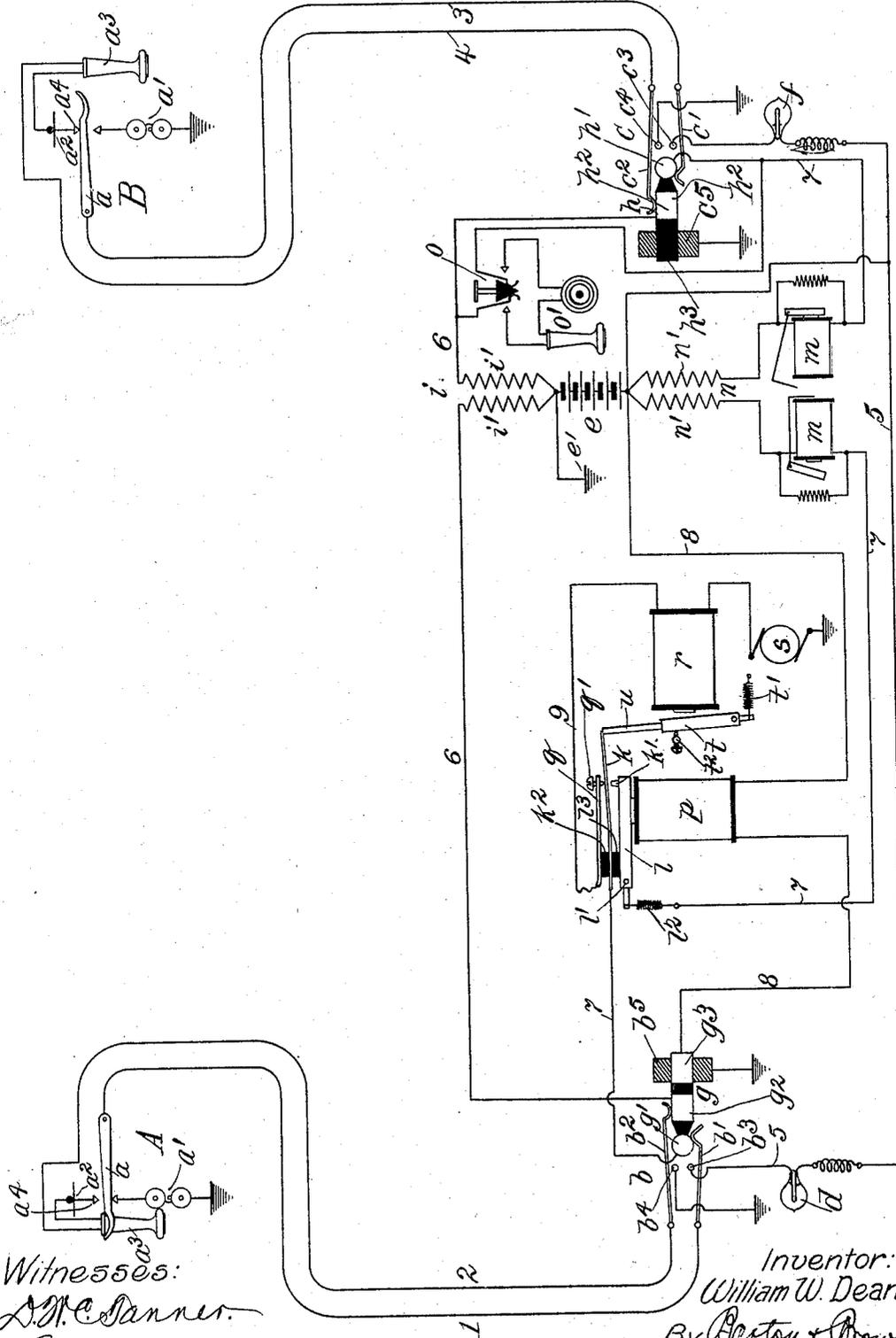


(No Model.)

W. W. DEAN.
TELEPHONE SYSTEM.

No. 590,137.

Patented Sept. 14, 1897.



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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

SPECIFICATION forming part of Letters Patent No. 590,137, dated September 14, 1897.

Application filed September 28, 1896. Renewed August 2, 1897. Serial No. 646,832. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States, residing at St. Louis, in the State of Missouri, have invented a certain new and useful Improvement in Telephone Systems, (Case No. 20,) of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawing, forming a part this specification.

My invention relates to telephone-exchange apparatus and circuits; and its object, speaking generally, is to enable the operator, by simply inserting the plug into the switch of a subscriber called for, to throw the calling-generator to line simultaneously with making the connection, the circuits being so arranged and connected at the subscribers' stations that when a subscriber answers the call by taking down his telephone the signaling-current which had been thrown to line will be disconnected. This work is done automatically, and the construction of the apparatus is such that there is no liability of making false signals.

In my Patent No. 544,567, of August 13, 1895, I have shown means whereby signaling-current is directed over the line of the subscriber called by the act of the operator in inserting a plug into the spring-jack at the central office.

The system shown in the aforesaid patent is defective in that in case the subscribers connected have finished their conversation and the called subscriber has hung up his telephone signal for another connection from the calling subscriber before the disconnection at the central office has been made would again ring the bell of the called subscriber.

By my invention herein the operator is relieved from special manipulation of the subscribers' calling apparatus for throwing current to the line of the subscriber called by an improved and novel construction of apparatus and combination of circuits, whereby the liability of making false signals is removed, while at the same time the construction of the electromagnetic circuit-controlling devices used in connection with the cord-circuits at the central office is improved, and thereby made more certain and positive in action.

My invention herein is applied to a centralized battery system well known in the art. I thus am able to retain all the advantages of the centralized battery system, while the work of the operator is confined to inserting and removing the plugs and receiving and answering the calls. My invention, however, may with facility be applied to other systems—as, for example, to the more common and well-known system in which magneto-generators are employed at the subscribers' stations.

My invention will be more readily understood by reference to the accompanying drawing, which is a diagrammatic illustration of a telephone-exchange system equipped with the signaling apparatus of my invention.

Two subscribers' stations A B are shown. The apparatus at each station comprises a telephone-switch hook *a*, a signal-receiving grounded bell *a'* of, say, five thousand ohms resistance, transmitter *a*², and telephone-receiver *a*³. The telephone-hook of substation A is connected with the line-spring *b'* of the spring-jack *b* at the central office by a limb 1 of the telephone-line. The receiver *a*³ is connected with the line-spring *b*² of said spring-jack by a limb 2 of the telephone-line. When the telephone is hung on the switch, as shown at station A, the limb 1 of the line is closed to ground, while the limb 2 is left open at the switch. The subscriber B is similarly connected with the central office, limb 3 of the telephone-line extending from the switch-hook to the line-spring *c'* of the spring-jack *c*, while the telephone-receiver is connected with the line-spring *c*² of said spring-jack by a limb 4 of the telephone-line. Back contacts *b*³ *b*⁴ are engaged by the line-springs *b'* *b*² when said line-springs are not engaged by a plug. Back contact *b*³ is connected by a conductor 5 through a line-indicator *d*, preferably a small incandescent lamp, located near the spring-jack and a grounded battery *e*. The back contact *b*⁴ is grounded. Back contacts *c*³ *c*⁴ are likewise normally engaged with the line-springs *c'* *c*², back contact *c*³ being connected through line-indicator *f* and grounded battery *e*, while back contact *c*⁴ is grounded. Grounded metallic thimbles *b*⁵ *c*⁵ are also provided in connection with each spring-jack, which guide the plugs *g* and *h* as they are be-

ing inserted within the spring-jacks into contact with the line-springs.

The line-signals are operated by the subscribers when they remove the telephone-receivers from their supporting-hooks, the limbs of the telephone-lines being closed at a^4 , thus closing circuit through the line-indicators. These circuits may be traced from the grounded back contacts of the spring-jacks through both limbs of the telephone-lines to the remaining back contacts of the spring-jacks, and thence through the individual indicators and grounded battery e .

The plug g is the connecting-plug, while the plug h is the answering-plug. Plug g is provided with three contact-terminals $g^1 g^2 g^3$, adapted to engage the line-springs $b^1 b^2$ and the thimble b^5 , respectively. Plug h is provided with two contact-terminals $h^1 h^2$, adapted to make contact with the line-springs $c^1 c^2$, respectively. The heel portion h^3 of the answering-plug is preferably of insulating material. Terminals $g^2 h^2$ of the plugs are connected by a conductor 6, which includes helices $i^1 i^2$ of a repeating-coil i . The terminals $g^1 h^1$ are normally connected by a conductor 7, which includes a spring k , contact-anvil k' , normally in contact with said spring, and armature l , supporting said spring and contact-anvil, the clearing-out indicators $m m$, and the helices $n^1 n^2$ of the repeating-coil n . A telephone-key o is provided for the purpose of bridging the operator's telephone set o' between the conductors 6 and 7.

A conductor 8 extends from the metallic heel-piece of plug g^3 to ground through the battery e . This conductor includes an electromagnet p , which may be wound to a resistance of, say, five hundred ohms.

Under conditions which will be hereinafter set forth this electromagnet is adapted to attract the armature l , pivoted at l' and maintained in an elevated position when unattracted by a retractile spring l^2 . The armature carries a block of insulation l^3 , upon which the spring k is supported, a second block of insulation k^2 being provided upon said spring to support contact-plate q . An adjustable contact q' is mounted upon the free end of plate q , adapted under conditions which will be hereinafter set forth to make contact with spring k .

A conductor 9 extends from the plate q through a magnet r and grounded-current generator s . An armature t is adapted to be attracted by the magnet r , a retractile spring t' being provided to hold said armature against an adjustable stop t^2 when said armature is unattracted. A finger u is carried by the armature. When the armature t is in an unattracted position, the finger u lies within the path of the spring k , so that when the armature t is attracted by magnet p the spring k is removed by said finger from its contact with anvil k' and brought into contact with the anvil q' , whereby the generator s is con-

nected with conductor 7. When the armature t is attracted, which occurs after the attraction of armature l , the finger u is removed from the path of spring k , whereby contact between anvil k' and said spring k is restored and contact between said spring and anvil q' is broken, thus removing the generator s from its connection with conductor 7.

Having thus specifically set forth the apparatus of my invention, I will now particularly describe the manner by which signaling-current is transmitted over the telephone-lines to the call-bells at the subscribers' stations.

Subscriber B, desiring communication with subscriber A, removes his telephone-receiver from its hook, thereby operating his line-signal f . The operator in response to the signal inserts the answering-plug h and operates her listening-key o' to cut her telephone set into circuit with the calling-subscriber's telephone set. By this act the indicator f is removed from the line and the grounded back contact c^4 is removed from line-spring c^2 .

The operator having ascertained the connection desired, inserts the connecting-plug g into the spring-jack b of the called subscriber. A circuit which is independent of and incapable of being changed by the apparatus at the subscribers' stations includes magnet p . I term this independent circuit a "local" circuit. The particular independent or local circuit herein shown and which I prefer to employ is completed when plug g is inserted, which circuit may be traced from the grounded thimble b^5 , through the conductor 8, magnet p , and through the grounded battery e . The armature l of magnet p is thereupon attracted, the spring k coming in contact with the finger u as said armature is being moved to its attracted position, whereby the generator s is thrown upon conductor 7 by the contact of anvil q' with the spring k . Current from generator s passes from said conductor 7 by way of contact g^1 of the connecting-plug g , line-spring b^1 , limb 1 of the telephone-line, through the grounded calling-bell a' at the called subscriber's station. Said bell being of very high resistance, the current from generator s , through the magnet r , is reduced sufficiently to prevent said magnet from being energized, whereby the finger u is permitted to remain in engagement with spring k during the time that the called-subscriber's telephone is upon its hook, the bell being constantly rung until the called subscriber responds by removing his telephone. The called subscriber in responding to the signal thus transmitted removes his telephone-receiver from its hook, thereby connecting the limb 2 of his telephone-line in circuit with generator s , the limb 2 being grounded at e' . The circuit from the generator s may now be traced through the magnet r , conductor 9, plate q , spring k , conductor 7, terminal g' of plug g , line-spring b^1 , limbs 1 and 2 of the

telephone-line, line-spring b^2 , terminal g^2 of plug g , conductor 6, the left-hand helix v' of the repeating-coil i , to ground at e' .

The circuit just described is of comparatively low resistance, whereby the current from generator s is increased sufficiently to cause the magnet r to attract its armature, the finger u being thereby removed from the path of spring k , which of its own resiliency breaks contact with anvil q' and makes contact with anvil k' , this newly-adjusted position of the parts being shown in Fig. 2. The continuity of conductor 7 is thus completed at k' , whereby the connection between the two subscribers is completed, while the generator s at the same time is removed from the line. During the time that the connecting-plug is within the spring-jack switch of the called subscriber a local circuit is closed through the magnet p , whereby the armature l is attracted, as before described.

After the finger u has been withdrawn from the path of spring k the armature l and the parts mounted thereon are maintained in the position shown in Fig. 2 until the connecting-plug is withdrawn. It will be observed that immediately upon the attraction of the armature l circuit through the magnet r is broken at q' , but the spring k prevents the return of the finger u and the armature l to their normal unattracted position. I have thus provided an electromagnet for including a calling-generator in circuit with the subscribers' signaling apparatus which is under the exclusive control of apparatus at the central office, this magnet being thus irresponsive to any changes of the apparatus at the subscribers' stations, whereby the sending of false signals is obviated, the second electromagnet r under the control of the called-subscriber's apparatus serving to remove the calling-generator when the signal has been responded to.

I preferably form finger u of steel and harden the tip thereof to prevent the finger from being worn away by its frequent frictional contact with the spring k .

In my aforesaid patent, No. 544,567, is shown a signaling device at the central office, comprising two electromagnets having armatures, these magnets being energized by the calling and called subscribers upon the removal of their telephones from the telephone-hooks. The armature of the called-subscriber's magnet is connected with a source of signaling-current adapted to be included in circuit with the called-subscriber's bell upon the attraction of the armature of the calling-subscriber's magnet, which is brought into engagement with an extension of the armature of the called-subscriber's magnet for this purpose. The called subscriber upon removing his telephone causes his armature to be attracted, whereby the electrical contact between the armatures of the magnets is broken and the calling-generator removed from line. An objection to this device is that a stronger current is sometimes required to withdraw the

armature of the called-subscriber's magnet from engagement with the armature of the calling-subscriber's magnet than is present in the system.

The device of my present invention is an improvement above the aforesaid signaling device in the respect that the only thing to be taken into consideration in this connection is the strength of the spring k , which should be made light enough and so placed as to permit the withdrawal of the finger u from its path when the magnet r is energized.

In my application for United States Letters Patent for improvement in telephone systems, Serial No. 610,901, filed November 3, 1896, I have shown another type of apparatus and circuits for accomplishing the general results that are accomplished by my present invention.

I have purposely omitted the description of details and the enumeration of many modifications which may be made without departing from the principles of my invention, because to set these forth at length would obscure rather than make clear the more essential features.

Having, however, fully set forth the construction of one type of apparatus to be employed in practicing my invention, I claim and desire to secure by these Letters Patent, together with all such modifications as may be made with mere skill, the following:

1. In a telephone-exchange system the combination of line-wires leading from a central office to subscribers' stations, with calling apparatus at the subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in circuit with the subscribers' calling apparatus, means operated by the called-subscriber's apparatus for removing said generator, and apparatus at the central office for exclusively controlling the operation of said electromagnet whereby its operation by substation apparatus is prevented and false signals obviated, substantially as described.

2. In a telephone-exchange system the combination of line-wires leading from a central office to subscribers' stations, with calling apparatus at the subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in circuit with the subscribers' calling apparatus, apparatus at the central office for exclusively controlling the operation of said electromagnet whereby its operation by the substation apparatus is prevented and false signals obviated, and a second electromagnet within the control of the called subscriber adapted to remove said generator, substantially as described.

3. In a telephone-exchange system the combination of line-wires leading from a central office to subscribers' stations, and plugs adapted to connect subscribers for conversation, with calling apparatus at the subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in

circuit with said calling apparatus, means operated by the called-subscriber's apparatus for removing said generator, a local circuit including said electromagnet at the central office, and means controlled by the connecting-plug for governing said local circuit, said electromagnet being thus independent of the substation apparatus, whereby false signals are prevented, substantially as described.

4. In a telephone-exchange system, the combination of line-wires leading from spring-jacks at a central office to subscribers' stations, and plugs adapted to connect subscribers for conversation, with calling apparatus at the subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in circuit with said calling apparatus, means operated by the called-subscriber's apparatus for removing said generator, and a local circuit including said electromagnet at the central office, said spring-jacks and a connecting-plug being adapted to govern said local circuit, said electromagnet being thus independent of the substation apparatus, whereby false signals are prevented, substantially as described.

5. In a telephone-exchange system, the combination of line-wires leading from spring-jacks at a central office to subscribers' stations, and plugs adapted to connect subscribers for conversation with calling apparatus at the subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in circuit with said calling apparatus, a local circuit including said electromagnet at the central office, means controlled by a connecting-plug for governing said local circuit, said electromagnet being thus independent of the substation apparatus, whereby false signals are prevented, and a second electromagnet within the control of the called subscriber adapted to remove said generator, substantially as described.

6. In a telephone-exchange system, the combination of line-wires leading from a central office to subscribers' stations, a calling-generator, an electromagnet adapted to include said generator in circuit with the subscribers' calling apparatus, apparatus at the central office for exclusively controlling said electromagnet whereby its operation by the substation apparatus is prevented and false signals obviated, a second electromagnet within the control of the called subscriber's apparatus adapted to remove said generator, and an interlocking device between said electromagnets for governing the circuit including said calling-generator, substantially as described.

7. In a circuit-controlling device, the combination of an electromagnet p having an armature l with a spring k for governing a circuit, mounted upon said armature, switching apparatus for including said electromagnet in circuit with a source of electricity, an element, as u normally disposed within the path of said spring k which is adapted to be pressed

upon said element by the armature upon which it is mounted, a magnet r adapted to withdraw said element from the path of said spring, and switching apparatus for including electromagnet r in circuit with a source of electricity, substantially as described.

8. In a telephone-exchange system, the combination with two united telephone-lines, each provided with a signal bell or device at the subscriber's station thereof, of a calling-generator, a calling-switch for including the generator in circuit with the signal-bell at the called subscriber's station, an electromagnetic circuit-controlling device adapted to operate said switch, a circuit including said circuit-controlling device independent of either of said telephone-lines, means for changing the condition of said circuit and thereby the operative condition of said circuit-controlling device to operate the calling-switch and maintain the generator in circuit with the signal-bell at the called subscriber's station, means for removing said generator from line, switches, one at each station, each switch being adapted when its station is the called station to control the means for removing the generator, and switching apparatus at the central office for connecting subscribers for conversation, substantially as described.

9. In a telephone-exchange system, the combination with two united telephone-lines, each terminating in line-switches at the exchange, of a connecting-plug and cord-circuit uniting the telephone-lines, each of which is provided with a signal bell or device at the subscriber's station thereof, a calling-generator, a calling-switch associated with the plug-and-cord circuit for including the generator in circuit with the signal-bell at the called subscriber's station, an electromagnetic circuit-controlling device also associated with said plug-and-cord circuit adapted to operate said switch, a circuit including said circuit-controlling device independent of either of said telephone-lines, means for changing the condition of said circuit and thereby the operative condition of said circuit-controlling device to operate the calling-switch and maintain the generator in circuit with the signal-bell at the called subscriber's station, means for removing said generator from line, and switches, one at each station, each switch being adapted when its station is the called station to control the means for removing the generator, the said telephone-lines being disassociated from the calling-switch and the electromagnet by the plug-and-cord circuit when connection between the lines is broken, substantially as described.

In witness whereof I hereunto subscribe my hand and name this 23d day of September, A. D. 1896.

WILLIAM W. DEAN.

Witnesses:

WM. J. WOELK,
W. E. HARKNESS.