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AUTOMATIC RINGING SYSTEM.

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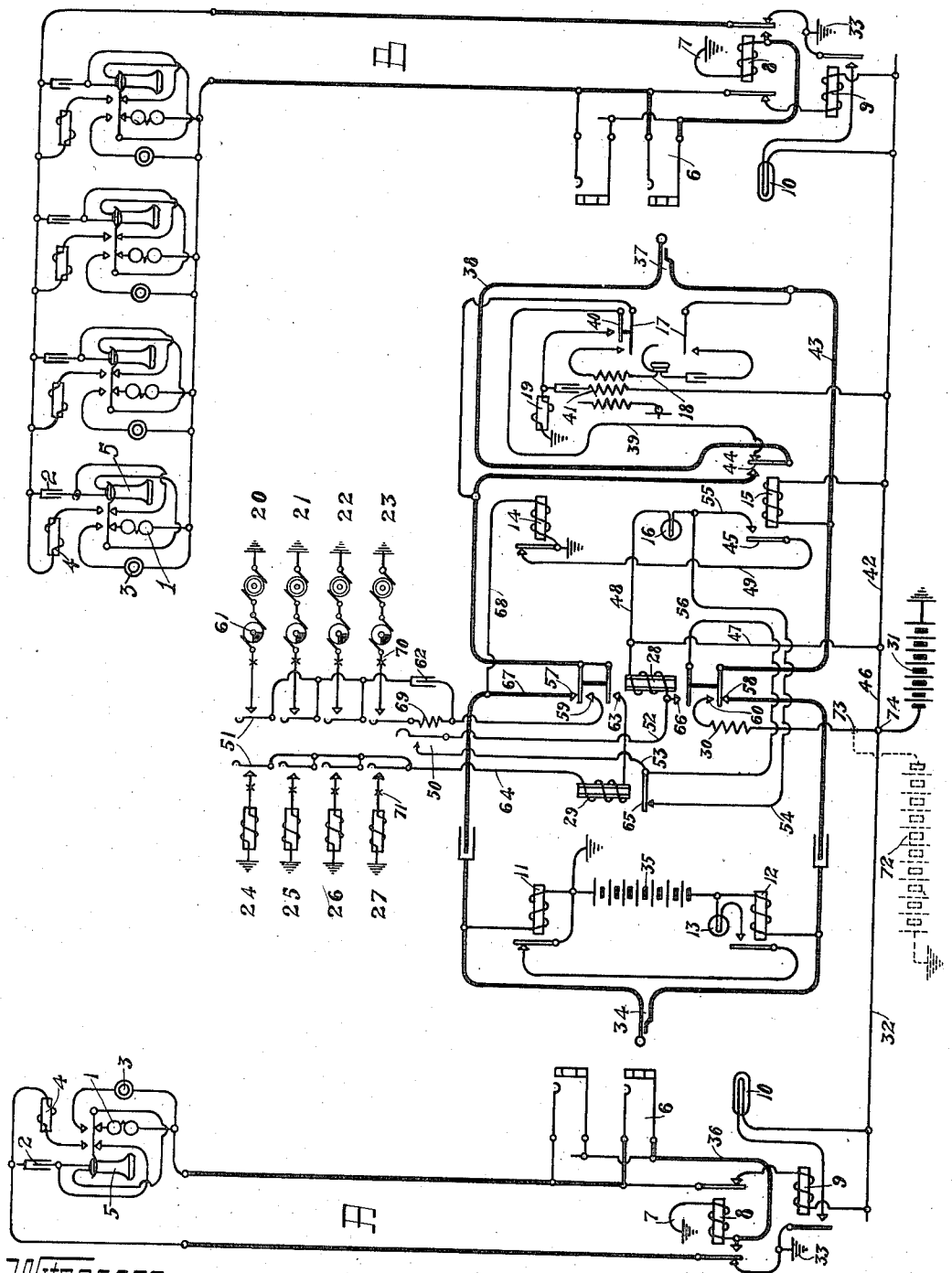

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AUTOMATIC RINGING SYSTEM.

1,029,649. Specification of Letters Patent. Patented June 18, 1912.

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To all whom it may concern:

Be it known that I, ALFRED H. WEISS, a citizen of the United States, residing in Wilmette, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Automatic Ringing Systems, of which the following is a specification.

My invention relates to common battery telephone exchange systems, and more particularly to a system of automatic ringing for such systems, by means of which the desired subscriber's bell is rung automatically by the act of inserting the plug in the jack of the line, the ringing of the subscriber's bell continuing until the subscriber responds to the call by removing his telephone receiver from the switch-hook, when the ringing is automatically discontinued. I prefer to use an intermittent ringing current rather than a continuous ringing current.

The object of my invention is to provide simple and efficient means for calling the subscribers as above described.

In the drawing I have shown a common battery telephone exchange system embodying one form of my invention.

The invention may be used for signaling upon polystation lines, and I have accordingly shown a line with a single subscriber upon the left, and a line with a plurality of subscribers located thereon upon the right of the figure.

Both of the telephone lines A and B have the same equipment and the same reference numerals are used to indicate like parts in both lines.

The substation apparatus shown consists of a bell 1 and condenser 2 connected in series when the telephone receiver is upon its hook, for signaling purposes, the bell being removed from the circuit when the receiver is removed from the hook for conversation, and a path for current is then closed through the transmitter 3 and the impedance coil 4, the voice currents being shunted through the receiver 5 and the condenser 2. Any form of substation circuit may be employed in lieu of that described. The limbs of the telephone lines terminate in jack contacts 6, the sleeve contacts of the jacks being connected to the ground 7 through the winding of the cut-off relay 8. A line relay 9 and line lamp 10 are also provided for each line. Two supervisory relays 11 and 12 are preferably provided for the answering end of the cord circuit, these relays jointly controlling the circuit of the supervisory lamp 13. Corresponding supervisory relays 14 and 15 are provided for the calling end of the cord circuit, said relays being adapted to jointly control the circuit of the supervisory lamp 16. The usual operator's listening key 17 and head telephone 18 are provided, and a testing coil 19 is associated with the listening key in such a manner as to inform the operator of the idle or busy condition of the desired line when the line is tested by producing the usual click in her telephone receiver.

Referring more particularly to the automatic ringing features of the system, I provide suitable generators 20, 21, 22 and 23 and impedance coils 24, 25, 26 and 27, a control relay 28, a slow-acting relay 29, and a non-inductive resistance 30 with key mechanism and circuits for suitably associating these elements with those previously mentioned. For the purpose of explaining the operation of the system, we will assume the subscriber on the line A desires a connection with one of the subscribers on the line B. He will remove his receiver from the hook, closing a path for current from the battery 31, through conductor 32, line relay 9, the limbs of the telephone line, including the substation apparatus to ground 33. The line relay will respond to this current attracting its contact spring and lighting the line lamp 10. The operator attracted by this signal will insert her answering plug 34 in the jack 6 of the calling line which will close a path for current from the battery 35, through the sleeve supervisory relay 12, sleeve contacts of the plug and jack, conductor 36 and the winding of the cut-off relay 8 to the ground 7. The cut-off relay will attract its contact springs opening the circuit of the line relay 9 at one contact to retire the line signal 10, and removing the ground 33 at the other contact connecting that limb of the line with the sleeve of the jack. A portion of the current flowing to ground through the cut-off relay 8 will flow over the limbs of the telephone line and through the substation apparatus, returning to the battery 35 through the tip contacts of the jack and plug and the winding of the supervisory relay 11. The supervisory relay 12 is energized as long as the plug is in the jack through the local circuit provided by the

ground 7, and closes the circuit of the supervisory lamp 13 at its contacts, but due to the fact that the subscriber's telephone is off its hook, the supervisory relay 11 is energized, opening the circuit of the supervisory lamp 13 at the contacts of relay 11, so that the supervisory signal 13 remains inert, but is lighted as a clearing out signal through the deënergization of relay 11 when the subscriber replaces his receiver upon the hook at the conclusion of the conversation.

The operator after inserting the plug 34 in the jack of the calling line, throws her listening key 17 and inquires the number of the desired subscriber. Ascertaining that a subscriber upon the line B is desired, she tests the condition of the line by touching the tip of her calling plug 37 to the sleeve contact of the line. If there is a connection already established with the line at some other position of the switchboard, a potential above that of earth will exist upon the sleeve contact of the multiple jack of the line, and when the tip of the plug is touched to and removed from the sleeve contact, battery will flow through the tip strand 38 of the cord circuit, the normally closed back contact of supervisory relay 15, conductor 39, contact 40 on the listening key to ground through the impedance coil 19. The discharge from the impedance coil 19 during the testing process will pass through the tertiary winding 41 to ground through battery 31, thus notifying the operator by an inductive click in her telephone receiver, that the line is busy. If no connection exists with the desired line, no current will flow through the path just traced when the line is tested, and no click will be received in the operator's receiver.

If the line is idle, the operator will insert the plug 37 in the jack of the desired line, closing a path for current from battery 31, over conductor 42, the winding of supervisory relay 15, sleeve strand 43, and sleeve contacts of the plug and jack to ground through the winding of cut-off relay 8. The cut-off relay will attract its contact springs, opening the circuit of the line relay 9 at one contact, preventing the operation of the line lamp 10 and removing the ground 33 from the other limb of the line, connecting said last mentioned limb with the sleeve contact of the jack. Current in this path will operate the supervisory relay 15 which will attract contact spring 44, removing the testing conductor 39 from the tip of the plug and establishing the continuity of the tip cord strand 38 at the front contact of said relay for conversation. Contact spring 45 of supervisory relay 15 will also be attracted, closing the circuit of supervisory lamp 16 at this point, but due to the fact that the subscriber has not yet removed his telephone from the hook, tip supervisory relay 14 is not yet energized, thus lighting the supervisory lamp 16 from battery 31, over conductors 46, 47, 48 and 49 to ground at the closed contacts of supervisory relay 14. When the called subscriber responds, supervisory relay 14 will be energized over the telephone line, opening the circuit of the supervisory lamp 16 at that point, thus indicating to the operator that the subscribers are in conversation. Also, when the called subscriber replaces his telephone upon the hook at the termination of the conversation, a path for current through the supervisory relay 14 will be interrupted, permitting its spring to drop back, reëstablishing the circuit of the supervisory lamp 16 to indicate to the operator that the conversation is terminated.

I preferably provide a separate generator for each station upon the line, the arrangement being such that the bell at each station is responsive to current from one generator only. I prefer to accomplish this selective signaling by providing different frequencies of ringing current for each generator and tuning the bells at the substations to respond to the different frequencies of current. It should be understood, however, that this method of selective signaling is shown for the purpose of describing the operation of my automatic ringing system, and that other methods of selective or non-selective signaling may be employed with my automatic ringing arrangement.

I have shown four generators 20, 21, 22 and 23 preferably adapted to deliver alternating current to the line of four-thousand, three-thousand, two-thousand and one-thousand cycles respectively per minute, the bells of the four subscribers' stations upon the line B being adapted to respond to these frequencies. Impedance coils 24, 25, 26 and 27 are adapted to be connected between ground and the alternate contact of each generator key. An additional key contact 50 is also provided, which is adapted to be closed momentarily when any of the generator keys are closed, the arrangement being such that the generator will remain closed to continue the operation of ringing, while the key 50 will be closed momentarily and then released to restore to its normally open condition.

The operator having now ascertained the number of the subscriber desired and inserted the calling plug 37 in the jack of the line B, will operate the ringing key corresponding to that station. We will assume that she operates ringing key 51. Ringing key 50 will also be closed momentarily which will close a path for battery current through the control relay 28 which may be traced from battery 31, over conductors 46 and 47, the winding of said control relay 28, conductor 52, key contacts 50 and con-

ductors 53, 54, 55 and 49 to ground at the contact of supervisory relay 14. Control relay 28 will be energized by this flow of current and attract its contact springs, closing a locking circuit for itself which may be traced from battery 31, over conductors 46 and 47, the winding of said relay, contact 66 conductors 56, 54, 55 and 49 to ground at the contacts of supervisory relay 14. The energization of control relay 28 opens the tip and sleeve strands of the cord circuit at back contacts 57 and 58 to prevent the ringing current from passing back over the line of the calling subscriber. It also closes the path for ringing current at its front contacts 59 and 60, the path for said ringing current being traced from generator 20, through the interrupter 61, ringing key contact 51, condenser 62, contact 59 of control relay 28, tip strand 38 of the cord circuit, the limbs of the telephone line and the substation apparatus, sleeve strand 43 of the cord circuit, contact 60 of control relay 28, the non-inductive resistance 30 to ground through battery 31. Ringing current in this path will be applied intermittently due to the rotation of the circuit-breaker 61 until the called subscriber responds by removing his telephone receiver from the hook. It will be noted that the return path for the ringing current includes the winding of supervisory relay 15 and conductors 42 and 46 to battery 31, and the non-inductive resistance 30 is placed in a shunt about the supervisory relay 15 to prevent the ringing current from chattering said relay.

It will be noted that a path for current also exists from the contact 63, through relay 29, conductor 64, the depressed ringing key contact and the associated impedance coil 24, to ground. This path is provided for battery current when the subscriber responds to the call, said battery current being adapted to energize relay 29 and attract its armature 65, thus opening the locking circuit of control relay 28 and restoring the ringing apparatus to normal condition. Assuming now that the subscriber removes his receiver from the hook in response to the signaling current from generator 20, a path for battery current is closed through the substation apparatus which may be traced from battery 31, over conductors 46 and 42, the winding of supervisory relay 15, sleeve strand 43, sleeve contacts of the plug and jack, the limbs of the telephone line, the tip contacts of the jack and plug, tip strand 38 of the cord circuit, front contact 63 of control relay 28, the winding of relay 29, conductor 64 and the ringing key contacts to ground through impedance coil 24. Current in this path will energize relay 29 which will attract its contact spring 65, opening the locking circuit of control relay 28 and permitting its contact springs to drop back. The continuity of the cord circuit will be reëstablished at back contacts 57 and 58 of the control relay, the ringing current will be cut off at intermediate contacts 59 and 60 of said relay and the circuits of the relays 28 and 29 will be opened at front contacts 63 and 66, thus restoring the ringing apparatus to normal condition. When the contact 63 is open, the battery current flowing to ground through relay 29 will be diverted through contact 57, and conductors 67 and 68 to ground through tip supervisory relay 14. Said relay will be energized opening the circuit of the supervisory lamp 16 which will be extinguished to notify the operator that the called subscriber has responded.

The impedance coils 24, 25, 26 and 27 are of very high impedance to the alternating ringing current so as to permit the passage of very little of the ringing current, and relay 29 is preferably provided with a copper shell to prevent its possible energization in response to such alternating ringing current as may pass through the impedance coils 24, 25, 26 or 27. It is not responsive therefore to the ringing current, which is practically all forced by the impedance coils to take the alternate path over the telephone line and through the substation ringer. The impedance coils, however, afford a ready path for the battery current when the subscriber responds to the call, and relay 29 is energized by the flow of battery current as above described. The battery 31 is preferably of high voltage, from forty to forty-eight volts, in order to insure the operation of relay 29 over a line of high resistance.

The low frequency ringing current adapted to be impressed upon the line by generator 23 will not pass readily through the condenser 62 and the condenser at the subscriber's station in series, and for this low frequency of current, the non-inductive resistance 69 is provided for the ringing current instead of the condenser 62 which is used for the three higher frequencies. The generator circuit is common to a plurality of cord circuits at the point 70 and the impedance coil is common to a plurality of cord circuits at the point 71. In ringing two or more subscribers at one time from the low frequency generator 23, the relay 29 of each cord circuit being rung would be bridged across the common points 70 and 71. Now if the non-inductive resistance 69 were low enough, there might be a tendency to operate the said several relays 29 when any one of the subscribers being called by the low frequency current, would respond. This would be caused by current from battery 31 flowing out over the line of the responding subscriber, to contact 59 and then through resistance 69 to the common point

70. From there it would flow through the key contact, resistance 69, contacts 59 and 63 and through the relay 29 of the other cord circuits to ground at impedance coil 27, actuating the other relays 29 and releasing their associating ringing apparatus. To prevent this possible premature release of any of the ringing apparatus, the non-inductive resistance 69 is made of high ohmic resistance, preferably one thousand ohms. It would be necessary for the battery current to flow through two of these coils in series to accomplish the premature release of the ringing apparatus and one thousand ohms has been found sufficient to prevent such an occurrence.

If it is desired to use a battery of low voltage such as twenty or twenty-four volts for talking and signaling purposes, a booster or assisting battery for the purpose of releasing relay 29 upon the response of a called subscriber, may be employed. I have shown battery 72 in dotted lines for this purpose, sixty volts being sufficient for the purpose when used in connection with a twenty-four volt battery for talking purposes. The battery 72 would be connected at the point 73 and the conductor between this point and point 74 would be removed.

With the circuit so arranged, when the operator closes the ringing springs and relay 28 is energized, there will result a reversal of current flow in the relay 15, due to the closing of contact 60 of said relay 28. This reversal is due to the voltage of battery 72 overcoming that of the battery 31. The reversal of current through supervisory relay 15, would therefore momentarily de-energize said relay and there would be a tendency to open the contact 45, thereby opening the locking circuit of relay 28. To prevent said relay 28 from retracting its armature and moving its contacts to normal when a high voltage or booster battery is employed, the said relay 28 is provided with a copper shell upon its core, rendering it sluggish in its action. Therefore, should the relay 15 momentarily retract its armature the relay 28 will retain its armature in an attracted position, preventing its springs from restoring to normal.

Upon the response of the called subscriber current will flow from battery 72 to resistance 30, contact 60 to sleeve strand 43, the sleeve contact of the plug and jacket, and then over the path previously described in connection with the battery flow from battery 31 upon response of the called subscriber.

I claim:

1. In a telephone system, the combination with a calling and a called subscriber's telephone line, an operator's link circuit connecting said lines, a source of ringing current, a disconnect relay, a ringing key, a control relay energized responsive to actuation of said key to connect said disconnect relay and ringing current in separate bridges of said called line through contacts of said control relay and disunite the calling and called lines, and means under the control of the called subscriber to energize said disconnect relay, whereby said bridges are removed and the continuity of said connection is established.

2. In a telephone system, the combination with a calling and a called subscriber's telephone line, a cord circuit connecting said lines, a source of ringing current, a disconnect relay, means for connecting said current and said relay in separate permanent bridges of said called line until a response of the called subscriber is secured, a source of battery current, and means actuated upon response of the called subscriber to include said battery current in said relay bridge whereby said relay is energized, and means effective upon the energization of said relay to disconnect said ringing current.

3. A telephone system comprising a called subscriber's telephone line, a link circuit for connection thereto, a source of ringing current, a source of battery current, means for simultaneously connecting said currents in separate bridges of said called line, a relay included in said battery bridge, a signal for said subscriber's line actuated responsive to said ringing current bridge, and means controlled by the called subscriber to render the battery bridge effective to energize said relay, whereby said ringing current bridge is disconnected.

4. In a telephone system, the combination with a called subscriber's telephone line, of a cord circuit connected thereto, a supervisory signal actuated responsive to said connection, a ringing key actuated to signal the called subscriber, a control relay energized responsive to said actuation to disunite the answering and calling ends of said cord circuit while the called line is being signaled, a battery, a supervisory relay disconnected from the calling end of said cord circuit, means actuated upon the response of the called subscriber to deënergize said control relay to establish the continuity of said cord circuit, said supervisory relay being thereupon connected to the calling end of said cord circuit and energized by battery over said line, said signal being effaced upon the energization of said supervisory relay.

5. In a telephone system, the combination with a cord circuit, a calling and a called subscriber's telephone line connected thereby, a grounded source of ringing current and a grounded source of battery current having their ungrounded terminals connected to opposite limbs of the called line, said ringing current serving to signal the called subscriber, a disconnect relay having one ter-

minal connected to the limb which is connected to the ringing current and the other terminal to ground, means for simultaneously maintaining said connections of the ringing current and relay to said limb, means at the called substation for preventing a flow of current from said battery through said relay, and a switch at the called substation for rendering the last said means ineffective, whereby said relay is energized by said battery over said line to disconnect said ringing current.

6. In a telephone system, the combination with a called subscriber's telephone, a pair of conductors therefor leading to the exchange, a source of signaling current in bridge of said conductors for signaling the called subscriber, a battery, and a relay connected in a separate bridge of said line, an impedance coil included in the latter bridge to prevent shunting said signaling current by said bridge, means at the substation for preventing a flow of battery current through said relay over the limbs of said line, and a switch at the substation actuated upon response of the called subscriber to render the latter means ineffective whereby said relay is energized to disconnect said signaling current.

7. A telephone system comprising a called substation telephone line, a link circuit connected thereto, a source of ringing current, a battery and a relay, means for connecting and simultaneously maintaining said ringing current, and said battery and relay in separate bridges of the cord circuit and line, a signal at the called substation responsive to said ringing current, means at the substation for preventing a flow of current from said battery through said relay, and a switch at the substation actuated to effect a flow of current from said battery through said relay whereby said relay is energized and said current is disconnected.

8. A telephone system comprising a called substation telephone line, a link circuit connected thereto, a grounded source of ringing current connected to the tip conductor of said link circuit, a relay and impedance coil serially connected from ground to said tip conductor, a grounded source of battery current having its ungrounded terminal connected to the sleeve conductor of said link circuit, a signal at the called substation responsive to said ringing current, means at the substation to prevent a flow of current from said battery through said relay and impedance coil, and a switch at the substation actuated to effect a flow of current from said battery through said relay and impedance coil, whereby said relay is energized to cause disconnection of said ringing current from said tip conductor.

Signed by me at Chicago, county of Cook and State of Illinois, in the presence of two witnesses.

ALFRED H. WEISS.

Witnesses:
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