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H. G. WEBSTER.

TELEPHONE EXCHANGE SYSTEM.

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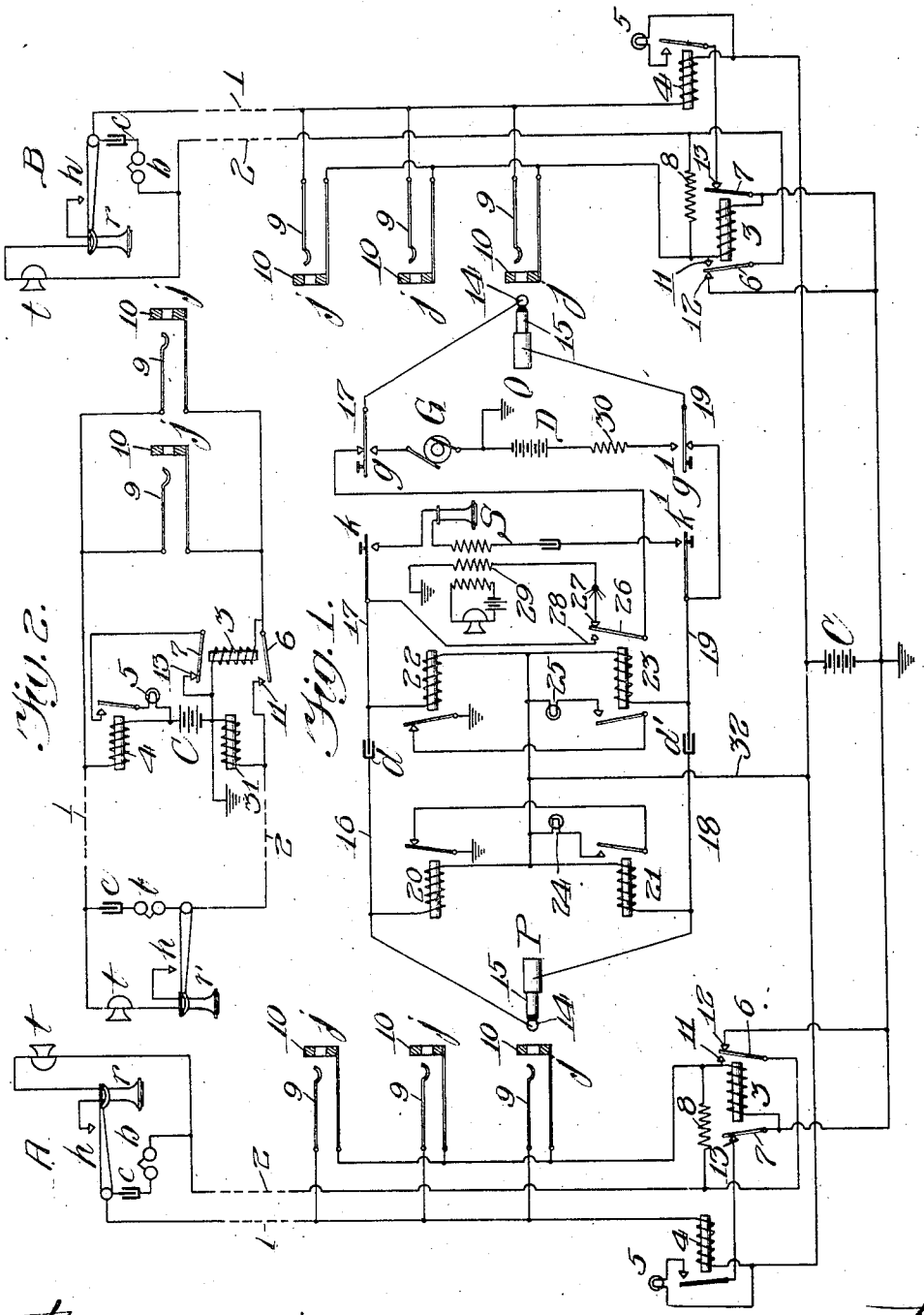

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TELEPHONE-EXCHANGE SYSTEM.

No. 855,546. Specification of Letters Patent. Patented June 4, 1907.

Application filed December 16, 1904. Serial No. 237,145.

To all whom it may concern:

Be it known that I, HARRY G. WEBSTER, a citizen of the United States, and a resident of Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part of this specification.

My invention relates to telephone exchange systems in which current for transmission and signaling is furnished from a central source located at the exchange; in which the spring jacks or connection terminals are provided with but two contact pieces corresponding to the two line limbs, one contact piece being utilized as a test terminal; and in which the normal battery connections of the line are broken or altered by the actuation of a cut-off relay upon the insertion of a connecting plug into a spring jack. In systems of this character, it has been common practice to leave one or both of the spring jack contacts normally disconnected from the line limbs, and by the action of the cut-off relay to disconnect one or both line limbs from the calling battery and subsequently connect them with the wires leading to the spring jack terminals. One result of this circuit arrangement is that when a subscriber is waiting for the operator to answer his call, the breaking of the normal line connection, which follows the insertion of the answering plug, causes an objectionable noise or "click" to be heard through his receiver.

The object of my invention is to provide an improved organization of circuits and apparatus for systems of this class in which this objectionable "click" or noise is eliminated.

Other advantages of my improved system will be apparent from the following description.

In accordance with my invention, I provide spring jacks or switching terminals at the central exchange permanently connected with the line; and so arrange the circuits controlled by the cut-off relay that the circuit of the line limbs is not interrupted upon the insertion of an answering plug in response to a calling signal.

My invention will be further understood from the accompanying drawing in which

Figure 1 illustrates diagrammatically two complete line circuits with appropriate cord connecting apparatus organized in accordance with a preferred form of my invention; and in which Fig. 2 illustrates a modification of the line circuit arrangement, with which the cord circuit of Fig. 1 is also adapted to co-operate.

Like characters refer to corresponding parts in the two figures.

Referring to Fig. 1, the subscriber's apparatus shown at A is represented as consisting of a telephone hook switch *h*, signal bell *b*, condenser *c*, receiver *r* and transmitter *t*; the bell and condenser being in permanent bridge of the two line limbs, and circuit being closed through the receiver and transmitter upon the elevation of the hook switch. Although I have shown but one arrangement, it will be understood by those skilled in the art that various other arrangements of the subscriber's apparatus may be used, and I do not confine myself to the particular arrangement illustrated. Under normal conditions, the receiver hangs upon its hook switch, maintaining its upper contact open, and the condenser *c* prevents a normal flow of current from battery C at the central office over the line limbs. When the subscriber removes his telephone from its hook, thus closing the upper contact of hook switch *h* and establishing a relatively low resistance path for the flow of current through the transmitter *t* and receiver *r*, relay 4 at the central office will be operated by the flow of current from said battery C through the winding of relay 4, limbs 1 and 2 of the telephone line, armature 6 and anvil 12 of relay 3, and thence to the office return or grounded side of the battery C. This flow of current through relay 4 causes its energization and the consequent illumination of calling lamp 5; the circuit of lamp 5 being completed from battery C through anvil and armature of relay 4, anvil 13 and armature 7 of relay 3, to the return side of the battery. Each subscriber's line is provided with one or more spring jacks *j*, each having contact pieces 9 and 10 associated with limbs 1 and 2 of the line, respectively; contact piece 9 being directly connected with limb 1 and contact piece 10 being connected with limb 2 through the resistance 8. The illumination of signal lamp 5 indicating to the operator that the subscriber has removed his receiver from its hook for the purpose of

making a call, she inserts the answering plug P into a spring jack *j* corresponding to the calling signal, thus causing contact piece 14 of the plug to engage contact piece 9 of the spring jack and contact piece 15 of the plug to engage contact piece 10 of the spring jack. Current will now flow from battery C through conductor 32, relay 21, plug and jack contact 15—10 to the junction point of resistance 8 and the winding of relay 3, at which point it will divide, a portion going through relay 3 to the return side of the battery C, and a portion going through resistance 8, armature 6 and anvil 12 to the return side of the battery; and resistance 8 is so proportioned with relation to the resistance of the winding of relay 3 that relay 3 will at this time receive sufficient current to cause its actuation. The initial actuation of relay 3 interrupts a circuit of lamp 5 at armature 7 and anvil 13 and also interrupts the circuit previously traced through resistance 8 at armature 6 and anvil 12, and the further movement of armature 6 causes it to engage anvil 11, thus short circuiting resistance 8. After the disengagement of armature 6 with anvil 12, the current through relay 21 will all flow through the winding of relay 3, while the current in the line limbs will flow through relay 3 as well, resistance 8 being included in this latter circuit until short circuited by the engagement of armature 6 with anvil 11. The closing of contact 14—9 of the plug and spring jack has also completed a circuit of battery C through relay 20 to limb 1 of the line, thus increasing the current in the line limbs which was originally set up through relay 4, and causing the energization of relay 20 as long as the circuit of the limbs is completed through the receiver and transmitter. It will be seen at this time that, relay 21 being energized, the circuit of lamp 24 will be closed at the contacts of this relay, but the lamp will remain dark as long as its circuit is interrupted at the contacts of relay 20 through the energization of the latter relay.

After being informed with what line connection is desired, in this case that of subscriber B, the operator tests in the usual manner by touching the tip of her calling plug O to the contact piece 10 of a jack associated with that line. It will be seen that under normal conditions, no noise will be heard in the receiver of the operator's set S for the reason that the contact piece 14 of the calling plug is normally connected to earth or office return, and that contact piece 10 of the jack has a direct connection to the same earth or return which may be traced from the junction point of limb 2 with resistance 8, through armature 6 and anvil 12 of relay 3. If, however, a connecting plug is in a spring jack of the line tested, this direct earth connection of resistance 8 is interrupted through the energization of relay 3, and current will then flow from battery C through relay 21 or 23 associated with the aforesaid connecting plug, through contact 15—10 of the said plug and spring jack, contact piece 10 of the jack tested, contact piece 14 of the testing plug and thence through strand 17, armature 26 of relay 23, anvil 27 and winding 29 of the operator's induction coil, thus producing the customary "click" which indicates that the line is busy. Upon the insertion of the plug and the actuation of the ringing key, relay 3 of the called line is energized by current flowing from battery D through resistance 30, contact 15—10 and thence through the winding of relay 3 to the ground or office return. At the same time, the circuit of calling generator G is completed through strand 17, contact 14—9, limbs 1 and 2 of the line and thence to the office return. Upon the restoration of the ringing key, a circuit for relay 23 is completed similar to that previously traced for relay 21, and the consequent energization of relay 23 closes the circuit of lamp 25 causing its illumination, and armature 26 disengages anvil 27, thus disconnecting the test winding 29 from the cord circuit, and engages anvil 28 thus completing the circuit of strand 17. When the subscriber answers, a circuit of battery C is completed through relay 22 and strand 17 similar to that previously traced through relay 20 and the consequent energization of this relay interrupts at its contacts the circuit of lamp 25, causing its extinguishment. Strands 16 and 17, and strands 18 and 19 of the cord circuit are inductively united by the condensers *d* and *d*^{1} respectively, and the subscribers are now able to converse; current for the energization of their transmitters being furnished over the circuit which includes the winding of relay 4 in multiple with relay 20 or 22, limbs 1 and 2 of the line and the winding of relay 3. If either subscriber hangs up his receiver, the consequent deënergization of relay 20 or 22 completes the circuit of the corresponding supervisory lamp 24 or 25 and the illumination of both lamps constitutes the usual disconnect signal. It will also be noted that after the disengagement of armature 6 and anvil 12, relay 3 will be energized to maintain the attracted position of its armatures as long as circuit is closed through the substation receiver and transmitter, or through contact 10—15 of the plug and spring jack; and that it requires the interruption of both of these circuits before the relay will become deënergized.

The line circuit arrangement of Fig. 2 differs from that of Fig. 1 in that the resistance 8 of Fig. 1 is replaced by the impedance coil 31 in permanent bridge of the line with the battery C and relay 4. Its operation is substantially the same as that of the arrangement of Fig. 1 and will be readily understood. Upon the insertion of a connecting plug, cur-

rent from battery C will flow through relay 21 or 23, contact 15—10 of the plug and jack and the winding of relay 3, causing the energization of both relays. The actuation of relay 3 causes armature 6 to engage anvil 11, thus bringing relay 3 into multiple circuit with impedance 31; the circuit of lamp 5 is controlled in the manner previously described. The resistances of impedance 31 and relay 3 are so proportioned that after the engagement of armature 6 with anvil 11, relay 3 will still receive sufficient current to maintain the attracted position of its armature as long as the plug remains in the spring jack, or circuit is closed through the substation receiver and transmitter. The circuit conditions in this figure for the supply of transmission current and during the process of testing and ringing will be readily understood from the description of the arrangement of Fig. 1.

While separate batteries, C and D, have been indicated and separate grounds or return connections for these batteries and the generator G, it will be understood that these may be one and the same. It will be seen in both arrangements indicated that after the removal of the receiver from the hook switch to initiate a call, there is no instant, as in systems of the prior art, during which current ceases to flow through the substation apparatus, and it is this feature of my improved system which results in the elimination of the objectionable "click."

It will be understood by those skilled in the art that various modifications of my invention may be made without departing from its spirit and I, therefore, do not limit myself to the precise structures shown and described.

Wherever the terms "spring jacks" or "connection terminals" are employed in the following claims, I desire it to be understood that they refer to such organizations as a whole, rather than to their individual parts; but wherever in said claims a portion only of the spring jack is meant, such distinction is clearly pointed out.

I claim:—

1. The combination with a metallic telephone line, of a talking contact forming a part of a connection terminal for the line, said contact being normally connected to earth, a central source of current associated with the line and adapted to be included in the metallic circuit of the line when a connection exists to furnish current to the substation transmitters for talking purposes, means for establishing a direct earth connection intermediate of said contact and its associated line limb when the line is not in use, means operated by current from said source to connect said contact directly with the line when the line is in use and testing apparatus to co-operate with said contact to indicate the condition of the line, substantially as described.

2. A telephone system comprising a telephone line extending in two limbs from a substation to the central office, tip and sleeve terminal contacts in which said line limbs terminate, a cord circuit for making connection to said line, means for holding conversation over said line and cord circuit, a source of current, means under the control of the subscriber for completing a calling circuit including said line and source of current, a signal actuated in response to the completion of said circuit, a controlling electromagnet associated with said telephone line, a resistance, said resistance and an energizing winding of said magnet being connected serially with the sleeve limb of said telephone line and said source of current, a normal short circuit between the line limb and said source of current about said resistance and energizing winding, means under the control of the operator for energizing said magnet, and means operated by said magnet to remove said short circuit, to short circuit said resistance and to place said signal beyond the control of the subscriber.

3. A telephone system comprising a telephone line extending in two limbs from a substation to the central office, tip and sleeve terminal contacts in which said line limbs terminate, a cord circuit and connecting plug for establishing connection through said terminal contacts to said line limbs, means for holding conversation over said line and cord circuit, a source of current, means under the control of the subscriber for completing a calling circuit including said line and source of current, a signal actuated in response to the completion of said circuit, a resistance connected in circuit with the sleeve limb of said line and its terminal contact, a controlling electromagnet having an energizing winding connected in circuit between said terminal contact and said source of current, a normal short circuiting path between said line limb and said source of current about said resistance and energizing winding, means under the control of the operator for energizing said electromagnet, and means operated by said magnet to remove said short circuit, to short circuit said resistance and to place said signal beyond the control of the subscriber.

4. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a line signal normally under the control of the subscriber, an electromagnet for destroying said normal substation control, a source of current, a connection terminal for said line having a test contact, a resistance, said resistance and an energizing winding of said electromagnet being connected in parallel circuit between said test contact and said source of current, con-

tacts controlled by said electromagnet included in said parallel circuit, means under the control of the operator for operating said electromagnet and for determining the idle or busy condition of the line through the agency of said test contact.

5. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a line signal normally under the control of the subscriber, an electromagnet for destroying said normal substation control, a source of current, a connection terminal for said line having a test contact, a resistance connected in circuit between said contact and a line limb, means operated by said electromagnet for establishing a connection between said contact and line limb about said resistance, and means under the control of the operator for operating said electromagnet and for determining the idle or busy condition of the line through the agency of said test contact.

6. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a line signal normally under the control of the subscriber, an electromagnet for destroying said normal substation control, a source of current, a connection terminal for said line having a test contact, a resistance, said resistance and an energizing winding of said electromagnet being connected in parallel circuit between said test contact and said source of current, a normal short circuit about said energizing winding, means operated by said electromagnet for removing said short circuit, and means under the control of the operator for operating said electromagnet and for determining the idle or busy condition of the line through the agency of said test contact.

7. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a line signal normally under the control of the subscriber, an electromagnet for destroying said normal substation control, a source of current, a connection terminal for said line having a test contact, a resistance connected in circuit with said contact, a portion of said line limb and said source of current, a parallel branch including an energizing winding of said electromagnet and said source of current, means operated by said electromagnet for establishing a connection between said contact and said line limb about said resistance and for interrupting the normal line limb connection to said source of current, and means under the control of the operator for operating said electromagnet and for determining the idle or busy condition of the line through the agency of said test contact.

8. A telephone system comprising a telephone line extending in two limbs from a substation to a central office, a line signal normally under the control of the subscriber, an electromagnet for destroying said normal substation control, a source of current, a resistance, said resistance and source of current being connected serially with an energizing winding of said electromagnet and one limb of said telephone line, a connection terminal for said telephone line having a test contact connected at a point between said resistance and said electromagnet winding, means operated by said electromagnet for establishing a connection between said contact and line limb about said resistance, and means under the control of the operator for operating said electromagnet and for determining the idle or busy condition of the line through the agency of said test contact.

In witness whereof, I hereunto subscribe my name this 10th day of December, A. D., 1904.

HARRY G. WEBSTER.

Witnesses:
L. D. KELLOGG,
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