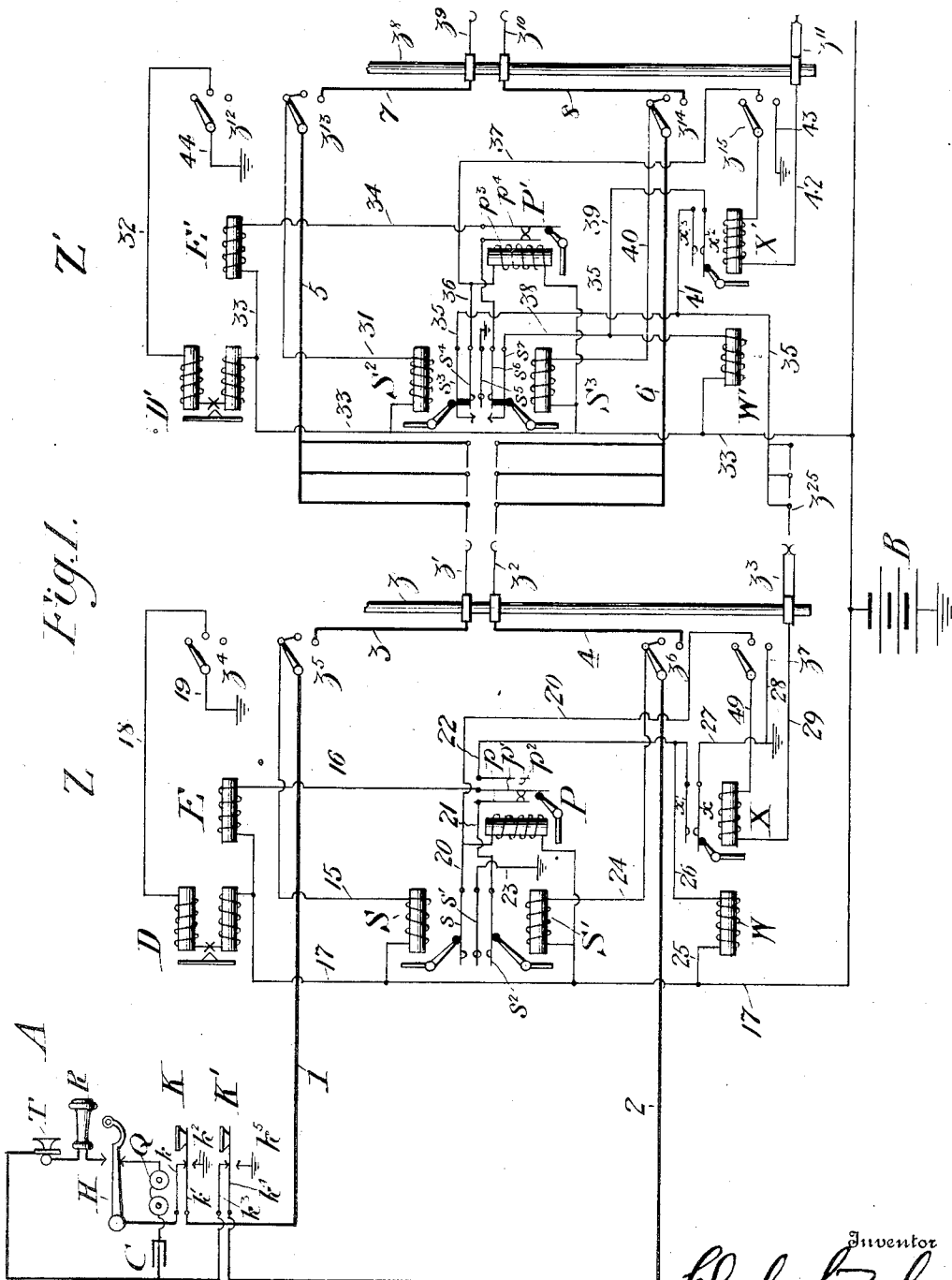


C. L. ZAHM.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED SEPT. 19, 1905.

2 SHEETS—SHEET 1.



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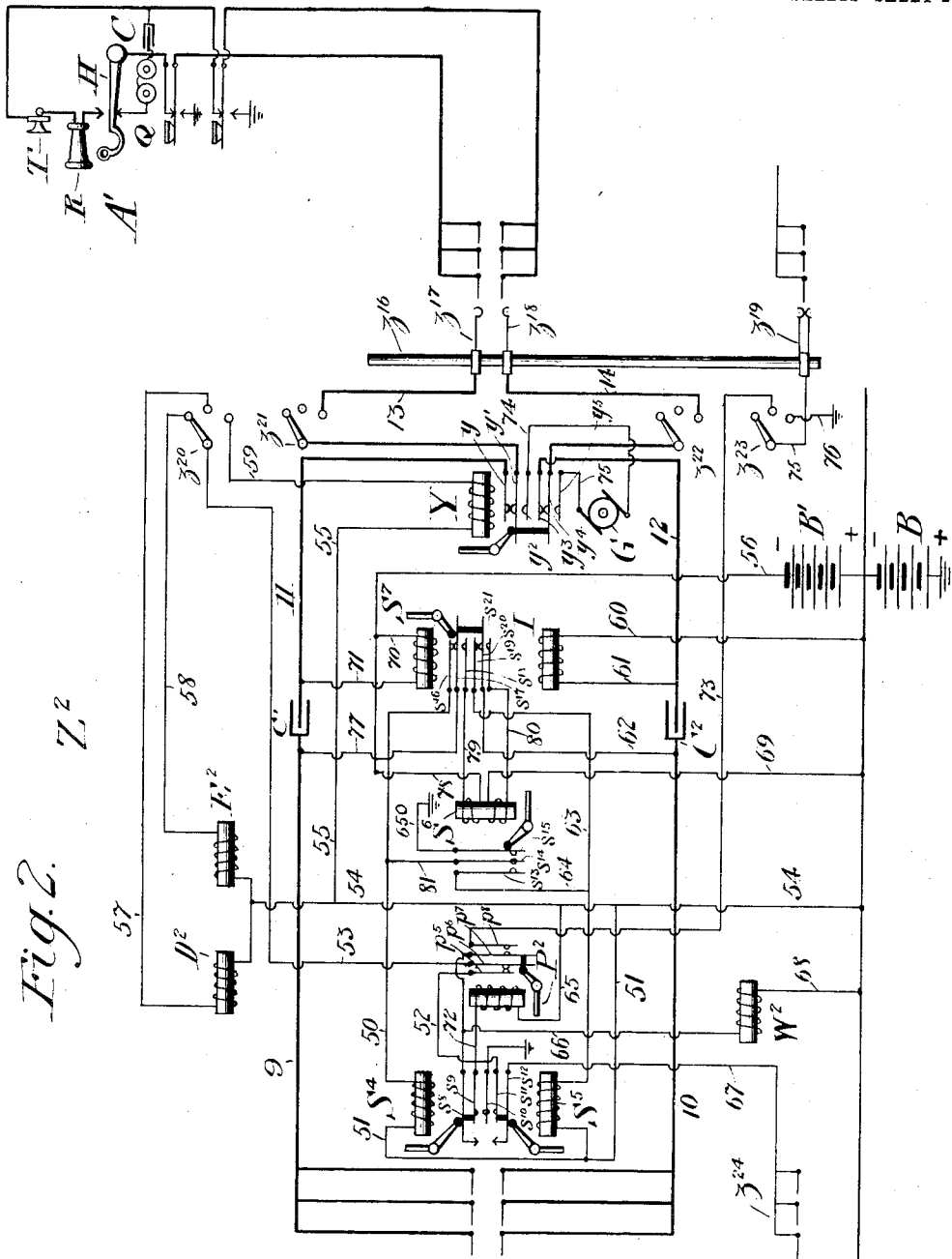


Fig. 2.

Z.2.

Witnesses

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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

941,839.

Specification of Letters Patent. Patented Nov. 30, 1909.

Application filed September 19, 1905. Serial No. 279,124.

To all whom it may concern:

Be it known that I, CHARLES L. ZAHM, a citizen of the United States, residing at Los Angeles, in the county of Los Angeles and State of California, have invented new and useful Improvements in Telephone-Exchange Systems, of which the following is a specification.

My invention relates to telephone exchange systems, and particularly to the so-called automatic systems wherein interconnection of subscribers' and other lines is effected through automatic machines controlled by the subscribers, or operators at the distant stations. In the systems known of this class the subscribers' lines and the machines are ordinarily supplied with current from a common source at the exchange, for working purposes only, that is for switching, local batteries at the outlying stations being employed to furnish current for the telephone transmitters. The disadvantages of this arrangement have long been apparent, but owing to the necessity for producing certain combinations of current impulses to manipulate the switching devices from a distance, it has been difficult to adapt the well-known bridged common battery to automatic circuits in general.

It is the principal object of my present invention to adapt bridged common battery to the automatic circuit, or it might be better to say adapt the automatic circuit to the employment of bridged common battery, without disturbing or changing either the standard features of construction or the present standard methods of operation. I consider it undesirable in any system to the use of which the public has become educated, to make such changes that this education is at fault, and it will be observed that I have attained my object in such manner as to avoid the slightest difference in operation or appearance at the substations.

Briefly stated, my invention comprises the usual means for completing a connection through the selector and connector switches, and thereafter in the connector substituting a bridged battery for the grounded battery of the calling line. It will be observed that since this change is made in the connector switches the percentage of change is a minimum, since the first and second selector switches constitute by far the larger part of

the total number employed. I provide the called line with permanently bridged battery on the wipers of the connector through the side switch, and I include relays in the bridge wires which cut off the working relays of the calling end of the connector circuit, with their interposed grounded battery, and cut on a peculiar differentially wound relay by means of which control of the switch release devices is retained while the talking battery is enabled to be bridged across the calling circuit with one of its windings on each side. These windings, being end on, serve as impedance coils, but for battery current neutralize each other as to magnetic effect upon their core. By my arrangement the calling subscriber is enabled to clear out a connection whether the called subscriber has hung up or not.

My invention is illustrated in the accompanying drawings wherein—

Figure 1 shows in diagram a subscriber's station and first and second selector switches of the Strowger type; Fig. 2 shows in similar diagram a subscriber's station and a Strowger connector switch, with my additional apparatus and wiring.

I do not deem it necessary to illustrate the mechanical switching devices employed in my system, since the same are clearly illustrated and described in the following Letters Patent: 815,176, Keith and Erickson, March 13th, 1906. 815,321, Keith and Erickson, March 13th, 1906.

Referring to Fig. 1, the subscriber's station, A, is equipped with apparatus usual in common battery systems, consisting of transmitter, T, receiver, R, hook, H, ringer Q and condenser C. In addition to the talking set there is added the sending apparatus for transmitting impulses to operate switches at central. I have for simplicity represented the sending apparatus by the two push buttons, K, K'. The button K' when depressed grounds No. 2 side of line and sends impulses which operate the vertical relays in the various switches, while the button K when depressed sends in the impulse over No. 1 side of line which operates the rotary relays, which in turn move the side switches in the selectors and connectors. At the ends of the connection both buttons are depressed which sends in an impulse over both sides of line simultane-

ously, affecting both the vertical and rotary relays and releasing the various switches.

The first and second selector switches Z and Z' being the regular Strowger type without change, need not be described in detail. In first selector switch Z, the vertical relay S' responds to impulses over No. 2 side of the line, and operates the vertical magnet E, which steps up the spindle, z , carrying the trunk wipers z' , z^2 , and the test wiper z^3 , vertically. The rotary relay S operates in response to impulses over No. 1 side of the line and in turn operates the private relay, P, actuating the rotary magnet I and causing side switches z^4 , z^5 , z^6 , z^7 to assume successively different positions, cutting off the vertical and rotary relays S', S and connecting the back-release relay X to the test wiper z^3 . This relay, when operated, closes the circuit of the release magnet W which restores the switch to normal position. In the second selector Z' the vertical relay S³, which operates in response to impulses sent over No. 2 or "vertical" side of the line in turn operates the vertical magnet E', causing the spindle z^8 carrying the trunk wipers z^9 , z^{10} and test wiper z^{11} to step up vertically. The rotary relay S² operates in response to impulses sent in over No. 1 or "rotary" side of the line and in turn operates the private relay P', actuating the rotary magnet L' and causing the side switches to assume successively different positions, cutting off the vertical and rotary relays S³, S² and connecting the test wiper z^{11} to ground through the back release relay X'. The relay X' when operated closes the circuit of the release magnet W' which restores the switch to its normal position.

Referring now to Fig. 2, I have there shown the connector switch Z², wherein my invention really lies, and as I proceed will point out the additional apparatus I have inserted and the necessary changes in the wiring. One terminal each of the vertical relay S⁵ and the rotary relay S⁴ is connected to main battery B in the usual manner by wires 51, 54. The other terminal of each relay, instead of being connected permanently to trunk wire 9 or 10, is connected indirectly as follows: Relay S⁵, by wire 63, normally closed contacts s^{19} , s^{20} of relay S⁷, wire 62 to trunk wire 10; relay S⁴ by wire 50, normally closed contacts s^{16} , s^{17} of relay S⁷, wire 77 to trunk wire 9. There are no other changes in the circuits of the vertical and rotary relays S⁵, S⁴. The relay S⁵ responds to impulses sent in over No. 2 side of the line and operates the vertical magnet E² causing the spindle z^{16} carrying the trunk wipers z^{17} , z^{18} and test wiper z^{19} to step up in a vertical direction. The rotary relay S⁴ responds to each impulse sent in over No. 1 side of the line and operates the private relay P², causing the mechanically connected side switches

z^{20} , z^{21} , z^{22} , z^{23} to assume the second position, cutting off the vertical magnet E² in the side switch z^{20} and cutting on the rotary magnet D², placing it under control of the vertical relay S⁵. The next set of impulses coming in over No. 2 side of the line actuate the vertical magnet S⁵ as before and this now, by reason of the change in the side switch, operates the rotary magnet D² causing the spindle z^{16} to rotate. So far, as can readily be seen, the operation of the switch has been identical with that of the standard Strowger type.

To the trunk wires 11, 12 in the Strowger system there are connected a pair of back release relays, one terminal of each relay going to battery B. In place of these relays I use the relay S⁷ and retardation coil I, one terminal of the relay being connected to trunk wire 11 by the wire 71 and the other terminal being connected to the minus side of an additional set of batteries B', by the wires 70 and 56. The plus side of this set of batteries is connected to the minus side of main battery B which has its plus side grounded. One terminal of the retardation coil I is connected to trunk wire 12 by wire 61, the other terminal being connected to plus side of battery B' by wire 60. The battery B' supplies talking current through the relay S⁷ and the coil I to the called subscriber. I have also added a differentially wound relay S⁶, a terminal of one coil being connected to battery B' by wires 78, 56, and the other terminal to contact s^{18} of relay S⁷. One terminal of the second coil is connected to battery B' by the wire 69, and the other terminal is connected to contact s^{21} of the relay S⁷. The contact s^{15} of relay S⁶ is connected to ground by wire 650, the contact s^{14} by the wires 81 and 50 to relay S⁴ and the contact s^{13} by the wires 64 and 63 to relay S⁵. The condensers C', C² are inserted between the trunk wires 9, 11 and 10, 12 respectively as usual. When the relay S⁷ is energized by the closing of the circuit of the called subscriber's line it attracts its armature, opening the contacts s^{16} , s^{17} and s^{19} , s^{20} disconnecting the relays S⁴, S⁵, and in their place connecting the relay S⁶ to the wires 9 and 10 respectively by closing the contacts s^{17} , s^{18} , and s^{20} , s^{21} .

The calling subscriber is now supplied with talking current through the two windings of the differential relay S⁶. This relay will not respond to or become energized by current flowing in the metallic circuit for talking purposes, but at the end of the conversation when the calling subscriber depresses both buttons K and K' to release, he thereby grounds both sides of the line, and current then flowing through both windings of the relay S⁶ in parallel through the main battery B to ground, energizes it. Attracting its armature, the relay closes the

contacts s^{13} , s^{14} , s^{15} , which upon operating, release the switch in the regular manner. If the calling subscriber disconnects before the called subscriber answers he would release in the ordinary manner by relays S^4 and S^5 which would be affected directly, being then connected to wires 9 and 10 through the closed contacts of the relay S^7 . There are no changes in the ringing relay Y , which, as usual, when energized by the vertical relay S^5 on the last movement of the side switch, opens the calling end of the trunk and connects the ringing generator on the wipers z^{17} , z^{18} and thence to the called subscriber's station.

The circuit of the release magnet W^2 remains the same as usual being under the control of the wiper z^{19} in testing for a busy line and under control of the vertical and rotary relays S^5 and S^4 in disconnecting at the end of a conversation.

The apparatus at the subscriber's station A' is identical with and is lettered the same as that of A , hence it need not be described.

The complete operation of the system embodying my invention is as follows: Suppose the subscriber at station A desires to call the subscriber at station A' , whose number is 3524. Removing the receiver from the hook he depresses the button K' three times, making and breaking the contacts k^4 and k^5 , sending in impulses over No. 2 side of the line and operating the relay S' , which in turn closes the circuit of the vertical magnet E by the following path: Ground, 23, s' , s^2 , 21, p , p' , 16, E , 17 to battery B . As the button K' is depressed three times the magnet E causes the spindle z to step up accordingly and the wipers z' , z^2 and z^3 come opposite the third row of contacts whose trunks lead to second selector switches. After thus sending in impulses over No. 2 side of the line, the subscriber then depresses the button K closing the contacts k' , k^2 , sending in an impulse over No. 1 side of the line which causes the rotary relay S to attract its armature, closing the circuit of the private relay P by the following path: Ground, 23, s' , s , 20, P , 17 to battery B . The relay P becoming energized opens the contacts p , p' , disconnecting the vertical relay E thus preventing the spindle z from moving in a vertical position. After the impulse has come in over No. 1 side of the line, private relay P is released and turns the mechanically moved side switches z^4 , z^5 , z^6 , and z^7 to the second or test position. The private relay P is connected to the test wiper z^3 by the following path: 29, X , 49, z^7 , 20, P , 17 to battery B ; and the circuit of the rotary magnet D is closed by the following path: Ground, 19, z^4 , 18, D , 17 to battery B causing its armature to vibrate. This magnet continues to operate causing the spindle to rotate until the test wiper z^3 finds a contact

leading to a second selector switch which is not busy, that is to say a contact free from ground. As soon as such contact is found the relay P becomes deenergized and causes the side switches to take the third position cutting off the rotary magnet D causing the spindle to come to rest with the wipers on contacts leading to an idle second selector switch.

The side switches in taking the third position connect the line wires 1, 2, to the wires 3 and 4 leading to the wipers z' and z^2 , cut off the relays S and S' and ground the test wiper z^3 by the following path: Ground, z^7 , 49, X , 29, z^3 , making the test contact in the second selector busy. The calling subscriber is now connected to a second selector switch in the desired thousand. He now depresses the button K' five times sending impulses over No. 2 side of the line, operating the vertical magnet S'' in the selector switch Z' which in turn closes the circuit of the vertical magnet E' by the following path: Ground, s^5 , s^6 , p^3 , p^4 , 34, E' , 33 to battery B . The operation of this magnet according to the number of impulses sent in causes the spindle z^8 to step up in a vertical position bringing the wipers z^9 , z^{10} , z^{11} opposite a row of contacts leading to connector switches of the desired hundred. The subscriber now depresses the button K sending in an impulse over No. 1 side of the line, operating the rotary relay S^2 in the switch Z' which in turn closes the circuit of the private relay P' by the following path: Ground, s^5 , s^4 , 26, 33 to battery B . The relay P' becoming energized attracts its armature and opens the contacts p^3 , p^4 , disconnecting the vertical relay E' thus preventing the spindle z^8 from moving in a vertical position. After the impulse has come in over No. 1 side of the line the private relay P' is released and turns the mechanically moved side switches z^{12} , z^{13} , z^{14} and z^{15} to the second or test position. The private relay P' is connected to the test wiper z^{11} by the following path: 42, X' , z^{15} , 37, P' , 33 to battery B ; and the circuit of the rotary magnet D' is closed by the following path: Ground, 44, z^{12} , 32, D' , 33 to battery B causing it to vibrate. This magnet continues to operate causing the spindle to rotate until the test wiper z^{11} finds a contact leading to a connector switch which is not busy, that is to say a contact free from ground. As soon as such a contact is found the relay P' becomes deenergized and causes the side switches to take the third position cutting off the rotary magnet D' causing the spindle to come to rest on contacts leading to an idle connector switch. The side switches in taking the third position connect the wires 5 and 6 to the wires 7 and 8 leading to the wipers z^9 and z^{10} , cut off the relays S^2 and S^3 and ground the test wiper z^{11} by the fol-

lowing path: Ground, 43, z^{15} , X' , z^{11} making the test contact in the connector switch busy. The calling subscriber is now connected to a connector switch in the desired hundred. He now depresses the button K' two times sending impulses over No. 2 side of the line, operating the vertical relay S^5 in the connector switch Z^2 which in turn closes the circuit of the vertical magnet E^2 by the following path: Ground, s^{10} , s^{11} , 52, p^5 , p^6 , 53, z^{20} , 58, 54 to battery B. The operation of this magnet according to the number of impulses sent in causes the spindle z^{16} to step up in a vertical position bringing the wipers z^{17} , z^{18} , z^{19} opposite a row containing the contacts of the subscriber wanted. The subscriber now depresses the button K sending in an impulse over No. 1 side of the line, operating the rotary relay S^4 in the switch Z^2 which in turn closes the circuit of the private relay P^2 by the following path: Ground, s^{10} , s^9 , 72, p^2 , 65, 54, to battery B. The relay p^2 becoming energized, attracts its armature and opens the contacts p^5 , p^6 , disconnecting the vertical relay E^2 , thus preventing the spindle z^{16} from moving in a vertical position.

After the impulse has come in over No. 1 side of the line the private relay P^2 is released and turns the mechanically moved side switches z^{20} , z^{21} , z^{22} and z^{23} to the second or test position, and disconnects the vertical magnet E^2 and in its place connects the rotary magnet D^2 . The subscriber now depresses the button K' four times sending impulses over No. 2 side of the line, again operating the vertical relay S^5 in the connector switch Z^2 which now in turn closes the circuit of the rotary magnet D^2 by the following path: Ground, s^{10} , s^{11} , 52, p^5 , p^6 , 53, z^{20} , 57, D^2 , 54 to battery B. The operation of this magnet according to the number of impulses sent in causes the spindle z^{16} to rotate, bringing the wipers to rest on the contacts leading to the desired line. The subscriber now depresses the button K sending an impulse over No. 1 side of the line, operating the rotary relay S^4 which in turn closes the circuit of the private relay P^2 . This relay becoming energized attracts its armature and connects the release magnet W^2 to the test wiper z^{19} by the following path: 75, z^{23} , 73, p^7 , p^8 , 66, W^2 , 68 to battery B. If the line called for is not busy the contacts on which the test wiper rests will be free from ground and the circuit of the magnet W^2 will remain open. In this case we will take it for granted that the line is not busy. After the impulse comes in over No. 1 side of the line the private relay P^2 becomes deenergized and causes the side switches to take the third position. In taking this position the rotary magnet D^2 is disconnected and the ringing relay Y is connected in its place, the trunk wires 11 and 12

are connected to the wires 13 and 14 leading to the wipers z^{17} and z^{18} through the contacts y , y' and y^3 , y^4 of the relay Y . The test contact of the called line is now made busy by the following path: z^{19} , 75, z^{23} , 76 to ground. The calling subscriber is now connected to the desired line and upon depressing the button K' he closes the circuit of the vertical relay S^5 which in turn operates the ringing relay Y by the following path: Ground, s^{10} , s^{11} , 52, p^5 , p^6 , 53, z^{20} , 59, Y , 55, 54 to battery B. The relay Y becoming energized attracts its armature, opens the contacts y , y' and y^3 , y^4 , disconnecting the trunk wires 11 and 12, and closes the contacts y' , y^2 and y^4 , y^5 , connecting generator current to the wipers z^{17} and z^{18} and from there to the line of the desired party. The called subscriber upon answering closes his line circuit, energizing the relay S^7 , which upon attracting its armature opens the contacts s^{16} , s^{17} and s^{19} , s^{20} disconnecting the relays S^4 , S^5 respectively from the wires 9 and 10 and closing the contacts s^{17} , s^{18} and s^{20} , s^{21} connecting the windings of the differentially wound relay S^6 to the wires 9 and 10 in place of the relays S^4 and S^5 . The calling subscriber is now supplied with current for talking by the battery B' being bridged between the windings of the relay S^6 . This relay, as before stated, will not become energized while battery current is flowing through its windings for talking purposes. If at the end of the conversation the calling subscriber disconnects first, that is if he depresses the buttons K and K' , both sides of the line being grounded simultaneously, current will flow through the windings of the relay S^6 in parallel through main battery B to ground. The relay S^6 now becomes energized and attracting its armature closes the contacts s^{13} , s^{14} , s^{15} , grounding both the vertical and rotary relays S^5 and S^4 . These two relays becoming energized simultaneously, close the circuits of the release magnets in all the switches in the following manner: First the circuit of the release magnet W^2 is closed in series with the release relay X' by the following path: Battery B, 68, W^2 , 66, s^8 , s^{12} , 67, z^{24} , z^{11} , 42, X' , z^{15} , 43 to ground. The magnet W^2 becoming energized restores the switch Z^2 to its normal position.

The relay X' becoming energized attracts its armature and closes the circuit of the magnet W' and X in series by the following path: Battery B, 33, W' , 38, 39, x^2 , x^3 , 41, 35, z^{25} , z^3 , 29, X , 49, z^7 , 28 to ground. The magnet W' becoming energized restores the switch Z' to its normal position. The relay X attracts its armature and closes the circuit of the magnet W by the following path: Battery B, 17, 25, W , 26, x' , x , 27 to ground. The magnet W becoming energized restores the switch Z to its normal position. Now,

if on the other hand the called subscriber hangs up before the calling subscriber disconnects, the following conditions will prevail: The relay S^7 becomes deenergized allowing the contacts to assume their normal position, disconnecting the differentially wound relay S^6 and again connecting the relays S^4 and S^5 back to the wires 9 and 10 respectively. The calling subscriber now disconnecting by sending an impulse over both sides of the line simultaneously, operates the two relays S^4 and S^5 directly, which, upon attracting their armatures, at the same time close the contacts s^8 , s^{12} affecting the release circuit in the manner before described, and restoring the various switches to their normal positions.

I do not wish to limit my invention in its mode of application to the use of two coils or magnets S^7 I, although the use of two magnets gives a better balanced circuit and more satisfactory results. Neither do I confine myself specifically to a differentially wound coil as at S^6 , for a coil not differentially wound might be used bridged on the line either by relay action or direct connection. Again, I do not confine myself to an extra relay, as I can arrange the battery and relays otherwise.

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

1. In a telephone exchange system, a subscriber's line, selector switches controlled thereby to connect with other lines, a connector switch controlled through said selector switches, a pair of bridged magnets with a bridged battery in the calling end of said connector switch, a differential relay in the answering end of the same switch, a pair of operating relays also in the answering end of the switch bridged with a grounded battery between them, and connections such that when the magnets in the calling end of the switch respond to the act of the called subscriber in answering, they will disconnect the operating relays from the switch trunk wires and place them under the control of the differential relay, at the same time connecting the differential relay to the trunk wires, substantially as described.

2. In a telephone exchange system, a subscriber's line and a connector switch controlled thereby to connect the line to other lines, operating magnets in said switch normally bridged and grounded through an operating battery from an intermediate point of the bridge, means at the subscriber's station to ground one or the other side of line to operate said magnets, a pair of condensers dividing the answering from the calling end of the switch circuit, a pair of bridged controlling magnets across the calling end of the circuit with a source of current between them, means at the called sub-

scriber's station to determine the flow of current from said source in his line, a bridging magnet with a source of current for the answering end of the circuit but normally disconnected therefrom, and means operated by the said controlling magnets in responding to current in the called line, to disconnect the operating magnets from the circuit and place them under the control of the bridging magnet, and to connect the bridging magnet across the switch circuit, substantially as described.

3. In a telephone exchange system, a subscriber's line and a connector switch controlled thereby having its circuit divided into answering and calling portions by suitable condensers, a pair of controlling relays for the switch normally bridged and connected from a point between their windings to a grounded main battery, means at the subscriber's station to ground one or the other side of his line in calling, a relay and a bridged battery connected across the calling end of the switch circuit, and a relay and bridged battery connections for the answering end of the circuit but normally disabled, the relay for the answering end being so wound as to be inoperative on current from the bridged battery for talking purposes, together with means whereby the relay of the calling end will become energized in completing a connection and will disable the controlling relay connections to the line, placing said relays under control of the answering bridged relay, and the latter under control of the line and calling subscriber, substantially as described.

4. In an automatic telephone exchange system, a subscriber's metallic circuit and a connector switch controlled thereover, means at the subscriber's station for grounding one side or the other of the line, controlling magnets in the connector connected to the two sides of line and a grounded battery, means for disconnecting the same from the line in completing a connection with another line, and a magnet and a bridged battery thereby connected across the calling line, said magnet normally irresponsive to current from said bridged battery when the line is free from grounds but becoming responsive when the same is grounded to operate the controlling magnets and release the switch mechanism, substantially as described.

5. In an automatic telephone exchange system a connector switch having a metallic circuit divided by condensers into answering and calling ends, a pair of operating magnets normally bridged across the answering end and acting separately to set the switch but jointly to release and restore it, a grounded battery connected to and between said magnets and means at each subscriber's station to ground one or the other side of the line in calling, a relay and bridged bat-

tery across the calling end of the circuit, and a normally disconnected control relay for the answering end of the same, with means whereby the relay on the calling end will be actuated in completing a connection between lines to disable the line control of the operating magnets and transfer the same to the control of the control relay, placing the latter under the control of the line together with a bridged battery for supplying talking current thereto, substantially as described.

6. In a telephone exchange system a connector switch having a metallic circuit divided into two ends or portions by condensers, a pair of operating magnets for the switch which when energized separately act to set the same and when energized jointly act to release and restore the same to normal or zero position, a grounded battery connected to the magnets and line in parallel, and means whereby a calling subscriber may control the ground circuit and magnets directly in initiating a connection, a bridging connection for said switch normally connected to furnish battery current for talking to the calling side but disconnected on the answering side of the condensers, and means brought under the control of the calling line in completing a connection to control the operating magnets indirectly, with a bridged talking battery in circuit, substantially as described.

7. In an automatic telephone exchange system, a connector switch having a vertical and a rotary magnet and a vertical and a rotary relay therefor connected to opposite sides of the switch circuit, a release magnet jointly controlled by said relays and a battery connected through the same to line in parallel branches, a cut-off relay for said relays and a differentially wound controlling relay cut on in place of the same when they are cut off, a battery bridged between the two windings of the differential relay, and contacts in the said differential relay controlling the operation of the vertical and rotary relays jointly, substantially as described.

8. In a telephone exchange system, a connector switch having a vertical and a rotary magnet and a vertical and a rotary relay therefor, connected to opposite sides of the switch circuit, a release magnet jointly controlled by said relays and a battery connected through the same to line in parallel branches, a cut-off relay for said first named relays adapted to be energized when a connection is complete, and a differential relay cut on in place of the vertical and rotary relays when they are cut-off, means whereby the joint operation of said relays is thereafter controlled by said differential relay, a bridged battery cut across the circuit to fur-

nish talking current through the windings of the differential relay, and a supplemental battery connected from one side of the same to ground, substantially as described.

9. In an automatic telephone exchange system, a connector switch having actuating mechanism and release mechanism, a differentially wound relay in a bridge of the main circuit, actuating means for the release mechanism controlled by said relay, a source of talking current connected so as to supply the main circuit and subscriber's line through the windings of said relay in series, and a supplemental battery connected from a point between the said windings to ground, whereby the flow of talking current during conversation will not affect the release mechanism of the switch, but the same will be restored by the subscriber grounding the line at the conclusion of the conversation, substantially as described.

10. In a telephone exchange system, a connector switch having actuating and release mechanism, a controlling magnet with differential windings in a bridge of the main circuit with a source of current supply between them, a supplemental source of current connected from one side of the first source to ground, and means at the subscribers' stations to permit the flow of current in the metallic circuit from the bridged source for their transmitters, and to produce a current flow from the grounded source to energize the control magnet for clearing out the connection, substantially as described.

11. In a telephone exchange system, an automatic switch having a bridged source of current supply for subscribers' transmitters, and a clearing out current source connected in a branch from one side of the main source to ground, means for actuating the switch, means for releasing the same, and a controlling electro magnet therefor wound and connected so as to take current from both sources, but to be irresponsive to current from the bridged source and responsive to current from the grounded source only, together with means for permitting flow of transmitter current from the bridged source during conversation only, and to ground the main circuit so as to cause a flow from the grounded source to release the switch and clear out the connection, substantially as described.

12. In a telephone exchange system, a link circuit and an automatic switch, a source of talking current bridged across the link circuit, a supplemental source of current connected from one side of the main source to ground, electromagnets adapted to actuate the switch, relays for controlling said magnets, deriving their current from the grounded source, a release magnet for the switch, and a release relay wound and connected so

as to permit the passage of but to be ir-
responsive to current from the bridged source
flowing over the link circuit and a connected
subscriber's line, but responsive to current
5 from the grounded source, together with
means to ground the circuit of the switch
and link to energize the actuating magnets
before and the release magnet after a con-
versation, but during the same maintaining

the circuit clear of grounds, substantially as 10
described.

In testimony whereof I affix my signa-
ture, in presence of two subscribing wit-
nesses.

CHARLES LOUIS ZAHM.

Witnesses:

C. D. McCONAHY,

GEO. E. HIGGINS.