrupted, relays 74 and SW are de-energized. Following the de-energization of relay 74 a circuit for release relay RR is established from ground at alternate contact PON', through the winding of said relay RR, normal contacts 121 and 98 to battery. Relay RR, therefore, closes its contact 75, connecting ground to its test conductor 73 and contacts 10, preventing any other switch from effecting connection with connector D during its release. Although relay SW de-energized as just stated at the time its energizing circuit was interrupted at relay TR, it immediately energizes again upon the closing of its normal contact 81 due to the ground connection from PON', and is again locked up through its alternate contact 84 to ground at alternate contact 75, remaining so until the restoration of PON'.

Returning now to relay RR, the closing of its alternate contacts 86, 87, causes the releasing operation of magnet SM' as previously described, whereby switch D is restored to normal, causing the restoration of primary off-normal contact PON' and relays RR and SW, switch D now being at normal is available for use in establishing other connections.

While I have illustrated and described my invention operation with a specific form of a system, it is to be understood that it is capable of operating with many other circuit arrangements, 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.

What I claim as new and desire to secure by United States Letters Patent is:

1. A telephone system including a non-numerical non-restoring automatic line switch, a test relay and a driving magnet for said switch, a circuit of said test relay including a contact of said driving magnet, and a circuit for said driving magnet including a contact of said test relay.

2. A telephone system including a non-restoring automatic switch provided with wipers, a motor magnet for advancing said wipers, a test magnet, and circuits for said motor magnet and test magnet controlled by contacts of each other, whereby when one of said magnets is energized, it operates to de-energize the other of said magnets.

3. A telephone system including a non-

restoring automatic switch, a test magnet, a motor magnet and a cut-off magnet for said switch, a circuit for said motor magnet including contacts of said test magnet, and a circuit for said test magnet including contacts of said motor magnet and said cut-off magnet.

4. A telephone system including a subscriber's telephone line, a link circuit, a non-restoring automatic switch for connecting said link circuit and said subscriber's line, a test magnet for said switch, a circuit for said test magnet controlled over the subscriber's line, and a second circuit for said test magnet, including a passive bank contact of said switch, said latter circuit being opened upon each step of said automatic switch.

5. A telephone system including a telephone line, a progressive switch therefor, contacts for said line upon said switch, selectors having multiple contacts upon said switch, a test relay and a driving magnet for said switch, a circuit for said test relay including a contact of said driving magnet, a circuit for said driving magnet including a contact of said test relay, mechanism at the substation on said line for initiating the operation of said switch to cause the line contacts of said line to register with multiple contacts of an idle selector, whereby said line is operatively connected with said selector, and release means for said line effective to disconnect the same from said selector without altering the operative position of said progressive switch.

6. A telephone system including a telephone line, selector switches associated therewith, multiple terminals of said selector switches, an automatic switch, mechanism for said switch including a test relay and a motor magnet, a circuit for said test relay including a contact of said motor magnet, a circuit for said motor magnet including a contact of said test relay, means for operating said mechanism of said automatic switch to cause it to connect said line with terminals of an idle selector, together with means for freeing said line from said selector when disconnection is desired without altering the selective position of said automatic switch.

7. A telephone system including a subscriber's telephone line, an individual trunking switch for said line, trunks adapted to be selected by said switch, a test magnet and a motor magnet for said switch, a circuit for said test magnet controlled over the subscriber's line, a second circuit for said test magnet including conductors of said trunks, said latter circuit adapted to be opened upon each energization of said motor magnet, and means for disconnecting said line from a selected one of said trunks while maintaining said switch in its advanced position.

8. A telephone system including a sub-

scriber's line, an individual trunking switch for said line, trunks adapted to be selected by said switch, a test magnet and a motor magnet for said switch, a circuit for said test magnet including mechanism controlled over the subscriber's line, a second circuit for said test magnet including conductors of said trunks, said latter circuit adapted to be opened upon each energization of said motor magnet, and means for disconnecting the subscriber's line from a selected one of said trunks without alternating the operative position of said trunking switch.

9. A telephone system including an automatic switch provided with an active test contact, passive contacts, a motor magnet, a test magnet, means controlled by said motor magnet for moving said active contact over said passive contacts, means controlled by said motor magnet for connecting said test magnet through said active contact to each passive contact moved over by said active contact, means controlled by said test magnet to cause said motor magnet to continue to operate as long as busy passive contacts are engaged by said active contact, and means for releasing said switch while maintaining said switch in its antecedent progressive position.

10. A telephone system including an automatic switch, a test relay and a driving magnet for said automatic switch, a circuit for said test relay including normally closed contact of said driving magnet, a circuit for said driving magnet including a normally open contact of said test relay, and release means for said switch for restoring said switch to normal while maintaining said switch in its antecedent progressive position.

11. A telephone system including a non-restoring automatic switch, provided with a motor magnet and a test magnet, and circuits for each of said magnets, controlled by contacts of the other, said magnets operating over said circuits alternately to operate said switch.

12. A telephone system including a telephone line, selective switch mechanism including a test relay and a motor device, said test relay controlling a circuit for said motor device and said motor device directly controlling a circuit for said test relay, selectors having multiple contacts in said mechanism, means for causing said mechanism to select contacts of an idle selector and for connecting the limbs of said telephone line to the selected contacts, release means for terminating the connection of said limbs with said contacts without altering the selective position of said mechanism as at the time of release.

13. A telephone system including a telephone line, selective switch mechanism including a test relay and a motor device, said test relay controlling a circuit for said motor

device and said motor device directly controlling a circuit for said test relay, contacts individual to said line at said mechanism, selectors having multiple contacts at said mechanism, means for causing contacts of said line to be connected with multiple contacts of an idle selector, and means for opening the connection between said line and said selector without altering the selective position of said mechanism as at the time of such opening.

14. A telephone system including a non-restoring automatic switch, active contacts for said switch, passive contacts for said switch, means including a test magnet and a motor magnet for moving said active contacts into engagement with idle passive contacts, a circuit for said test magnet controlled directly by said motor magnet, a circuit for said motor magnet extending through contacts of said test magnet, said test magnet and motor magnet operable over said circuits alternately in moving said active contacts over said passive contacts and into engagement with an idle set of passive contacts, and means for releasing said automatic switch while maintaining said active contacts in engagement with said selected passive contacts.

15. A telephone system including a non-restoring automatic switch, active contacts for said switch, passive contacts for said switch, means including a test relay and a motor magnet for moving said active contacts into engagement with idle passive contacts, a circuit for said test magnet controlled by said motor magnet, a circuit for said motor magnet passing through contacts of said test magnet, means for releasing said automatic switch while maintaining said active contacts in engagement with said selected passive contacts, and means for again operating said switch to extend a call while maintaining said active contacts in engagement with said passive contacts and without operating said test magnet and said motor magnet.

16. A telephone system including an automatic switch, a test magnet and a motor device for said switch for use in selecting an idle trunk line, a circuit for said test magnet, including a contact of said motor device, a circuit for said motor device including a contact of said test magnet, said motor device and said test magnet adapted to energize and de-energize alternately to operate said switch, and means for again connecting to said idle trunk line without operating said motor device.

17. A telephone system including a subscriber's line, trunk lines, an automatic switch for connecting said subscriber's line to said trunk lines, a line relay and a cut-off relay for said switch, means controlled over the two sides of the subscriber's line in

series for energizing said line relay, means controlled by said line relay for energizing said cut-off relay to connect the subscriber's line to one of said trunk lines without moving the wipers of said switch, and a double-wound cut-off relay for said switch for disconnecting said subscriber's line from said line relay.

18. A non-restoring line switch for telephone systems, including only contacts and co-operating wipers, motor mechanism for rotating said wipers, simple relays including a test relay and a cut-off relay, each of said relays having individually controlled contacts, contacts controlled by said test relay for operating said motor mechanism, contacts operated by said motor mechanism for closing a circuit for said test relay, a circuit for said cut-off relay adapted to be held closed while said switch is in use, and means for opening said holding circuit, thereby restoring said switch.

19. A telephone system including a subscriber's telephone line, an automatic trunking switch for said line, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines, which trunk line is always the one last employed by said switch for extending a call, an automatic switch at the end of each of said trunk lines, a motor magnet and a double-wound test relay for said trunking switch, subscriber controlled means for energizing said test relay, a circuit for said motor magnet passing through contacts of said test relay, a circuit for said test relay passing through contacts of said motor magnet, means controlled by said magnet and said relay for connecting said subscriber's line to an idle one of said automatic switches, a cut-off relay for said trunking switch for preventing the operation of said double-wound test relay and said motor magnet when said line wipers are in engagement with an idle trunk line, and means controlled over the subscriber's line for releasing said trunking switch while maintaining said trunking switch in its antecedent progressive position.

20. A telephone system including a subscriber's telephone line, an automatic trunking switch for said line, trunk lines for talking purposes leading therefrom, said switch having line wipers always in electrical engagement with some one of said trunk lines, which trunk line is always the one last employed by said switch for extending a call, an automatic switch at the end of each of said trunk lines, a motor magnet and a test relay for said trunking switch, subscriber controlled means for energizing said test relay, a circuit for said motor magnet controlled by said test relay, a circuit for said test relay including contacts of said motor

magnet, means controlled by said magnet and said relay for connecting said subscriber's line to an idle one of said automatic switches, a cut-off relay for said trunking switch, a holding circuit for said cut-off relay including a conductor of the trunk extending to the selected automatic switch, and means controlled over said telephone line for opening said holding circuit to restore said relay, thereby rendering said trunking switch available for extending other calls.

21. A non-numerical non-restoring-wiper automatic switch for telephone systems comprising bank contacts and co-operating wipers, electromagnetically controlled motor mechanism for advancing said wipers, simple relays provided with only individually controlled contacts, a circuit for said motor mechanism including contacts of one of said simple relays, a circuit for one of said simple relays including contacts of said motor mechanism, said motor mechanism adapted when operated to connect said wipers with a set of said bank contacts, and means for restoring said switch without altering its antecedent progressive position.

22. An automatic switch of the character described, including a single-wound relay, a double-wound relay, means for closing a circuit through one of the windings of said double-wound relay and the winding of said other relay, whereby said single-wound relay is caused to be operatively energized, and other means for closing a circuit through both windings of said double-wound relay to cause it to be operatively energized.

23. A system of the character described including a subscriber's telephone line, an automatic switch, active contacts for said switch, a pair of relays for said switch, a subscriber controlled means for closing a series energizing circuit for said pair of relays, whereby one of said relays will be effectively energized if said active contacts are in engagement with an idle trunk line and the other of said relays will be energized if said active contacts are in engagement with a busy trunk line, either of said relays being adapted to effectively disconnect said active contacts from said subscriber's line.

24. A telephone system including a subscriber's telephone line, a switch therefor provided with active contacts always in engagement with some one of a plurality of the trunk circuits, which trunk line is always the one last employed by said switch for extending a call, a pair of relays for said switch, means for closing a series energizing circuit for said relays, said relays being so constructed and the circuits of said switch being so arranged that one of said relays is energized if said active contacts are

in engagement with an idle trunk line, while the other of said relays will be operatively energized if said active contacts are in engagement with a busy trunk line, and means for energizing said last relay when said subscriber's line is a called line.

25. A telephone system including a subscriber's telephone line, a trunking switch for said line, trunk lines, extending from said switch, active contacts for said switch always in engagement with some one of said trunk lines, which trunk line is the one last employed by said switch for extending a connection therefrom, a cut-off relay and a test relay for said switch, a subscriber's line relay for closing a series circuit for said cut-off relay and said test relay, and means whereby said cut-off relay is energized if said active contacts are in engagement with an idle trunk line and whereby said test relay is energized if said active contacts are in engagement with a busy trunk line.

26. A telephone system including a subscriber's telephone line, a trunking switch for said line, trunk lines, extending from said switch, active contacts for said switch always in engagement with some one of said trunk lines, which trunk line is the one last employed by said switch for extending a connection therefrom, a pair of relays for said switch, means for closing a series circuit for said relays, a shunt circuit for one of said relays, and means whereby said shunt circuit is only closed if said active contacts are in engagement with a busy trunk when the subscriber makes a call, means for energizing either of said relays to the exclusion of the other and a motor magnet for said switch.

27. A selecting system for automatic exchanges including a telephone line and a relay with a winding adapted to be energized by current flowing in said line, a second relay operated to disconnect said first relay from the line, a traveling switch pertaining to said relays, a magnet, and circuits for setting up a vibratory operation between said magnet and said second relay, and automatic test means to terminate the operation.

28. An automatic telephone system including a telephone line and a relay directly operated by current in the line, a second relay to disconnect the first relay from said line when said second relay is energized, and a switch adjusting magnet in vibrating

relation with said second relay during automatic selecting travel of said switch.

29. In a telephone system, a telephone line, a relay directly operated by current over the talking circuit of said line, a second relay having a back contact in circuit between said first relay and the talking circuit of said line, a switch adjusting magnet, a contact of said second relay in the circuit of said magnet and contact of said magnet in the circuit of said second relay.

30. A line switch for automatic telephone systems including a relay and a telephone line, said relay serving, when connection is made to said line as a called line, to disable the selecting circuits of the switch, an adjusting magnet for the switch and connections for operating said relay and magnet in vibratory relation when a call is initiated over said telephone line.

31. In an automatic telephone system, a subscriber's telephone line, a relay individual thereto, means for energizing said relay when connection is made to the line as a called line to open the normal battery connections of said line, and circuits whereby said relay operates as a vibratory test relay and is energized each time a busy trunk is engaged in selecting an idle trunk when the subscriber initiates a call.

32. A telephone system of the character described including an automatic switch having a motor magnet, a double wound test relay, a cut-off relay for said switch, and a circuit for said cut-off relay including a contact of said motor magnet and one of the windings of said test relay.

33. A telephone system including an automatic switch having a double-wound test and cut-off relay, a test circuit for said relay including only one winding thereof, and a second circuit for said relay including the two windings thereof, and subscriber-controlled means for closing said second circuit.

34. A telephone system including an automatic switch having a double-wound relay, means for closing a circuit for one winding of said relay when it is used for calling purposes, and means for closing a circuit through the two windings of said relay when it is used for called purposes.

Signed by me at Chicago, in the county of Cook and State of Illinois, this 28th day of September, 1918.

GEORGE A. YANOCHOWSKI.