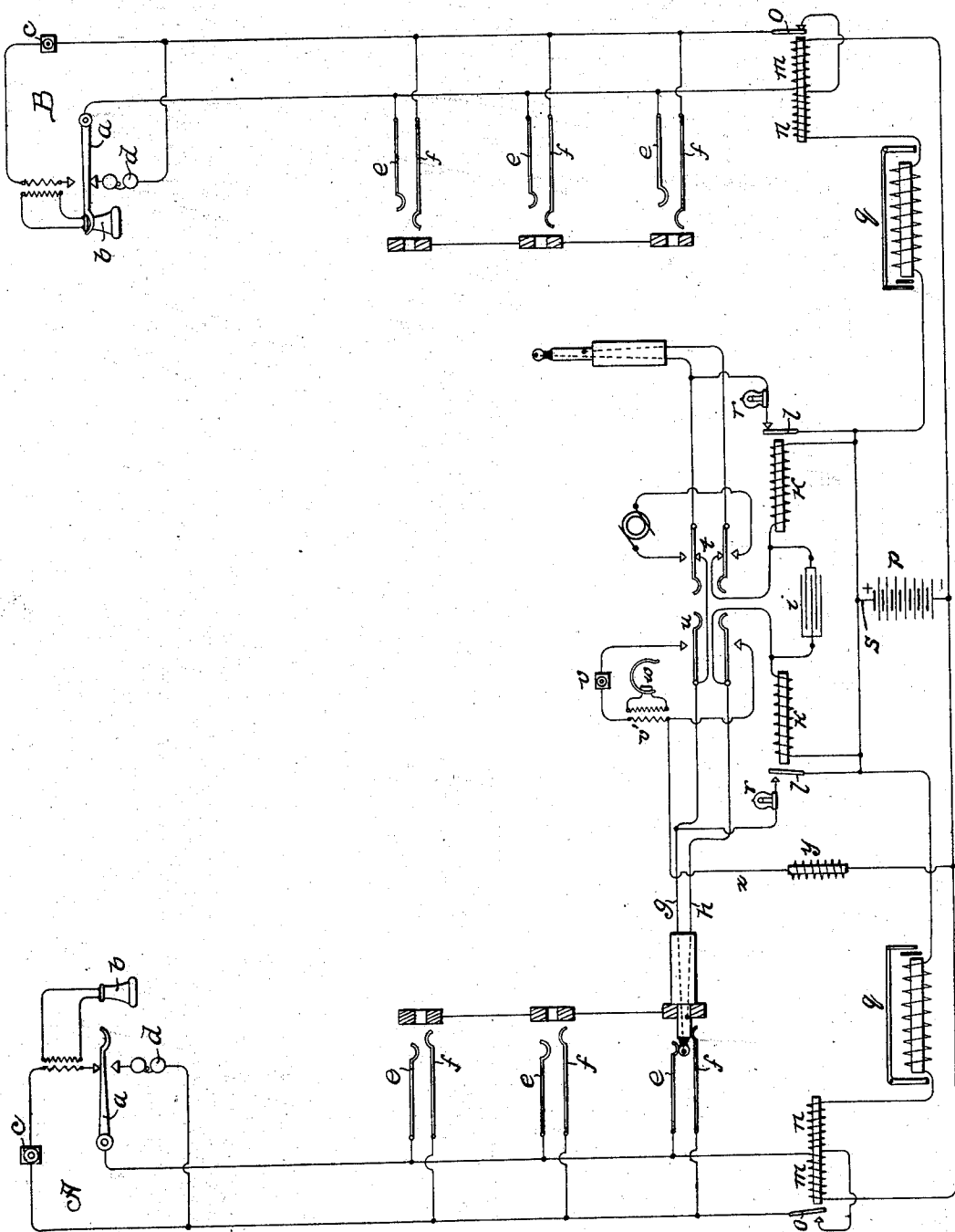


No. 752,761.

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W. M. DAVIS.
MULTIPLE SWITCHBOARD SYSTEM.
APPLICATION FILED DEC. 7, 1900.

NO MODEL.



Witnesses:
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UNITED STATES PATENT OFFICE.

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MULTIPLE-SWITCHBOARD SYSTEM.

SPECIFICATION forming part of Letters Patent No. 752,761, dated February 23, 1904.

Application filed December 7, 1900. Serial No. 38,984. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Multiple-Switchboard 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 multiple-switchboard systems, and has for its object the provision of means whereby the line-indicating mechanism set forth in the Patent No. 688,452 of Harry G. Webster may be employed without making it necessary to have a break in the telephone-line at the said mechanism, which is objectionable for the reason that each added contact included serially in the talking-circuit increases the impairment of the transmission of voice-current. Generally speaking, the line-indicating mechanism illustrated in the said above-mentioned patent may be said to comprise a differentially-wound relay, the oppositely-wound coils of which when included in circuit with the battery serve to exert neutralizing effect upon each other, so that the armature of the relay will not be actuated. The armature of the relay normally rests against a normal contact that is connected with one terminal of a line-indicator, and the indicator and relay are so associated with the telephone-line that a subscriber in initiating a call will effect the passage of current through the coils of the relay and the said indicator or the electromagnet of the indicator to effect the operation of the same, the arrangement being such that the current flowing through the coils of the relay will not serve to remove its armature from the said normal contact, whereby the signal may be effected and maintained until the operator modifies the circuit conditions by means of her switching apparatus. For this purpose the operator's switching apparatus that is employed for connecting subscribers for conversation is preferably associated with switch parts that cooperate with the switching appa-

ratus when the same is operated in establishing connection to afford a path of lower resistance through one of the coils of the relay, the other coil thereby being practically shunted from circuit, so that the former will alone create a field to effect the attraction of the relay-armature. The armature when thus attracted is removed from the contact connected with the line-indicator, whereby said indicator and the idle relay-coil are cut out of circuit, the armature being thereupon brought into contact with an alternate contact-anvil, whereby the circuit through the active relay-coil is maintained and the line-annunciator preserves an open circuit during the establishment of a connection. In effecting the control of the line relay and indicator by means of line-connecting apparatus there is preferably employed an electromagnet in the cord-circuit, and there is also provided a switch controlled by the said electromagnet, which in its normal position will afford a local circuit for that coil of the relay that is to remain active, the said electromagnet being adapted for inclusion directly in the line-circuit when the relay-armature is attracted from its normal to its alternate position, whereupon the electromagnet serves to operate its associated switch to open the local circuit, the active coil of the relay and the said electromagnet being thereupon included, preferably, in a bridge of the circuit. A common battery is preferably employed and is preferably located between the active coil of the line-relay and the said electromagnet, the said active coil and electromagnet thereby affording the necessary impedance to prevent the shunting of voice-currents.

In the previously-devised system the switch controlled by the line-relay normally maintained the telephone-line in open circuit for the purpose of test, this circuit being closed when the switch was actuated to effect a change in the condition of the test-circuit and to complete the telephone-line. In the said system one side of the line was connected directly with test-thimbles, which also served as switch parts in connecting lines together for conver-

sation, while the other side was connected with line-springs.

In accordance with my invention I provide a telephone-line that is permanently continuous between each jack-switch connected thereto and the substation, and I include in a bridge of the telephone-line the line-relay, the line-indicator, and the battery, a switch being included in the bridge and adapted for actuation by the said relay in establishing a connection, the switch serving the sole purpose of opening the bridge as the line is closed where said bridge-conductor is connected. With this arrangement I employ test-thimbles that are electrically connected and preferably distinct from the jack-switch parts.

I will explain my invention more fully by reference to the accompanying drawing, in which is illustrated a multiple-switchboard telephone-exchange system equipped and constructed in accordance with my invention.

In the drawing I have illustrated two telephone-stations A and B, each provided with a telephone switch-hook *a*, a telephone-receiver *b*, a transmitter *c*, and a signal-receiver *d*. The system illustrated is a common battery system, and therefore the substations are in this instance not provided with magneto-generators; but I do not wish to be limited to such a system. Each telephone-line extends by its limbs to the exchange and is there connected with the tip line-springs *e* and the sleeve-springs *f*, three jacks of a multiple switchboard being here illustrated. Two plugs are preferably employed having tips and sleeves connected by a tip-strand *g* and a sleeve-strand *h*. The sleeve-strand *h* includes a condenser *i*. Electromagnets *k* *k* are included in a conductor that is in shunt of the condenser, while switches *l* *l* are included in branches that connect the tip-strand with the sleeve-strand.

The line-signaling mechanism comprises in its preferred embodiment a relay having oppositely or differentially wound coils *m* *n*, which create equal opposing effects. The armature *o* of the relay normally includes the coils of the relay in series with the common battery *p*, that may be of forty volts, and the line-indicator or the electromagnet of the line-indicator *q*, the said instrumentalities being preferably connected normally in bridge of the corresponding telephone-line, so that when a subscriber removes his telephone from its switch-hook a circuit is completed through the said instrumentalities, whereby a calling-signal is manifested, which calling-signal is maintained as long as the coils *m* and *n* exert their opposing effects, the armature *o* then remaining in its normal position. When the operator inserts a plug in response to a signal or in connecting a called subscriber, current from the battery *p* is principally confined to a path that includes the helix *m*, the tip line-spring, the tip of the inserted plug, the separable contacts

of the switch *l*, the clearing-out indicator *r*, and the conductor *s*, that is connected with the remaining terminal of the battery. The current is confined principally to this path, as the winding of the line-indicator of the battery *p* is connected with the sleeves of the plugs, so that when a line is busy the test-thimbles will be charged with the battery from that terminal thereof connected with the sleeves of the plugs, which, for example, may be the positive terminal of the battery. The tip of the testing-plug is also connected with the positive terminal of the battery through the switch *l* when it is closed, which is its condition when the cord-circuit is idle.

The following busy-test is provided, as shown in the drawing: When the answering-plug is inserted in the calling subscriber's jack and the calling-plug of the cord-circuit is idle, a circuit may be traced through the operator's set as follows: from the negative side of the battery through the winding *y*, through the primary winding *y'* of the operator's induction-coil, through the operator's transmitter *v*, through the top spring of the listening-in key, to the tip-strand of the cord-circuit, through the signal *r* and armature *l* associated with the calling-plug, and back to the opposite side of the battery. The operator wishing to apply a busy-test to the substation B attaches the tip of the calling-plug to the testing-thimble, and if this line is not in use the test-thimbles therefor will not be positively charged, and the current conditions through the operator's set will not be changed, and consequently no click will be manifested in the operator's receiver. If the line connecting with substation B, however, is in use, the test-thimbles will be positively charged through the winding of the relay *k* connected with the plug in use. This inclusion in circuit of the resistance of the winding *k* changes the current conditions when the tip of the calling-plug is touched to the test-thimble and a click is manifested in the operator's earpiece, thus notifying her that the line to substation B is busy.

As is apparent from the foregoing, I am enabled to employ continuous sides of the telephone-lines in which no break need be employed, so that voice-currents need not be passed through separable contacts in the line.

In certain of the claims I speak of a continuation of the telephone-line beyond the jack in which the said line is said to terminate, meaning that such a jack embraces the final terminal or terminals at the exchange for the purpose of connection, or, if the board is not a multiple switchboard, the only terminals of the line at which connection may be made, the line being in the embodiment of the invention shown continued beyond these terminals not so much for the purpose of talking as for the purpose of creating proper circuit connection.

tions for the propagation of battery-current and signaling-current, &c.

While I have herein shown and particularly described the preferred embodiment of my invention, it is obvious that changes may be made without departing from the spirit thereof, and I do not, therefore, wish to be limited to the precise disclosure herein set forth; but,

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. In a multiple-switchboard telephone-exchange system, the combination with a telephone-line extending by permanently continuous limbs from a subscriber's station to an exchange and connected thereat with a plurality of jack-switches, the limbs of the telephone-line having permanently continuous or unbroken connection with all of the jacks, of a line-relay provided with differentially-wound coils, a source of current, a line-indicator, means controlled at the subscriber's station for closing circuit through the line relay and indicator, whereby the said indicator is operated and the relay remains inactive, the aforesaid jack-switches being provided with switch-contact parts connected with the limbs of the telephone-line, a third contact part acting as a testing means and located in front of the jack-switches but normally insulated therefrom and from the line, a test-circuit adapted to include the aforesaid testing means located before the jacks, and a test-manifesting means included also in the test-circuit, substantially as described.

2. In a multiple-switchboard telephone-exchange system, the combination with a telephone-line extending by permanently continuous limbs from a subscriber's station to an exchange and connected thereat with a plurality of jack-switches, the limbs of the telephone-line having permanently continuous or unbroken connection with all of the jacks, of a line-relay provided with differentially-wound coils, a source of current, a line-indicator, means controlled at the subscriber's station for closing circuit through the line relay and indicator, whereby the said indicator is operated and the relay remains inactive, the aforesaid jack-switches being provided with switch-contact parts connected with the limbs of the telephone-line, a third contact part acting as a testing means and located in front of the jack-switches but normally insulated therefrom and from the line, a test-circuit adapted to include the aforesaid testing means located before the jacks, a test-manifesting means included also in the test-circuit, the said differentially-wound relay and line indicator being included in bridge of the telephone-line, a switch adapted to exclude the line-indicator from circuit, and means whereby the operator's switching appliance employed for connecting subscribers for conversation, may actuate the relay to operate said switch and

thereby exclude the line-indicator from the circuit, substantially as described.

3. In a multiple-switchboard telephone-exchange system, the combination with a telephone-line extending by permanently continuous limbs from a subscriber's station to an exchange and connected thereat with a plurality of jack-switches, the limbs of the telephone-line having permanently continuous connection with each of the jack-switches, of a line-relay provided with differentially-wound coils, a source of current, a line-indicator, means controlled at the subscriber's station for closing circuit through the line relay and indicator, whereby the said indicator is operated and the relay remains inactive, means at the exchange for increasing the energization of one of the coils of the differentially-wound relay with respect to the other to effect the operation of the relay to cut out the line-indicator, the aforesaid jack-switches being provided with switch-contact parts connected with the limbs of the telephone-line, a third contact part acting as a testing means and located in front of the jack-switches but normally insulated therefrom and from the line; a test-circuit adapted to include the aforesaid testing means located before the jacks, and a test-manifesting means included also in the test-circuit, substantially as described.

4. In a multiple-switchboard telephone-exchange system, the combination with a telephone-line extending by permanently continuous limbs from a subscriber's station to an exchange and connected thereat with a plurality of jack-switches, the limbs of the telephone-line having permanently continuous connection with each of the jack-switches, of a line-relay provided with differentially-wound coils, a source of current, a line-indicator, means controlled at the subscriber's station for closing circuit through the line relay and indicator, whereby the said indicator is operated and the relay remains inactive, line-connecting apparatus, means controlled by the line-connecting apparatus for increasing the energization of one of the coils of the differentially-wound relay with respect to the other to effect the operation of the relay to cut out the line-indicator, the aforesaid jack-switches being provided with switch-contact parts connected with the limbs of the telephone-line, a third contact part acting as testing means and located in front of the jack-switches but normally insulated therefrom and from the line, a test-circuit adapted to include the aforesaid testing means located before the jacks, and a test-manifesting means included also in the test-circuit, substantially as described.

In witness whereof I hereunto subscribe my name this 3d day of December, A. D. 1900.

WILLIAM M. DAVIS.

Witnesses:

MAX W. ZABEL,
HARVEY L. HANSON.