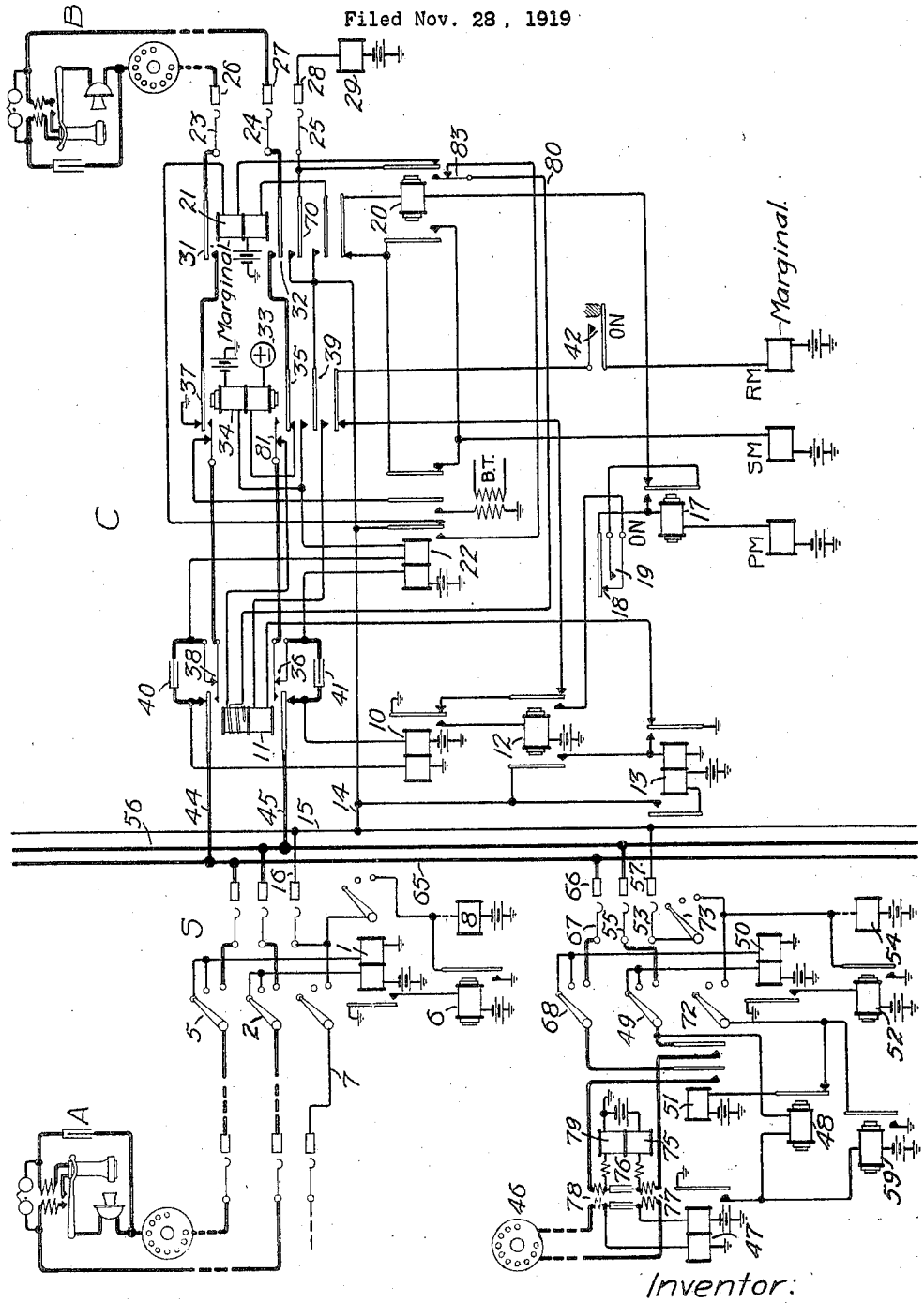
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R. L. STOKELY

MACHINE SWITCHING TELEPHONE EXCHANGE SYSTEM

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MACHINE-SWITCHING TELEPHONE-EXCHANGE SYSTEM.

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To all whom it may concern:

Be it known that I, RAY L. STOKELY, a citizen of the United States, residing at Floral Park, Long Island, in the county of Nassau, State of New York, have invented certain new and useful Improvements in Machine-Switching Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to machine switching telephone exchange systems, and particularly to multi-office systems.

In a connection involving two stations local to the office, satisfactory transmission is secured by feeding talking current to the transmitters through a pair of supervisory relays which may control the release of the switches. When however the connection leads through a number of offices, better transmission is secured by substituting for this relay bridge, a repeating coil bridge.

In accordance with this invention the connectors are accessible to local second or third selectors, dependent upon the number of lines in the office in which the connectors are located, and also to incoming selectors which are used when the call comes from or through a distant office, and the circuit arrangement is such that the path over which the connector is seized determines the character of the battery feeding arrangement to be used in energizing the transmitters of the connected lines.

The invention contemplates a circuit arrangement wherein the electrical condition of the test wire of the selector seizing such connector determines the operation of an electromagnetic switch connected to the test wire of the connector which controls the current feeding bridges.

More specifically, when a connector is seized by a selector serving local calls only the bridges for feeding talking current through a pair of relays are left connected across the connector talking conductors to energize the substation transmitters of the local lines. In case however, this connector is seized by an incoming selector, it being understood that these connectors appear in multiples in these selectors as well as the local selectors, a relay is operated to cut off these bridges, and substitute a repeating coil bridge at the incoming selector for feeding current to energize the transmitter at the called station.

As shown, in the present embodiment, the third conductor from the preceding local selector is connected to the free pole of the battery and when the connector is seized this third conductor is extended to the third conductor of the connector in which a relay is included. This relay thereupon operates and interposes a break in the circuit of a relay which would otherwise operate when the called party answers and cut off the local relay bridges. If, however, the connector is seized by an incoming selector from a distant office the relay referred to in the third conductor of the connector is shunted, due to the presence of ground on the third conductor leading from such incoming selector, and, consequently upon the response of the called subscriber, the bridge cut-off relay referred to operates and removes the supervisory relay bridges normally connected across the connector talking conductors and transfers the called line talking conductors to the repeating coil bridge at the incoming selector.

Referring to the drawings, which show only so much of a telephone exchange system as is necessary for a comprehension of the invention, the connector C is located in the office to which the lines terminating in substations A and B belong. The incoming selector shown below selector S is also located in this office. The sender 46 is, however, located at a distant office. The connector group including connector C is multipled to the local selectors S and also to the incoming selectors, so that it may be seized by a trunk from a distant office terminating in incoming selectors as well as locally by selectors S.

With this preliminary description it is believed that an understanding of the invention will be most easily acquired by following in detail the building up of a call of each class. A local connection will first be traced. Upon the removal of the receiver at substation A, the calling line is extended over a series of switches in the well-known manner to the selector S just preceding the connector, whereupon the following circuit is closed: free pole of battery, left winding of stepping relay 1 of the selector, side switch arm 2, position 1, the lower talking conductor, through the substation apparatus, returning over the upper talking conductor, side switch arm

5, position 1, right winding of stepping relay 1 to ground. Relay 1 in energizing, operates slow relay 6, which, in attracting its armature, grounds the third wire 7, leading back to the preceding switches to hold the same in their set position, in accordance with well-known practice, and operates release relay 8 to interpose a break in the circuit of the release magnet not shown of the switch to which stepping relay 1 belongs. The calling subscriber now operates his sender to set the selector S to the level of the trunks terminating in connectors C, whereupon the selector automatically hunts for and seizes an idle connector in the well-known manner. Upon the extension of the calling line to the connector, the side switch of selector S advances to position 3, cutting off the bridge including relay 1. Before the slow relay 6 can retract its armature, however, the stepping relay 10 of the connector is operated over the following circuit: free pole of battery, right winding of relay 10, lower armature and back contact of relay 11, over the lower talking conductor to the calling substation and returning over the upper talking conductor, upper armature of relay 11 and its back contact, left winding of relay 10 to ground. Relay 10, in attracting its armature, operates slow relay 12, which, in attracting its right armature, connects the primary stepping magnet PM to the back contact of stepping relay 10, and in attracting its left armature operates relay 13 through the following circuit: ground, right winding of relay 13, left armature of relay 12, conductors 14, 15, 16, to the free pole of the battery, through the winding of relay 8. The left armature of relay 13 is arranged to close its front contact before the right armature. It thus locks itself over the left armature of relay 12 and its own left and right armatures. The ground applied to the third or test wire by the right armature of relay 13 is applied before the slow relay 6 of the preceding selector S has had time to release and relay 8 is thus held energized. This ground causes the connector C to test busy to other selectors.

The calling subscriber now operates his sender to transmit impulses to the connector corresponding to the tens digit of the wanted number. Upon the first retraction of the armature of relay 10, an impulse is transmitted over the following circuit, to operate the primary stepping magnet PM of the connector: armature and back contact of relay 10, right armature and front contact of relay 12, off-normal contact 18 controlled by the connector shaft, slow relay 17, magnet PM, free pole of battery. At the beginning of the movement of the selector shaft, off normal contact 18 opens and off normal contact 19 closes. Relay 17, when it operated, connected the stepping magnet to the back contact of the stepping relay 10 over the contact 19 independently of contact 18. The subsequent impulses, therefore, pass by way of contact 19 and the front contact of the slow relay 17 to the magnet PM. A short interval after the sender restores, relay 17 retracts its armature, transferring the stepping circuit to connector secondary stepping magnet SM. The calling subscriber now transmits impulses corresponding to the units digit of the wanted line. The first impulse passes over the following circuit to operate the magnet SM: armature and back contact of magnet 10, armature and front contact of slow relay 12 which as before, becomes energized upon the receipt of the first impulse and remains energized during the transmission of the impulses, contact 19, armature and back contact of slow relay 17, slow relay 20, lowermost armature of relay 21, outer armature and back contact of relay 22, magnet SM and free pole of battery. The subsequent impulses pass over the following path to operate magnet SM: armature and back contact of relay 10, right armature and front contact of relay 12, contact 19, armature and back contact of relay 17, slow relay 20, lowermost armature and back contact of relay 21, and over the left armature and front contact of relay 20, and outer right armature of relay 22 in parallel magnet SM, free pole of battery. Relay 20, in attracting its right armature, maintains the test circuit open during units selection. When the sender reaches its normal position, the brushes 23, 24 and 25 of the connector are in engagement with the multiples 26, 27, 28 of the desired line. The idle condition of a line is indicated by full potential upon the multiples 28. A short interval after the connector is set, slow relay 20 retracts its armatures and if the line is idle the following circuit is closed for a marginal test relay 21: free pole of battery, called line cut-off relay 29, multiple 28, brush 25, right armature and back contact of relay 20, upper low resistance winding of relay 21, inner armature of relay 22, to the third wire, grounded at the right armature and front contact of relay 13. Relay 21, in attracting one of its lower armatures which is arranged to make contact before the others, locks itself to the grounded third wire through its lower winding. Due to the circuit through this winding the relay is able to attract its remaining armatures. In attracting its armature 70 it connects the grounded test wire directly to the test multiples 28 of the selected line, thus reducing the potential on such multiples to cause the same to test busy to other connectors. In attracting its lowermost armature, it opens the connection between magnet SM

and the sender, thus preventing the subscriber from transmitting any more impulses to the connector. Upon the attraction of the armatures 31, 32 of relay 21, the bell at substation B is operated over the following circuit: ringing generator 33, lower winding of ringing cut-off relay 34, armature 35 of said relay, armature 32 of relay 21, brush 24, multiple 27, lower talking conductor, the bell at the called station, upper talking conductor, multiple 26, brush 23, armature 31 of relay 21 and its front contact, upper armature of relay 34, to ground. When the called party removes his receiver the ringing cut-off relay 34 attracts its armature 39, closing a locking circuit including its upper winding and the grounded third wire. This relay, due to the increase in its magnetization from the current through the locking winding, attracts its remaining armatures, disconnecting the ringing current generator from the called line and substituting therefor the called supervisory relay 22. The called supervisory relay 22 is now operated over a called line circuit as follows: free pole of battery, left winding of relay 22, contact 36 of relay 11, lower talking conductor including armature 35 and front contact of relay 34 and armature 32 of relay 21 and its front contact, brush 24, multiple 27, lower talking conductor through the telephone apparatus at substation B, upper talking conductor, multiple 26, brush 23, armature 31 of relay 21 and its front contact, armature 37 of relay 34 and its front contact, contact 38 of relay 11, right winding of relay 22, armature 39 and front contact of relay 34, to the grounded third wire. The subscribers may now converse, talking current being supplied to energize the transmitter at the calling station through the calling supervisory relay 10, and to the transmitter of the called station through the called supervisory relay 22, the calling and called ends of the connecting circuit being conductively separated and inductively connected by condensers 40 and 41 in accordance with well-known practice.

Upon the replacement of the receiver by the calling party, relay 10 becomes deenergized, resulting in the deenergization of slow relay 12. Relay 12 in releasing, opens the locking circuit of relay 13 which in retracting its right armature, removes ground from the release wire leading back to the preceding set switches whereupon they release. The removal of this ground from the test wire also causes the relay 34 to unlock whereupon the following circuit is closed for the release magnet RM of the connector. Magnet RM, off-normal contact 42, lowermost armature of relay 34, and its back contact, armatures and back contacts of relays 12 and 10 to ground. Upon reaching its normal position, off-normal contact 42 is opened, opening the release circuit.

Assume now that the substation B is called from a distant office. The incoming selector having been reached over a number of selectors, not shown, is set by the sender 46 at the distant office to the level containing the trunk group in which the connectors C terminate. The selector thereupon seizes an idle one of these connectors. The circuits of the repeater and incoming selector are not shown in detail since they may be of any well known type. Only so much is shown as is necessary to comprehend the present invention. When the calling line is extended to the stepping relay 47 of the repeater which may be in the same office as the called line B, this stepping relay operates closing a circuit including slow relay 48, side switch arm 49 of the incoming selector, stepping relay 50 of the incoming selector, free pole of battery. Relay 50, in operating, energizes a slow relay 52 which operates release relay 54 thereof to interpose a break in the circuit of the release magnet, not shown, of the incoming selector to prevent premature release. The impulses for setting the incoming selector pass over the path just traced including the right armature and front contact of relay 47, the slow relay 48 and the stepping relay 50. When the selector seizes an idle connector C the incoming selector side switch passes to the third position, the stepping relay 50 is cut off and the right-hand grounded armature and front contact of the repeating relay 47 is extended to the talking brush 55 of the selector. The side switch arm 72 reaches its third position and connects the grounded armature of relay 59 to the release relay 54 before the ground which initially energized this relay is removed by the release of slow relay 52 due to the cutting off of stepping relay 50 from the lower talking conductor. Ground from the armature of relay 59 is, in the third position of the side switch, extended over arm 73 to the third or test brush and thence to the third wire of the connector to cause the same to test busy to testing selectors. This ground also shunts relay 13 to prevent its energization for a purpose which will appear. The testing circuits for the selectors are not shown. They may be of the type shown in Patent No. 1,236,858 of August 14, 1917. When the connector is seized the stepping relay 10 thereof becomes energized over the following circuit: free pole of battery, right winding of relay 10, lower armature of relay 11, talking conductor 45, multiple 57, brush 55, arm 49, slow relay 48 to the armature and front contact of relay 47. When the calling party transmits the tens impulses the connector is set in operative relation to the level containing the desired line. Simi-

larly when the units impulses are transmitted, the connector is set on the desired line multiples 26, 27 and 28. These operations are the same as previously described except that the relay 10 is operated over one side of the line from the right armature of relay 47 instead of over a metallic circuit.

The ringing of the bell at the called station B occurs, as previously described in the case of the local call, but in this case when the ringing cut-off relay 34 operates, a circuit is closed for relay 11 including the right armature and back contact of relay 13, this relay, in the case of calls coming from or through a distant office, not operating as it does in the case of a local call, since in the former case it is shunted at the armature and front contact of relay 59. The circuit for relay 11 is as follows: free pole of battery, magnet RM which is marginal and does not operate in this circuit, off-normal contact 42, lowermost armature and front contact of relay 34, lower winding of relay 11, to ground through the armature and back contact of relay 13. Relay 11, in attracting its armatures, disconnects the bridges including the relays 10 and 22, and extends the calling line directly through to the connector talking brushes 23, 24. Relay 34, by attracting its lowermost armature, interposes a break in the circuit of release magnet RM before the slow relay 12 has time to retract its armatures when the relay 10 is cut off. Battery is now fed to the called line from the repeating coil over the following circuit: free pole of battery, lower winding of retardation coil 75, windings 76, 77, lower talking conductor, outer armature of relay 51, which operated when relay 48 became inert due to the cutting off of the connector stepping relay 10 from the lower talking conductor, side switch arm 49, talking brush 55, multiple 57, conductor 56, lower talking conductor 45 of the connector, lower armature and front contact of relay 11, armature 35 and front contact of relay 34, armature 32 and front contact of relay 21, brush 24, multiple 27, the called line B, multiple 26, brush 23, armature 31 and front contact of relay 21, upper armature and front contact of relay 34, upper armature and front contact of relay 11, conductors 44, 65, multiple 66 of the incoming selector, brush 67, side switch arm 68, inner armature and front contact of relay 51, windings 78, 79 and upper retardation coil winding of the repeater to ground.

When the calling party permanently opens the calling line circuit upon the conclusion of the conversation relay 47 becomes inert. This results in the deenergization of slow relay 59, which in removing ground from the third wire leading to the connector, unlocks ringing cut-off relay 34. This relay, in retracting its lowermost armature closes the circuit of release magnet RM of the connector including the armatures and back contacts of relays 10 and 12. When the connector restores, off-normal contact 42 is opened to deenergize the release magnet. The deenergization of relay 59 in removing ground from the third wire also opens the circuit of the release relay 54 of the selector whereupon release of the selector takes place.

The operation of the circuit arrangement in case the called line B is busy, will now be described. It will be recalled that the slow relay 20 is in series with the secondary stepping magnet SM of the connector, and is maintained energized during the transmission of the secondary impulses. Upon the termination of these impulses, however, this relay, after an interval, retracts its armatures. If the selected line is busy its multiple 28 is grounded due to the connection of a grounded test brush 25 at another connector, or to ground thereon from the line finder or other equivalent switch in case it is busy as a calling line. Before relay 20 has time to retract its armatures, however, the following circuit is closed to operate relay 22 to apply busy tone to the calling line: grounded multiple 28, brush 25, right armature and front contact of relay 20, conductor 80, upper non-inductive winding of relay 11, contact 81 of relay 34, now closed, contact 36 of relay 11, left winding of relay 22, free pole of battery. Relay 22 immediately upon energization, locks itself up over the following circuit: free pole of battery, relay 22, contact 36 of relay 11, contact 81, upper winding of relay 11, contact 83 of relay 20, inner right armature of relay 22, to the grounded third wire. The middle armature of relay 22 applies busy tone to the calling line in the well-known manner. Test relay 21 does not operate in case the line is busy, since by the time the right armature of relay 20 is fully retracted relay 22 in attracting its inner right armature has opened the energizing circuit of such relay, thus preventing ringing current from being applied to this busy line. Upon the replacement of the receiver by the calling party the switches are released. If the call was a local call from substation A to substation B, the replacement of the receiver by the calling party results in the deenergization of relays 10 and 12, whereupon the switches are restored as previously described in the case of a successful connection. In the case of an incoming call involving the incoming selector, it will be recalled that the bridge containing the stepping relay 10 at the connector is not cut off until the called subscriber responds. Relay 10 is thus operated and is holding slow relay 12 energized and relay 12 is maintaining a break in the circuit of release magnet RM. Upon hearing the busy tone, the calling party at the distant end of

the connection including the sender 46, breaks down the connection, thus releasing repeating relay 47. This relay, in retracting its right armature, opens the circuit of stepping relay 10 of the connector, which in retracting its armature, opens the circuit of slow relay 12. This relay, after an interval, closes its right back contact whereupon release magnet RM of the connector is energized over the following circuit: right armatures and back contacts of relays 10 and 12, lowermost armature of relay 34, offnormal contact 42, magnet RM, free pole of battery. The retraction of the left armature of relay 47 opens the circuit of release relay 54 of the incoming selector, which thereupon restores.

It will thus be seen that by virtue of the present invention connectors of a given office may be accessible to both local calling lines and calling lines leading over or through distant offices, and in each case the connector automatically adapts itself to the particular class of call being set up, in the one case feeding current to the local lines through supervisory relays, and in the other case cutting off these relays and extending a current feeding and transmission circuit arrangement to the called line which is more suitable for long distant calls.

What is claimed is:

1. In a machine switching telephone exchange system, the combination with talking trunk conductors, an automatic switch wherein said trunk conductors terminate, a battery and feed coils normally bridged across said talking conductors at said switch, of an electromagnetic switch controlling the connection of said battery and feed coils to said conductors, a plurality of paths over which said automatic switch may be selected, means controlled by the path over which said switch is selected for controlling the operation of said electromagnetic switch, a second bridge for feeding talking current, and means actuated when the first bridge is cut off for connecting said second bridge to said trunk conductors.

2. In a machine switching telephone exchange system, talking trunk conductors, an automatic switch in which said conductors terminate having feed coils and a battery, normally connected to said conductors, said automatic switch being reached by a plurality of paths, and means for removing said feed coils and battery from said conductors, said means being controlled by the path over which the automatic switch is reached, a bridge for feeding talking current to said trunk conductors, and means actuated when said feed coils and battery are disconnected from said conductors for connecting said bridge thereto.

3. In a machine switching telephone exchange system, a calling and a called line, a plurality of selectors and a connector, talking trunk conductors wherein said connector terminates, a feed coil and battery normally bridged across said conductors at said connector, an electromagnetic switch controlling the connection of said feed coil and battery to said conductors, the operation of said switch being dependent upon the selector used in extending the connection to the connector, a bridge for feeding talking current to said trunk conductors including a repeating coil, and means actuated when said feed coil and battery are disconnected for substituting said bridge.

4. In a machine switching telephone exchange system, a connector, a plurality of selectors for seizing the same a feed coil and a battery at said connector, a relay normally connecting said coil and battery to the talking conductors of said connector, said relay being operated to disconnect the same only when the connector is seized by certain of said selectors, and a bridge at said last mentioned selectors for feeding talking current to said trunk conductors, including a repeating coil substituted for said feed coil by the operation of said relay.

5. In a machine switching telephone exchange system, telephone lines, a connector, a plurality of selectors for seizing the same, a pair of condensers, a battery and a pair of supervisory relays at said connector, one on each side of said condensers through which talking current is fed from said battery to the connected lines, an electromagnetic switch normally connecting said battery and relays across the talking conductors of said connector, the operation of said switch being dependent upon the selector employed in extending the connection to the connector, a bridge for feeding talking current to said trunk conductors, said electromagnetic switch in operating to cut off said supervisory relays, substituting said bridge therefor.

6. In a machine switching telephone exchange system, a connector, a local selector, an incoming selector, a bridge at said incoming selector having a pair of condensers and a repeating coil, a pair of battery feed coils at said connector normally connected across the connector talking conductors, and a relay operated in case the connector is seized by said incoming selector for disconnecting said feed coils and substituting said bridge and for extending the talking conductors of said selector directly through to the connector brushes.

7. In a machine switching telephone exchange system, telephone lines, a connector, a talking battery, a local selector, an incoming selector, a pair of feed coils through which said battery is connected to the talking conductors of said connector, a switching relay for cutting off said coils, a circuit

therefor closed when the called party responds, a second relay controlling at a back contact said circuit, said second relay being included in the test conductor of said connector, and an energizing circuit for said second relay closed only when said connector is seized by said local selector to prevent operation of said switching relay upon the response of the called party.

In witness whereof, I hereunto subscribe my name this 24th day of November A. D., 1919.

RAY L. STOKELY.