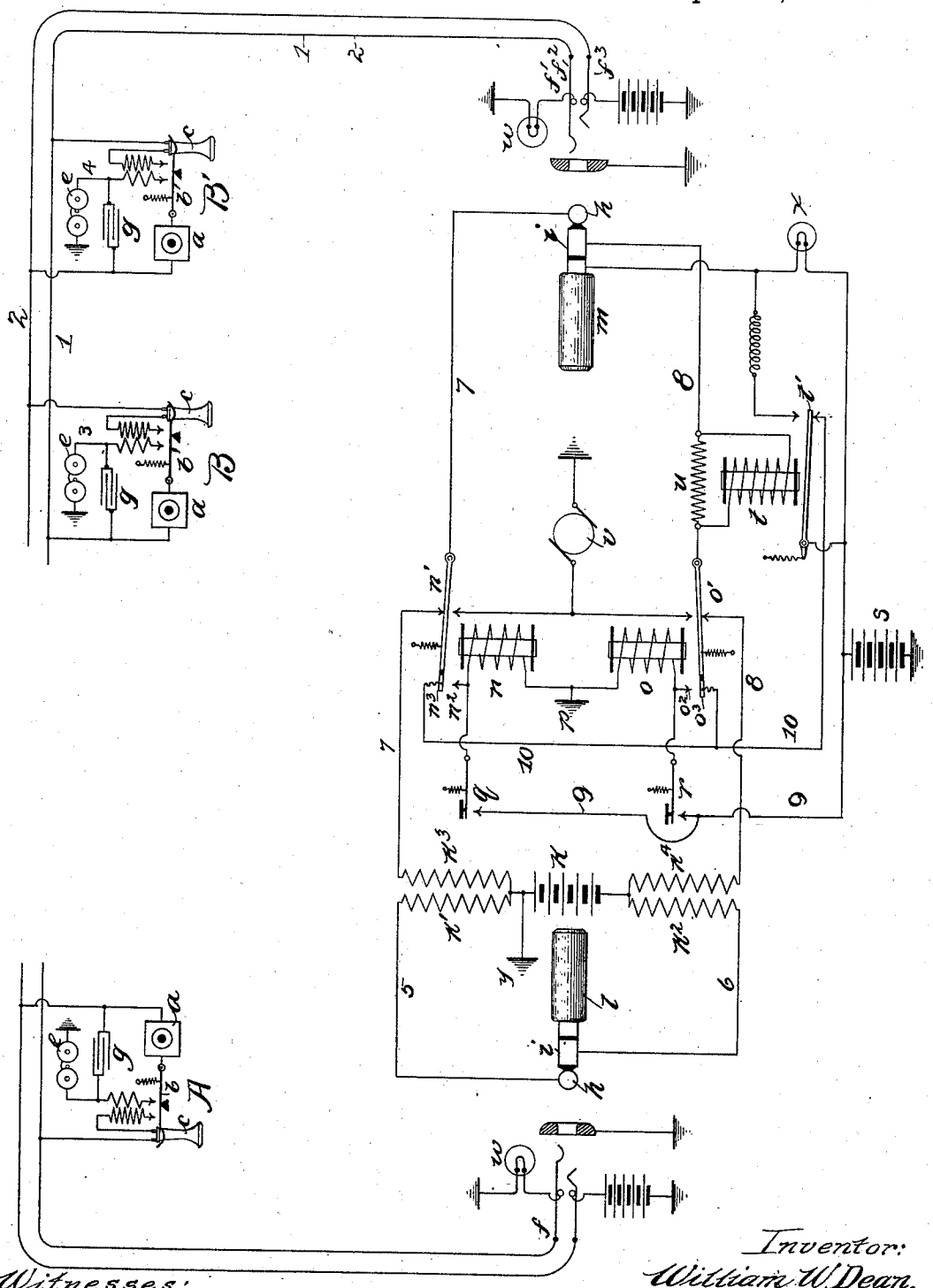
(No Model.)

# W. W. DEAN.

## TELEPHONE EXCHANGE SYSTEM.

No. 590,185. Patented Sept. 14, 1897.



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# UNITED STATES PATENT OFFICE.

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## TELEPHONE-EXCHANGE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 590,185, dated September 14, 1897.

Application filed July 2, 1897. Serial No. 643,190. (No model.)

*To all whom it may concern:*

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at the city of St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Telephone-Exchange Systems, (Case No. 22,) 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, and particularly to switching mechanism employed at the central office for including the calling-generator in circuit with the signal-receiving apparatus at the subscribers' stations and disconnecting the generator from line.

In my application Serial No. 607,126, filed September 28, 1896, I have shown and described relay switching apparatus in combination with interlocking mechanism, whereby the calling-generator will be included in circuit with the signal at the called-subscriber's station upon the establishment of a connection, the called-subscriber's switch-hook being adapted upon the removal of the telephone to operate said apparatus to remove the generator from line, the interlocking mechanism being at the same time placed in a condition to prevent the reinclusion of the generator in circuit with either of the signals at the connected stations irrespective of the condition of the switching mechanism thereat.

The results secured by the apparatus disclosed in my aforesaid application are due, in the embodiment of that invention shown, to the mechanical relation of parts controlled by two electromagnets, one electromagnet exclusively controlled by the apparatus at the central office serving to include the generator in circuit with the line, while the second electromagnet is controlled by the called-subscriber's switching mechanism, which upon being operated serves to mechanically disengage elements of the interlocking mechanism to remove the generator from line.

My invention herein consists in circuits and apparatus adapted to accomplish these results without the intervention of mechanical interlocking mechanism, and is especially adaptable for party-line service, though it may be employed with equal efficiency in single-line service. By my present invention I am enabled to employ a plurality of electromagnets, each controlled by apparatus at the central office and each adapted to include a generator in circuit with the signaling apparatus at a station on the party-line, in combination with a single electromagnet under the control of the apparatus at any of the stations of the party-line, which is adapted to remove the generator from line.

Generally speaking, the preferred embodiment of my invention consists in an electromagnet included in a local circuit, which may be closed through two paths, one path being preferably closed by a manual key, the armature of the electromagnet being arranged to close the second path, so that the magnet remains energized upon the release of the key, relay-contacts being controlled by said electromagnet to include the generator in circuit with the called-subscriber's signal-receiving apparatus or bell. In the second path a switch is included which is actuated to open the circuit through the electromagnet, and thereby remove the generator from line, by a second electromagnet which is operated by the called-subscriber's switch upon the removal of the telephone. By governing the calling-generator relay-switches by circuits rather than the mechanical engagement of the parts of an interlocking mechanism a single relay under the control of the apparatus at any of the stations of a party-line may be made common to several of said relay-switches or electromagnet circuit-controlling devices.

Other embodiments of my invention may be readily made without departing from its spirit.

I will explain my invention more particularly by reference to the accompanying drawing, which illustrates so much of a telephone-exchange system as is necessary to understand the adaptability of the invention.

At each of the subscribers' stations A B B' is provided a transmitter *a*, telephone switch-hook *b*, receiver *c*, and call-bell *e*, preferably of high resistance—as, for example, five thousand ohms. The telephone-lines terminate in spring-jacks *f f'*, limbs 1 and 2 of the party-line leading to the stations B B' being

connected, respectively, with line-springs $f^2$ $f^3$. The signal-bells at stations B B′ are included in ground branches 3 and 4, which are respectively connected with limbs 1 and 2 of the line, each of said branches including a condenser $g$.

Two alternate contact-anvils are provided in connection with each of the telephone-hooks, which form the terminals of a bridge-conductor across the limbs 1 and 2 of the telephone-line, the bridge-conductor at either station being closed upon the removal of the receiver thereat, the portions of the ground branches including the condensers $g$ forming also parts of the bridge-conductors. The circuits and apparatus at station A are similar to those at stations B B′.

At the central office a pair of switch-plugs is shown, each plug being provided with a tip $h$ and sleeve $i$, adapted to engage the short and long line-springs of the jacks, respectively. Conductors 5 and 6 connect the centralized battery $k$ with the tip and sleeve of the answering-plug $l$, while conductors 7 and 8 connect the tip and sleeve of connecting-plug $m$ with the same battery, whereby the transmitters at the subscribers' stations may be supplied with battery-current. Repeating-coils $k'$ $k^2$ are included in circuit with conductors 5 and 6, while repeating-coils $k^3$ $k^4$ are included in circuit with conductors 7 and 8. The association of the repeating-coils and centralized battery shown is well known to those skilled in the art. Conductors 7 and 8 also include armatures $n'$ and $o'$ of magnets $n$ and $o$, with their normal contact-anvils, said armatures being in the nature of calling-switches controlled by said magnets. A terminal of each of the magnets $n$ and $o$ is permanently grounded at $p$, the other terminal of each of said magnets being connected with manual keys or switches $q$ and $r$, preferably of the form shown, and anvils $n^2$ $o^2$, adapted to contact with the contact portions $n^3$ $o^3$, supported upon armatures $n'$ $o'$, respectively, upon the attraction thereof. Either of the keys $q$ or $r$ upon being depressed is adapted to close circuit from the grounded battery $s$ through path 9 and magnets $n$ and $o$, respectively. A second path 10, also grounded through battery $s$, is provided, which is connected with the insulated contact portions $n^3$ $o^3$ and which includes armature $t'$ of magnet $t$. Magnet $t$ is included in the conductor 8, a non-inductive shunt $u$ being provided about the same. The alternate contact-anvils of armatures $n'$ and $o'$ are grounded through the calling-generator $v$, said generator being included in circuit with conductor 7 and the signal-bell at station B′ when armature $n'$ is attracted, while it is included in circuit with conductor 8 and the bell at substation B when the armature $o'$ is attracted. Line-signals $w$ $w$ and the clearing-out signal $x$ are provided, whose operation will be apparent to those skilled in the art.

I have not deemed it necessary to show an operator's telephone outfit, as its association with the cord circuit is well understood by those skilled in the art.

Having thus particularly described the details of one embodiment of my invention and a telephone system in connection with which the same is adapted to be employed, I will now describe the operation thereof.

Subscriber A, desiring communication with subscriber B, signals the central office and informs the operator of the connection he desires. The operator, having previously inserted the answering-plug $l$ into the calling-subscriber's spring-jack, inserts the connecting-plug $m$ into the spring-jack of the called subscriber and depresses the key $r$, whereby circuit is closed through magnet $o$, the armature whereof is attracted to include the generator in circuit with conductor 8, limb 1 of the telephone-line, and the signal-bell at the called station. The armature of said magnet upon being thus attracted closes the contacts $o^2$ $o^3$ together, whereby the second path through said magnet is closed and the armature maintained in circuit with the calling-generator after the key $r$ is released. The called subscriber B upon removing his telephone from its switch-hook closes the bridge between the limbs 1 and 2 of the telephone-line, whereby current from generator $v$ finds path from limb 1 at the substation across the bridge to limb 2, thence through conductor 7 and coil $k^3$ to ground $y$. The new path for current from the generator is of low resistance, whereby sufficient current is diverted through magnet $t$ to cause the attraction of its armature $t'$, whereby the second path or circuit through the magnet $o$ is opened or rendered ineffective. Magnet $o$ is thus deënergized, the switch operated thereby being released to remove the generator from line. If the calling subscriber desires connection with subscriber B′ of the party-line, she depresses key $q$, whereby circuit is closed through magnet $n$, the armature whereof is attracted to include the calling-generator in circuit with conductor 7, limb 2 of the telephone-line, and the signal-bell at station B′. The armature of the magnet upon being attracted closes the contacts $n^3$ $n^3$ together, so that the armature remains attracted upon the release of key $q$. Subscriber B′ upon removing his telephone from its switch closes the bridge-conductor between the limbs 1 and 2 of the telephone-line, whereby current from the generator $v$ is diverted from limb 2 to limb 1, thence to conductor 8 through magnet $t$ and coil $k^4$ to ground $y$. The new path offers less resistance to the generator-current, current of sufficient strength being thus diverted through magnet $t$ to cause the attraction of armature $t'$, whereby the second path through the magnet $n$ is opened, the armature of said magnet being released to remove the generator from line.

In the claims I use the term "signal-bell"

in the sense of any signal-receiving apparatus at the subscribers' stations.

It is obvious that the circuit through the magnets *n* and *o* might be closed by other means than the keys *q* or *r* and that said magnets might be deënergized in other ways than opening the circuits including the same. I therefore do not wish to be limited to the precise mechanism and system of circuits herein shown and described; but,

Having thus described my invention, I claim as new, and desire to secure by Letters Patent, together with all modifications that may be made by those skilled in the art, the following:

1. In a telephone-exchange system, the combination with a telephone-line having a switch and a signal-bell at the subscriber's station thereof, of a circuit independent of said telephone-line, an electromagnetic circuit-controlling device connected in said circuit, means governed by said switch for changing the electrical condition of said circuit, whereby the operative condition of the electromagnetic circuit-controlling device may be altered, switching apparatus at the central office for uniting and disconnecting telephone-lines, a calling-generator, and a calling-switch adapted to be operated by said circuit-controlling device to include the generator in circuit with the signal-bell at said station when the condition of said independent circuit is normal or unchanged by the operation of the switch at the subscriber's station, said switching apparatus being adapted to associate said calling-switch with the telephone-line upon being manipulated to connect subscribers for conversation, substantially as described.

2. In a telephone-exchange system, the combination with a telephone-line having a switch and a signal-bell at the subscriber's station thereof, of a circuit independent of said telephone-line, an electromagnetic circuit-controlling device connected in said circuit, means governed by said switch for changing the electrical condition of said circuit, whereby the operative condition of the electromagnetic circuit-controlling device may be altered, switching apparatus at the central office for uniting and disconnecting telephone-lines, a calling-generator, a calling-switch adapted to be operated by said circuit-controlling device to include the generator in circuit with the signal-bell at said station when the condition of said independent circuit is normal or unchanged by the operation of the switch at the subscriber's station, said switching apparatus being adapted to associate said calling-switch with the telephone-line upon being manipulated to connect subscribers for conversation, and a switch in said independent circuit also provided for the purpose of controlling the same, substantially as described.

3. In a telephone-exchange system, the combination with a telephone-line having a switch and a signal-bell at the subscriber's station thereof, of a circuit independent of said telephone-line, an electromagnetic circuit-controlling device connected in said circuit, an electromagnet in circuit with said switch and adapted to be operated thereby, said electromagnet being adapted to change the circuit condition of said circuit-controlling device, whereby the operative condition of the electromagnetic circuit-controlling device may be altered, switching apparatus at the central office for uniting and disconnecting telephone-lines, said switching apparatus being adapted to electrically connect said telephone-line with said electromagnet when manipulated to connect subscribers for conversation, a calling-generator, and a switch adapted to be operated by said circuit-controlling device to include the generator in circuit with the signal-bell at said station when the condition of said independent circuit is unchanged by the operation of the switch at the subscriber's station, substantially as described.

4. In a telephone system, the combination with a telephone-line having a signal-bell and a switch at the subscriber's station thereof, of a calling-generator, an electromagnet, a calling-switch connected or adapted to be connected with said telephone-line and adapted to be controlled by the armature of said electromagnet, a circuit independent of said telephone-line adapted to be closed through the electromagnet when its armature is actuated to operate the calling-switch whereby the generator is maintained upon the line, and means controlled by the switch at the subscriber's station for removing the generator from line, substantially as described.

5. In a telephone system, the combination with a telephone-line having a signal-bell and a switch at the subscriber's station thereof, a calling-generator, an electromagnet, a second switch connected or adapted to be connected with said telephone-line and adapted to be actuated by said electromagnet to include said generator in circuit with the aforesaid bell, a key at the central office for closing circuit through said electromagnet to operate the latter switch to include the generator in circuit with said bell, means controlled by the electromagnet for also closing a circuit through the same when said magnet is energized, and a second electromagnet connected or adapted to be connected with the telephone-line and adapted to be operated upon the operation of the switch at the subscriber's station, the latter electromagnet being also adapted to change the condition of the circuit including the aforesaid electromagnet to release the switch controlled by the latter, whereby the generator is removed from line, substantially as described.

6. In a telephone system, the combination with a telephone-line having a switch and a signal-bell at the subscriber's station thereof, of switching apparatus at the central office for uniting and disconnecting telephone-lines, an electromagnet, means for including the same

in circuit with a source of current, a switch adapted to be connected with said telephone-line and adapted to be actuated by said electromagnet, a calling-generator adapted to be connected with said telephone-line by said switch when thus operated, a second electromagnet also connected or adapted to be connected with said telephone-line and to be actuated upon the operation of the switch at the subscriber's station, and means operated by the latter electromagnet when actuated to deënergize the other electromagnet, whereby the generator is removed from line, subtantially as described.

7. In a telephone system, the combination with a telephone-line having a switch and a call-bell at the subscriber's station thereof, of an electromagnet, a switch adapted to be operated thereby, a calling-generator, said switch being adapted to include said generator in circuit with the call-bell when operated by said electromagnet, a circuit for said electromagnet, a manually-operated switch adapted to close circuit through the same, terminals of a circuit also including said electromagnet adapted to be closed thereby upon its operation, whereby the electromagnet remains energized upon the release of said manual switch, and means controlled by the switch at the subscriber's station for opening or rendering ineffective the circuit through the electromagnet, whereby the same is deënergized and the switch operated thereby released to remove the generator from line, substantially as described.

8. In a telephone system, the combination with a telephone-line having a switch and a call-bell at the subscriber's station thereof, of an electromagnet, a calling-switch adapted to be operated thereby, a calling-generator, said switch being adapted to include said generator in circuit with the call-bell when operated by said electromagnet, a circuit for said electromagnet, a manually-operated switch adapted to close circuit through the same, terminals of a circuit also including said electromagnet adapted to be closed thereby upon its operation, whereby the electromagnet remains energized upon the release of said manual switch, a second electromagnet, a connecting-plug at the central office adapted to connect said generator-switch and the latter electromagnet with the telephone-line, the latter electromagnet being adapted to be operated by the switch at the subscriber's station, a switch controlled by the latter magnet adapted to open or render ineffective the circuit including the other electromagnet, whereby the generator-switch is released and the generator removed from line, substantially as described.

9. In a telephone system, the combination with a telephone-line, of a signal-bell and an automatic telephone-switch at the subscriber's station thereof, an electromagnet, a calling-switch adapted to be operated thereby, a second electromagnet, a connecting-plug adapted to connect said calling-switch and the latter electromagnet with the telephone-line, a calling-generator adapted to be included in circuit by the calling-switch when operated with the signal-bell at the subscriber's station, the circuit including said bell being of high resistance, a manual switch for closing circuit through the former electromagnet, terminals of a circuit also including said electromagnet adapted to be closed together by the same when energized, a switch controlled by the second electromagnet adapted when operated to open or render ineffective the circuit including the former electromagnet, a path of low resistance including said generator being adapted to be closed by the automatic telephone switch-hook at the subscriber's station upon the removal of the telephone therefrom, whereby the volume of current passing through the second electromagnet from the generator is increased, said electromagnet being thereby actuated to operate said switch, the former electromagnet being thereby deënergized and the calling-switch released to remove the generator from line, substantially as described.

In witness whereof I hereunto subscribe my name this 29th day of June, A. D. 1897.

WILLIAM W. DEAN.

Witnesses:
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JOHN A. MUCKEL.