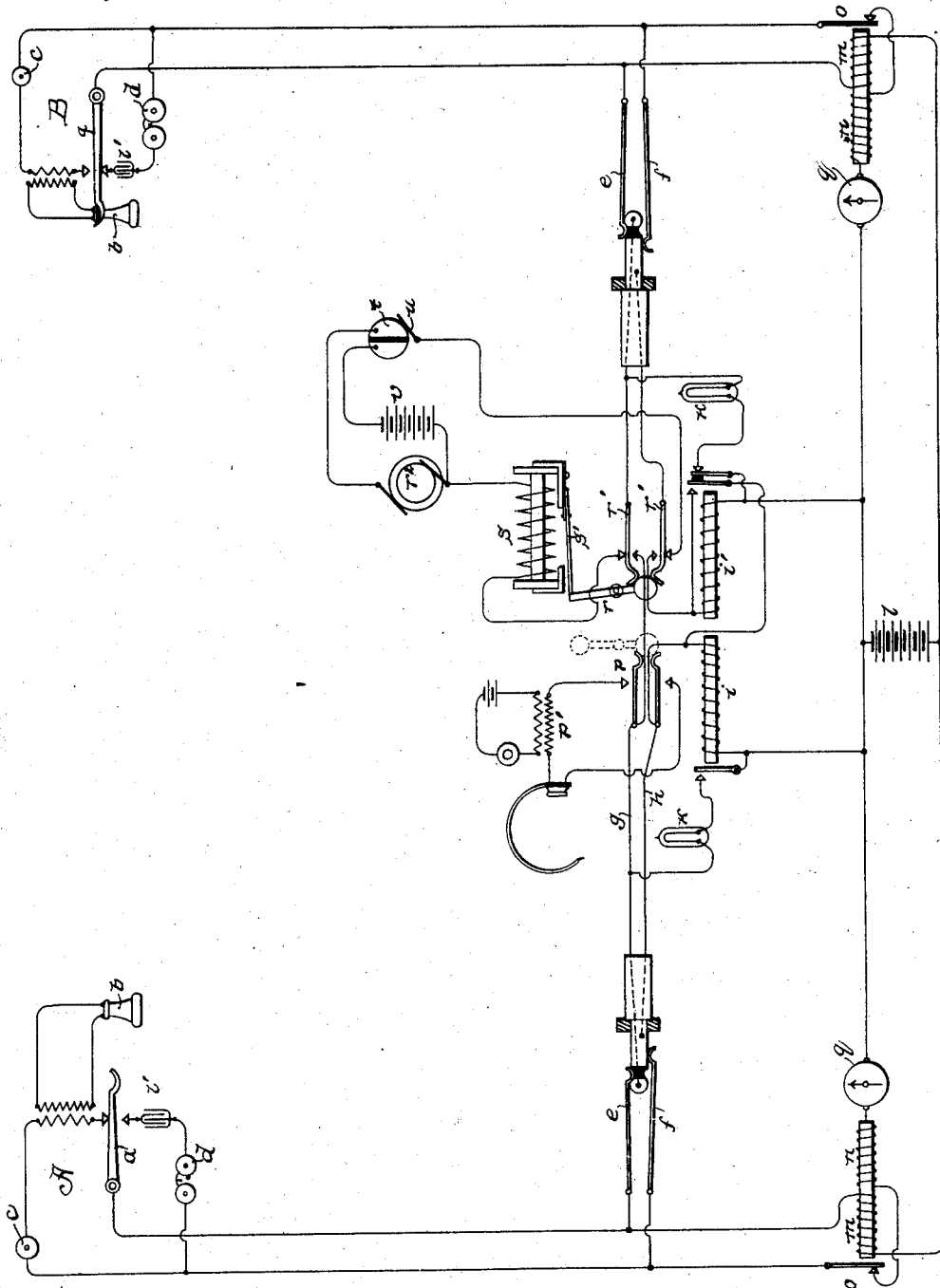


W. M. DAVIS.
TELEPHONE EXCHANGE SYSTEM.

APPLICATION FILED APR. 26, 1901. RENEWED OCT. 8, 1903.

901,696.

Patented Oct. 20, 1908.



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UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

No. 901,696.

Specification of Letters Patent.

Patented Oct. 20, 1908.

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To all whom it may concern:

Be it known that I, WILLIAM M. DAVIS, 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 Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to telephone exchange systems, and has for its object the provision of improved means whereby the source of calling current that may be included in circuit with a signal at a subscriber's station by manually operated means, may be automatically removed from the circuit by a change in circuit connections effected at the subscriber's station.

The invention has for its further object, the provision of means in connection with the instrumentalities for effecting an intermittent inclusion of calling current with the called subscriber's signal, whereby the generator may be immediately removed from the circuit with the bell, irrespective of the operative condition of the means employed for effecting this intermittent inclusion of the calling generator, so that the called subscriber will not be subject to the disagreeable click in his receiver.

My invention will be best understood by reference to the accompanying drawing which illustrates the preferred embodiment thereof, although other embodiments of the invention may be devised.

The drawing illustrates a telephone exchange system in which two telephone lines extend from subscribers' stations and are connected by means of instrumentalities at the exchange.

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 herein is a common battery system, and therefore the sub-stations are, in this instance, not provided with magneto generators, but I do not wish to be limited to such a system, in practicing all features of my invention. Each telephone line extends, by its limbs, to the exchange, and is there connected with the tip line spring *e* and the sleeve line spring *f*. Two

plugs are preferably employed for each operator's cord circuit, having the tips and sleeves connected by a tip strand *g* and a sleeve strand *h*. Relays or electromagnets *i*, *i'*, that control the supervisory signals *k*, *k'* are normally included in the sleeve strand, while a common battery *l* is included in bridge between one side of each telephone line and the correspondingly opposite side of the cord circuit, the latter connection being located between the relays. In order that the battery *l* may not have a constant flow over the telephone lines, there is included at each sub-station a condenser *l'* in the same bridge with the signal bells. Many forms of line signals may be employed in the system of my present invention. The form illustrated includes 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 *l* that may be of forty volts, and a line indicator, or the electromagnet of a line indicator *q*. When a subscriber removes his telephone from its switch-hook a circuit is completed through the coils of the relay and the magnet of the line indicator, whereby a calling signal is manifested, which calling signal is maintained as long as coils *m* and *n* exert their opposing effects, the armature *o* then remaining in its normal position. When the operator inserts her plug in response to a signal, or in connecting a called subscriber, current from battery *l* is principally confined to a path that includes the helix *m*, the tip line spring of the engaged jack, the tip of the plug inserted within said jack, and thence through the cord circuit instrumentalities to the battery. The current by being confined principally to this path of comparatively low resistance, the magnet of the line indicator being preferably 500 ohms, produces a greater magnetizing effect in the coil *m* than in the coil *n*, whereby the armature *o* is attracted and circuit to the magnet of the line indicator is broken. When a subscriber initiates a call, the operator inserts her answering plug and actuates her listening key *p* to include her telephone set *p'* in circuit with the calling subscriber to ascertain the connection desired. The operator thereupon inserts the connecting plug in the jack of the called subscriber and operates the ringing key *r* which

forces the springs r' apart to thereby include the calling generator r^2 in the circuit with the called subscriber's line and signal bell. A magnet s is included in series with the calling generator, but as the call bells are preferably of high resistance, this magnet is not sufficiently energized to attract its armature s' until the called subscriber has removed his telephone from its switch-hook. When the operator actuates the ringing key, the armature, or a part physically united therewith that previously rested upon the upper end of the ringing key lever, now falls by gravity to prevent the wedge or ball of the key from being returned by the action of the ringing key springs r' thereon, so that until the said armature or the obstruction carried thereby is removed from engagement with the ringing key lever, the generator is maintained in circuit with the called subscriber's bell. When the called subscriber removes his telephone from its switch-hook, the resistance encountered by the current passing through the generator from the helix of the magnet s is decreased so that the said magnet becomes sufficiently energized to cause an attraction of its armature, which is thereby removed from the path of the ringing key lever, whereupon the springs of the ringing key may act upon the said lever to restore it to its normal position.

In order that the generator may not effect a continuous operation of the called subscriber's bells, I preferably include a make and break device t which is preferably in the form of a cylinder divided longitudinally by insulating material, whereby the halves of the cylinder are electrically distinct. One of these halves is connected with the generator permanently. A brush u bears upon the cylinder and is included serially in circuit with the generator, the brush coming alternately into contact with the halves of the cylinder, the brush by its alternate engagement with the halves of the cylinder, alternately including and excluding the generator in circuit with the called subscriber's bell.

It is obvious that with the arrangement thus far described, if the called subscriber should remove his telephone from its switch-hook while alternating current is being supplied to the telephone line, his receiver will have its diaphragm actuated to cause annoying clicks. In order to effect the exclusion of the generator from circuit with the called subscriber's line, irrespective of the position that the said switching cylinder or disk t may occupy, that half or portion of the cylinder that is not designed to include the generator in circuit with the called subscriber's bell is connected with a battery v or other suitable source of current that will not actuate the subscriber's bell, by which arrangement either one or the other of the sources of current r^2 or v is included in circuit with the

called subscriber's line, the line condition then being such that immediately upon the removal of the telephone receiver, the magnet s will be actuated and the alternating current generator immediately removed from circuit.

It is obvious that many modifications may be made from the apparatus of my invention herein shown and particularly described, and I do not, therefore, wish to be limited to the precise construction herein shown and particularly described; but

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

1. In a telephone exchange system, the combination with a telephone switch-hook at the subscriber's station for opening and closing the telephone circuit thereat, a telephone line extending from the subscriber's station to an exchange, a signaling generator at the exchange adapted for connection with the telephone line, a bell at the subscriber's station to be operated by current from the said generator, a second source of current, an electromagnet serving directly to disconnect the generator from the telephone line, means for alternately including the said sources of current in circuit with the telephone line, the switch-hook at the subscriber's station serving to afford a path for current from both of the said sources to energize the said magnet to remove the generator from the line, substantially as described.

2. In a telephone exchange system, the combination with a telephone switch-hook at the subscriber's station for opening and closing the telephone circuit thereat, a telephone line extending from the subscriber's station to an exchange, a signaling generator at the exchange adapted for connection with the telephone line, a bell at the subscriber's station to be operated by current from the said generator, a second source of electricity furnishing direct current, an electromagnet serving directly to disconnect the generator from the telephone line, means for alternately including the said sources of current in circuit with the telephone line, the switch-hook at the subscriber's station serving to afford a path for current from both of the said sources to energize the said magnet to remove the generator from the line, substantially as described.

3. In a telephone exchange system, the combination with a central exchange station, of a subscriber's substation, a telephone line connecting said central station with said substation, a signal bell at the substation normally connected with the telephone line, a main signaling circuit at the central exchange, a key for connecting said signaling circuit with the telephone line, an electromagnet in said main circuit, the armature of said electromagnet when unattracted acting

in conjunction with said key to maintain connection with said signaling circuit and the telephone line, a signaling generator at the central station, a source of direct current in parallel relation therewith, a switch for alternately including said generator and said source of current in circuit with said electromagnet, the signal bell at the substation being responsive only to currents from the generator and the resistance thereof being high enough to prevent sufficient energization of said electromagnet, and means at the substation to change the circuit conditions to allow sufficient energization of said electromagnet, whereby its armature is attracted to break the connection between said signaling circuit and the telephone line, substantially as described.

4. In a telephone exchange system, the combination with a telephone line extending from a central exchange to a substation, of a signal bell at the substation, a circuit normally connecting said signal bell with the line limbs, a signaling generator at the central exchange, a key at the central exchange

for connecting said generator in bridge of the line limbs whereby said signal bell is actuated, a source of direct current associated with said signaling generator, means for alternately connecting said signaling generator and said source of current in the ringing circuit, an electromagnet included in the ringing circuit, the adjustment of said signal bell circuit preventing energization of said electromagnet, an armature for said electromagnet normally inert and adapted to lock said key upon actuation, whereby said ringing circuit is maintained in connection with the line, actuation of substation apparatus allowing sufficient current to flow to cause energization of said electromagnet whereby said armature is attracted and said key released to disconnect the ringing circuit from the line.

In witness whereof, I hereunto subscribe my name this 20th day of April A. D., 1901.

WILLIAM M. DAVIS.

Witnesses:

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